Estimation of Length-weight relationship and Condition factor of freshwater Commercial fish *Channa striata* (Bloch., 1793) from Pantanaw environs, Ayeyarwady region

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Abstract

The aim of this study was to estimate the relationships between body length and body weight of collected species and to analyse their condition factors for the well- being of *Channa striata*, locally known as Nga Yant, from Pantanaw environs (16˚59' 0″N and 95˚28' 0″E). The study periods lasted from December 2018 to March, 2019. Species were identified according to Talwar and Jhingram (1991). The linear regression fitted line plot showed that there was highly positive correlation between body weight and length of male ($P<0.001$) and female of *Channa striata* ($p<0.001$) . The highest monthly mean length and mean weight were found in Janurary in both sexes, and the highest condition factors were also found in March in both sexes. In the present study, mean Condition factor K was 1.67 in male and 1.86 in female which were greater than one, indicating that the better condition in their natural environment allows healthy population.

Keywords: Length-weight relationship, Condition factor, *Channa striata*, Pantanaw environs, Ayeyarwady region

Introduction

Pantanaw, in Ayeyarwady region, is home to different species of fish most of which are commercial and popular with Myanmar locals. Although the number of consumers has increased over the years, the species studied in this paper are still available on the market at affordable price for general population. Thus it is necessary to monitor the well-being of fish in Pantanaw environs, assessing the length-weight relationships of collected species and analyzing their condition factor with the prospect for the sustainable fishery.

The knowledge of length weight relationships (LWR) plays an important role in the adequate management of any fish species which, in turn, have been applied in the assessment of fish stocks and populations (King, 2007). It is also useful in local and interregional morphological comparison of populations (Froese, 2006).

In addition to being one of the standard methods that provide authentic biological information, the length weight relationship is of great importance in fishery assessments. It establishes the mathematical relationship between the two variables, length and weight, and helps assess the variations from the expected weight for the known length groups. This is particularly useful for computing the biomass of a sample of fish from the length frequency of that sample. The length weight relationship is a major factor to consider for proper exploitation and management of the population of fish species (Anene, 2005).

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In fisheries science, the condition factor is used in order to compare the "condition", "fatness" or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal, 1978).

Condition factor is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). Differences in the condition factor have been interpreted as a measure of histological events such a fat reservation, adaptation to the environment and gonadal development (LeCren, 1951).

Thus, the aim of this study was to estimate the relationships between body length and body weight of collected species and to analyse their condition factors in order to assess the well- being of this species which showed light on the status of the aquatic ecosystem of Pantanaw environs.

Materials and Methods

Study area and Study periods

Study area was situated at Pantanaw environs (16˚59' 0″N and 95˚28' 0″E) and study periods lasted from December 2018 to March, 2019(Fig.1).

Source: Google Earth (2017)

Fig 1. Map showing the study area and field survey point

Identification of species

Species were identified according to Talwar and Jhingram (1991).

Collection of specimens

Specimens were collected twice a month for each species from Pantanaw Environs.

Measurements and dissection

Morphometric characters (body weight and body length) were taken .The standard length was measured to the nearest centimeter and weight to the nearest gram. Then ventral-lateral dissection was made and the sex noted.

Condition factor(K)

The condition factor (K) was calculated according to formula stated by Tesch (1971).

Statistical analysis

Descriptive statistics was used to calculate mean± SD and Linear regression fitted line was used for the relationships between body weight and body length of three species. Analysis was performed using MINITAB 14. P values of less than 0.05 were considered statistically significant.

Results

A total of sixty individuals under family Channidae of males and females of freshwater fishes *Channa striata* were collected from Pantanaw Environs. (Plate1 and Plate 2).

Plate 1. *Channa striata* (Male)

Plate 2. *Channa striata* (Female

Mean morphometric measurements (Standard Length(cm), and Body weight(g) and condition factors of recorded species were calculated in Table.1.

Boxplot depicted 25^{th}, 50^{th}, and 75^{th} percentile of median value of condition factors from males and females (Fig.2).

In addition , in this study, the mean calculated total length (TL) was from 15.45 cm to 24.03 cm with a mean of 18.97 (male), and female 15.7 cm to 23.6 cm with a mean of 18.18 cm in this species. The mean calculated body weight (BW) was from 61.89 g to 217.66 g with a mean of 104.52 g (male) , female77.03 to197.39 with a mean of 118.16 g. The mean calculated condition factor (K) was from 1.27 to 2.22 with a mean of 1.67 (male) , female 1.50 to2.28 with a mean of 1.863. The highest monthly mean length and weight were found in January in both sexes and the highest condition factors were also found in March in both sexes (Table1).

Table1. Monthly Mean ±SD of Standard length, Total weight and Condition factor of male and female *Channa striata* from Pantanaw environs

	Channa straiata (Male)				*Channa straiata* (Female)			
Month	n	Standard length (cm)	Total weight (g)	Condition factor	n	Standard length (cm)	Total weight (g)	Condition factor
January	4	24.03 ± 2.38	217.66 ± 13.20	1.58± 0.21	1	23.60	197.39	1.50
February	9	18.38 ± 1.38	103.23 ±13.32	1.71± 0.43	1	17.50	123.02	1.77
March	7	17.11 ± 0.79	111.14 ±16.05	2.22± 0.25	3	17.5± 1.06	131.57 ±19.04	2.28±0.10
April	5	15.96 ± 1.30	81.59 ± 26.71	1.94± 0.24	3	16.03±1.22	91.77± 18.93	2.22±0.27
May	4	15.45 ± 0.73	61.89± 7.33	1.68± 0.14	4	15.70±0.38	77.03± 16.51	1.99±0.41
June	2	17.70 ± 2.26	73.97 ± 27.49	1.30± 0.01	8	18.71 ± 3.03	103.34 ±46.39	1.52±0.27
July	7	17.89 ± 1.49	80.14 ±16.96	1.27± 0.35	3	18.23 ± 2.51	102.48 ±23.42	1.76±0.60
Total	38	18.97 ± 2.82	104± 52.78	1.671 ±0.33	23	18.18± 2.63	118.16 ±39.45	1.863± 0.313

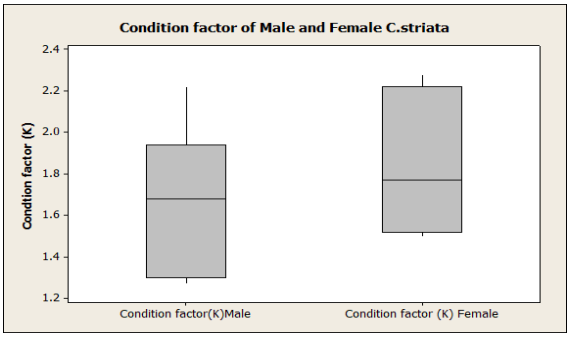

Fig 2. Variation in median value of condition factors of Males and Females *Channa striata*

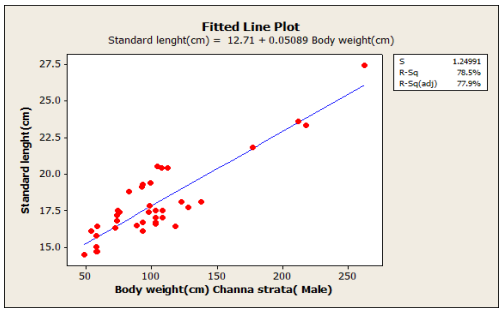

Fig 3. The relationship between Standard Length(cm) and Body weight(g) of Male *C. striata*

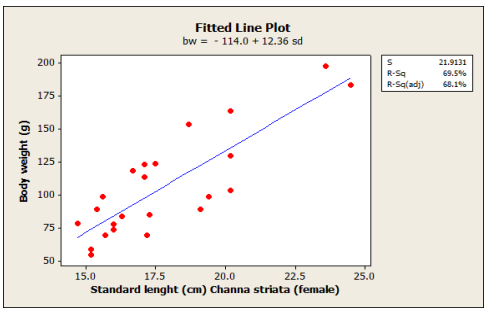

Fig 4. The relationship between Standard Length(cm) and Body weight(g) of Female *C. striata*

Table 2. The relationship between standard length and body weight of recorded species *Channa striata*

Variable	r value		P value	
	Male	Female	Male	Female
Standard length and Body weight of *Channa straiata*	0.89	0.83	0.0001*	0.0001*

*highly significant

The linear regression fitted line plot showed that there were highly positive correlation between body weight of male ($p<0.001$) and female of *Channa striata* ($P<0.001$) (Table 2). The regression line revealed high correlation with determination coefficient (r) is 0.89 female and 0.83 male. LWR analysis for females showed lower coefficient determination than the males.

Discussion

During study periods, a total of sixty specimens were collected from Pantanaw environs, Ayeyarwaddy region. Based on morphometric characteristics, the collected specimens of ichthyofauna belonging to family Chanidae was identified as *Channa striata*. In this study, the relationship between body length and weight of recorded species and condition factors were statically analysed according to morphometric measurements.

Dumalagan *et al*. (2017) stated that in Philippines, the mean total length was 28.13 and weight of *Channa striatus was* 02.195 g respectively. In this study, the mean length was found to be 18.97 cm in male and 18.18 cm in female. The mean weights were 104.52 g (male) and in male and 118.16 g in Pantanaw environs, Myanmar.

Regarding the relationship between length and weight of the recorded species, in the present study, positive correlation between length (cm) and weight (g) were found in male and female. Correlation coefficient value (r) close to 1 is better growth in male and

female of *C.striata* which was agreed with Dumalagan *et al*. (2017). They stated that high correlation between total length and body weight of *C. striata* were found in Philippine.

Gupta and Banergee (2015) reported the length weight relationship (LWR) and condition factor(K) value of fish were affected by factors such as feeding intensity, availability of food , fish size, age , sex , stage of maturation. Similarly, in the present study, condition factors of this recorded species were used to assess the degree of well-being of fish.

Taking into consideration of condition factor, the highest condition factors were also found in March in both sexes. It seemed to be pre-spawning period which was agreed with Naing Naing Aung (1988). She stated that the spawning period was from April to June in Taunggi environs. Htun Han (1978a) also stated that seasonal variation of condition factor was found in all fishes and generally decline during the spawning and post-spawning periods.

Oni *et al*.(1983) have pointed out that the condition factor is a better indicator of growth and physiological 'well -being' of a fish species. Ujjania *et al.* (2015) revealed that condition factor greater or equal to one is good, indicating a good level of feeding, and proper environmental condition. In the present study, mean Condition factor K was 1.67 in male and 1.86 in female which were greater than one and they would attain a better condition in their natural environment which was in line with Kurup and Samuel (1987). They revealed that fluctuations in condition factor of many fishes were observed in relation to their reproductive cycle, feeding rhythms, physio-chemical factors of the environment, age, physiological state or some other environment factors.

Conclusion

It was concluded that statistically, the robust growth of the species Icthyofauna in Pantanaw was recorded by identifying this species with morphometric measurements in this study. It would come as no surprise to the scientist that Pantanaw environs were still known to be environmentally and economically sustainable despite some mismanaged human activities and pollution factors because this finding was validated by length weight relationship which could estimate condition factor of the recorded fish species and fish biomass through the length frequency. The favourable condition factors of this species were an index which expressed the degree of the well-being and robustness. Although the demand for this commercial fish by the consumers has increased significantly, Pantanaw environs have not witnessed the shortage of this species. It was explained by the facts in this research that good condition factors resulted in the increase of fish population. Thus fishermen and locals alike have responsibility for the long-term sustainability of the environs' aqua ecology.

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Effects of Salinity on the Decapsulation of *Artemia* Cyst

Cherry*

Abstract

A study was performed to determine the effect of salinities (25, 28 and 30 ppt) and temperatures on the decapsulation of *Artemia* cyst. The dry *Artemia* cyst was hydrated up to 2 hrs in fresh water with adensity 0.3 g/ 50 ml water. Saline water was prepared using salt (NaCl) and hatching rate of *Artemia* cyst was counted after 36 hours of incubation. Highest hatching rate (74.7462± 5.03), (73.43± 3.67) and (86.12±0.70)% were observed in 25, 28 and 30 ppt salinities , respectively. Lowest hatching rate (61.3927 ± 3.67), (68.0172 ± 8.06), and (66.6321 ± 2.71) % were measured in 25, 28 and 30 ppt salinities , respectively. The maximum hatching rate (86.12± 0.96)% was found in 30 ppt salinity and minimum hatching rate (61.3927± 2.71) % was observed in 25 ppt salinity . Therefore, 30 ppt salinity could be the optimum salinity for *Artemia* cyst decapsulation.

Key words: Salinity, decapsulation, *Artemia*.

Introduction

Artemia is commonly known as the brine shrimp. It is a crustacean. It lives in high saline water. It is widely distributed throughout the world; it is the most important live feed organism. *Artemia* lives in high saline environment where its predators cannot survive. Hence, *Artemia* can be effectively cultured in saline water. Such water bodies are found in solar saltpans, which occur all along Indian coast. More than 85% of the marine animals with cultivated thus far have been offered *Artemia* saline as food source, either together with other foods or more often as a sole diet.

Artemia is a crustacean live food item distributed all over the world including tropical, subtropical and temperate zones. It is widely used as live food for larvae of finfish and shellfish especially *Macrobrachium rosenbergii* (De Man 1879) and *Penaeus monodon* (Fabricius 1798) (Lavens and Sorgeloos 1996, Triantaphyllidis *et al.* 1998, Lavens *et al*. 1986). Every year, more than 2000 metric ton *Artemia* cyst are marketed all over the world for aquaculture production purposes. The demand of *Artemia* cyst is increasing day by day in aquaculture industry and it comprises almost 40% of total larval food in aquaculture production (Sorgeloos *et al.* 2001).

In Bangladesh, *Artemia* cyst are used in a large scale specially in shrimp and prawn hatchery due to its higher nutritional value and ease of uses (Naser *et al.*2016). Generally, *Artemia* cyst are imported from different countries like USA, China, Brazil etc. and cyst are decpsulated in the hatchery. The decapsulation rate of *Artemia* cyst greatly depends on the salinity, temperature, aeration and pH of water (Ahmed *et al.* 1997, Lavens and Sorgeloos 1996). A small number of work has been conducted to observe the effect of salinity on the decapsulation of cyst (Ahmed *et al.* 1997, Sharahi and Zarei 2016). But, there was lack of research work of precise salinity or their

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combined effect on cyst decapsulation. That is why an experiment was conducted to find out the influence of salinity and on the decapsulation of cyst.

Materials and methods

Study site

The investigation of *Artemia* was carried out in Laboratory of Aquatic Bioscience, Department of Zoology,University of Yangon ,Kamayut Township,Yangon Region, Located between 16º83´98"N Latitude and 96º14´08" E Longitude.(Plate-1)

Study period

Field investigations were conducted from August, 2019 to September, 2019.

Materials

- *Artemia* cyst
- NaCl Salt
- Seawater refractometer
- Aerator (SB-248 A air pump)
- Plastic bowls (container)
- Magnifying Glass
- Electric Balance

Methods

Artemia cyst was purchased from the local market shops in Tarmwe Towship, Yangon. *Artemia* cyst is protected by a hard shell that encysts the dormant *Artemia* embryo. This *Artemia* embryo was completely removed from the cyst by a short term incubation in saline solution with aeration. This procedure is called decapsulation of cyst (Lavens and Sorgeloos 1996). *Artemia* cysts were purchased from aquarium shop which is located in Tarmwe Towship, Yangon. The cysts were stored in refrigerator before starting the experiments. Here, the cysts must be dry.

The decapsulation solution was prepared using 500 ml of water in a plastic bowl with NaCl salt. The amount of salt was calculated using following formula:

$$\text{The amount of salt needed (g)} = \frac{\text{Desired salinity (ppt)} \times 500}{1000}$$

For 25ppt, 12.5 gm NaCl salt was added to 500 ml of water. For 28ppt, 14 gm of NaCl salt was used and for 30ppt, 15gm of NaCl salt was used respectively. Salinity of water was checked using seawater refractometer. For 25ppt, three pink plastic bowls were used. For 28ppt, three green plastic bowls and for 30ppt, three blue plastic bowls were used.

2.5gm of *Artemia* cysts were added to each bowl. Each color of three plastic bowls was the same sample salinity for each kind ppt. During the decapsulation of *Artemia* cyst, continuous aeration was offered in each bowl for proper hatching of embryo. For this

porpose, aerator (SB-248A air pump) was used. Hatching rate of the decapsulated cyst was observed after 18 hours of aeration.

From each bowl, 5ml was taken to count the hatched and unhatched number of *Artemia* cyst. 5ml was put into a piece of white cloth and 10X magnifying glass was used to count the number of embryo.

In 25ppt salinity, the first pink replicate had 51 hatched embryo, the second one had 52 hatched embryo and the third one had 43 hatched embryo.

In 28ppt salinity, three green replicates had 48,51 and 48 hatched embryo respectively.

In 30ppt, three blue replicates had 60,57 and 47 hatched embryo respectively.

The hatching rate data obtained from the study were analyzed statistically using statistical Chi squared test. All data were presented with mean ± and standard error (SE).

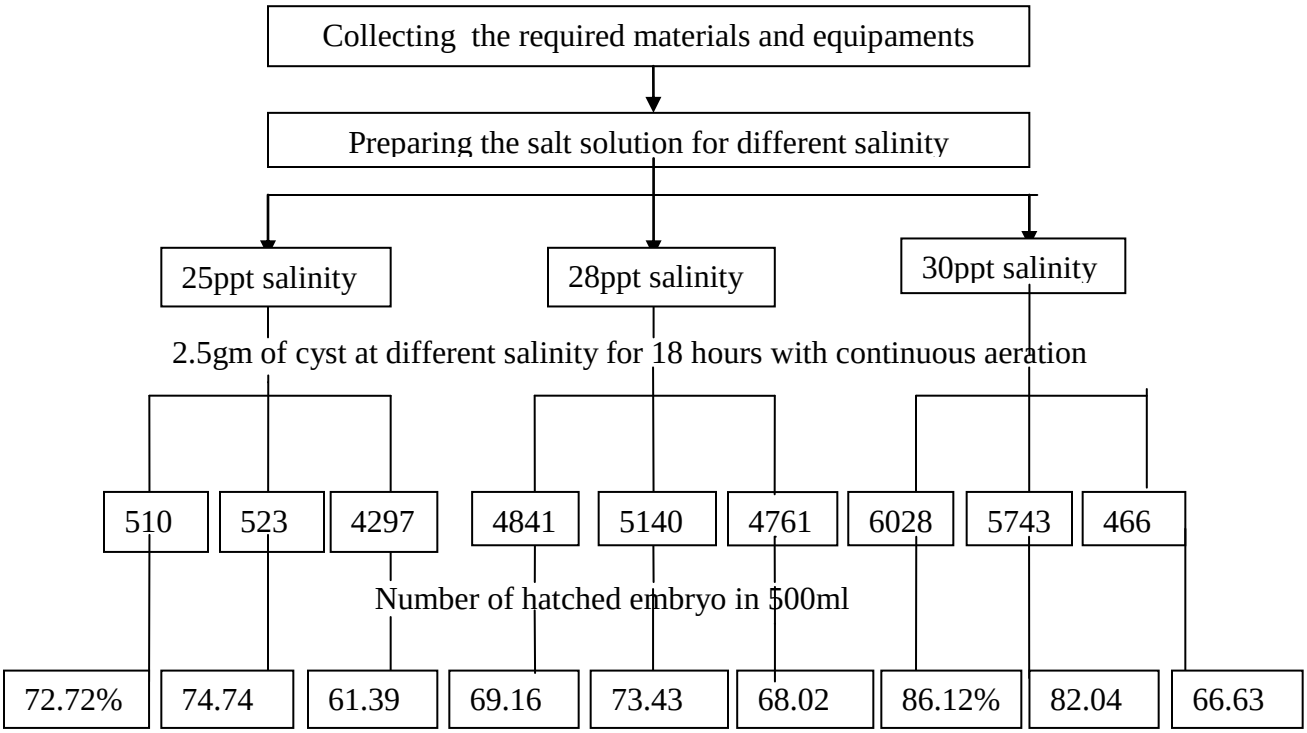
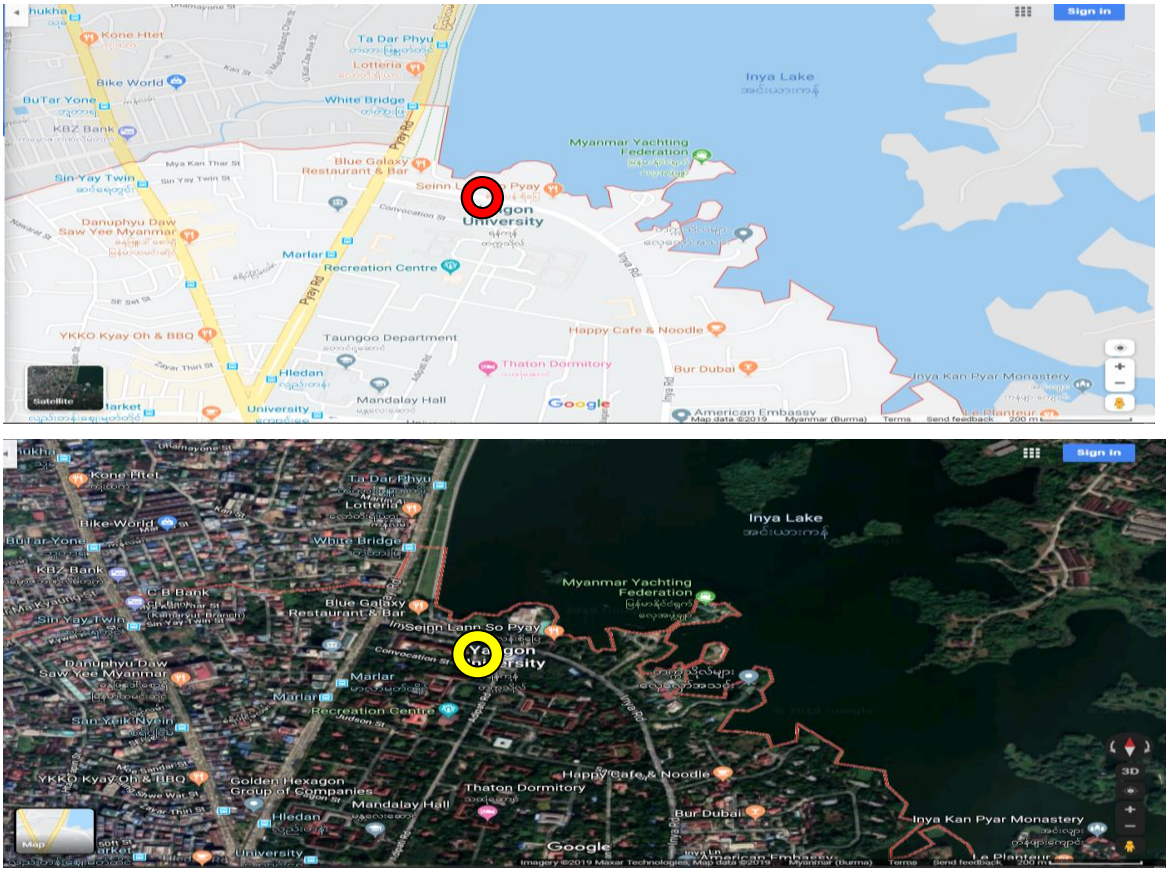


Fig.1. Method of hatching embryo (*Artemia* cysts)

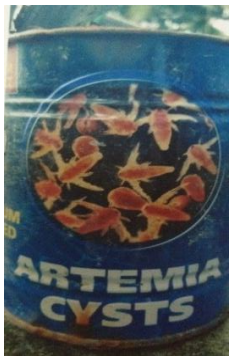


Source: Google Earth 2019

Plate.I . Map of Hatching Site Area

A. 12.5g of salt (25ppt) B. 14g of salt (28ppt) C. 15g of salt (30ppt) D.2.5g of *Artemia* cyst

E. 25 ppt F. 28 ppt G. 30 ppt H. Seawater Refractometer



I. Can of *Artemia* J. Aerator (SB-248A air pump) K. Magnifying Glass (10X)

Plate 2. Materials and samples for experiment

A. *Artemia* cyst in 25 ppt salinity

B. *Artemia* cyst in 28 ppt salinity

C. *Artemia* cyst in 30 ppt salinity

Plate.3 .Decapsulation process of *Artemia* cyst in plastic bowls

Results

Artemia cyst one spoon (2.5g) contained 7000 cysts.

At 25ppt, the number of hatched embryo was obtained-5100, 5232 and 4297. The number of unhatched embryo was obtained-1900, 1768 and 2703. The number of hatched and unhatched embryo according to hatching rate at 25 ppt is shown in Table 1.

At 28ppt, the number of hatched embryo was obtaibed -4841, 5140 and 4761. The number of unhatched embryo was obtained-5159, 1860 and 2239. The number of hatched and unhatched embryo according to hatching rate at 28 ppt is shown in Table 2.

At 30ppt, the number of hatched embryo was obtained-6028, 5743 and 4664. The number of unhatched embryo was obtained-972, 1257 and 2336. The number of hatched and unhatched embryo according to hatching rate at 30 ppt is shown in Table 3.

Null-hypothesis and hypothesis of hatching rate at 25ppt, 28ppt and 30ppt on *Artemia* cyst were shown in Table 4.

The effect on decapsulation of *Artemia* cyst at 25ppt salinity is presented in Fig.1.Highest hatching rate (74.7462±3.39%) was observed at 25ppt salinity. Lowest hatching rate (61.3927±3.39%) was found at 25ppt salinity. There was significantly different within the treatment of 25ppt ($x^2 = 9.722, p < 0.05$).

The effect on decapsulation of *Artemia* cyst at 28ppt salinity is presented in Fig.2. Highest hatching rate (73.43±1.35%) was observed at 28ppt salinity. Lowest hatching rate (68.0172±1.35%) was found at 28ppt salinity. There was no significantly different within the treatment of 28ppt ($x^2 = 0.343, p > 0.05$).

The effect on decapsulation of *Artemia* cyst at 30ppt salinity is presented in Fig.3. Significantly highest hatching rate (86.12±7.54%) was found and lowest hatching rate (66.6321±7.54%) was found at 30ppt salinity. There was no significantly different within the treatment of 30ppt ($x^2 = 0.205, p > 0.05$).

Among different treatments $x^2 = 2.937, p > 0.05$. So, there was no significant difference among 25, 28 and 30ppt.

Table 1. Number of hatched and unhatched embryo at 25ppt salinity

	25ppt	
Pink plastic bowls	Hatched number	Unhatched number
1.	5100	1900
2.	5232	1768
3.	4297	2703
Mean	4876.33	2123.66

Table 2. Number of hatched and unhatched embryo at 28ppt salinity

	28ppt	
Green plastic bowls	Hatched number	Unhatched number
1.	4841	5159
2.	5140	1860
3.	4761	2239
Mean	4914	3086

Table 3. Number of hatched and unhatched embryo at 30ppt salinity

	30ppt	
Blue plastic bowls	Hatched number	Unhatched number
1.	6028	972
2.	5743	1257
3.	4664	2336
Mean	5478.33	1521.66

Table 4.Null-hypothesis and hypothesis of hatching rate at25ppt, 28ppt and 30ppt salinity

	25ppt	28ppt	30ppt	Total
1.	72.72%	69.16%	86.12%	228
2.	74.75%	73.43%	82.04%	230.22
3.	61.39%	68.02%	66.63%	196.04
Total	208.86	210.61	234.79	654.26
Mean	69.62	70.20	68.26	-
Chi-squared x^2	9.722	0.343	0.205	2.937
Standard deviation SD	5.88	2.33	13.06	-
Standard error SE	±3.39	±1.35	±7.54	-

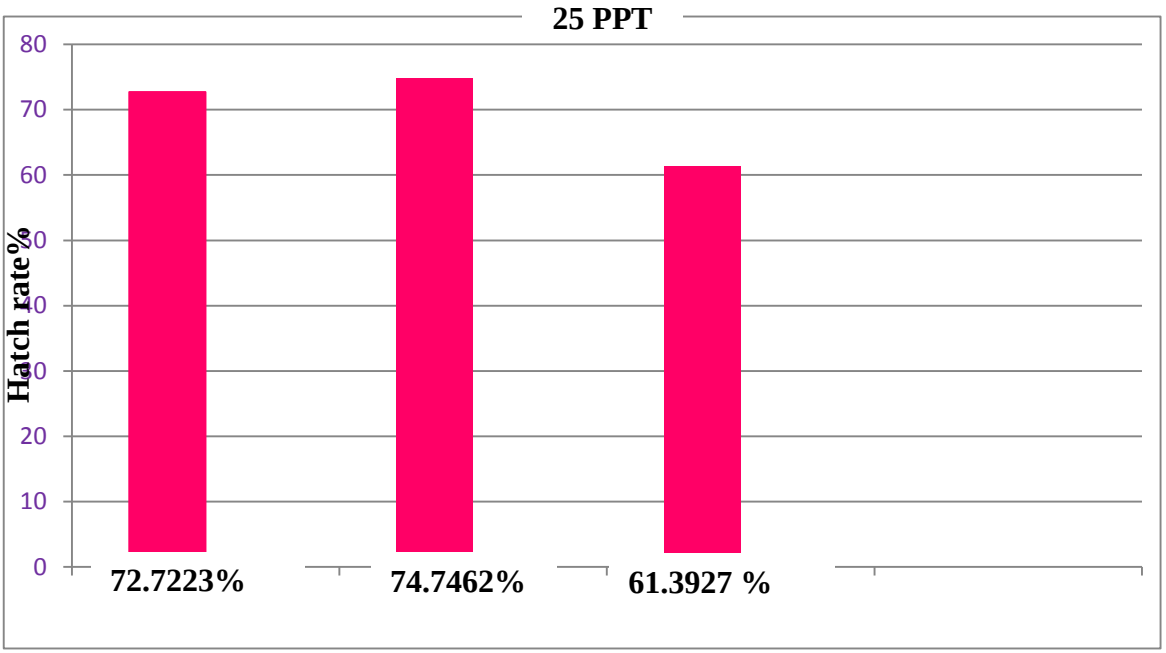


Fig.(2) Effect on decapsulation of *Artemia* cyst at 25 ppt salinity.

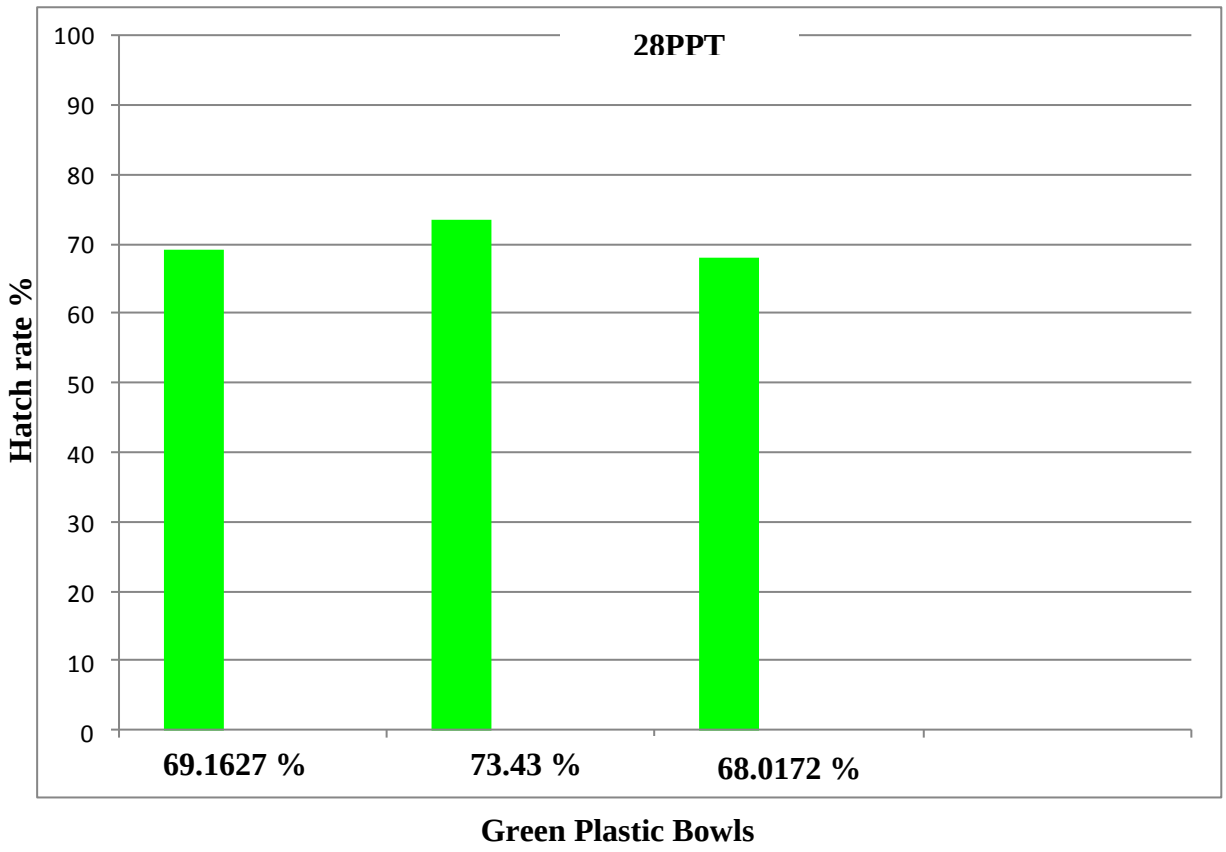
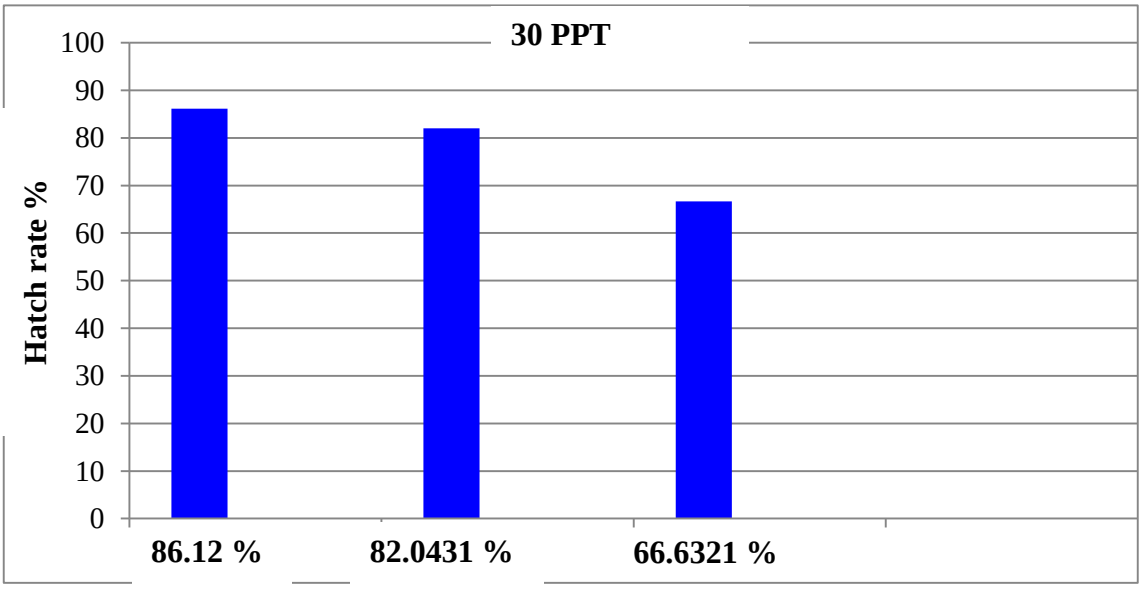


Fig.(3) Effect on decapsulation of *Artemia* cyst at 28 ppt salinity.



Blue Plastic Bowls

Fig.(4) Effect on decapsulation of *Artemia* cyst at 30 ppt salinity

Discussion

Rajkumar and Babu (2015) recorded 72% hatching rate at 25 ppt salinity. Highest hatching rate (74%) was obtained and lowest hatching rate (61 %) at 25 ppt salinity after 18 hrs of incubation. So the highest hatching rate is similar to this study.

An experiment was conducted by Rajkumar and Babu (2015) on the influence of salinity and temperature on the hatching of *Artemia.* They observed 87% hatching rate of *Artemia* cyst at 30 ppt salinity Wansonga and Olendi (2017) found highest (58.7 ± 1.5 %) and lowest (45.7±3.5%) hatching rate were calculated at 30 ppt salinity after 36 hours of incubation (Ahmed *et al.* 1997).

Sorgeloos and Skujlasekarapandian (1984) suggested 35 ppt salinity of sea water is ideal for *Artemia* cyst decapsulation in laboratory condition. But Rajkumar and Babu (2015) found 75 and 58% hatching rate at 32 and 35 ppt salinity respectively. Ahmed *et al.* (1997) recorded maximum (47.7 ± 2.1%) hatching rate and minimun (40.3 ± 1.2%) at 40 ppt salinity for processed and preserved cyst whereas Wansonga and Olendi (2017) observed 89.88% hatching rate at 40 ppt salinity. But this result did not match properly with the previous literature.

Generally, *Artemia* cyst decapsulation depends on many factors like temperature, salinity, pH, cyst quality, aeration etc. Moreover, fixed temperature, cyst density and container's design also play important role in maximal production of *Artemia* cyst (Lavens and Sorgeloos 1996, Sharahi and Zarei 2016). The variation of *Artemia*

decapsulation rate in different literature could be the effect of different above mentioned factors.

It can be concluded from the above discussion and the findings of this study that the decapsulation rate of *Artemia* cyst greatly depends on salinity. This result, 30 ppt salinity could be the best combination of higher rate of decapsulation of *Artemia* cyst. Moreover, the decapsulation rate decreases below 28 ppt salinity.

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Fish Fauna of Taping River Segment, Banmaw Township, Kachin State

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Abstract

The present study was undertaken to report the fish fauna diversity of Taping River segment, Banmaw Township, Kachin state. The sutdy was carried out in between December, 2019 to March, 2020. A total of 32 fish species belonging to 15 families, 27 genera and six orders were recorded. Order Cypriniformes was the most dominant group represented by 15 (46.87%) species followed by orders Perciformes with 7(21. 88 %) species, Siluriformes with 5 (15.63%) species, Synbranchiformes with 3(9.38%) species and Osteoglossiformes and Beloniformes with 1(3.13%) species each. Among the recorded species, 10 species were recorded throughout the study period while *Monopterus albus* was encountered only in the month of December. In the present study, five fish species were observed as introduced species.

Keywords: Fish species diversity, Occurrence, Freshwater fish fauna, Taping River

Introduction

Myanmar is endowed with rich natural resources both in freshwater and marine fisheries. Nowadays, the increasing pressures from industrial and urban development and increased demand for fish and fishery product owing to population growth as well as global climate change can cause for damage to degradation of ecosystems including fisheries resources (DOF, 2018).

Riverine fish resources are fast depleting due to lack of fish resource information and over exploitation. Sustainable exploitation of water bodies require detailed analysis of fish fauna inhabiting lotic water and scientific management through regular monitoring and proper check on fishing pressure, including unscientific fishing methods (Rathore and Dutta, 2015).

While covering less than 1% of the Earth's surface freshwater ecosystems provide humans with a wealth of goods and services, and provide a home for around 10% of the world's described species, including a quarter of all vertebrates (Strayer and Dudgeon, 2010: cited by Shelke, 2018). Asia has the largest fisheries production of all the world's continents and many livelihoods are dependant upopn freshwater biodiversity, which provides food security to the poorest of communities (Shelke, 2018).

Although the information regarding fish and their status are well documented on many parts of the world, it is in the premature stage in countries like Myanmar. Myanmar with a huge amount of water resources and rich diversity of fish species, has a tremendous potential for fisheries development as well as enormous opportunity to develop fish base assessment techniques. The inland water resources of Myanmar include

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natural water such as, rivers, lakes and reservoirs. So, there are a fair number of lists of fish from different regions and rivers in Myanmar, but most of them are not complete and precise.

The Taping River, known as Ta Hkaw Hka in Kachin and Daying River in Chinese, is river in Yunnan province, China and northern Myanmar. It is the first tributary of the country's chief river, the Ayeyawady. It meet Ayeyawady River in Banmaw Township, Kachin State, it flows through Momauk Township and continue towards the south-west near Naunglite village, Myothit Town. The Ayeyawady River and Taping River are joined near Naungkho village.The objective of the present research is to identify and record the fish species of Taping River segment, Banmaw Township and to determine the monthly assemblages of fish species in the study area .

Materials and Methods

Study Area

Taping River segment, Banmaw Township, Kachin state was selected as study area. It is located at latitude 24˚ 18′ 45.56″ N and longitude 97˚ 15′ 59.98″ E (Fig. 1).

Fig.1 Map of Study Area (Source from Google Earth)

Study Period

The present study was conducted from December, 2019 to March, 2020.

Collection and Preservation of Specimens

The fish specimens were collected on monthly basis with the helpfulness of local fishermen. Data of fish was noted and coloured photographed taken soon after catching. The collected speciemens were examined and recorded soon after the fish had been caught because body colour usually disappears when preserved in formalin. The fishes

were preserved in different percentage of formalin solution according to the size of specimens for future study and identification.

Identification and Classification

Identification of fish species were made according to Day (1878), Talwar and Jhingram, Ferraris (1997) and Jayaram (2013). The classification of fish was made according to Jayaram (2013).

Data Analysis

The data obtained from present work was analyzed for species occurrence and composition. Species composition was calculated after Thrusfield, 1995.

Results

A total number of 32 species was collected during the study period. These fish species were confined to six orders, 15 families and 27 genera (Table.1).

Table.1 List of Fish Species recorded from Taping River segment

ORDER	FAMILY	SCIENTIFIC NAME
1 Osteoglossiformes	1 Notopteridae	1 *Notopterus notopterus* (Pallas, 1769)
2 Cypriniformes	2 Cyprinidae	2 *Salmophasia sardinella* (Valenciennes,1842)
		3 *Raiamas guttatus* (Day, 1869)
		4 *Amblypharyngodon atkinsonii* (Blyth, 1861)
		5 *Ctenopharyngodon idellus* (Valenciennes, 1844)
		6 *Cyprinus carpio* (Linnaeus, 1758)
		7 *Osteobrama belangeri* (Valencennes, 1844)
		8 *Puntius chola* (Ham., & Buch., 1822)
		9 *Puntius sarana* (Ham., & Buch., 1822)
		10 *Barbonymus gonionotus* (Bleeker, 1850)
		11 *Cirrhinus mrigala* (Ham., & Buch., 1822)

			12 *Catla catla* (Ham., & Buch., 1822)
			13 *Labeo boga* (Ham., & Buch., 1822)
			14 *Labeo calbasu* (Ham., & Buch., 1822))
			15 *Labeo rohita* (Ham., & Buch., 1822)
			16 *Labeo stoliczkae* (Steindachner, 1870)
3	Siluriformes	3 Bagridae	17 *Mystus cavasius* (Ham., & Buch., 1822)
		4 Siluridae	18 *Ompok bimaculatus* (Bloch, 1797)
			19 *Wallago attu* (Schneider, 1801)
		5 Schilbeidae	20 *Clupisoma prateri* (Hora, 1937)
		6 Clariidae	21 *Clarias batrachus* (Linnaeus, 1758)
4	Beloniformes	7 Belonidae	22 *Xenentodon cancila* (Ham & Buch, 1822)
5	Synbranchiformes	8 Synbranchidae	23 *Monopterus albus* (Zuiew, 1793)
		9 Mastacembelidae	24 *Macrognathus aral* (Bloch & Schneider,1801)
			25 *Mastacembelus armatus* (Lacepede, 1800)
6	Perciformes	10 Ambassidae	26 *Parambassis ranga* (Ham., & Buch., 1822)
		11 Cichlidae	27 *Oreochromis* sp. (Gunther, 1885)
		12 Gobiidae	28 *Glossogobius giuris* (Ham., & Buch., 1822)
		13 Anabantidae	29 *Anabas testudineus* (Bloch, 1795)
		14 Belontidae	30 *Trichogaster pectoralis* (Regan, 1909)
		15 Channidae	31 *Channa marulius* (Ham., & Buch., 1822)
			32 *Channa puntatus* (Bloch, 1793)

The recorded six orders were Osteoglossiformes, Cypriniformes, Siluriformes, Beloniformes, Synbranchiformes and Perciformes. Order Osteoglossiformes was represented by a single species *Notopterus notopterus* belonging to the family Notopteridae. The order Cypriniformes was represented by 15 species, distributed among

11 genera, belonging to the family Cyprinidae. The order Siluriformes was represented by five species, distributed among five genera and belonging to four families namely Siluridae with two representative genera, family Bagridae, Schilbidae and Clariidae each with only one representative genus. The order Beloniformes on the other hand was represented by a single species *Xenentodon cancila*, belonging to family Belonidae. The order Synbranchiforme was represented by three species, distributed among three genera, belonging to two families, namely Synbranchidae with one genera and Mastacembelidae with two representative genera. The order Perciformes was represented by seven species distributed among six genera and belonging to six families namely Channidae, Ambassidae, Cichlidae, Gobiidae, Anabantidae and Belontidae each with only one representative genus.

In the present study, the perentage of fish species composition show that order Cypriniformes was most dominant (46.87%), followed by order Perciformes (21.88%), order Silurifromes (15.63%), order Synbranchiformes (9.38%) order Osteoglosssiformes and Beloniformes constituting (3.13%) of the total fish species recorded (Fig.2).

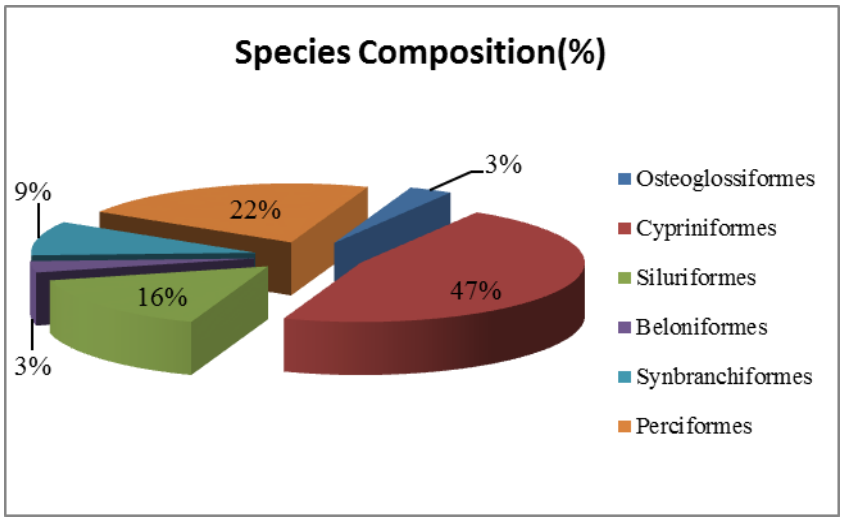

Fig.2 Species Composition of recorded fishes in different orders from Taping river segment

With respect to the families, Cyprinidae was dominant family and represented by15 species, followed in order by Siluridae, Mastacembelidae and Channidae represented by two species in each. The family Notopteridae, Bagridae, Schilbidae, Clariidae, Belonidae, Synbranchidae, Ambassidae, Cichlidae, Gobiidae, Anabantidae and Belontidae were confined to only one species in each.

During the study period, the percentage of species composition was the highest in family Cyprinidae (46.87%), followed by Siluridae, Mastacembelidae and Channide (6.25% each). The remaining 11 families, Notopteridae, Bagridae, Schilbidae, Cichlidae, Belonidae, Synbranchidae, Ambassidae, Cichlidae, Gobiidae, Anabantidae and Belonlidae each with 3.13% (Fig.3).

Among the genera, the most dominant genus was *Labeo* with four species, followed by the genus *Channa* with two species and the rest of the other genera were represented by single species each.

In accordance with monthly recorded data, the highest number of 30 fish species was found in December and the lowest number of 19 fish species in February. Among the recorded species, *Notopterus notopterus*, *Salmophasia sardinella*, *Osteobrama belangeri*, *Puntius chola*, *Catla catla*, *Labeo rohia*, *Xenentodon cancila*, *Paramabassis ranga*, *Oreochromis sp.* and *Glossogobius giuris* were dominant species because they were observed throughout every months of the study period. However, *Monopterus albus* was recorded only in December (Table.2). Monthly recorded data showed that the order Osteoglossiformes and Beloniformes were the most dominant in February (5.26%), order Cypriniformes (55.00%) in March, order Siluriformes (18.52%) in January, order Synbranchiformes (10.00%) in December and order Perciformes (26.32%) in February (Fig.4).

Table.2 Monthly occurrence of fish species recorded from Taping River segment

No.	Species Name	Dec	Jan	Feb	March	Total
1	*Notopterus notopterus*	+	+	+	+	4
2	*Salmophasia sardinella*	+	+	+	+	4
3	*Raiamas guttatus*	+	+	-	-	2
4	*Amblypharyngodon atkinsonii*	+	-	+	+	3
5	*Ctenopharyngodon idellus*	+	+	-	-	2
6	*Cyprinus carpio*	+	+	+	-	3
7	*Osteobrama belangeri*	+	+	+	+	4
8	*Puntius chola*	+	+	+	+	4
9	*Puntius sarana*	+	+	-	+	3
10	*Barbonymus gonionotus*	-	+	+	+	3
11	*Cirrhinus mrigala*	+	+	-	+	3
12	*Catla catla*	+	+	+	+	4
13	*Labeo boga*	+	+	-	+	3
14	*Labeo calbasu*	-	+	+	-	2
15	*Labeo rohita*	+	+	+	+	4
16	*Labeo stoliczkae*	+	-	+	+	3
17	*Mystus cavasius*	+	+	-	-	2
18	*Ompok bimaculatus*	+	+	-	-	2
19	*Wallago attu*	+	+	-	+	3
20	*Clupisoma prateri*	+	+	-	-	2
21	*Clarias batrachus*	+	+	+	-	3
22	*Xenentodon cancila*	+	+	+	+	4
23	*Monopterus albus*	+	-	-	-	1

No.	Species Name	Dec	Jan	Feb	March	Total
24	*Macrognathus aral*	+	+	-	-	2
25	*Mastacembelus armatus*	+	-	+	+	3
26	*Parambassis ranga*	+	+	+	+	4
27	*Oreochromis* sp.	+	+	+	+	4
28	*Glossogobius giuris*	+	+	+	+	4
29	*Anabas testudineus*	+	+	+	-	3
30	*Trichogaster pectoralis*	+	-	+	+	3
31	*Channa marulius*	+	+	-	+	3
32	*Channa puntatus*	+	+	-	-	2
	Total number of species	30	27	19	20	

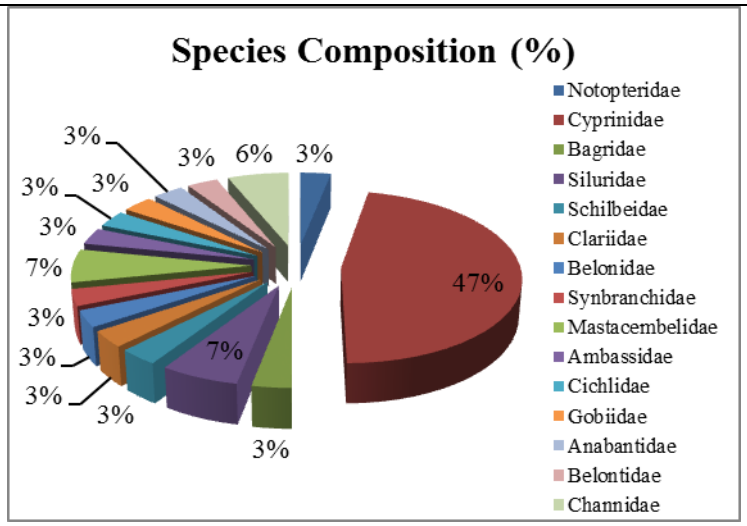

Fig.3 Species Composition of recorded fishes in different families fromTaping river segment

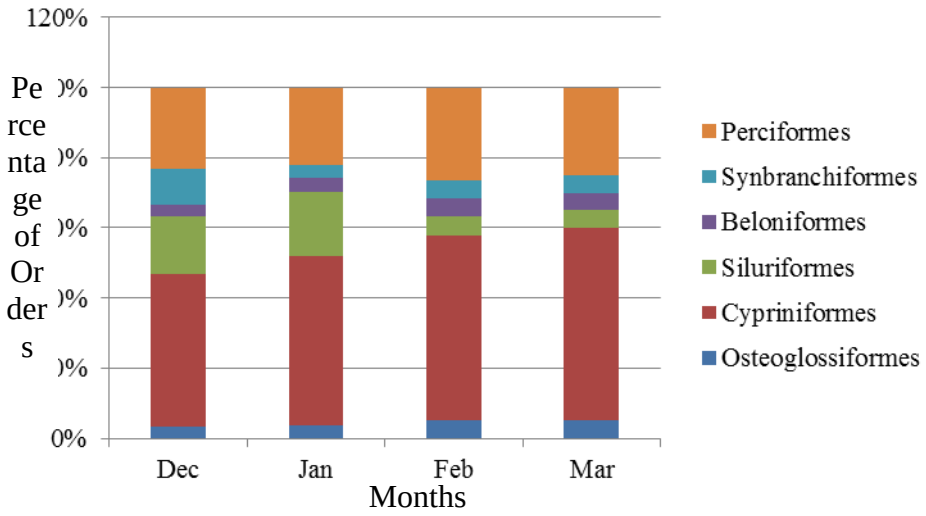

Fig.4 Monthly occurrence of fish species composition from Taping River segment

Discussion

The fish fauna diversity was surveyed from the Taping river segment, Banmaw township, Kachin State. Taping river is the first tributary of the country's chief river, the Ayeyawady. It has a rich fauna and provides fishes to the local consumers throughout the whole year. A total of 32 species under 27 genera and 15 families belonging to six orders of freshwater fishes were recorded from the Taping river segment, Banmaw Township.

During the present study, the highest species compostion (46.87%) was observed in order Cypriniformes. Therefore, the order Cypriniformes was the predominant order because the highest number of both genera and species were encountered in that order. Then, the second dominant order was Perciformes (21.88%), followed by Siluriformes (15.63%), Synbranchiformes (9.38%), and Osteoglossiformes and Beloniformes consisting (3.13%) each of the total fish species.

Nelson (1984) reported that order Cypriniformes was the largest order of the freshwater fishes which include 2422 species. Shelke (2018) also reported that order Cypriniformes was the most dominant group represented by 20 species in Girna River, Maharashtra, India.

Sanda Maung (2013) also described that a total of 43 species belonging to 31 genera confined to 19 families under seven orders were recorded from Pauk In (Lakes), Pakokku Township. Most species of this study belong to the order Cypriniforme (39.53%) followed by Perciformes (27.91%). Similarly, Ni Ni Aye (2013) suggested that a total of 36 fish species belonging to 26 genera, 15 families and seven orders were from Sunye In (Lake), Sintkaing Township. The composition of fish species found to be highest in order Cypriniformes followed by order Perciformes and order Siluriformes. In accordance with the previous local works focused on Ayeyawady river segment undertaken by local researchers, Phyu Phyu Khin (2015) and Nway Nway Win (2017), they described the order Cypriniformes was predominant in their study area. So, order Cypriniformes was dominant order in Ayeyawady river and its tributary.

Compared with the finding of Naw Htoo Di (2018), although her study area was same the present study the following fishes, *Anguilla bengalensis*, *Gudusia variegata*, *Aspidoparia morar*, *Osteobrama cunma*, *Labeo angra*, *L. dyocheilus*, , *Botia histrionic*, *Lepidocephalichthys thermalis*,*Sperata aor*, *Mystus Leucophasis*, *Hemibagrus menoda*, *Eutropiichthys vacha*, *Gagata cenia*, *Bagarius yarrellii*, *Erethistes maesotensis*, *Heteropneustes fossilis*, *Cephalocassis jatia* and *Rhinomugil corsula* were not recorded in the present study. Although, some fishes such as *Salmophasia sardinella*, *Ctenopharyngodon idellus*, *Puntius sarana* , *Barbonymus gonionotus*, *Labeo boga*, *L. calbasu*, *L. rohita*, *Clupisoma prateri*, *Macrognathus aral* and *Channa marulius* were not among those recorded by Naw Htoo Di (2018).

Comparison between the data of the previous works and also with the data accumulated durig the present work revealved that some of the fish species were common to all the study area and some were not recorded in some study area.This differences may be due to duration of study period, time factors and environmental condition.

Among the families, according to fish species composition, family Cyprinidae (46.87%) was found to be dominant group in the present study. UNEP-WCMC (2008)

reported that the Cyprinidae family as an important family in freshwater fishes. Naw Htoo Di (2018) also reported that the family Cyprinidae was the dominant family in Taping River. Nway Nway Win (2018) and Zin Wai Phyo (2018) also described that the family Cyprinidae was the most dominant family in Ayeyawady river.

During the present study, some species were recorded monthly, but some species were not.With respect to the monthly number of species recorded, the maximum number of fish species (30) was found in December, followed by 27 species in January and 20 species in March. The minimum number of species (19) was observed in February. So, the highest number of species were observed in cold months (December and January) of the year and declined in the hot months (February and March). It is due to the shallow water in hot months and habitat condition.

In the present study, the status of fish species according to Fish-base (2017) five introduced species of *Ctenopharyngodon idellus*, *Cyprinus carpio*, *Barbonymus gonionotus*, *Oreochromis* sp. and *Trichogaster pectoralis* were recorded.

In the present study, *Notopterus notopterus*, *Ctenopharyngodon idellas*, *Cyrpinus carpio*, *Osteobrama belangeri*, *Cirrhinus mrigala*, *Catla catla*, *Labeo calbasu*, *L. rohita*, *L. stoliczkae*, *Ompok bimaculatus*, *Wallago attu*, *Clarias batrachus*, *Oreochromis* sp., *Channa marulius* and *Channa puntatus* were commercially important fish species. Other fish species were supporting the local consumers. Therefore, Taping river is provided food and income for fishermen and local people.

Conclusions

The result of the present study revealed that Taping River provides rich and diverse of the freshwater fish fauna. Most of the economically important fish species are recorded in Taping River. So, Taping River is a good natural ecosystem for many freshwater fish species and support the protein source of food for local consumption and livelihood. Moreover, the Taping river becomean an important role for economy of the local peoples. It is needed to maintain the eco-friendly nature of the Taping River, and also to sustain the fish fauna diversity of Taping River for future generation.

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The Infestation of Pest Beetle Species in Ma-U Village at Monywa Township, Sagaing Region

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Abstract

This study was carried out in Ma-U Village at Monywa Township, Sagaing Region from October 2018 to February 2019. The aims of the present study were to identify the pest beetles in the study area and to assess the composition of pest beetles that are infected with the host plants and stored products. A total of 14 species belonging to 14 genera, 11 families under six superfamilies of order Coleoptera were recorded. Among recorded pest species, Cucujoidea was the largest superfamily (42.86%) comprising six species, while the smallest superfamilies were Scarabaeoidea, Chryosomeloidea, and Dermestoidea (7.14% each). Eight pest species were infested the stored products, and four species were damaged the host plants except for*Lophocateres pusillus* and *Tenebroides mauritanicus* both vegetables and the stored products. the present research should hope to be some aids in gardeners and farmers.

Keywords: Infestation, Pest Beetles, Host Plants, Stored Products

Introduction

Beetles are a group of insects that form the order Coleoptera. The word "coleopteran" means sheathed wing, because most beetles have two pairs of wings, the front pair, the elytra, being hardened and thickened into a shell-like protection for the rear pair and the beetle's abdomen. The diversity of beetles is very wide-ranging. They are found in almost all types of habitats, but not known to occur in the sea or in the polar region (Imm, 1964).

Beetles are not only pests, but also benefit, usually by controlling the populations of pests. Many species of beetle are serious pests of agriculture and forestry, stored food, wood, leathers, furs, fabric. Some beetles cause trouble for farmers and people in forests because they eat crops or trees. Vegetable beetles are widespread in agricultural land. Some has become a pest of winter crop and were found to have caused crop damage. Some may be seen chewing on crop seedlings (Luther, 2006). Many beetles feed on the foliage and roots of plants, causing much damage to crops; they can kill huge tracts of valuable forests in a short time. Others damage our wooden homes, our furniture and many kinds of stored foods and other products. Beetles are of immense ecological and economic importance. Many are vital in the cycles of decomposition of plant and animal matter. Others are predators of insects and other invertebrates that damage crops and other plants (Scudder and Cannings, 2005).

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According to Dieke (1947) about one sixth of all the described species of the family Cocilinellidae and almost all Epilachna beetles feed most actively in the morning and evening during the summer and feeding declines rapidly in the middle of the day and after the night. Khan *et al.* (2000) state that Epilachna beetle is a pest of vegetables commonly found in beans and it is widely distributed in Southeast Asia, Australia, America and East Indies.

Moreover, large quantities of stored products are destroyed on contaminated because of the presence of arthropods, and beetles are by far the most important around the world have been found associated with stored products (Hinton, 1945). Many storage pests have been associated with human activity for a long time. Families Tenebrionidae, and Silvanidae were well established as pests of grain in ancient Egypt (Rees, 2004).

There are many crops and grains which are cultivated in Myanmar. among them rice is staple food in Myanmar. Paddy and milled rice were infested by insects (Coleoptera, Lepidoptera, Psocoptera) that resulted great losses and poor yield quality. Among above orders, Coleoptera (beetle) was more observed than other orders. Like the other crops, a large number of pest attacks on vegetables from soon after germination to the fruiting time and even in post harvesting period. It limits the quantity and quality of products of vegetables. Since these plants are grown mainly in the tropical climates, pests play in commercially important role in the production of these crops and plants (Sallam, 2016).

Ma-U village is situated at the southern part of the Monywa Township, beside the Monywa-Mandalay road. Many kinds of vegetables and crops were commercially grown in Monywa environs, including Ma-U village, to consume local people and to wholesale to other areas. Most people cultivated the vegetable and crops around the Ma-U village. Therefore, the present study was conducted with the following objectives:

- to identify the pest beetles in the study area and to assess the composition of pest beetles that infected with the host plants and stored products

Materials and Methods

Study area

Ma-U village in Monywa Township is located at 22º04'07.90" N latitudes and 95º10'42.14" E longitude. It is situated 78 meter above the sea level. It has an area 162.0 square hectare. It is away from 11.265 kilometers in the southern part of Monywa Township (Fig. 1).

Study sites

Different six study sites were assigned into different crops fields. They were rose, cabbage, eggplant, bean, cucumber and paddy field. Different crops and grains of stored products were observed in stored houses of famers in the study area.

Study period

The present study was conducted from October 2018 to February 2019.

Study methods

The varied of plant numbers in different farms were observed in the present study. Collection of specimen was done by hand for all rows of plants during the study period. The pest beetles were collected, by net in the field of various vegetables and by hand in the stored products such as rice, wheat, maize and legume. The recorded species were photographed by Hot Viewer microscope and checked in characters with deserting microscope or electron microscope (Plate 2).

Classification and identification of species

The collected specimens were placed in plastic box and brought to the laboratory for detailed study and identification was carried out according to Borror and Delong (1957), Imms (1964), Bousquet (1990), and Crowson (2012). The identification of host plants was checked by Kress *et al.* (2003).

Fig. 1 Location map of the study site (Source: Google Earth, 2020)

(A) Hot viewer microscope

(B) Materials used for identification

(C) Plastic boxes containing specimens

(D) Net for collecting specimens

Plate 2. Collecting materials and specimens collected from study sites and from stored products

Results

A total of 14 species belonging to 14 genera, 11 families under six superfamilies of order Coleoptera were recorded during the study period.

Species composition of pest beetles

A total of 14 species belonging 14 genera, 11 families under six superfamilies of order Coleoptera were recorded in the study area during October 2016 to February 2017 (Table 1). Among recorded pest species, Cucujoidea was the largest superfamilies (42.86%) comprising six species (Table 2, Fig..2).

Among the recorded species, eight pest species were infested the stored products, and four species were damaged the host plants except *Lophocateres pusillus* and *Tenebroides mauritanicus* both vegetables and the stored products (Table 3).

Table 1. Species composition of pest beetles under superfamily in the study sites

Superfamily	Number of family	Number of genus	Number of species	Species composition (%)
Scarabaeoidea	1	1	1	7.14
Chryosomeloidea	1	1	1	7.14
Cleroidea	2	2	2	14.29
Cucujoidea	4	6	6	42.86
Bostrychoidea	2	3	3	21.43
Dermestoidea	1	1	1	7.17
Total	11	14	14	

Table 2. List of the pest beetle species recorded in Ma-U Village, Monywa Township

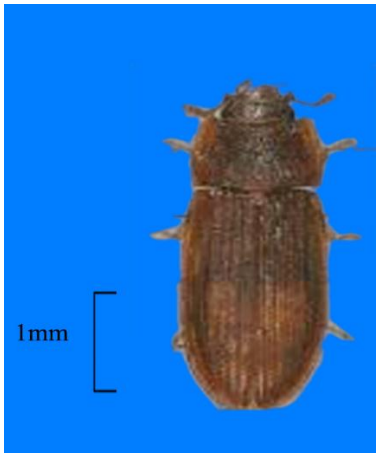
Family	Genus	Species	Common name
Scarabaeidae	*Adoretus*	*Adoretus* sp.	
Chryosomelidae	*Deloyala*	*Deloyala guttata*	Mottled Tortoise Beetle
Trogositidae	*Lophocateres*	*Lophocateres pusillus*	Siamese Grain Beetle
Cleridae	*Necrobia*	*Necrobia rufipes*	Red-legged ham beetle
Nitidulidae	*Carpophilus*	*Carpophilus hemipterus*	Dried fruit beetle
Silvanidae	*Oryzaephilus*	*Oryzaephilus surinamensis*	Sawtoothed grain beetle
Coccinellidae	*Epilachna*	*Epilachna varivestis*	Epilachna beetle
Tenebrionidae	*Tenebroides*	*Tenebroides mauritanicus*	Cadelle beetle
	Alphitobius	*Alphitobius diaperinus*	Litter beetle
	Tribolium	*Tribolium castaneum*	Red flower beetle
Anobiidae	*Lasioderma*	*Lasioderma serricorne*	Cigarette beetle
Bostrychidae	*Dinoderus*	*Dinoderus minutus*	Bamboo borer
	Rhyzopertha	*Rhyzopertha dominica*	Lesser grain borer
Dermestidae	*Trogoderma*	*Trogoderma granarium*	Khapra beetle

Table 3. Recorded pest beetles infested in plants and stored products

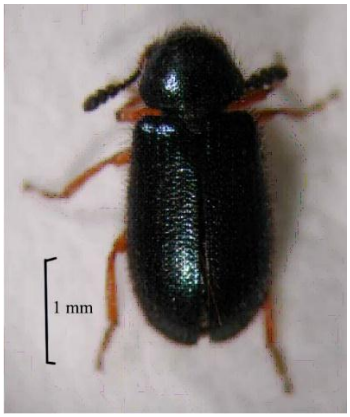
Species	Host plants	Stored products
Adoretus sp.	Sunflower	-
Deloyala guttata	Cabbage, Eggplant	-
Lophocateres pusillus	Paddy	Rice, Wheat grain
Necrobia rufipes	-	Sunflower seed
Carpophilus hemipterus	-	Corn
Oryzaephilus surinamensis	-	Corn, Rice
Epilachna varivestis	Bean Plant, Cucumber	-
Tenebroides mauritanicus	Paddy	Wheat grain, Corn
Alphitobius diaperinus	-	Sunflower seed
Tribolium castaneum	-	Rice, Chick-pea
Rhyzopertha dominica	-	Wheat grain, Cow-pea
Trogoderma granarium	Paddy	-
Lasioderma serricorne	-	Rice, Wheat
Dinoderus minutus	-	Chick-pea

(A) *Adoretus* sp.

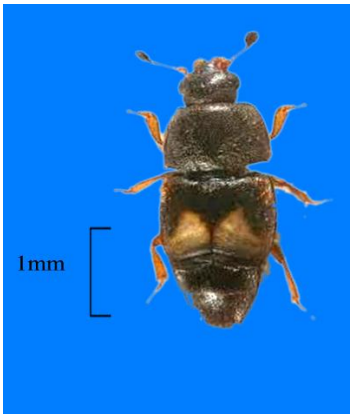
(B) *Deloyala guttata*



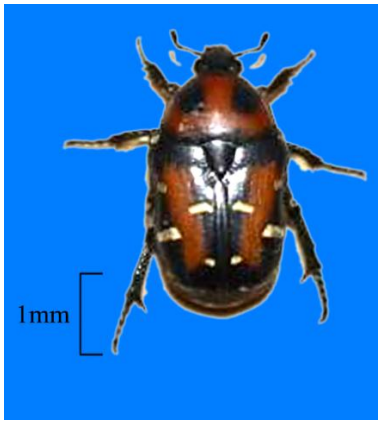
(C) *Lophocateres pusillus*



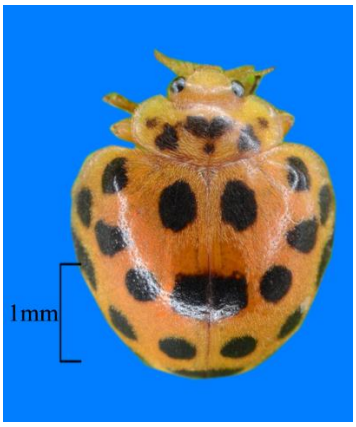
(D) *Necrobia rufipes surnamensis*



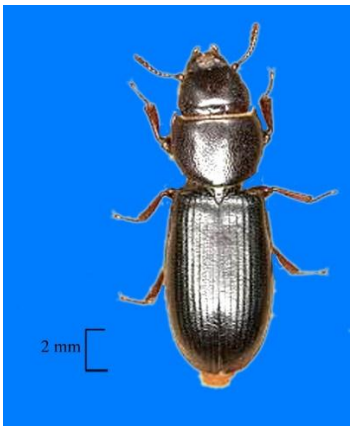
(E) *Carpophilus hemipterus*



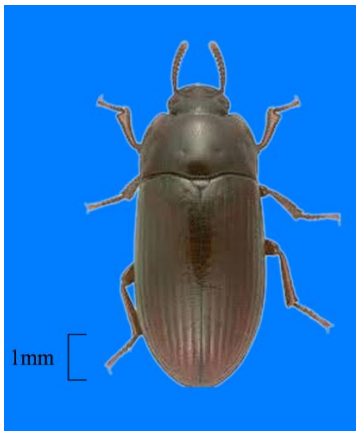
(F) *Oryzaephilus*



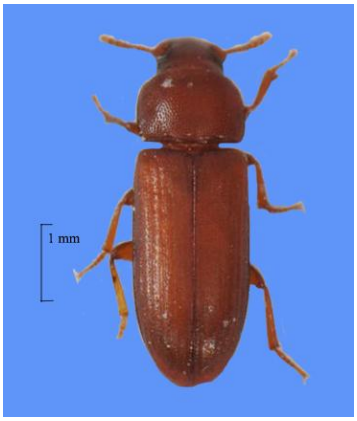
(G) *Epilachna varivestis*



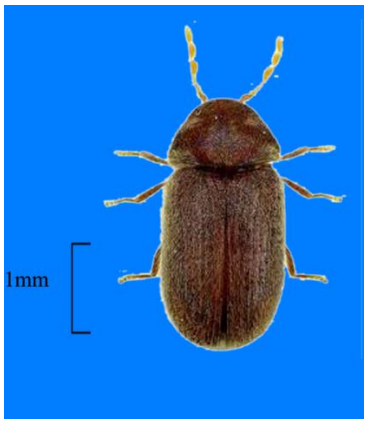
(H) *Tenebroides mauritanicus*



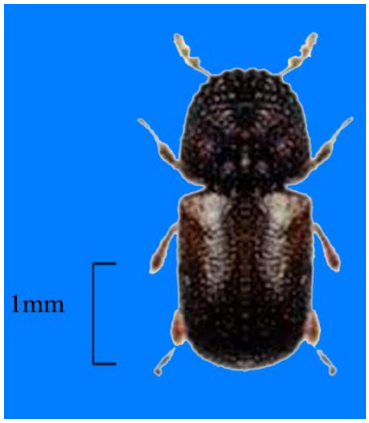
(I) *Alphitobius diaperinus*



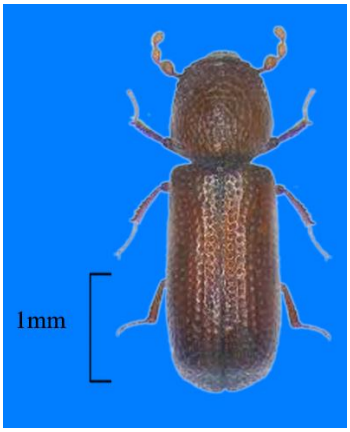
(J) *Tribolium castaneum*



(K) *Lasioderma serricorne*



(L) *Dinoderus minutus*



(M) *Rhizopertha dominica*

(N) *Trogoderma granarium*

Plate 2. Recorded pest beetle species in the study area

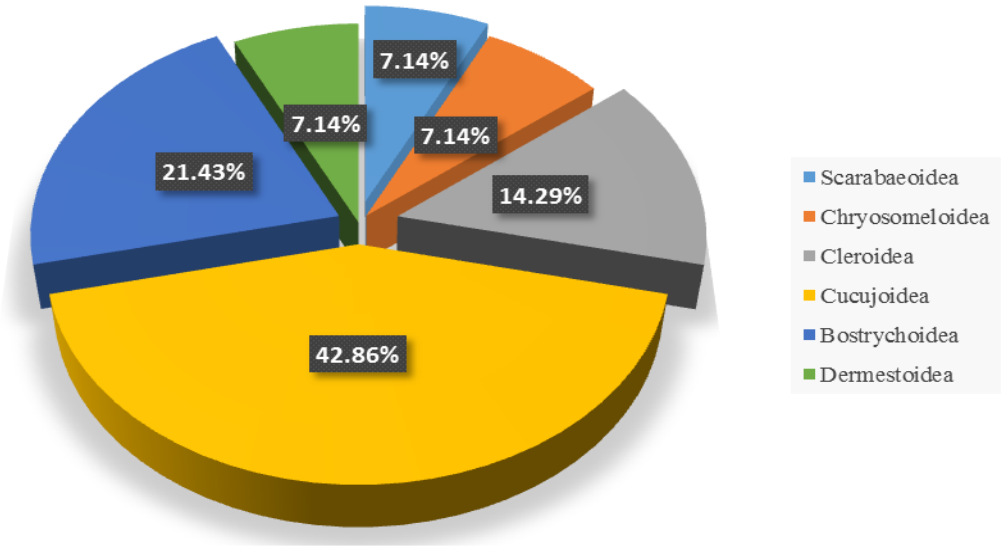


Fig. 2 Species composition of superfamilies under Order Coeleoptera

Discussion and Conclusion

In the present study, a total of 14 species of pest beetles were observed during the study period from October 2018 to February 2019 in the study site. The recorded pest species were recorded and identified by artificial keys based on simple characters such as colouration, the shape of pronotum and the antenna and size. The recorded species were grouped and identified with similar characters under superfamily. The recorded species were checked as pests or predators by reviewed of kinds of literature and the visual observation. Although *Adoretus* sp. was checked and identified with keys characters, that species was identified in a genus level.

The largest species composition was observed in Cucujoidea (42.86%) but the smallest composition in Scarabaeoidea, Chryosomeloidea and Dermestoidea (7.14% in each). Robertson *et al.* (2015) stated that Cucujoidea is a diverse superfamily of beetles and greatly exceeds any other superfamily of Coleoptera. The diversity of structure and habit among them is correspondingly great. In the present study, the species composition in Cucujoidea was mostly abundant in the study site. The present result must be agreed with theories mentioned above.

Among the recorded pest beetles, stored products were more observed than vegetables in the Ma-U village. Out of 14 recorded species, eight recorded pest species were damaged in stored products such as wheat, rice, corn, peas, and sunflower seed. Three pest beetles were infested with cultivated plants such as paddy, cabbage, eggplant, cucumber, and bean plant. Two pest beetle species, namely *Lophocateres pusillus* and *Tenebroides mauritanicus* were infested in both cultivated plants and stored products.

Shepard *et al.* (1999) revealed that the ladybird beetles (family Coccinellidae) are common to vegetable and soybean fields in Southeast Asia. Hill (1983) reported that *Epilachna* sp. are major pests of cucurbit vegetables. Moreover, Khan *et al.* (2000) stated

that *Epilachna* sp. is a very important insect pest of vegetables. It is widely distributed in Southeast Asia. The recorded species *Epilachna varivestis* was observed in cucumber and bean plants. Mostly pest species (eight species) were observed in stored products although four species only in crops.

Among the recorded pest beetles, *L. pusillus* and *T. mauritanicus* were observed both paddy and stored products. Kolibac, (2013) stated that *Lophocateres pusillus* lives in storage facilities. But, Sukprakarn (2019) observed that *L. pusillus* infested the paddy plants. In the present study, this species were infested both cultivated plant (paddy) and stored products (rice and wheat grain). This finding was agreed with theories mentioned above. *Tenebroides mauritanicus* commonly known as the cadelle bettle, is a cosmopolitan and the common pest in storehouses and granaries. It is one of the longest-lived insects which attacks stored grain and are very destructive and easily dispersed by Mason and Gibb, (2008).

L. pusillus exists in large numbers of both paddy and rice in some Asian countries. This species was mostly found in rice as stored grains. *T. mauritanucus* was observed in paddy plants and wheat and corn. This species was consumed entirely the damaged grains. The larva and adult of *T. mauritanucus* were observed in stored products such as wheat grain and maize. Sallam (2016) stated that Family Tenebrionidae is a large and varied group of insects that contain more than 10,000 species which about 100 species are associated with stored products. This species preys upon rice-weevils, and thus considered as beneficial insects, but it has also been noticed that it feeds upon grains even when rice-weevils are present. In the present study, *T. mauritanucus* was mostly found in paddy fields and in stored products such as wheat and maize grains. Infestation by this species resulted in unappealing smell due to the secretion from the abdominal glands. Both larvae and adults of this species were damaged especially to broken or damaged grains (Sallam, 2016).

Hill (1983) pointed out that the damage of pests to young plants can delay crop maturity. Insect pests are capable of evolving to biotypes that can adapt to a new situation, for example, overcome the effect of toxic materials or bypass natural or artificial plant resistance, which further confounds the problem (Roush and McKenzie, 1987). Several factors are responsible for this considerably low level of production, of which insect pests are chiefly involved (Sallam, 2016). Crop products are eventually stored for varied periods of time depending on market demand, size of production and the farmer's needs. Storage is the most important and critical postharvest operation. Deterioration of the grain quality during storage can be due to improper storage and which leads to insect infestation. The polyphagous species of coleopteran were capable of damaging in every parts of crop plants, vegetables and also stored products. Thus, the result should hope to be some aids in gardeners and farmers in the field of pests.

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Study on Some Bird Species in Banmaw Environs (Family-Sturnidae), Banmaw Township

Ei Ei Win[1], Myint Naung[2], Mi Mi Khaing[3], Cho Nandar[4]

Abstract

A total of eight bird species belonging to family, Sturnidae under Orders, Passeriformes were recorded from Banmaw Environs. Descriptive accounts of the collected species together with the photographs were provided for each species. This research was conducted from June, 2019 to November, 2019.

Key words: Descriptive account, Family- Sturnidae, Banmaw Environs,

Introduction

Birds are the most popular groups of animals than other animals. Ornithologists recorded nearly ten thousand living bird species in the world (2008) and estimated that fewer than hundred others, of limited range in the remote regions remain undiscovered (Wetmore, 1973). Birds live everywhere in the world – in town and cities, over the sea, on the top of mountains and in the coldest and hottest parts of the world. Their spectacular color, shape and voice appeal to human eyes and ears, many are of economic importance serving as food and supplying eggs and by keeping down the population of harmful insects and rodent pests by consuming them (Wallace, 1963).

Myanmar is the largest country in mainland Southeast Asia with a total land area of 676,577 square kilometers (261228 sq miles). Myanmar is endowed with numerous agricultural resources and the Ayeyawady delta. Myanmar called the last frontier of biodiversity in Asia, has 251 known species of mammals, and 272 known reptile species, more than, 1000 bird species, and more than 11,000 plant species (Forest Department, 2015).

There are around 114 bird species of family Sturnidae distributed in worldwide and 23 species in South-east Asia. They are native to Africa, Asia, and Europe, but have been introduced to other parts of the world. The members of family Sturnidae are generally medium-sized passerines with strong feet. They are stocky and relatively short-tailed, with strong legs and strong, pointed bills. They are gregarious, mostly in more open habitats. They feed on insects, fruit, nectar and some species are omnivorous. Smaller starlings have rather pointed wings and fast direct flight. Larger starlings and mynas have more rounded wings and slower flight, with more deliberate wingbeats (Robson, 2011).

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Many species are considered agricultural pests. Some occur in such great numbers in urban areas that their acidic droppings damage buildings and monuments and cause health risks. Some are considered hazardous to human health because of their large roosting congregations near or in human cities. Many species are considered beneficial because they help control insect pests. Others help maintain forest tree species diversity through dispersal of seeds (Wikipedia, 2012).

The study area, Banmaw Township is located at the South-eastern part of Kachin State. The natural vegetation of study area varies according to the condition of geographic location, soil and bed rock or parent materials and contains medium and tall trees, bushes, bamboo trees, swamp, grass land and buildings. The main objectives of the present study are:

- to record the birds of family Sturnidae in Banmaw Environs
- to find out the different characters of bird species in family Sturnidae

Materials and Methods

Study Area

Banmaw Township is located at the South-eastern part of Kachin State and lies between 23º 58' 8" to 24º 42' 23" N and between 96º 54' 36" to 97° 21' 13" E and 117.43m elevation. It has a humid subtropical climate. The area of the township is 1965.84km^2.

Study Period

This study was conducted from June 2019 to November 2019.

Collection of Specimen

The data collection was made on weekly basic from June to November. Birds were viewed using binoculars. The photos of birds were taken immediately with digital camera after viewing and Species of birds were recorded.

Identificationand Classification

Identification of birds was made following Robson (2011) and (2015). Birds' nomenclature was based on Robson (2016) and Avibase (2018) – Bird Checklists of the world, Myanmar.

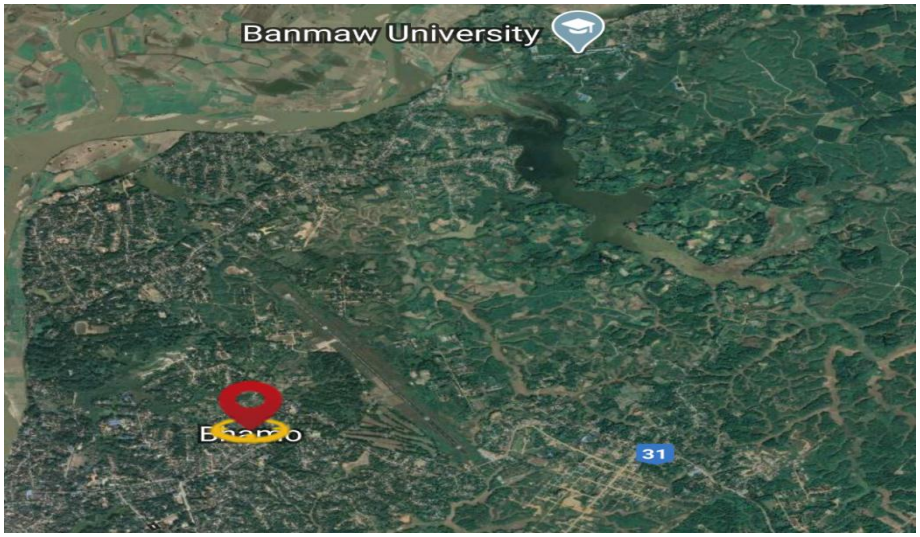


Fig.1 Location Map of Banmaw Environs (Source: Google earth)

Results and Discussion

Results

A total of eight species belonging three genera of family Sturnidae Under order Passeriformes were observed (Table1).

Classification of the Collected Species

Kingdom - Animalia

Phylum - Chordata

Class - Aves

Order - Passeriformes

Family - Sturnidae

Genus (1) - *Acridothere*

Species (1) - *Acridothere grandis* Moore, 1858

Species (2) - *Acridothere albocinctus* Godwin-Austen & Walden, 1875

Species (3) - *Acridothere tristis* (Linnaeus, 1766)

Genus (2) - *Sturnus*

Species (4) - *Sturnus burmannicus* (Jerdon, 1862)

Species (5) - *Sturnus malabaricus* (Gmelin, 1789)

Species (6) - *Sturnus vulgaris* Linnaeus, 1758

Genus (3) - *Gracupica*

Species (7) - *Gracupica nigricollis* (Paykull, 1807)

Species (8) - *Gracupica contra* Linnaeus, 1758

Descriptions of the Recorded Bird Species

***Acridothere grandis* Moore, 1858**

Common name - White-vented Myna

Local name - kywe-kyaung-zayet

The White-vented Myna is black with elongated forehead feathers forming frontal crest that may curl backwards. Its beak and feet are yellow. It is white from vent to tip of tail and a white wing patch (Plate I A).

***Acridothere albocinctus* Godwin-Austen & Walden, 1875**

Common name - Collared Myna

Local name - zayet-lei-kya

Collared Myna has broad white collar on neck-side, and blackish-grey undertail-coverts with broad white tips. Its beak and feet are yellow. Feathers of forehead hackled and erect, forming short crest and pale blue eyes. (Plate I B).

***Acridothere tristis* (Linnaeus, 1766)**

Common name - Common Myna

Local name - zayet

Common mynas are stocky, brown birds with black head, throat and upper breast. It has yellow bill, bare yellow skin behind the eyes and yellow legs. There is a white patch on the outer primaries and the wing lining on the underside is white. Females and males are familiar in appearance and birds are usually seen in pairs, while juveniles are duller in colors (Plate I C).

***Sturnus burmannicus* (Jerdon, 1862)**

Common name - Vinous-breasted Starling

Local name - zayet-gaung- phyu

Vinous-breasted Starling has red bill with blackish base. It has dark-grey upper parts with whitish head and narrow naked black mask eyes. It has wine-colored breast and belly. Juveniles are browner overall with dull mask (Plate I D).

***Sturnus malabaricus* (Gmelin, 1789)**

Common name - Chestnut-tailed Starling

Local name - zayet-taung-pan-phyu

Chestnut-tailed Starling has a light grey head with whitish streaking especially on crown and collar region. The under parts are whitish tinged rufous, especially on the flanks and crissum (the under tail coverts surrounding the cloaca). They have a blue-based yellowish bill. The sexes are similar, but juveniles have whitish under parts and just chestnut tips to the tail feathers (Plate I E).

***Sturnus vulgaris* Linnaeus, 1758**

Common name - Common Starling

Local name - zayet

The plumage of common starling is iridescent black, glossed purple - green, and spangled with white, especially in winter. The under parts of adult male common starling are less spotted than those of adult female. The throat feathers of males are long and loose and are use in display while those of females are small and more pointed. The legs are stout and pinkish or greyish-red. The bill is narrow and conical with a sharp tip that changes seasonally from black in winter to yellow during nesting. Juveniles are gray-brown with a streaked breast and dark bill (Plate I F).

***Gracupica nigricollis* (Paykull, 1807)**

Common name - Black-collared Starling

Local name - zayet-lei-net

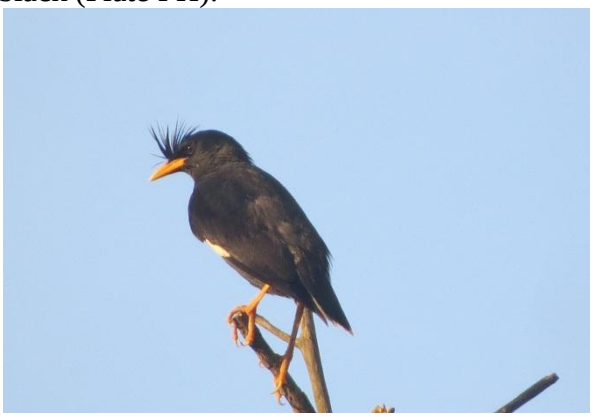
The head of Black-collared Starling is white, with a yellow patch of bare skin around the eye, and a black collar around the neck. The mantle, back and wings are dark brown, appearing almost black. The under parts are white, often with a grey-brown tinge. The tail and most of the covert and flight feathers are tipped white, with the primary coverts completely white. The beak is black, and the legs are pale grey. The male and female are alike. The juvenile bird is browner and has a streaked neck and breast; it also has an eye-patch but not a collar (Plate I G).

***Gracupica contra* Linnaeus, 1758**

Common name - Asian Pied Starling

Local name - zayet-kya

Asian Pied Starling is striking marked in black and white with rather long, pointed red-based yellowish bill. The bare skin around the eye is reddish. The upper body, throat and breast are black while the cheek, lores, wing corverts and rump are contrastingly white. The sexes are similar in plumage but young birds have dark brown in place of black (Plate I H).



A. ***Acridothere grandis***

B. ***Acridothere albocinctus***

C. ***Acridothere tristis***

D. ***Sturnus burmannicus***

E. ***Sturnus malabaricus***

F. ***Sturnus vulgaris***

G. ***Gracupica nigricollis***

H. *Gracupia contra*

Plate I. Recorded species of bird in the study area

Table 1.List of recorded species of bird in the study area

No.	Order	Family	Scientific name	Common name	Local name
1	Passeriformes	Sturnidae	*Acridothere grandis*	White-vented Myna	kywe-kyaung-zayet
2			*Acridothere albocinctus*	Collared Myna	zayet-lei-kya
3			*Acridothere tristis*	Common Myna	zayet
4			*Sturnus burmannicus*	Vinous-breasted Starling	zayet-gaung-phyu
5			*Sturnus malabaricus*	Chestnut-tailed Starling	zayet-taung-pan-phyu
6			*Sturnus vulgaris*	Common Starling	zayet
7			*Gracupia nigricollis*	Black-collared Starling	zayet-lei-net
8			*Gracupia contra*	Asian Pied Starling	zayet-kya

Discussion

Eight species of avian fauna belonging to three genera of family Sturnidae under Order- Passeriformes were recorded from June 2019 to November 2019. Among the recorded bird species, the genus *Acridothere* and *Sturnus* (three species each) and the genus *Gracupica* (two species each) were observed.

Among the eight species, three species of genus *Acridothere* were *Acridothere tristis* (Common Myna), *Acridothere grandis* (White-vented Myna), and *Acridothere albocinctus* (Collared Myna). The three species of genus *Sturnus* were *Sturnus burmannicus* (Vinous-breasted Starling), *Sturnus malabaricus* (Chestnut-tailed Starling) and *Sturnus vulgaris* (Common Starling). The two species of genus *Gracupia* were *Gracupia nigricollis* (Black-collared Starling) and *Gracupia contra* (Asian Pied Starling). Seven species were found throughout the year where as *Sturnus vulgaris* was record in winter. *Sturnus vulgaris* recorded in this area was reported by Robson (2011) stated that this species was vagrant and winter visitor of North Myanmar. This finding was agreed with the statement of Robson (2011).

There are 17 species of Family Sturnidae in Myanmar and 11 species were residents (Wikipedia, 2013). Throughout the study period, *Acridothere tristis*, *Sturnus burmannicus*, *Sturnus malabaricus*, *Acridothere grandis*, and *Acridothere albocinctus* were found the highest number of individuals while *Gracupia nigricollis*, *Gracupia contra* and *Sturnus vulgaris* were found the lowest number of individuals. Paddy fields,

bushes, high trees, flowering trees and various plantations in surrounding areas are the habitats of bird species which provide better foraging and nesting opportunities. Occurrence of bird species was assumed that the nature habitats and food resources.

In accordance the various species of bird were found in Banmaw Environs because this site is abundance with medium and tall trees, bushes, grassland, bamboo trees and paddy fields. The study site provides food and shelter for birds so it is occupied by large number of bird species.

Conclusion

During the study period, eight species of avian fauna belonging to three genera of family Sturnidae under orders Passeriformes were collected and observed. The identification of bird was based on head form, feather (color, wing pattern), bill pattern, types of feet, etc. The physical characters of collected species were agreed with the descriptions stated by Robson (2011, 2015). Birds are the friends of farmers and fishermen, the best environmental weather indicators, so the study of birds is very much benefits for the human and essential work. Banmaw Environs have a rich variety of bird species owing to its topography and different habitats which enhanced the diversity of birds.

Acknowledgement

We are greatly obliged to Dr Aung Kyaw Thin, Rector and Dr Aye Aye Han, Pro-rector, Banmaw University for their consent to present this paper. Special gratefulness goes to Dr Yin Yin Toke, Professor and Head, Department of Zoology, Banmaw University for her permission to conduct this research.

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Gonad Developmental Stages of *Otolithoides pama* in Twante Canal, Yangon Region

Thin zar Aung[1], Myint Myint Win[2], Kyu Kyu Win[3]

Abstract

A total 246 specimens of *Otolithoides pama*, which belonged to Order, Perciformes were selected from TwanteCanal,Yangon Division, during the study period from January to December 2018.Reproductive biology of fish is not only need to conserve the species in natural water system but develops the aquaculture system. Reproductive studies of the fishes require knowledge of the stages of gonad development. In the present study, gonadosomatic index,Hepatosomatic index,macroscopic and microscopic gonadal maturation stages have been studied.In the present study, the highest value of GSI was observed in May.But in *Otolithoidespama*, the peak value was occurred three times a year.Female and male gonads were classified into five macroscopic developmental phases.Eight oogenesis stages and four spermatogenesis were classified.These findings are very important to fishery management to fix closed season and closed areas for conservation of fish population.

Key Words: *Otolithoides pama*, macroscopic, microscopic

Introduction

Reproductive studies of the fishes require knowledge of the stage of the gonad development, to understand the physiology of reproduction, the study of the seasonal developmental changes of gonads through both macroscopic and microscopic observation is necessary (Priyadharsini*et al*., 2013). Studies on the reproductive behavior of fishes require knowledge of the stage of gonadal maturation in each individual fish.

Gonado somatic index (GSI), Hepato somatic index (HSI), and macroscopic and microscopic gonadal maturation stages play an important role to determine the maturation stages of gonads and the fish species population. One of the most appropriate methods for determining the gonad development cycle in fishes is to examine the seasonal development of gonads (Sivakumaran *et al*., 2003).

Classification system for teleost ovarian developmental classes based both on macroscopic and on microscopic criteria. Morphologically, the stages can be classified according to the shape, size and color of the gonads. In nature, the males are smaller than the females in size. Females acquire a large rounded shape abdomen due to maturation of the ovary, but males are slender. Female reproductive stages are virgin, maturing virgin, developing, developed, gravid and spent stages and male reproductive stages are inactive, developing, spawning and spent (Halfawy et al., 2007).

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Ovaries and testes are examined microscopically and individuals are generally grouped into various developmental or seasonal classes (Moe, 1969). Many authors defined different stages of gonad developments based on histological studies. Mohamed (2010) stated that general pattern of the histological development of the ovaries includes six periods; (1) Immaturation period, (2) maturation period, (3)vacuolization period, (4) yolk deposition period, (5) ripening period and (6)spawning-spent period.

Otolithoides pama commonly known as pama croaker is a commercial fish species of the family Sciaenidae. The family Sciaenidae consists of about 275 species in about 70 genera; it belongs to order Perciformes. Information on gonadal development and spawning season of a species make its management easier.

The present work was conducted with the following objectives:

1 to find out the different aspects of, gonadosomatic index (GSI) and hepatosomatic index (HSI),

2 to observe gonad developmental stages of *Otolithoidespama*by macroscopically and microscopically, and

3 to estimate the spawning season of *Otolithoides pama*from monthly data collection.

Materials and Methods

Study area

The present work was carried out in Twante Canal, Yangon Region (between Twantewa Village and Phayangoteto Village) 16˚ 41´ 14.92″ N and 95˚51 ´ 29.59″ E and 6 ˚ 43 ´ 28.79″ N and 96˚0 ´ 16.09″ E.

Study period

The study period lasted from Januaryto December, 2018.

Sample collection

Total 246*Otolithoides pama*were collected and recorded from the local fisherman at the study site during the study period.

Identification and classification

The collected samples were identified referring to Talwar and Jhingran (1991) and Jayaram (2010).

Morphometric measurement

Monthly fish specimen were caught with the help of fisherman and total length (tip of the snout to the end of the caudal fin), standard length (tip of the snout to the end of the caudal pentacle) was measured to the nearest millimeters (mm) by a measuring scale .Total body weight was measured to the nearest 0.01 milligram by a digital balance. Fish specimens were dissected out ventrally to remove gonads carefully, and then surface moisture of gonads was removed using blotting paper. The recorded species were photographed and weight to the nearest gram and then prior to fixation in 10% natural buffer formalin for histology slide preparation.

Gonadosomatic Index (GSI)

Gonadosomatic Index (GSI) for each fish was calculated using the formula, (Nikolsky, 1963).

GSI = GW/BW x 100

Hepatosomatic Index (HSI)

Hepatosomatic Index (HSI) for each fish was calculated using the formula, (Biswas, 1993).

HSI = LW/BW x 100

Macroscopic and microscopic observation of gonads maturationstages

Macroscopic examination

The gonads appearance, color, space occupied in the body cavity, size of the gonads were noted down. Macroscopic gonads maturity stages were classified according to Jacob (2005), Bucholtz (2008).

Microscopic observation

The histological sections on the prepared slides were thorough observation under light microscopes at different magnifications. The developmental stages of germ cells in the testes and changes of the oocytes of ovary were noticed carefully. Color photomicrographs of selected histological sections were taken as required. Developmental stages of gonads were classified according to the Jacob, 2005, Lambert-JG, 1970 and Selman-K *et al*, 1993.

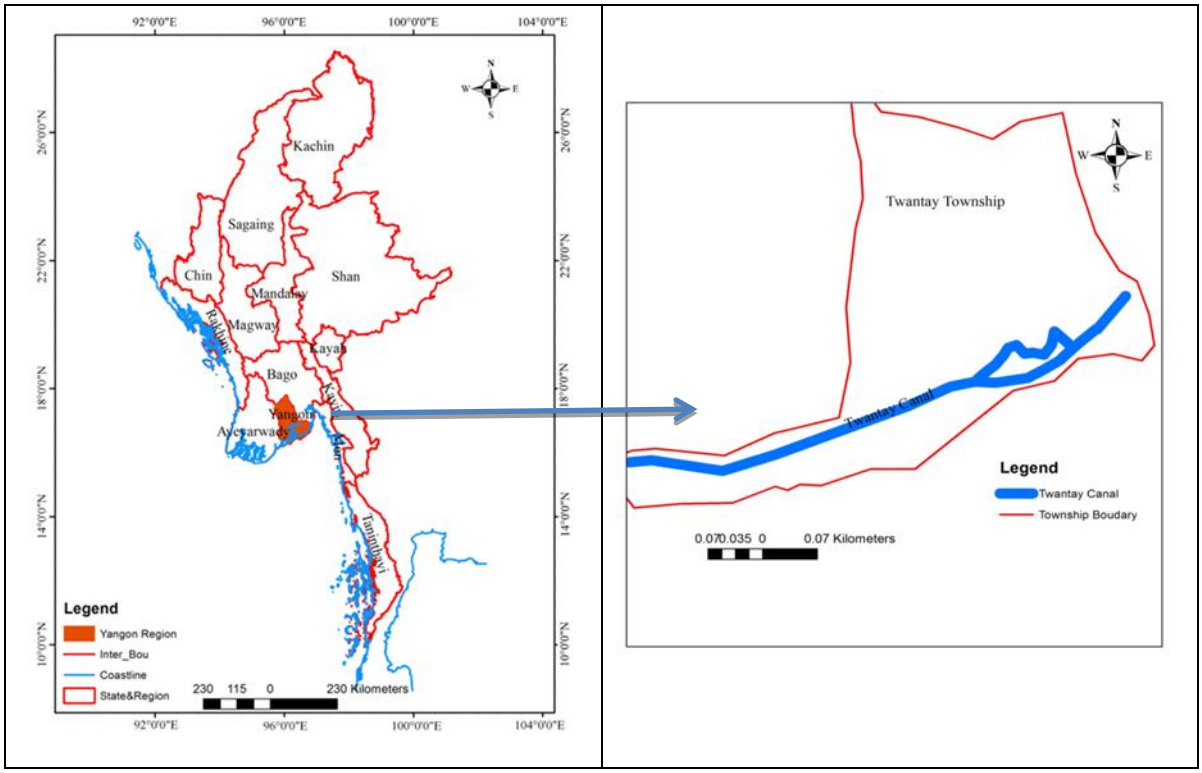


Fig.1.Map showing the location of Twante Canal

Fig.2 Fishing site

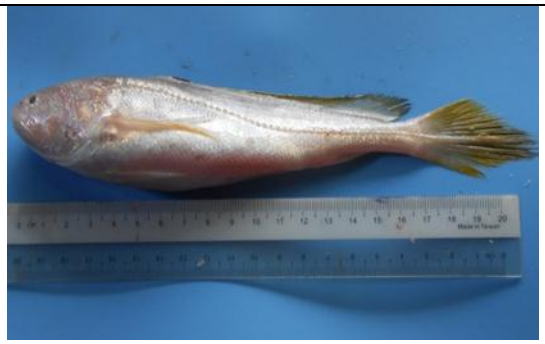


Fig.3 *Otolithoides pama*

Results

In *Otolithoides pama*, among a total 246 specimens, 147 were male and 99 were female. In *Otolithoides pama*, during the spawning season, the colors both sexes changed to light orange color on the fins and body. Especially, the color became brighter on the fins.

Gonado-somatic (GSI) and Hepato-somatic (HSI) index

In female *Otolithoides pama*, GSI value of was the highest (7.39 ± 7.07) in May and the lowest (0.53 ± 0.12) in July .The highest mean HSI value (1.44 ± 0.74) was observed in March and the lowest mean HSI value (0.56 ± 0.24) was in August. In male, mean GSI value was also peak (0.78 ± 0.08) in May and lowest (0.27 ± 0.15) in October .The highest mean HSI value (0.52 ± 0.27) was observed in April and the lowest (0.32 ± 0.09) was in May.

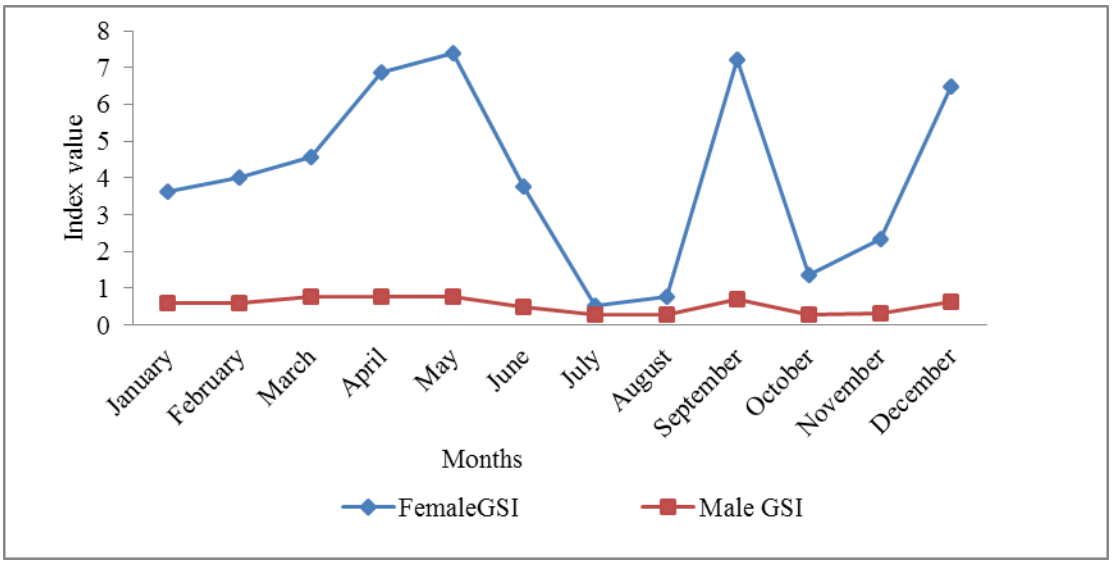


Fig. 4. Monthly changes of GSI of female and male *Otolithoides pama*,

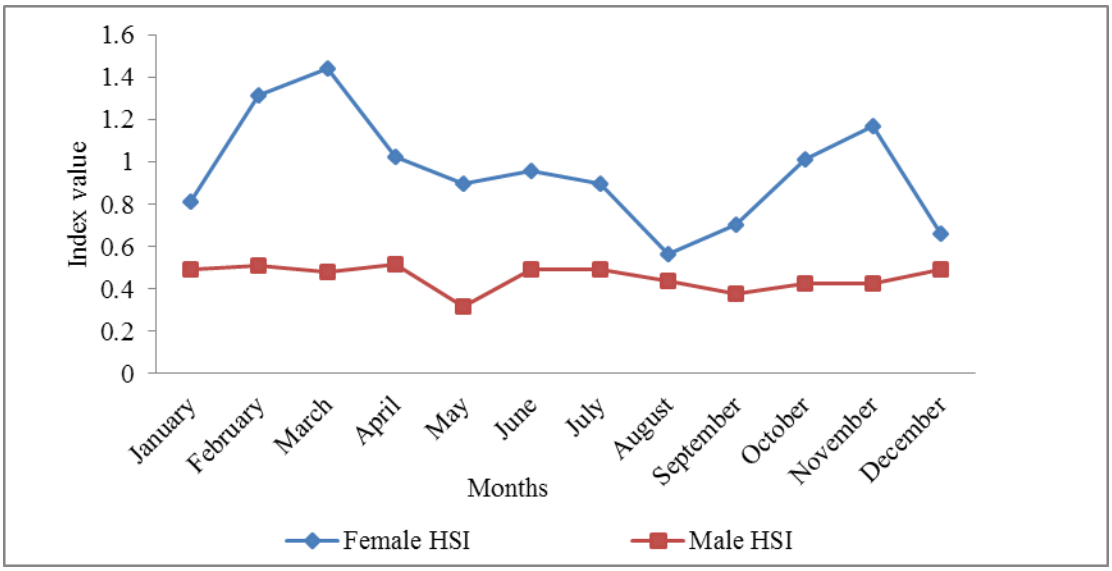


Fig 5. Monthly changes of HSI of female and male *Otolithoides pama*

Macroscopic developmental stages of female reproductive organ of *Otolithoides pama*

Immature ovary

Immature ovary was small, flat, paired organ and pale white color. This ovary was occupied half of the body cavity. Ova were not visible with the necked eye. This stage was found from July to August (Plate 1 A).

Developing ovary

Developing ovary was white in color and occupied half of the body cavity. This ovary was found from October to December (Plate 1 B, C).

Mature ovary

Mature ovary was large and yellowish in color. Ovaries were extended entire length of the body cavity. Ova were densely yolk laden and there was no space within the ovary. Mature ovary was found from January to April (Plate 1 D).

Ripe ovary

Ripe ovary was large sized with thin ovarian wall and yellow color. Ova were quite distinct and filled the entire length of the body cavity. This stage was ready for spawning and found in May (Plate 1 E).

Spent ovary

Spent ovary was shrunk and blood shot, occupied entire length of the body cavity. Spent ovary was found in July (Plate 1 F).

A.Immature ovary

B.Early developing ovary

C.Late developing ovary

D. Mature ovary

E. Ripe ovary

F. Spent ovary

Plate1.Macroscopic developmental stages of female reproductive organ of*Otolithoides pama*

Macroscopic developmental stages of male reproductive organ of *Otolithoides pama*

Immature testis

Immature testis was found in young individual, lanceolate shape and thread-like structure. Color was pale white translucent and occupied half of the body cavity. This stage was found from July to August (Plate 2 A).

Developing testis

Developing testis was found from the month of October to December. The color of the testes was creamy white and lager then the above stage. This testis occupied more than half of the body cavity (Plate 2 B).

Mature testis

Mature testis was milky white color and occupied nearly entire length of the body cavity. These testes found in the month of January and April (Plate 2 C).

Ripe testis

Ripe testis was opaque, milky- white color and occupied full of the body cavity. Ripe testis was found in May (Plate 2 D).

Spent testis

Anterior lobe of spent stage testis was started too shrunken and gradually diminished during spawning. Spent stage was found in July.(Plate 2 E)

A. Immature testis B. Developing testis C. Mature testis

D. Ripe testis E. Spent testis

Plate 2. Macroscopic developmental stages of male reproductive organ of *Otolithoides pama*

Microscopic developmental stages of oogenesis of *Otolithoides pama*

Oogonia

Germ cells or oogonia were embedded in the ovigerous tissue. Oogonia cells were observed in cluster and originated from the germinal epithelium (Plate 3 A).

First growth phase

Chromatin nucleolus stage

These cells were the youngest cells, strongly basophilic cytoplasm with large nucleus and one to two darkly stain nucleoli were found. The shapes of the cells were irregular and sizes were small, 31.96 ± 61.81 µm (Plate 3 B).

Pre-nucleolus stage

Oocytes were rounded or oval or polygonal shape. In this stage, cytoplasm was less basophilic and different size of nucleoli was situated in the periphery of the nucleus. This stage was found throughout the year. The sizes of the cells were 90.25 ±17.06 µm (Plate 3 C).

Second growth phase

Primary yolk stage

Oil droplets (Od) and yolk granules (Yg) were initially appeared in the cytoplasm. Cytoplasm was weak basophilic and nucleus was still present in central position. The sizes of the cells were 171.83 ±22.18 µm (Plate 3 D).

Secondary yolk stage

Cells were rapid growth and yolk granules (Yg) and oil droplets (Od) were increased in number and coalescence. Nucleus was irregular shaped. The size of the cells was 167.91±31.38 µm (Plate 3 E).

Tertiary yolk stage

Size and number of yolk granules (Yg) and oil droplets were increased. The size of the nucleus was small and it seen nearly disappeared. The sizes of the cells were 530 ±48.98 µm (Plate 3 F).

Germinal vesicle migration stage

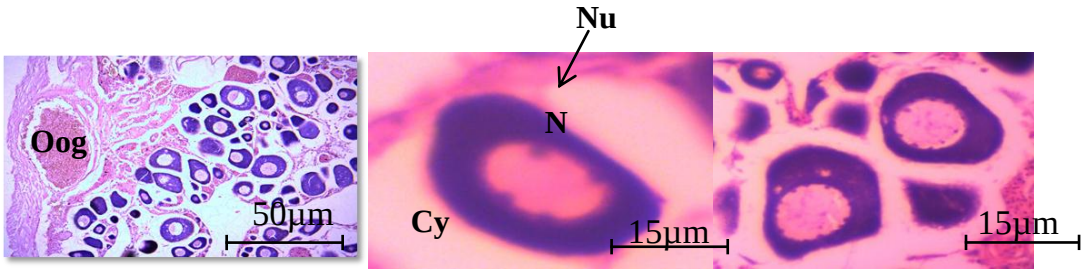
In this stage, nucleus (N) was moved toward the pole and oil droplets (Od) were accumulated in the cytoplasm (Cy). The nucleolus (Nu) were scattered in the nucleus. The size of the cells was 545.66±59.87 µm (Plate 3 G).

Germinal vesicle breakdown stage

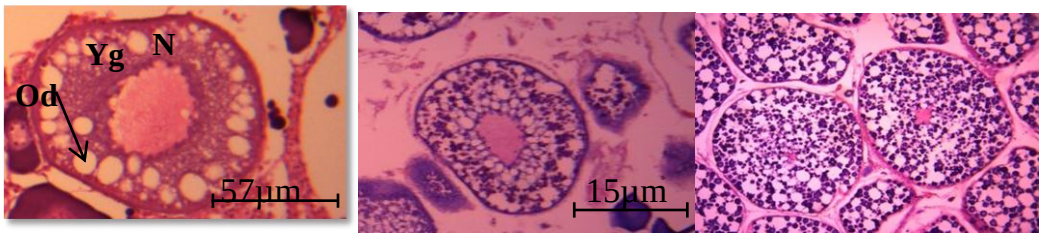
In this stage, nucleus substances were released into the cytoplasm (Cy) and nucleoli (Nu) were not clearly seen in the nucleus. Yolk globules (Yg) were fused to each other in the cytoplasm. The size of the cells was 602.33 ± 74.63 µm (Plate 3 H).

Postovulatory follicle stage

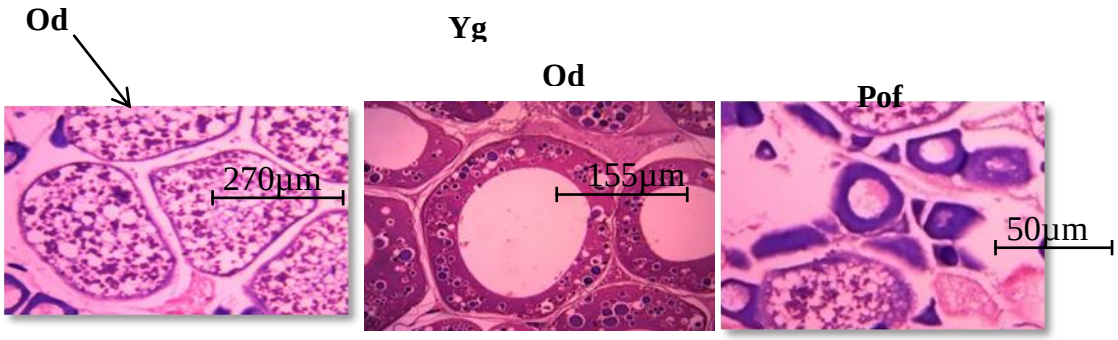
In this stage, various type of postovulatory follicle (Po) was found. Hydrolyse yolk granules, primary growth oocyte and oogonia were also observed found (Plate 3 I).



A.Oogonia B.Chromatinnucleolus stage C.Prenucleolus s



D.Primary yolk stage E. Secondary yolk stage F.Tertiary yolk stage



GGerminal vesicle migration H. Germinal vesicle breakdownI. Spent stage

Plate3.Microscopic developmental stages of oogenesis in *Otolithoides pama* , Cytoplasm (Cy), Nucleus (N), Nucleolus (Nu), Yolk granule (Yg), Oil droplet (Od), Follicular epithelium (FE), Zonaradiata (ZR)

Microscopic developmental stages of spermatogenesis of *Otolithoidespama*

Spermatogonia stage

The largest size of spermatogonia cells were observed and localized at the inner layer of seminiferous tubule wall. This cell contained basophilic nucleus and unstained cytoplasm (Plate 4 A).

Spermatocytes stage

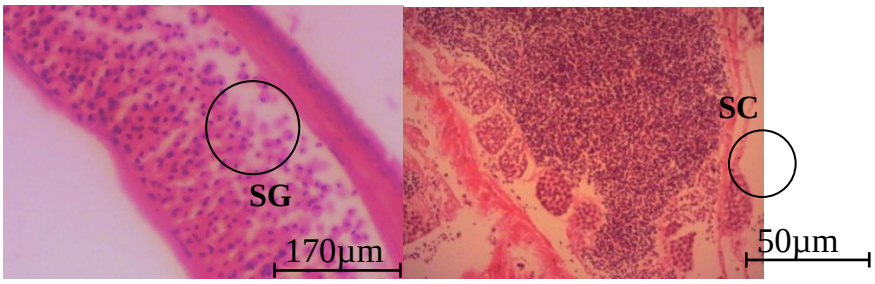
Spermatocyte cell became smaller in size than the spermatogonia. Spermatocytes were found the most abundant stage during the process of spermatogenesis (Plate 4. B).

Spermatids stage

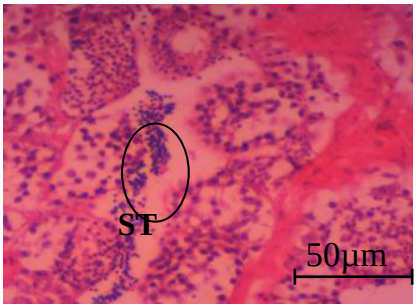
Spermatid was strongly basophilic spherical cell and observed densely as clusters. They were found in the inner layer of seminiferous tubules (Plate 4 C).

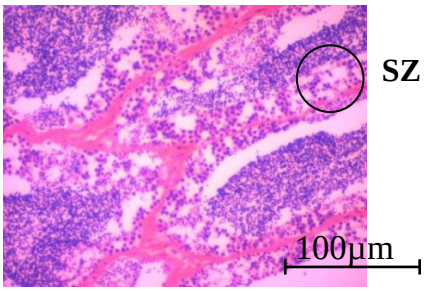
Spermatozoa stage

Mature spermatozoa contained spherical nucleus at the head region and a faint long tail. They were found in cluster in the central position of the lumen of the lobules (Plate 4 D).



A.Spermatogonia B.Spermatocyte





C.Spermatids D. Spermatozoa

Plate 4. Microscopic developmental stages of spermatogenesis in *Otolithoides pama*, ,Spermatogonia (SG), Spermatocytes (SC), Spermatid (ST) and Spermatozoa (SZ).

Discussion

Developmental stages of gonads of *Otolithoidespama*was examined from Twante canal, Yangon Region.

Otolithoides pama, the peak value of GSI was occurred three times a year. Min Oo (1995) and Khin Thu Zar Win (2009) stated that *Otolithoides pama* can breed continuously through the year, but reach a peak in the month of December and July.The differences in GSI value among the same species could be caused by different in food resources, environmental temperature or evolutionary adaptation of different population to the specific ecological properties of specific ecosystem.

The gonadosomatic index GSI is an important tool in establishing the breeding period of animals and fish (Assem et al., 2015; Saxena, 1986). The liver has the role in the ovarian development therefore, the hepatosomatic index HSI was negatively correlated with gonadosomatic index GSI. In the present study, GSI and HSI value of male and female *Otolithoides pama* showed irregular patterns.

Different authors have divided the gonads developmental stages according to their prominent features of changes during the process of gametogenesis (Gopalakrishnan, 1991; Saat and Veersaalu, 1990, Maddock& Burton, 1999, Jacob, 2005).Tin HninWai (2010) described eight stages of microscopic structure of ovary from *Otolithoides pama* in Pathein River, Ayeyawady Region.On the basis of gross morpho-histological changes occurred in the ovary and testes. Occurrence of developing oocytes was divided into eight stages and observation of developing spermatogonia was divided into four stages from studied fish species during the study period.

Dutt and Govindan (1975) reported that the lipid vesicles in *Anabas scandens* moved to the peripheral ooplasm from the center. In the present study, during oocyte maturation, the oil droplets were found to coalesce and formed single large oil droplets in the cytoplasm which might help the eggs to keep buoyant.

As a result of histological stages of testes, accumulation of unstained spermatogonia and dot like structure of stained spermatocytes were dominance over immature stages, all stages, spermatogonia, spermatocytes, spermatids and spermatozoa were observed in developing. Abundance of deep stain, basophilic and oval shaped head

with distinct tail spermatozoa were observed in maturation stages during this study period.

Conclusion

This, study is suggestive to take necessary step to monitor the aquatic medium to protect the fish reproductive physiology and fish population as a whole. Indeed, the present finding of the different developmental stages of gonads of study fish species; *Otolithoides pama* from natural brackish water, Twante Canal will provide valuable information of fishery resources concerning with their breeding season and also evidence outcomes for closing season to conservation and management on threatened fishes from natural water fishery resources.

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Occurrence of Fish Species in Chindwin River at Monywa Township, Sagaing Region

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Abstract

This study was carried out in Chindwin River (Monywa Segment), Monywa Township, Sagaing Region from June 2018 to May 2019. A total of 45 freshwater fish species, 34 genera, 16 families belonging to seven orders were recorded in the study area. Monthly collected fish samples from the Chindwin River have been identified systematically and supported by scaled photographs. The number of fish samples in the study site associated with the environmental condition was recorded. In this study, different species numbers were observed in the study site. So, Chindwin River (Monywa Segment) is one of the major resources for the nutrition and ecologically favorable for the fishes to thrive.

Keywords: Chindwin River, Freshwater fish, environmental condition

Introduction

Fish is an inexpensive source of protein and an important cash crop in many regions of the world (Bronmark and Hansson, 2005). Fish constitute almost half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitats 21,723 living species of fish have been recorded out of 39,900 species of vertebrates (Jayaram, 1999) of which 8411 are freshwater species and 11,650 are marine. Ichthyo diversity refers to the variety of fish species; depending on context and scale, it could refer to alleles or genotypes within the piscian population, to species of life forms within a fish community, and species of life forms across aqua regimes (Burton *et.al.*, 1992).

Asia has the most productive inland fisheries in the world. The fishery sector contributes significantly to the national economies of the region (Revenga *et al*. 2000). Inland fisheries also improve food security by providing a source of protein and a livelihood for millions of people in this part of the world, especially the rural poor. However, increasing competition for water resources, unregulated fishing and high population growth in riparian countries of major river basins have put mounting pressure on these resources and contributed to increasing threats to fisheries production. The values of river fisheries are numerous (Cowx *et al*. 2004).

South and Southeast Asia are one of the most speciose areas on the planet containing 20% of all known freshwater vertebrate species (Balian *et al*., 2008). The greatest number of fish species in the world inhabits the south-east Asia region. Indo–Burma has a remarkable freshwater fish fauna, with more than 1,262 documented

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species, or about 10 percent of the world's freshwater fishes. The freshwater fish diversity hotspots in Asia included major parts of Northeast India and Myanmar (Kottelat & Whitten, 1996).

The Chindwin River is the biggest tributary of the mighty Irrawaddy. It rises in the broad Hukawng Valley of Kachin State of Myanmar. The Chindwin River basin is a river complex in the Indo-Burma region, one of the hottest biodiversity hotspots of the world (Dugan *et al*., 2010).

Chindwin River provides natural habitats for freshwater fish species. It occupies a significant position in the socio-economic fabric of local people by providing not only nutritious food but also income and employment opportunities. The size and variety of local habitat types affect the occurrence of fish species. The basic objective of this study was to identify and record the fish species, and to determine the occurrence and species composition of fish species in this study area.

Materials and Methods

Study area

Chindwin River Segment is situated in Monywa Township, Sagaing Region. It is located between 22˚ 07′ 52.9″ and 22˚ 11' 22.3" N and 95˚ 04′ 27.0″ and 95˚ 05' 49.8" E. (Fig. 1).

Study period

The present study was conducted from June 2018 to May 2019.

Collection of fish samples

Fishes were collected twice per month during the study period. The fishes were collected with the help of the local fishermen by implementing fishing gears in the study site. Different types of fishing gears were utilized in this sample site depending on the size of fishes as size varied from species to species. The collected specimens were examined and photographic record was made immediately before the body natural color disappeared. The local names of the studied species were also noted down as informed by the local fishermen.

Classification and identification of species

Identification and classification of the collected fish species were made according to Jayaram (1981, 2013), Talwar and Jhingran (1991), Ferraris (1998) and Fishbase (2018). The classification and nomination of fish species were followed after Talwar and Jhingram (1991) and Jayaram (2013).

Analysis of data

Species composition was calculated as follows:

$$\text{Species composition} = \frac{\text{Total number of species in particular family or order}}{\text{Total number of all the species recorded}} \times 100$$

(Bisht *et al.*, 2004)

Fig 1 Location map of the study site (Source: Google Earth, 2020)

Results

A total of 45 species under 34 genera and 16 families belonging to seven orders of freshwater fish were recorded from study site during the study period.

Systematic position of recorded fish species

Kingdom	-	Animalia
Phylum	-	Chordata
Class	-	Osteichthyes
Subclass	-	Actinopterygii
Order	-	Osteoglossiformes
Family	-	Notopteridae
Genus	-	*Notopterus* Lacepede, 1800
Species	-	*N. notopterus* (Pallas, 1769)
Order	-	Cypriniformes
Family	-	Cyprinidae
Genus	-	*Salmostoma* Swainson, 1839
Species	-	*S. sardinella* (Valenciennes, 1842)
Genus	-	*Aspidoparia* Heckel, 1843
Species	-	*A. jaya* (Hamilton, 1822)
Genus	-	*Cabdio* (Hamilton, 1822)
	-	*C. morar* Hamilton, 1822
Genus	-	*Raiamas* Jordon, 1918
	-	*R. bola* (Hamilton, 1822)
	-	*R. guttatus* (Day, 1870)

Genus - *Amblypharybngodon* Bleeker, 1860
Species - *A. mola* (Hamilton, 1822)
Genus - *Osteobrama* Hackel, 1842
Species - *O. belangeri* (Valenciennes, 1844)
- *O. feae* Vinciguerra, 1890
Genus - *Chagunius* Smith, 1938
Species - *C. chagunio* (Hamilton, 1822)
- *C. nicholsi* (Myers, 1924)
Genus - *Puntius* Hamilton & Buchanan, 1822
Species - *P. sarana* (Hamilton, 1822)
- *P. sophore* (Hamilton, 1822)
Genus - *Barbonymus* Bleeker, 1849
Species - *B. gonionotus* (Bleeker, 1849)
Genus - *Cirrhinus* Cuvier, 1817
Species - *C. mrigala* (Hamilton, 1822)
Genus - *Catla* Valenciennes, 1844
Species - *C. catla* (Hamilton, 1822)
Genus - *Labeo* Cuvier, 1817
Species - *L. angra* (Hamilton, 1822)
- *L. boga* (Hamilton, 1822)
- *L. calbasu* (Hamilton, 1822)
- *L. rohita* (Hamilton, 1822)
Family - Cobitidae
Genus - *Botia* Gray, 1831
Species - *B. histrionica* Blyth, 1860
Genus - *Lepidocephalichthys* Bleeker, 1859
Species - *L. berdmorei* (Blyth, 1860)
Order - Siluriformes
Family - Bagridae
Genus - *Rita* Bleeker, 1858
Species - *R. rita* (Hamilton, 1822)
Genus - *Sperata* Holly, 1939
Species - *S. aor* (Hamilton, 1822)

Genus - *Mystus* Scopoli, 1777
Species - *M. cavasius* (Hamilton, 1822)
- *M. leucophasis* (Blyth, 1860)
Genus - *Hemibagrus* Bleeker, 1862
- *H. microphthalmus* (Day, 1877)
Genus - *Mystus* Scopoli, 1777
- *M. pulcher* (Chaudhuri, 1911)
Genus - *Ompok* Lacepede, 1803
Species - *O. bimaculatus* (Bloch, 1794)
Genus - *Wallago* Bleeker, 1851
Species - *W. attu* (Bloch & Schneider, 1801)
Family - Schilbeidae
Genus - *Eutropiichthys* Bleeker, 1862
Species - *E. vacha* (Hamilton, 1822)
Genus - *Silonia* Swainson, 1839
Species - *S. silondia* (Hamilton, 1822)
Family - Pangasiidae
Genus - *Pangasius* Valenciennes, 1849
Species - *P. pangasius* (Hamilton, 1822)
Family - Sisoridae
Genus - *Gagata* Bleeker, 1858
Species - *G. dolichonema* He, 1996
Genus - *Bagarius* Bleeker, 1853
Species - *B. yarrelli* (Sykes, 1839)
Order - Mugiliformes
Family - Mugilidae
Genus - *Rhinomugil* Gill, 1863
Species - *R. corsula* (Hamilton, 1822)
Order - Synbranchiformes
Family - Mastacembelidae
Genus - *Macrognathus* Lacepede, 1800
Species - *M. aral* (Bloch & Schneider, 1801)
Genus - *Mastacembelus* Scopoli, 1777
Species - *M. armatus* (Lacepede, 1800)

Order - Perciformes
Family - Ambassidae
Genus - *Parambassis* Bleek, 1874
Species - *P. ranga* (Hamilton, 1822)
Family - Sciaenidae
Genus - *Johnius* Bloch, 1793
Species - *J. coitor* (Hamilton, 1822)
Family - Cichlidae
Genus - *Oreochromis* Gunther, 1889
Species - *Oreochromis* sp.
Family - Gobiidae
Genus - *Glossogobius* Gill, 1862
Species - *G. giuris* (Hamilton, 1822)
Family - Osphronemidae
Genus - *Trichogaster* Bloch & Schneider, 1801
Species - *T. labiosa* (Day, 1877)
Family - Channidae
Genus - *Channa* Scopoli, 1777
Species - *C. punctata* (Bloch, 1793)
Order - Tetraodontiformes
Family - Tetraodontidae
Genus - *Tetraodon* Linnaeus, 1758
Species - *T. cutcutia* Hamilton, 1822

Composition of recorded fish species

In the present study, fish species belong to seven orders, Osteoglossiformes, Cypriniformes, Siluriformes, Mugiliformes, Synbranchiformes, Perciformes and Tetraodontiformes. A total of 45 species of 34 genera from 16 families were recorded (Table 1). The percentage of studied fish species of each order was presented by a pie graph (Figure 2).

Table 1 Composition of fish species in different orders from Chindwin River Segment during June 2018 to May 2019

Sr No	Order	Number of family	Number of genus	Number of species	Species composition %
1.	Osteoglossiformes	1	1	1	2.22
2.	Cypriniformes	2	13	21	46.67
3.	Siluriformes	4	10	13	28.89
4.	Mugiliformes	1	1	1	2.22
5.	Synbranchiformes	1	2	2	4.45
6.	Perciformes	6	6	6	13.33
7.	Tetraodontiformes	1	1	1	2.22
		16	34	45	100

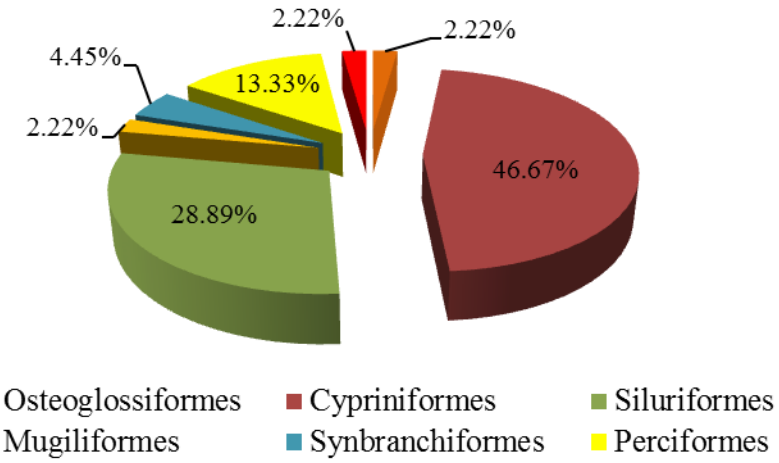

Fig. 2 Composition of fish species in different orders from Chindwin River Segment during June 2018 to May 2019

Monthly occurrence of fish species

Based on the monthly recorded data, occurrence of fish species was the highest in May (45 species) at study site whereas the lowest species in August (20 species) at study site (Fig. 3).

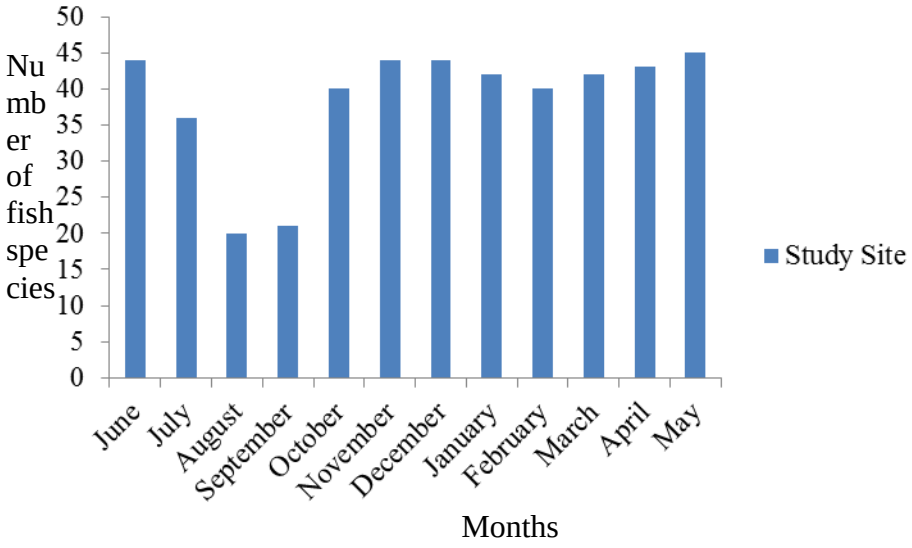

Fig 3 Monthly occurrences of fish species at study site during June 2018 to May 2019

Discussion and Conclusion

In the present work, a total of 45 species under 34 genera and 16 families belonging to seven orders of freshwater fish were recorded from the Chindwin River Segment, Sagaing Region from June 2018 to May 2019.

Among the recorded seven orders, Cypriniformes was the most abundant species followed by Siluriformes, Perciformes, Synbranchiformes, Osteoglossiformes, Mugiliformes, and Tetraodontiformes.

Cypriniformes included 46.67% of the fish species. The family Cyprinidae dominated with 19 species followed by Cobitidae with two species. Siluriformes included 28.89% of the fish species. The family Bagridae dominated with 8 species followed by Schilbeidae with two species, Pangasiidae with one species and Sisoridae with two species. Perciformes included 13.33% of the fish species. Each family Ambassidae, Sciaenidae, Cichlidae, Gobiidae, Osphronemidae, and Channidae were belonging to only one species in order Perciformes. Synbranchiformes included 4.45% of the fish species belonging to one family Mastacembelidae with two species.

Osteoglossiformes, Mugiliformes and Tetraodontiformes included 2.22% of the fish species and belonged to one family Notopteridae, Mugilidae and Tetraodontidae with one species respectively.

The highest number of species (19) recorded were of family Cyprinidae followed by families Bagridae (eight species), Cobitidae, Schilbeidae, Sisoridae, and Mastacembelidae
(two species) and Notopteridae, Pangasiidae, Mugilidae, Ambassidae, Sciaenidae, Cichlidae, Gobiidae, Osphronemidae, Channidae and Tetraodontidae (one species each).

The order Cypriniformes was predominant in the study area because the highest number of fish species belonged to that order than that of the other orders. Then, the

second predominant group was observed in order Siluriformes. The present study also agreed with Day (1889) who reported that carps (Cyprinidae) are well presented in freshwater estuaries of India, Ceylon, and Myanmar. Rainboth (1991) also reported the freshwater fish faunas of East and Southeast Asia are dominated by cyprinids.

In addition, about one-third of all freshwater fishes in western Borneo were represented by cyprinids (Robert, 1989). Nyanti (1995) and Leh (2000) reported that approximately 66% and 46% respectively of the fish collections in Sarawak were from the Cyprinidae family. The freshwater fish faunas of East and South East Asia are dominant by cyprinids (Rainboth, 1991). Similarly, 46.67% of cyprinids were dominant among the fish fauna in the study area. Concerned with the studies of fish from the Chindwin River Segment between Ahlone and Monywa by Aye Aye Maw (2017) also reported that the species composition was the highest in order Cypriniformes.

In this study, the different numbers of fish species were recorded during the study period in the study site. In August (2018), 20 species in the study site, 45 species in May (2019) in the study site were recorded. It is assumed that this variation of species occurrence may be due to several factors, water level, fishing efforts employed in the river and different habits of fish. Singh and Agarwal (2014) reported that composition and abundance of fish species are highly variable in space and time and closely related to environmental variables.

At the current study, at Chindwin River Segment, Sagaing Region may be considered as an important place for local fishery work and fish species are abundant, available and caught as an economically important food for local consumption. The present finding of the occurrence of fish species from the study area will provide knowledge and information to perform further studies of fish species concerning environmental pollution in natural water resources.

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A Systematic Study on Silurid Fishes (Bagridae, siluridae) from Myomyityoe "In", Banmaw Township, Kachin State

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Abstract

The research was conducted on the fish species in Myomyityoe In. It is situated on a long stretch of sandbank on the west of Banmaw. The study commenced from 2012 to 2013. The fish specimens were collected from this Inn by using nets three times per month. At least five specimens were collected for each species and identified by morphology and morphometric measurements. A total of 12 species belonging to three genera, two families and the order Siluriformes were recorded from Myomyityoe In. Among them, nine species were under family Bagridae and three were family Siluridae. The total species in family Bagridae were higher than in Siluridae within study period.

Keywords: silurid fishes, Myomyityoe In

Introduction

Fishes occupy a significant position in the socio-economic fabric of the South East Asian countries by providing with not only the nutritious food but also income and employment opportunities. Inland fishes are a treasured resource both in terms of their utility as food and as for scientific study (Talwar & Jhingran, 1991). Myanmar is endowed with a long seacoast, four large rivers, namely Ayeyarwaddy, Chindwin, Thanlwin, Sittaung and a number of streams, ponds, lakes and Ins. Ayeyarwaddy plays an important role in distributing fresh water throughout the whole country. Myomyityoe In which is one of the Ins situated on a long stretch of sand bank on the west of Banmaw in Kachin State. It is a seasonal In inundated by the flooding of the Ayeyarwaddy river. Fish fauna comprise both naturally recruited and introduced stocks. The sand bank is situated near the junction of the two rivers, Ayeyarwaddy and Taping. These two rivers unite near Banmaw. As these two rivers originate in different places it will be of interest to study the fish fauna of the In. So the study was centered on Silurid fishes only. It is hoped that the results of this study will add further information about the fishes that inhabit in Kachin State.

Materials and Methods

Study period, area and specimen collection, preservation and identification

The study period lasted from December 2012 to March 2013. **S**pecimen collection was made three times per week during the study period. At least five specimens were collected for each species. Photographic records were made soon after catch while the

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fishes are still alive. The local names as informed by the fishermen were also recorded. **S**pecimens were preserved in 5-10 percent formalin, depending on the size of fish. Smaller specimens were preserved in five percent formalin and larger ones were first injected with 40 percent formalin into abdomen and dorsal body before preserving them in 10 percent formalin. The preserved fish specimens were thoroughly washed under tap water and identified according to Day (1878, 1889), Jayaram (1981), Talwar and Jhingran (1991), Ferraris (1998, 1999) and Lagler (1977). Classification of the fishes followed that of Talwar and Jhingran (1991).

Results

A total of 12 species belong to five genera, two families and one order were recorded during the study period. The recorded species were *Aorichthys aor, Batasio tengana, Mystus bleekeri, M. cavasius, M. leucophasis, M. menoda, M. microphthalmus, M. pulcher, M. rufescen,s Ompok bimaculatus, O. pabo, Wallago attu* (Table 1). The species population in family Bagridae (75%) was higher than the family Siluridae (25%). In all genera, the highest individual species was found in genus *Mystus* (58.34%) followed by *Ompok* (16.67%). The individual species in the genera of *Aorichthys*, *Batasio* and *Wallago* (8.33% in each genus) were similar and the lowest individual species population was found in these genera (Fig. 1, 2).

Fin formula and distinct characters of recorded species

Aorichthys aor (Hamilton-Buchanan, 1822)

Fin formula: Barbel (B). XII; First dorsal fin (D_1). I/7; Second dorsal fin (D_2). Adipose; Pectoral fin (P) .I/9-10; Ventral fin (V) .6; Anal fin (A) .10-11; Caudal fin (C) .17.

Body elongated, compressed; abdomen rounded. Head depressed,long; snout depressed, broad and rounded; Eyes large, in the middle of head. Mouth transverse, moderately wide; jaws subequal; lips thin. Barbels four pairs; maxillary barbels extend to caudal fin base or even slightly beyond. Dorsal fin with a finely serrated spine, inserted above base of pectoral fin; adipose fin long, it base about two times in rayed dorsal fin; caudal fin forked, its upper lobe with a soft filamentous prolongation. Greenish blue on back, whitish on flanks and belly; caudal and dorsal fins tipped with black (Plate1.A).

Batasio tengana (Hamilton-Buchanan, 1882)

Fin formula -B.VI ; D_1 .I/7; D_2. Adipose; P.I/8; V.6; A.10; C.15-17.

Body moderately elongated and compressed. Head compressed, small, conical, with open pores on its sides and ventral surface. Snout rounded. Eyes moderate, Mouth inferior, small; jaw subequal; lips fleshy, fimbriated. Barbels four pairs, short, all not extending beyond head. Dorsal spine entire, strong; adipose dorsal long low; pectoral spine internally serrated; caudal forked. Many black dots on sides; dorsal and caudal dotted, its edges nearly black; 3-5 oblique irregular saddle-shaped crossbands on sides (Plate1.B).

***Mystus bleekeri* (Day, 1877)**

Fin formula: B.X; D_1.I/7-8; D_2. Adipose; P.I/9-10; V.6; A.9-10; C.17.

Body elongated and compressed. Head depressed; extends to basal bone of dorsal fin; Eye moderate. Mouth terminal. Barbels four pairs; maxillary barbels extend posteriorly to anal fin. Adipose fin large, inserted just behind rayed dorsal fin. Brownish green to bright yellow; with two light longitudinal bands, one above and the other below lateral line; often with a dark spot on shoulder and caudal peduncle (Plate1.C).

Mystus cavasius (Hamilton-Buchanan, 1822)

Fin formula: B.VI; D_1.I/7; D_2. Adipose; P.I/8- 9; V.6; A.8-9; C.17.

Body elongated, compressed. Head compressed; snout rounded. Eyes moderately large. Mouth terminal. Barbels four pairs; maxillary barbels extend to fork of caudal fin. Adipose fin long, well-developed, contiguous with rayed dorsal fin. Greyish silver; with a distinct dark spot at dorsal spine origin and a dark mark just behind operculum; rayed dorsal fin tipped with black and other fins dull white (Plate1.D).

Mystus leucophasis (Blyth, 1861)

Fin formula: B.XI; D_1. I/7; D_2. Adipose; P.I/8-9;V.5-6; A.9-10; C.16-17.

Body fuciform; Eye moderate. Mouth terminal; Barbels four pairs; maxillary barbels extend posteriorly to end of anal fin; adipose fin base short, well developed, commences far from rayed dorsal fin. Greenish black, scattered white spots on body in juveniles; all fins black; always swims with its belly upwards, ventral side darker than dorsal (Plate1.E).

Mystus menoda (Hamilton-Buchanan, 1822)

Fin formula: B.X; D_1. I/7; D_2.Adipose; P.I/9; V.6; A.12; C.16-17.

Body elongated and compressed; Head depressed, broad; occipital process long, Eyes small; Mouth, terminal. Barbels four pairs; maxillary barbels reaching to base of ventral fin. Adipose dorsal fin short, commences far from rayed dorsal fin. Greenish yellow above, dull white below; 11-12 distinct black spots above the lateral line; all the black spots flanked by two small spots (Plate1.F).

Mystus microphthalmus (Day, 1877)

Fin formula: B.X; D_1. I/7; D_2.Adipose; P.I/10;V.6; A.12; C.17.

Body elongated and compressed; Head depressed, broad; Eyes small, its diameter (12) times in head length. Mouth terminal. Barbels four pairs; maxillary barbels extending up to anterior base of anal fin. Dorsal spine weak and entire; adipose fin short, commences far from rayed dorsal fin. Light brown; fins darker at margins (Plate1.G).

Mystus pulcher (Chaudhuri, 1911)

Fin formula: B.VI; D_1 I/7; D2, Adipose; P.I/9; V.6; A.12; C.17.

Body elongated and compressed; Head compressed; Eye moderate; Mouth terminal; Barbels four pairs; maxillary barbels extend posteriorly beyond anal fin origin. Dorsal spine weak, finely serrated; adipose fin base short; Caudal fin forked. Brownish

green to bright yellow; with two light longitudinal bands, one above and the other below lateral line; with a dark spot on shoulder and caudal peduncle (Plate1.H).

Mystus rufescens (Vinciguerra, 1890)

Fin formula: B.XII; D_1 .I/7; D_2 .Adipose; P.I/7-8; V.6; A.9; C.17.

Body elongated and compressed; Head depressed; Eye moderate. Mouth terminal. Barbels four pairs; maxillary barbels extend posteriorly to end of pelvic fins. Dorsal spine serrated; adipose fin base long, inserted close behind dorsal fin. Body rufescent; often a black spot on base of caudal fin; caudal fin dusky (Plate1.I).

Ompok bimaculatus (Bloch, 1797)

Fin formula: B.XII; D.4; P.I/10; V.7-8; A.69-70; C.17.

Body elongated and strongly compressed; Head depressed, small, Eyes subcutaneous, Mouth superior, its cleft not reaching up to anterior margin of orbit. Barbels two pair; maxillary barbels extend to origin of anal fin. Rayed dorsal fin small, short, without spine; pectoral fin with a feeble spine; anal fin long, caudal fin deeply forked , with pointed lobes. Silvery; a black blotch present on shoulder (Plate1.J).

Ompok pabo (Hamilton-Buchanan, 1822)

Fin formula: B.XII; D.5; P.I/14; V.9; A.73; C.17.

Body elongated and compressed; Head broad; Eye subcutaneous, lying at corner of mouth, Mouth superior. Barbels two pairs; maxillary barbels very short ,extending up to hind edge of eye; rayed dorsal fin small, short, spineless; pectoral fin with a feeble spine; anal fin long; caudal fin deeply forked. Silvery grey (Plate1 K).

Wallago attu (Schneider, 1801)

Fin formula: B.XVIII; D.5; P.I/12-13;V.8-10; A.90-92; C.17.

Body elongated, compressed; Head large; Eye free from orbital rim, small, Mouth subterminal, wide and very long, reaching behind eyes; Barbels two pairs; maxillary barbels extend to beyond anal fin origin. Dorsal fin short, spineless; pectoral fin with a smooth feeble; anal fin long; caudal fin deeply forked, its upper lobe rounded and longer. Silvery (Plate1.L).

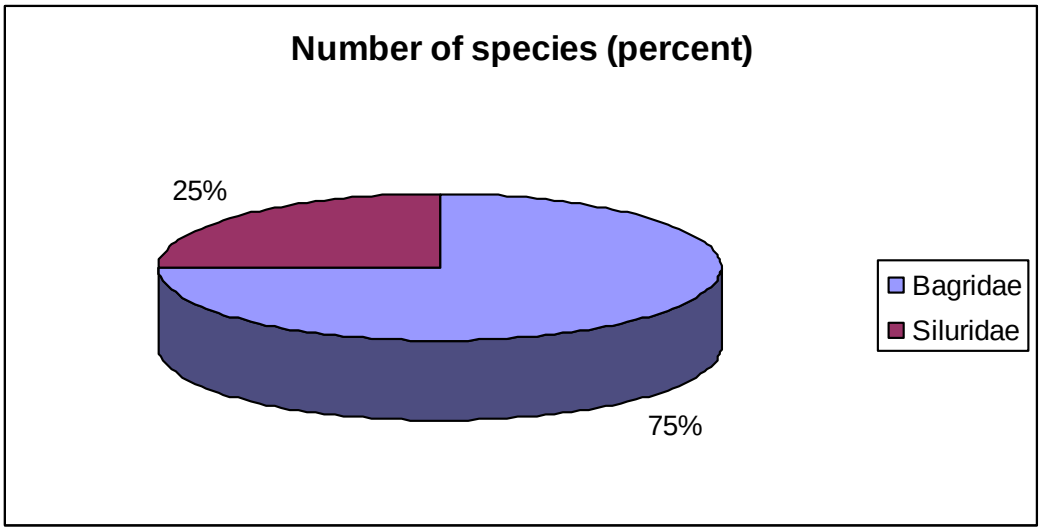


Fig. 1. Number of species in different families

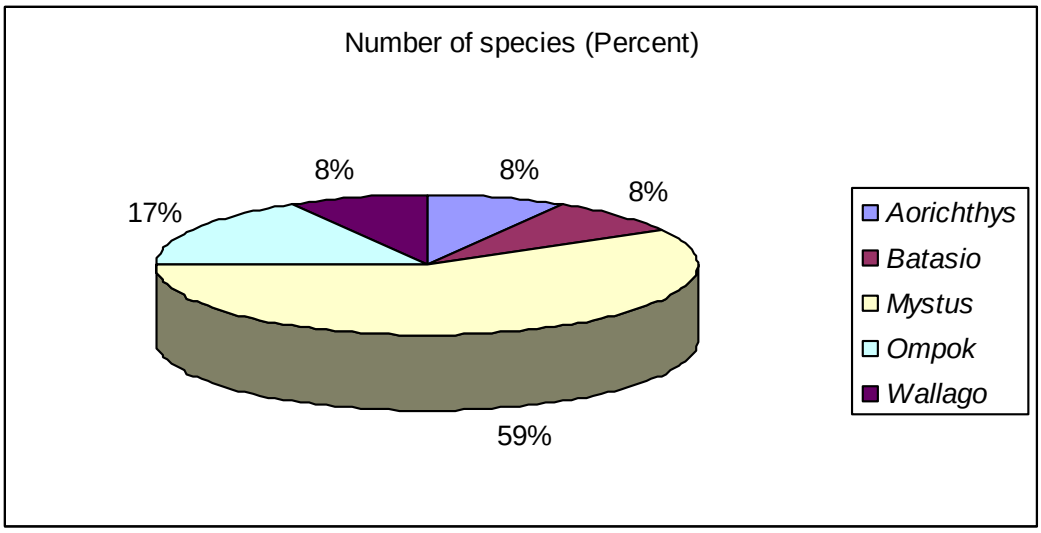


Fig. 2. Number of species in different genera

A. *Aorichthys aor* (Family-Bagridae)

B. *Batasio tengana* (Family-Bagridae)

C. *Mystus bleekeri* (Family-Bagridae)

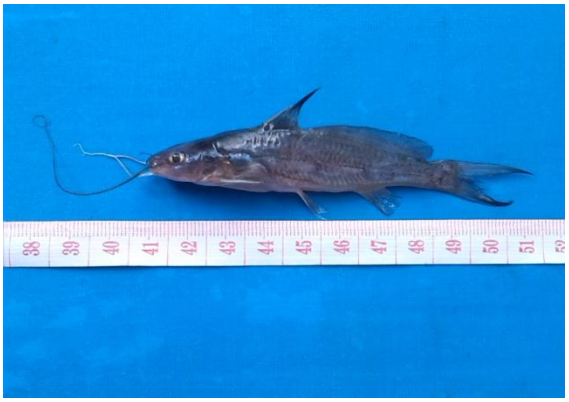
D. *Mystus cavasius* (Family-Bagridae)

E. *Mystus leucophasis* (Family-Bagridae)

F. *Mystus menoda* (Family-Bagridae)

Plate 1. Recorded species of Order Siluriformes

G. *Mystus microphthalmus* (Family-Bagridae)



H. *Mystus pulcher* (Family-Bagridae)

I. *Mystus rufescens* (Family-Bagridae)

J.*Ompok bimaculatus* (Family-Siluridae)

K. *Ompok pabo* (Family-Siluridae)

L.*Wallago attu* (Family-Siluridae)

Plate 1. Continue

Table 1. Recorded silurid species from Myomyityoe In

No	Order	Family	Genus	Species	Common name	Local name
1	Siluriforme	Bagrida	*Aorichthys*	*A. aor*	Long-whiskered cartfish	Nga-gyaung
2			*Batasio*	*B. tengana*	Assamese batasio	Nil
3			*Mystus*	*M. bleekeri*	Day's mystus	Nga-zin-yaing-ni
4				*M. cavasius*	Gangetic mystus	Nga-zin-yaing-phyu
5				*M. leucophasis*	Sittaung mystus	Nga-nauk-thwar
6				*M. menoda*	Menoda catfish	Nga-ngaik
7				*M. microphthalmus*	Irrawaddy mystus	Nga-yway
8				*M. pulcher*	Pulcher mystus	Nga-zin-yaing-kyet-chae
9				*M. rufescens*	Meetan mystus	Nga-zin-yaing
10		Silurida	*Ompok*	*O. bimaculatus*	Indian butter-catfish	Nga-nu-than
11				*O. pabo*	Pabo catfish	Nga-nu-than
12			*Wallago*	*W. attu*	Boal	Nga-butt

Discussion

The taxonomic study on the fishes of Myomyityoe In, Banmaw Town revealed 12 species confined to the only one Siluriformes and distributed among two families and three genera. The study period lasted from December 2012 to March 2013.

The two families of silurid fishes were recorded during the present study, the representatives of the family Bagaridae and Siluridae.

Assessment on the distribution of the 12 silurid species was recorded in the present study in the other sections of the Ayeyarwaddy river and adjoining water bodies in Upper and Central Myanmar revealed that *Heteropneustes fossilis* appeared as the most common species, as this species was encountered in all the records of the previous studies both from Upper and Central Myanmar.

Although *Mystus cavasius*, *Wallago attu*, *Ompok bimaculatus*, and *Clarias batrachus* appeared in almost every record of the previous worke and taken as common to both Upper and Central Myanmar, the first two species were not among those records from Putao and latter two species, not among those records from Myitkyina.

The three species namely, *Batasio tengana*, *Mystus rufescens* and *M. pulcher* were regarded as not common, although these species were recorded from some localities in Upper and Lower Central regions, not a single species in the data of silurid fishes recorded from Central Myanmar.

In addition, it was observed that, species namely, *Mystus microphthalmus* was recorded only from Upper and Central Myanmar and nowhere else in Lower Central Myanmar. These species were found to be confined to Upper and Central Myanmar.

Moreover in the present study out of the 12 silurid species recorded, three species namely, *Mystus bleekery*, *M. rufescens* and *M. pulcher* appeared as first time record in Kachin State (Upper Myanmar).

Myomyityoe In leasable fishery is based on both naturally recruited and introduced stocks. It also plays an important role in fish production for the consumption of local people.

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