Species Composition and Relative Abundance of Some Endemic Fish Species in Inle Lake

Myo Naing[1], Moe Nilar Tun[2]

Abstract

Inle Lake, the second largest lake in Myanmar, is a natural lake. The lake is home to many aquatic species and there are many endemic species. During the study period from November 2019 to August 2019, ten species belonging to three orders, four families and ten genera were recorded from Inle Lake. Order Cypriniformes, Anabantiformes and Synbranchiformes were recorded. Among them, order Cypriniformes was the most dominant (70%), the second dominant order Synbranchiformes was (20%) and the order Anabantiformes was (10%). The average relative abundance was determined as stated by Bisht *et al*., (2004). *Sawbwa resplendens*, *Danio erythromicron*, *Devario auropurpureus*, *Microrasbora rubescens* and *Yunnanilus brevis* were uncommon. *Cyprinus intha*, *Macrognathus caudiocellatus* and *Mastacembelus oatesii* were common while *Gymnostomus horai* and *Channa harcourtbutleri* were very common. As a result, the number of endemic fish species becomes to decline and threatens to be endangered. Therefore, it may be suggested that endemic fish species should be maintained by controlling exotic fish species and over fishing. The urgent requirements for maintaining on the status of a wide use of chemical pesticides, the waste products from human, deforestation and other indigenous or exotic species are needed.

Key words: relative abundance, endemic species, overfishing, Inle Lake, Fish

Introduction

Fish can be found in most bodies of water from high mountains streams to the deepest oceans. Fish exhibit greater diversity than any other group of vertebrates. They are important resources for humans worldwide especially as food because they have a cheap source of highly nutritive proteins and other essential nutrients. Fish are crucial for Myanmar people while it is certainly recognized that fish are the second only to rice in the diet of Myanmar. They have been a staple item in the diet of many people. Fisheries provide much of the human diet in many parts of the world (DoF, 2007).

Around the world, ornamental fish keeping is relatively popular. In many countries, ornamental fish is considered as favorable pets. Diversity of ornamental fishes available at the aquarium of ornamental industry is the main source of economy in many countries. Southeast Asia countries like Singapore, Malaysia and Philippines are famous for ornamental fish trade. Among them, Myanmar ornamental fish business was initiated during 1978 and then popular in Myanmar (Roy Mya Thein, 1995)

Relative species abundance is a component of biodiversity and refers to how common or rare a species is relative to other species in a defined location or community. Relative abundance is the percent composition of an organism of a particular kind relative to the total number of organisms in the area. Relative species abundance tends to conform to species patterns that are among the best-known and most-studied patterns in macroecology. Different populations in a community exist in relative proportions; this idea is known as relative abundance (Hubbell, 2001).

The present study sought to qualify the abundance of endemic fish species in Inle Lake with the ultimate view of developing a bio-assessment model specifically for Inle Lake. Inle Lake has rich and unique biodiversity with a variety of indigenous fishes. It acts as sanctuaries for commercial and biological important fish species. Thus, Inle Lake was chosen as the study area to conduct the present work with these objectives that is to record the endemic fish

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species, to examine the species composition and to determine the abundance of endemic fish species from Inle Lake.

Materials and Methods

Study sites and study period

The present study was conducted in Inle Lake, an ancient lake and located on the Shan plateau of Myanmar. The three sites, Tha-lae`-oo Village (20° 34' 54" N and 96° 55' 36" E), Naung-taw-lae-shay Village (20° 26' 46" N and 96° 54' 18" E) and Min-ywa Village (20° 18' 27" N and 96° 53' 36" E) were selected as the study sites. The present study was carried out from November 2019 to September 2020 (Plate 1and 2).

Fishing gears

Different fishing gears were used in the study area because the size of collecting fishes varied from species to species. Majority of fishes were caught by using bamboo trap (Hmyone) and nylon net (Tan pike).

Identification of fishes

The identification of fishes for each of the collected species was done according to Talwar and Jhingran (1991) and Fishbase (2018). The systematic position of the species was arranged according to Talwar and Jhingran (1991).

Collection and preservation

Specimen collections were done fortnightly in collaboration with the local fishermen. The collected specimen were counted and labeled with the local name. Scaled photographs were instantly taken to get natural size and color. The collected specimens were preserved in 5% formalin and brought to the laboratory for further identification and measurement work.

Data analysis

Relative species abundance and species richness describe key elements of biodiversity. Relative species abundance refers to how common or rare a species is relative to other species in a given location or community.

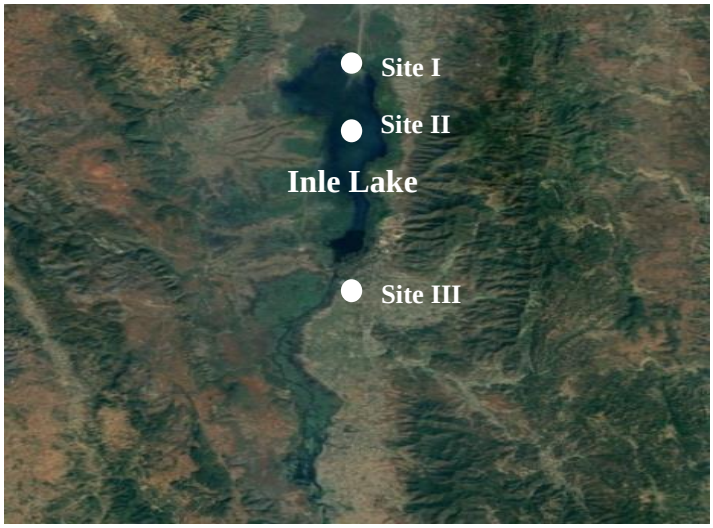
$$\text{Relative abundance} = \frac{\text{Total number of individuals of the species}}{\text{Total number of individuals of all species}}$$

The average relative abundance was determined as stated by Bisht *et al*. (2004).

Uncommon (uC) = having relative abundance less than 0.0100

Common (C) = having relative abundance of 0.0100 and above but less than 0.0500

Very common (vC) = having relative abundance of 0.0500 and above



Source: Google Earth 2019
Plate 1 Map of Inle Lake showing the study sites
Site I Tha-lae`-oo,
Site II Naung-taw-lae-shay,
Site III Min-ywa

Results

Recorded Fish species in Inle Lake

During the study period, a total of ten species belonging to ten genera, four families and three orders were recorded in the study area.

Three orders Cypriniformes, Anabantiformes and Synbranchiformes were recorded. Among them, order Cypriniformes was the most dominant (70%) with seven species, *Cyprinus intha*, *Sawbwa resplendens*, *Danio erythromicron*, *Devario auropurpureus*, *Microrasbora rubescens*, *Gymnostomus horai* and *Yunnanilus brevis*. The second dominant order Synbranchiformes was (20%) with two species, *Macrognathus caudiocellatus* and *Mastacembelus oatesii* and the order Anabantiformes was (10%) with one species *Channa harcourtbutleri* (Fig 1).

Monthly occurrence of recorded fish species in Inle Lake

In site I, the highest number of *Cyprinus intha* was found in the cold season, from December to February and the lowest was in the hot season, from March to May. *Devario auropurpureus, Gymnostomus horai, Yunnanilus brevis, Channa harcourtbutleri, Macrognathus caudiocellatus, Mastacembelus oatesii* could be found abundantly in the rainy season, from June to August and the least abundantly occurred in the hot season, from March to May. The three species, *Sawbwa resplendens, Danio erythromicron, Microrasbora rubescens* were not found in Site I (Table 1).

In site II, among ten species, five species such as *Cyprinus intha*, *Gymnostomus horai*, *Macrognathus caudiocellatus, Mastacembelus oatesii* and *Channa harcourtbutleri* were found to be the most plentiful in the cold season, from December to February but the most deficient number was in the hot season, from March to May. The rest five species, *Sawbwa resplendens*, *Danio erythromicron*, *Devario auropurpureus*, *Microrasbora rubescens*, *Gymnostomus horai* and *Yunnanilus brevis* were not found in Site II (Table 2).

In site III, *Cyprinus intha*, *Sawbwa resplendens*, *Danio erythromicron*, *Microrasbora rubescens*, *Yunnanilus brevis, Channa harcourtbutleri, Macrognathus caudiocellatus,*

Mastacembelus oatesii were found lavishly in the rainy season, from June to August. The lowest number of this species was found in the hot season, from March to May. *Devario auropurpureus* and *Gymnostomus horai* were not found in Site III (Table 3).

Average abundance of recorded fish species

Among the recorded ten species of fishes, *C. intha, C. harcourtbutleri, M. caudiocellatus* and *M. oatesii* were found in all study sites. *D. auropurpureus* can only be found in Site I (Tha-lae-oo Village). *G. horai* can be caught in Site I (Tha-lae-oo Village) and Site II (Naung-taw-lae-shay Village). *Y. brevis* can be found in Site I (Tha-lae-oo Village) and Site III (Min-ywa Village). *S. resplendens, D. erythromicron* and *M. rubescens* were only found in Site III (Min-ywa Village).

In site I (Tha-lae`-oo Village), *G. horai* and *C. harcourtbutleri* were found very common. *C. intha* was common and *D. auropurpureus*, *Y. brevis, M. caudiocellatus* and *M. oatesii* were uncommon. *S. resplendens, D. erythromicron* and *M. rubescens* were not found in site I (Table 1).

In site II (Naung-taw-lae-shay Village), *G. horai* and *C.harcourtbutleri* were found very common. *M. caudiocellatus* and *M. oatesii* were common. *C. intha* were uncommon. *S. resplendens, D. erythromicron, D. auropurpureus, M. rubescens* and *Y. brevis* were not found in site II (Table 2).

In site III (Min-ywa Village), *C. harcourtbutleri* was found very common. *M. rubescens* was common. *C. intha*, *S. resplendens, D.erythromicron, Y. brevis, M. caudiocellatus* and *M. oatesii* were uncommon. *D. auropurpureus* and *G. horai* were not found in site III (Table 3).

The average relative abundance of *G. horai* and *C. harcourtbutleri* were very common. *C. intha*, *M. caudiocellatus* and *M. oatesii* were common. *S. resplendens, D. erythromicron, D. auropurpureus, M. rubescens* and *Y. brevis* were uncommon (Table 4).

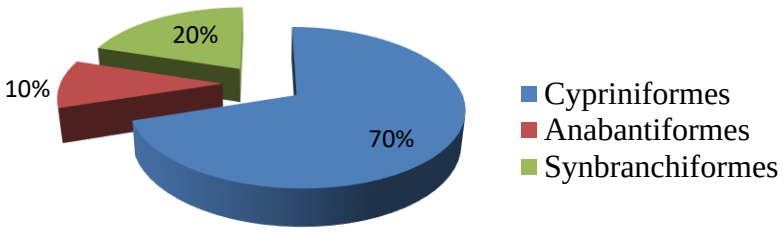
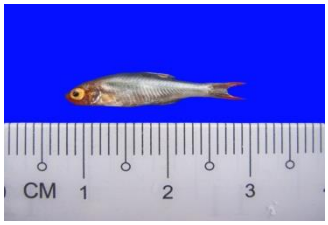


Figure 1. Species composition of endemic fishes found in Inle Lake according to orders

A. *Cyprinus intha*



B. *Sawbwa resplendens*

C. *Danio erythromicron*

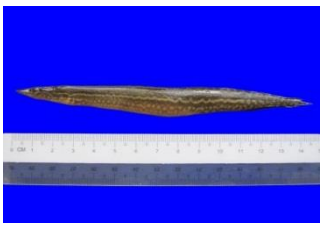
D. *Devario auropurpureus*

E. *Microrasbora rubescens*

F. *Gymnostomus horai*

G. *Yunnanilus brevis*

H. *Channa harcourtbutleri*



I. *Macrognathus caudiocellatus*

(J) *Mastacembelus oatesii*

Plate 2. Recorded endemic fish species from three study sites of Inle Lake

Table 1. Monthly occurrence and relative abundance of endemic fish species in Site I during December 2019 to August 2020

Species name	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Total	Relative abundance	Average relative abundance
Cyprinus intha	144	91	108	10	5	15	72	84	141	670	0.01	C
Sawbwa resplendens	-	-	-	-	-	-	-	-	-	-	-	-
Danio erythromicron	-	-	-	-	-	-	-	-	-	-	-	-
Devario auropurpureus	5	4	3	0	0	0	10	15	18	55	0.001	uC
Microrasbora rubescens	-	-	-	-	-	-	-	-	-	-	-	-
Gymnostomus horai	72	84	63	45	36	92	1890	2124	2262	6668	0.12	vC
Yunnanilus brevis	15	20	18	0	0	5	30	25	21	134	0.002	uC
Channa harcourtbutleri	4281	3831	2500	3538	2160	5284	6231	7041	8250	43116	0.83	vC
Macrognathus caudiocellatus	28	120	0	0	0	0	30	18	158	354	0.006	uC
Mastacembelus oatesii	21	137	0	0	0	0	35	15	132	340	0.006	uC
Total no: of individuals	4566	4287	2692	3593	2201	5396	8298	9322	10982	51337		
Total no: of species	7	7	5	3	3	4	7	7	7			

C = common (1) species vC = very common (2) species uC = uncommon (4) species

Table 2. Monthly occurrence and relative abundance of endemic fish species in Site II during December 2019 to August 2020

Species name	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Total	Relative abundance	Average relative abundance
Cyprinus intha	108	90	72	20	15	10	108	144	146	713	0.02	C
Sawbwa resplendens	-	-	-	-	-	-	-	-	-	-	-	-
Danio erythromicron	-	-	-	-	-	-	-	-	-	-	-	-
Devario auropurpureus	-	-	-	-	-	-	-	-	-	-	-	-
Microrasbora rubescens	-	-	-	-	-	-	-	-	-	-	-	-
Gymnostomus horai	105	95	73	30	25	70	846	1124	1895	4263	0.14	vC
Yunnanilus brevis	-	-	-	-	-	-	-	-	-	-	-	-
Channa harcourtbutleri	3990	3420	1710	1140	570	1644	2992	3280	3990	22736	0.79	vC
Macrognathus caudiocellatus	19	84	46	17	20	12	64	76	94	432	0.01	C
Mastacembelus oatesii	15	63	43	28	24	18	63	84	126	464	0.02	C
Total no: of individuals	4237	3752	1944	1235	654	1754	4073	4708	6251	28608		
Total no: of species	5	5	5	5	5	5	5	5	5			

C = common (3) species vC = very common (2) species uC = uncommon (0) species

Table 3 Monthly occurrence and relative abundance of endemic fish species in Site III during December 2019 to August 2020

Species name	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Total	Relative abundance	Average relative abundance
Cyprinus intha	25	27	30	0	0	0	0	36	48	166	0.04	C
Sawbwa resplendens	21	15	18	0	0	0	112	60	52	278	0.08	C
Danio erythromicron	38	20	21	0	0	0	130	50	62	321	0.09	C
Devario auropurpureus	-	-	-	-	-	-	-	-	-	-	-	-
Microrasbora rubescens	10	18	15	0	0	0	20	15	18	96	0.02	C
Gymnostomus horai	-	-	-	-	-	-	-	-	-	-	-	-
Yunnanilus brevis	4	2	1	0	0	0	5	2	3	17	0.005	uC
Channa harcourtbutleri	150	180	138	60	58	60	450	570	450	2116	0.62	vC
Macrognathus caudiocellatus	20	38	25	0	0	0	60	52	43	238	0.07	C
Mastacembelus oatesii	15	20	23	0	0	0	38	30	35	161	0.04	C
Total no: of individuals	283	320	271	60	58	60	815	815	711	3393		
Total no: of species	8	8	8	1	1	1	7	8	8			

C = common (6) species vC = very common (1) species uC = uncommon (1) species

Table 4 Relative abundance of endemic fish species in three study sites of Inle Lake during December 2019 to August 2020

Species name	Total individual number			Gross Total	Relative abundance	Index of relative abundance
	Site I	Site II	Site III			
Cyprinus intha	670	713	166	1549	0.01	C
Sawbwa resplendens	-	-	278	278	0.003	uC
Danio erythromicron	-	-	321	321	0.004	uC
Devario auropurpureus	55	-	-	55	0.001	uC
Microrasbora rubescens	-	-	96	96	0.001	uC
Gymnostomus horai	6668	4263	-	10931	0.13	vC
Yunnanilus brevis	134	-	17	151	0.002	uC
Channa harcourtbutleri	43116	22736	2116	67968	0.81	vC
Macrognathus caudiocellatus	354	432	238	1024	0.01	C
Mastacembelus oatesii	340	464	161	965	0.01	C
Total No. of individuals	51337	28608	3393	83338		

C = common (3) species vC = very common (2) species uC = uncommon (5) species

Discussion

Inle Lake is situated in the southern part of Shan State in Myanmar and home to many endemic flora and fauna. Primack (2006) described that an endemic species, however, is the one that grows naturally only in a single geographical area, the size of which could be either narrow or relatively large. A species may be both rare and endemic if they live in a narrow geographical area. Annandale (1918) reported that Inle Lake has no less than 12 species and 2 genera are apparently endemic. During the study period, ten endemic fish species belonging to three orders, four families and ten genera were recorded from the lake.

Out of three orders of endemic fishes, the percentage species composition was found to be highest under order Cypriniformes (70%) with seven species, followed by the order Synbranchiformes (20%) with two species and followed by the order Anabantiformes (10%) with one species. Moe Kyi Han (1991) reported that out of 41 species, 27 species were under the order Cypriniformes from Lawk Sawk lake, Nyaung Shwe, Pehkon. Nang Thi Thi Hann (1999) who reported 51 species from Moung Nai Township. Among them, 35 species were under the order Cypriniformes. Thus, the order Cypriniformes is dominant in Southern Shan State, Myanmar.

From three study sites, the average relative abundance of *G. horai* and *C. harcourtbutleri* were very common. *C. intha*, *M. caudiocellatus* and *M. oatesii* were common. *S. resplendens, D. erythromicron, D. auropurpureus, M. rubescens* and *Y. brevis* were uncommon (Table 4). Moe Nilar Tun (2014) reported that *M. rubescens* and *Y. brevis* were very common in Inle Lake. The number of *M. rubescens* and *Y. brevis* are declining in the present study when it is compared to the present finding.

Of the three sites, most species were found in Site III (Min-ywa Village) because the site is situated in the southern lower part. So it can be said that most of the fish species live there as their habitat. Besides, Min-ywa Village also has suitable environment for many fish species to live in. Therefore, in Site III (Min-ywa Village), most fish species can be found than other sites. The highest individual fish number can be found in Site I (51337 individuals) (Table 4).

Most of endemic fish species from Inle Lake are ornamental fish. Among the ten recorded endemic fish species: *S. resplendens*, *D. erythromicron*, *D. auropurpureus*, *M. rubescens*, *Y. brevis*, *C. harcourtbutleri*, *M. caudiocellatus* and *M. oatesii* are used in ornamental trade. . As ornamental fishes, the fishes from Inle Lake are very popular and are exported to the world annually, especially to Singapore (Moe Nilar Tun, 2014).

Five of the ten endemic species are uncommon, rare and the numbers are declining so it is hard to find. These species are *S. resplendens*, *D. erythromicron*, *D. auropurpureus*, *M. rubescens* and *Y. brevis*. According to IUCN red list, *S. resplendens* is listed as endangered B2ab (iii, v) ver 3.1, *D. erythromicron* is endangered B1ab (ii, iii, v) + 2ab (ii, iii, v) ver 3.1, *D. auropurpureus* is endangered B1ab (i, ii, iii, v) + 2ab (i, ii, iii, v) ver 3.1, *Microrasbora rubescens* is endangered B1ab (iii, v) + 2ab (iii, v) ver 3.1 and *Yunnanilus brevis* is vulnerable B1ab (iii); D2 ver 3.1.

Conclusion

The present findings reveal that the number of individual endemic fish species in Inle Lake is declining. Inle Lake is suffering from the environmental effects due to the increase in population living in the lake, the expansion of floating gardens, the sedimentation caused by deforestation in the surrounding mountains, using various agrochemicals in agriculture area. These changes have reduced the habitat of endemic fish species. In addition, the introduced exotic fish species, over fishing and illegal catching of the spawning fishes lead to decline in

endemic species. Besides some endemic fish species are exported as ornamental fishes to foreign country by catching from the wild population. Inle Lake needs to be managed and the data indicated that the lake is affected by human activities. Thus, Inle Lake needs to be conserved for endemic fish species and prevention for introduce exotic fish species. Local people also need to be educated and contributed knowledge about endemic fish species.

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