



Fisheries Administration



**Mekong River Commission
Fisheries Programme**

**MONITOR DRIFT OF FISH LARVAE AND FRY IN THE MEKONG
AND TONLE SAP RIVERS IN CAMBODIA**

Annual Report

Prepared for submission to the MRC Fisheries Programme

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Abbreviations and Acronyms

FP	Fisheries Programme of MRC
FiA	Fisheries Administration
IFReDI	Inland Fisheries Research and Development Institute
Inds	Individuals
LMB	Lower Mekong Basin
MRC	Mekong River Commission
sp.	One species
spp.	Species (plural)

Glossary

<i>Species diversity</i>	<i>Species diversity is the effective number of different species that are represented in a collection of individuals (a dataset). The effective number of species refers to the number of equally-abundant species needed to obtain the same mean proportional species abundance as that observed in the dataset of interest (where all species may not be equally abundant). Species diversity consists of two components: species richness and species evenness. Species richness is a simple count of species, whereas species evenness quantifies how equal the abundances of the species are.[1][2][3] http://en.wikipedia.org/wiki/Species_diversity</i>
Species Richness	Species richness is the number of different species represented in an ecological community, landscape or region.[1]Species richness is simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions. In contrast, species diversity takes into account both species richness and species evenness. http://en.wikipedia.org/wiki/Species_richness
Pielou's evenness index	Species evenness refers to how close in numbers each species in an environment are. Mathematically it is defined as a diversity index, a measure of biodiversity which quantifies how equal the community is numerically. The evenness of a community can be represented by Pielou's evenness index (constrained between 0 and 1) http://en.wikipedia.org/wiki/Species_evenness
Shannon diversity index	The Shannon diversity index (H) is another index that is commonly used to characterize species diversity in a community. Like Simpson's index, Shannon's index accounts for both abundance and evenness of the species present. Maximum diversity occurs when each individual belongs to a different species and minimum diversity occurs when each individual belongs to the one species http://www.tiem.utk.edu/~gross/bioed/bealsmodules/shannonDI.html
Margalef Index	A measure of species diversity. It is calculated from the total number of species present and the abundance or total number of individuals. The higher the index the greater the diversity http://www.gees.ac.uk/resources/hosted/fieldsim/con_margalef.htm

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Executive summary

The monitoring activities to assess fish larvae abundance and diversity were undertaken in two locations close to Phnom Penh: one in the Mekong River and the other in Tonle Sap River. In monitoring fish larvae drift, a bongo net with 1-metre diameter and a 1mm mesh size was used. The bongo net was equipped with a flow meter to measure the volume of filtered water. It was submerged 2 m below the water surface of the river and put in 20-30 m from the riverbank to sample fish larvae on a daily basis in the flooding season (June-September). The sampling four times a day at 6:00, 12:00, 18:00 and 24:00 hours conducted in the Mekong and Tonle Sap Rivers. Fish larvae samples were removed from the cod-end of the net and immediately preserved in 8% formalin. Subsequently, in the lab the larvae and fry were identified to the lowest taxonomic level possible.

in the Mekong River 57 species belonged to 20 families and in the Tonle Sap River 49 species belonged to 13 families. Larvae of *Cyprinid larvae* was the most abundances species in terms of quantity comprised of 44% in the Mekong and 47% in the Tonle Sap rivers respectively. Due to the rainy season is coming late in 2020 so the fish spawn in the upstream Mekong was late. The larvae quantity was presented with 2,328inds/sample occurred on 8th September 2020 in the Mekong River and 3,199/sample in Tonle Sap River in August 2020 respectively. Fish larvae in daytime abundant more than in night-time between September and October 2020 in the Mekong and Tonle Sap Rivers. *Henicorhynchus* spp was the most abundant species contributed 56.24% in the Mekong and 67.38% in the Tonle Sap Rivers. The larvae abundant in the daytime was higher than nightie in the Mekong and Tonle Sap rivers. Species diversity in the Mekong more divers than Tonle Sap River in term of quantity of species. The similarity between the Mekong and Tonle Sap rivers combining at 75.39% in terms of relative abundance and species

1. Introduction

Fish larvae in Cambodia was studied in 1925 (Chevey 1930) at the confluence of Mekong, Tonle Sap and Basac rives, close to Phnom Penh, Cambodia. Since 2002, the Fisheries Administration, with technical and financial support from the MRC Fisheries Programme, has

been monitoring the density of fish larvae at two sites in the Mekong and Tonle Sap rivers. Both sampling sites are located in Sangkat Chruy Changwa, Kbal Chruy village, Khan Russey Keo, Phnom Penh.

The fish larvae drift monitoring activity, using a bongo- net, focuses on collecting key data items including number of fish larvae, number of species and their diversity, water velocity and length frequency... These data sets allow for different types of analysis related to species composition, fish larvae quantity (abundance), density and species diversity. Ultimately, the monitoring intends to identify fisheries yield indicators in the Lower Mekong Basin (LMB) contributing to the interpretation of the status and trends of basin-wide capture fisheries as well as providing a more effective means of monitoring and assessing the effects of water management and basin development activities. This activity also helps to answer some basic questions, regarding such issues as the health of fisheries, effects of overfishing and the impacts of water management.

Many fish species in the Mekong river are believed to migrate upstream to spawn (Poulsen *et al* 2004, Baird *et al* 2003). The spawned eggs and larvae initially drift downstream to populate the river and floodplains. The density of fish larvae in the water flowing downstream is used to develop an index of the reproductive success and the likely levels of recruitment of young fish to stocks each year. In populations of fish with high natural mortality rates comprising few age groups (cohorts) typical of many of the small species of cyprinid that dominate landings in the LMB, annual recruitment of fish has a significant influence on fish yields each year. The objectives of study were as follows:

- To study larvae and juvenile fish abundance and diversity through two sampling locations – Mekong and Tonle Sap Rivers close to Phnom Penh.
- To assess fish larvae quantity and density.
- To compare fish larvae abundance, quantity/density, diversity, amongst the left, middle and right monitoring sites of the river.
- To assess the likely fish spawning grounds.

2. Methods

2.1. Sampling stations

Both larval sampling sites are located in Phnom Penh around Chaktomuk area in Chroy Changva District Chong Chruy village of Phnom Penh: one is located on the Mekong River (N: 11°34'19"; E: 104°56'26") and another on the Tonle Sap River (N: 11°34'38"; 104°55'52").

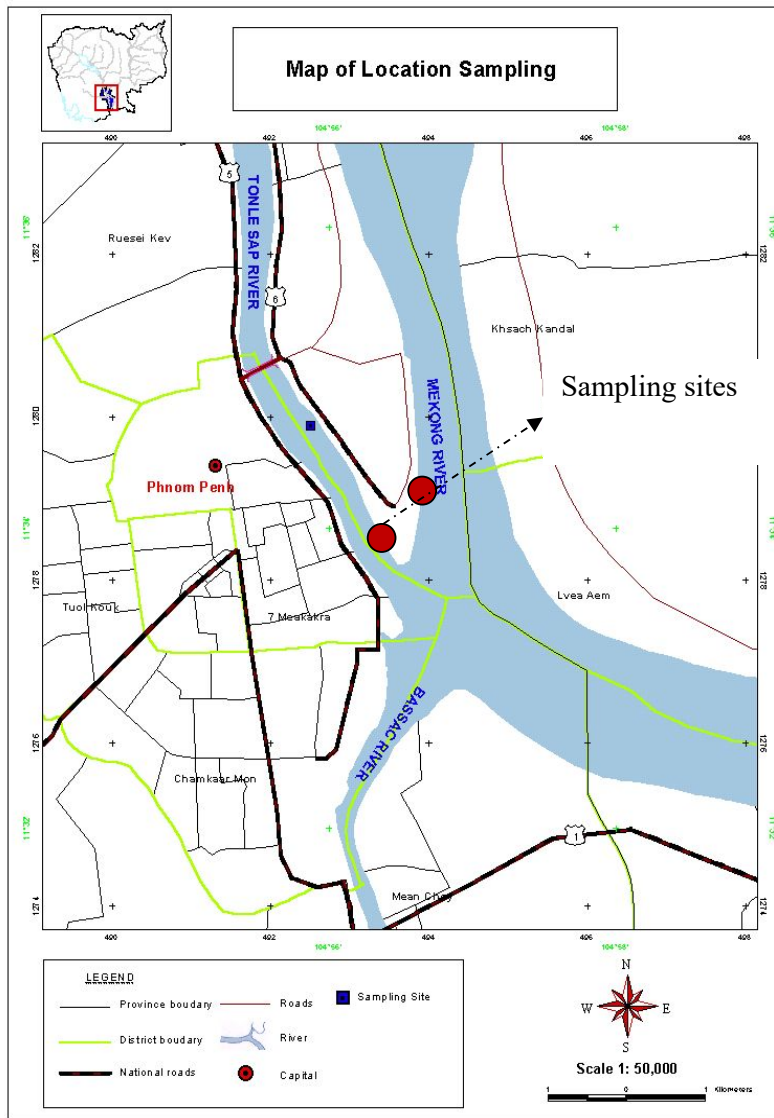


Figure 1 Map of sampling locations of fish larvae in the Mekong and Tonle Sap River

2.2. Frequencies of sampling

Samples were collected every day from June-September in both rivers 04 times per day (6:00, 12:00, 18:00 and 24:00 hours) during 30 minutes. Totally, 366 samples were collected in the Mekong and 366 samples were collected in the Tonle Sap Rivers.

2.3. Equipment used for sampling

The sampled fish larvae were collected by bongo net with 1-metre diameter and a 1-mm mesh size. The bongo net was equipped with a flow meter to measure the volume of filtered water in a specific period of time. It was set 2 m below the water surface of the river and 20-30 m from the riverbank to sample fish larvae on a daily basis in the flooding season.



Figure 2 the bongo-net for larval fish collection in the Mekong and Tonle Sap Rivers

2.4 Sampling in the middle and left side

Samples were collect every two weeks (July-September) mean 32 samples collected in the Mekong and 32 samples collected in the Tonle Sap Rivers at (6:00, 12:00, 18:00, and 24:00 hours) every six hours during 30 minutes.

2.5 Flow rate (m/s)

- Calculation of flow rate (m/s) = No. of rotations x 0.026854 (m)/time of setting (seconds)

2.6. Volume (m³)

- Calculate of volume passing the bongo-net: V (m³)
- $V = ([\text{Difference in count of flow meter revolutions} \times 26873] / 999999) \times ([3.14 \times \text{net diameter}^2] / 4)$
- Fish larvae density D: individuals/1000m³
- $D = 1000 N / V$
- Where
- D is fish larvae density per 1000m³
- N is number of fish larvae in the sample (collected number)

2.7. Diversity indices

Shannon-Wiener Index (H')

Was computed as:

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

P_i is the importance value of species as a proportion of all species
i: relative to total number of species present

$$D = (S-1)/\ln(N)$$

$$J' = H' / \ln(S)$$

Where

H' Shannon's diversity index,

S = the total number of species in the sample

N = the total individuals in the sample

D = Species richness (Margalef index)

J' = Pielous's evenness

2.8. Fish larvae and fries identified

Referring to the references of (Rainboth 1996), (Termvidchakorn 2003) and (Chevey 1930).

Due to budget limitation for study on spawning areas, so spawning ground was simple calculated as below:

2.9. Spawning areas

Spawning areas calculated by Age of larvae (days) × mean velocity before 5 days

2.10. Data analysis

Data storage in MS Access, analysed in Excel and Primer (Plymouth Routines in Multivariate Ecological Research) for the analysis of diversity indices.

2.11. Sample processing

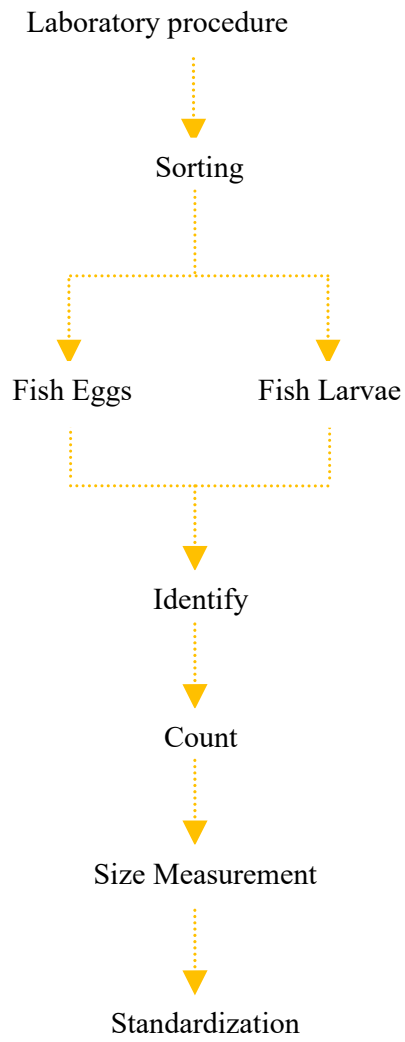


Figure 3 Fish larvae identification in the Laboratory

3. RESULTS

3.1. Species composition

3.1.1 Species composition in the Mekong

In the Mekong River a total of 57 species belonging to 20 families was identified of which Cyprinidae 25 species (44%), Pangasiidae 5 species (9%), Siluridae and Clupeidae each family has 4 species (4%) other 13 families (23%) each family has only one species.

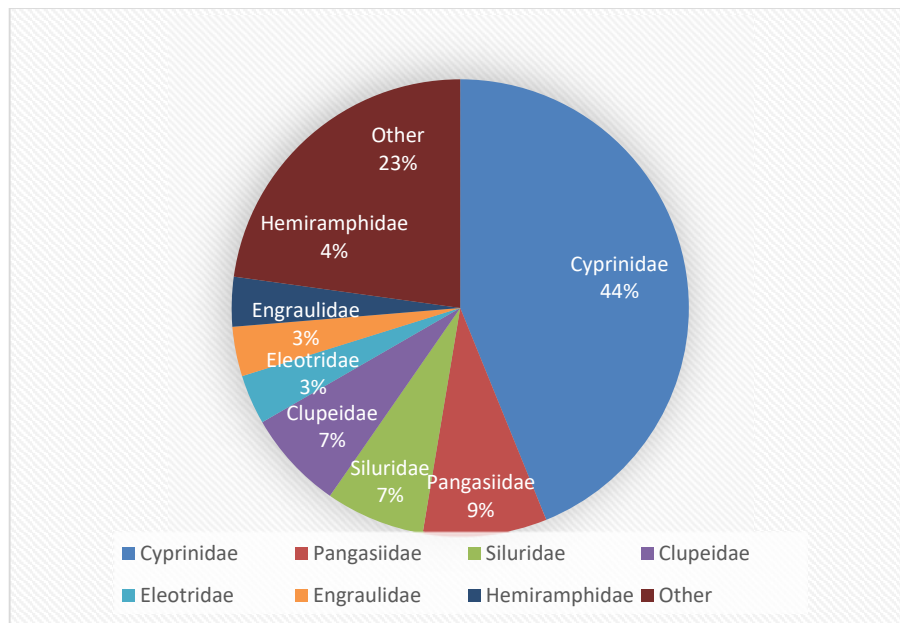


Figure 4 Species composition by family in the Mekong

3.1.2 Species composition in the Tonle Sap River

In the Tonle Sap River there are 49 species belonging to 13 families identified of which Cyprinidae 23 species (47%), Pangasidae 6 species (13%), Engraulidae 4 species (8%) and Chandidae each family has 3 species (6%) Eleotridae, and Channidae each family has 3 species (6%), Eleotridae and Channidae each family has 2 species (4%) the rest 6 family each family has 1 species (12%).

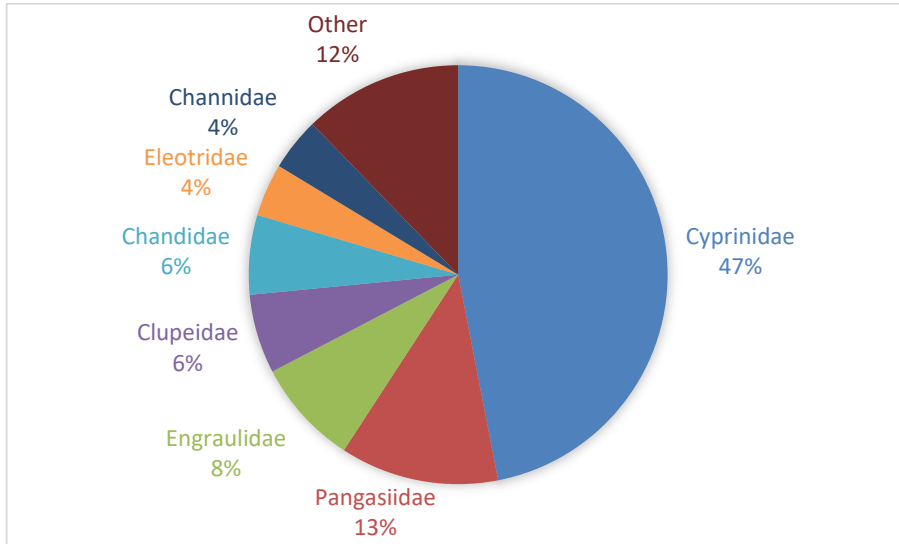


Figure 5 Species composition by family in the Tonle Sap River

3.2. Average larvae quantity and density

3.2.1 Average larvae quantity per sample in the Mekong River

The peak period of larval fish occurred with 2328inds/sample on 8th September 2020. Using a one-way ANOVA, there was no significant difference of larvae quantity in June, July, August and September ($F = 1.3 < F_{0.05} [4, 89] = 2.4$, $P = 0.05$).

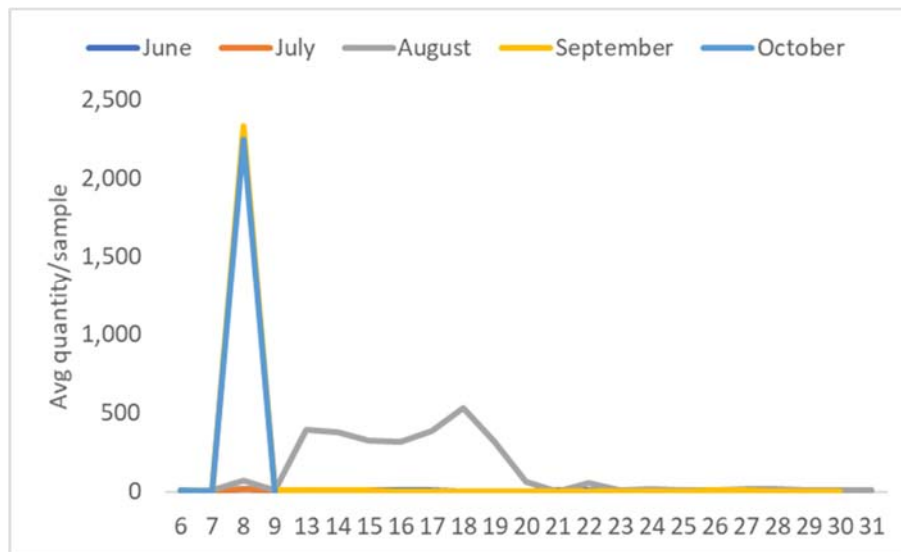


Figure 6 Average larvae quantity per sample in the Mekong River

3.2.2. Average larvae density per sample in the Mekong River

In the figure 8 shown the highest larvae density per sample was 357,596/1000m³ occurred on 8th September 2020. There was a significant difference of larvae density in June, July, August and September ($F= 2.9 > F_{0.05 [4, 89]} = 2.47$, $P = 0.05$).

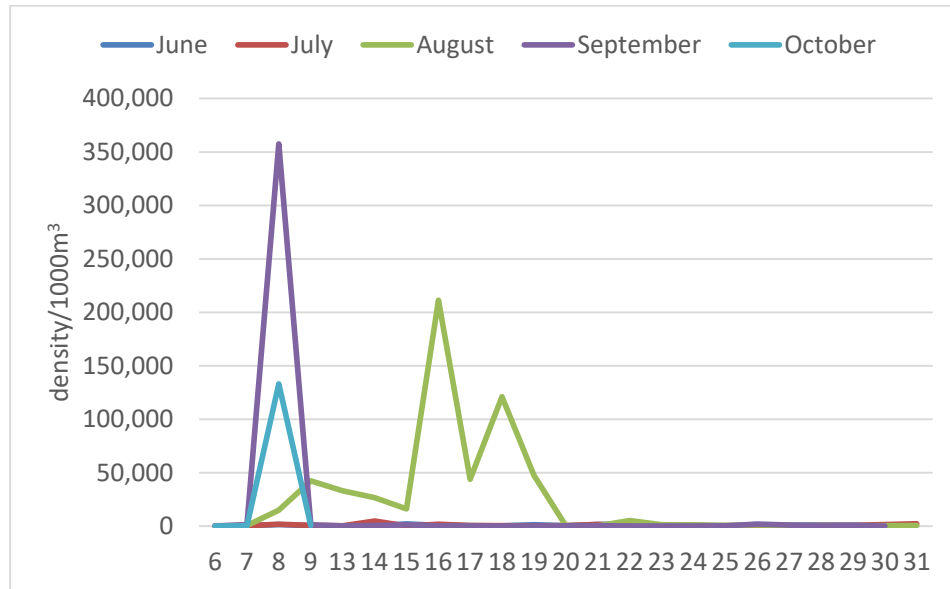


Figure 7 Average larvae density per sample in the Mekong River

3.2.3. Average larvae quantity per sample in the Tonle Sap River

In the Tonle Sap River the highest average larvae quantity per sample was 3,199/sample occurred on 8th August 2020. There was a significant difference of larvae quantity in June, July ($F= 5.68 > F_{0.05 [4, 88]} = 2.47$, $P = 0.05$).

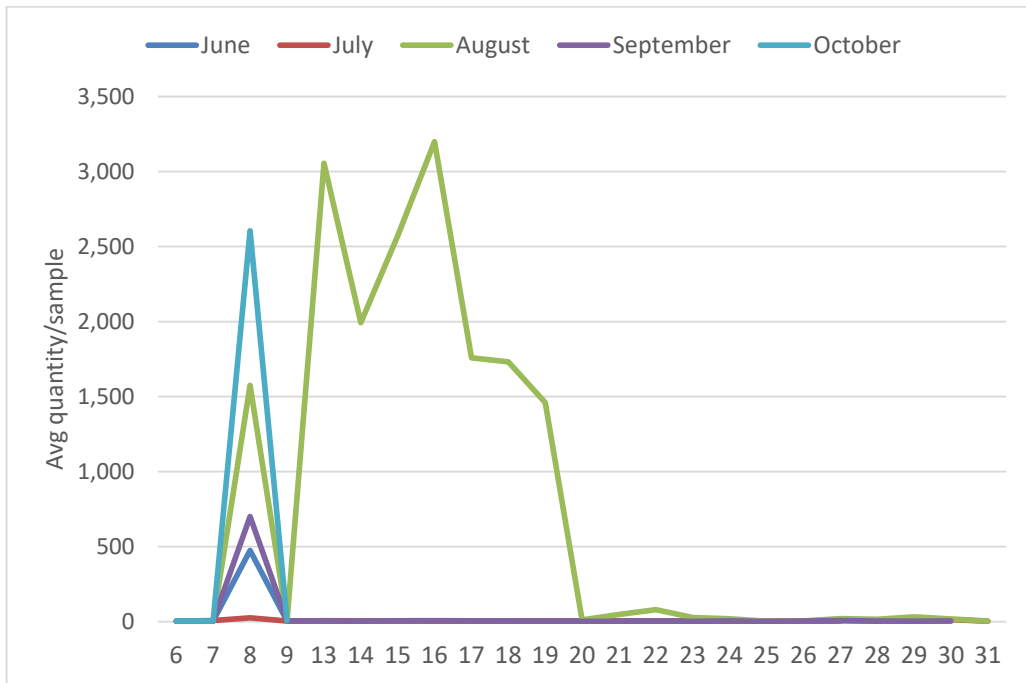


Figure 8 Average larvae quantity per sample in the Tonle Sap River

3.2.4. Average larvae density per sample in the Tonle Sap River

In the Figure 10 shown average larvae density per sample was 340,755inds/1000m³ occurred on 13th August 2020. There were significant differences of larvae density in June, July, August and September ($F = 6.78 > F_{0.05} [4, 88] = 2.47$, $P = 0.05$).

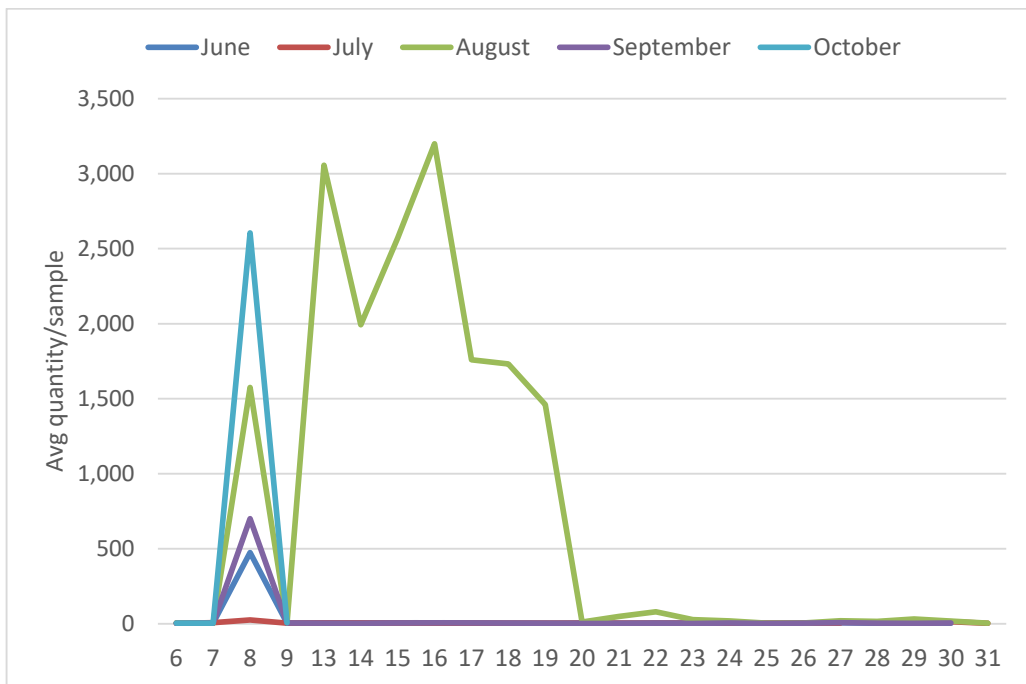


Figure 9 Average larvae quantity per sample in the Tonle Sap River

3.3. Comparison larvae quantity at daytime and night times in the Mekong River

3.3.1. Abundant at daytime and night times in the Mekong River

In term of larvae quantity, samples taken during the daytime was more abundant than night-time occurred in September and October 2020 in the Mekong River.

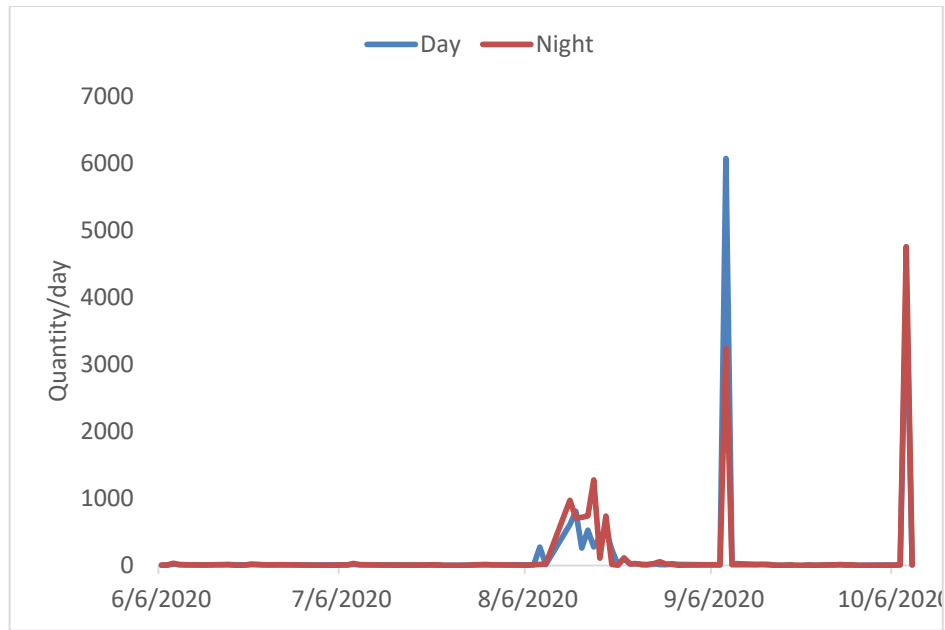


Figure 10 Quantity of fish larvae at day and night time in the Mekong River

3.3.2 Comparison larvae quantity at daytime and night times in the Tonle Sap River

In term of larvae quantity, samples taken during the daytime was more abundant than night-time occurred in September and October 2020 in the Tonle Sap River.

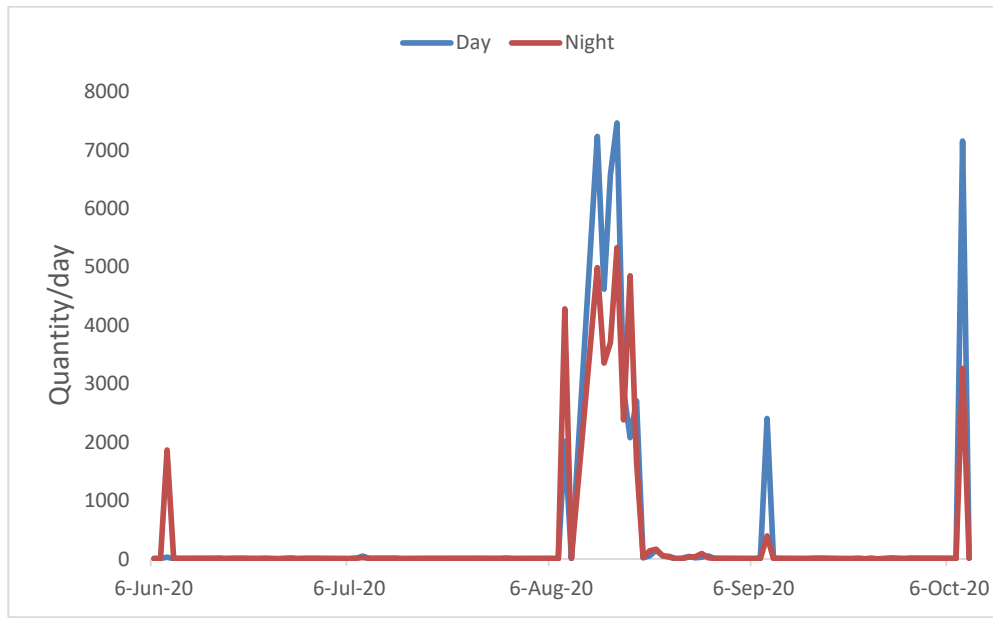


Figure 11 Quantity of fish larvae at day and night time in the Tonle Sap River

3.4. Catch composition in the Mekong and Tonle Sap Rivers

3.4.1 Catch composition in the Mekong

In the Mekong River *Henicorhynchus* spp. was the most abundant (56.24%) and in the Mekong River (Table 1)

Table 1 Percentage of quantities by species in the Mekong River

Species name	Quantity	Percentage (%)
<i>Henicorhynchus</i> sp.	16,528	56.24
<i>Cyprinidae</i>	5,433	18.49
<i>Labiobarbus lineata</i>	1,486	5.06
<i>Pangasianodon hypophthalmus</i>	1,460	4.97
<i>Pangasius</i> sp.	1,418	4.82
<i>Clupeoides borneensis</i>	899	3.06
<i>Pangasius bocourti</i>	689	2.34
<i>Clupeichthys aesarnensis</i>	343	1.17
<i>Barbonymus gonionotus</i>	317	1.08
<i>Corica laciniata</i>	160	0.54
Other	657	2.24

3.4.2 Catch composition in the Tonle Sap River

In the Tole Sap river Cyprinid larvae (67.38%) was the most abundant species, followed by *Pangasianodon hypophthalmus* (27.52%) and other species 0.51%.

Table 2 Percentage of quantities by species in the Tonle Sap River

Species name	Quantity	Percentage (%)
<i>Cyprinidae</i>	56,370	67.38
<i>Pangasianodon hypophthalmus</i>	23,022	27.52
<i>Pangasius sp.</i>	1,338	1.60
<i>Clupeoides borneensis</i>	1,107	1.32
<i>Puntioplites proctozysron</i>	486	0.58
<i>Corica laciniata</i>	362	0.43
<i>Pangasius macronema</i>	260	0.31
<i>Barbonymus altus</i>	132	0.16
<i>Barbonymus gonionotus</i>	86	0.10
<i>Channa striata</i>	67	0.08
<i>Other</i>	426	0.51

4. Species diversity

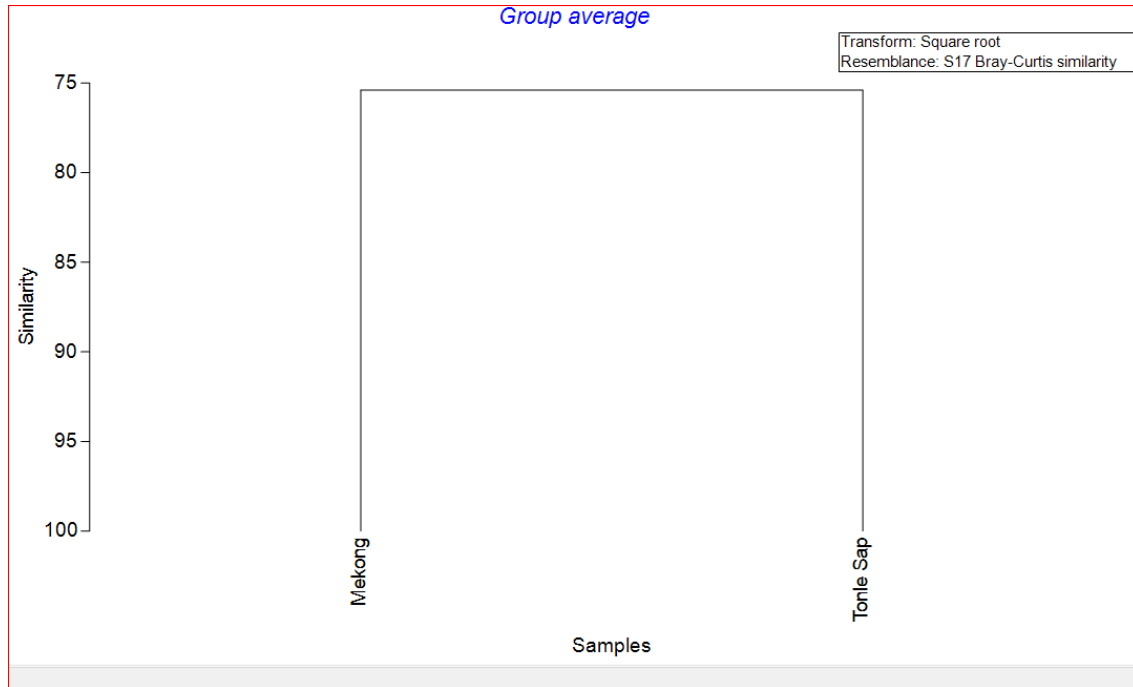
In the Table 1 shown at the Mekong there was 57 species included 29,390 inds and Tonle Sap 49 species with total 83,656 inds, the Shannon $H' = 1.55$ in the Mekong bigger than $H' = 0.88$ in the Tonle Sap river indicated that the diversity in the Mekong more divers than Tonle Sap River in term of quantity of species (Appendices 1).

Table 3 Diversity indices of larval fish at the Mekong and Tonle Sap Rivers

Sample	S	N	H'(loge)
Mekong	57	29,390	1.55
Tonle Sap	49	83,656	0.88

4.1 Similarity of larval fish in the Mekong and Tonle Sap rivers

The Cluster analysis shows the similarity between the Mekong and Tonle Sap rivers combining at 75.39% in terms of relative abundance and species..



5. Length frequency

Based on yearly occurrence of abundance species in June and July and its ages and length measured by (Termvidchakorn 2003) so we selected those 10 species to predict the spawning areas based on formula 2.1.9 in the methodology part, however some species were unknown its ages so the prediction of spawning areas cannot conducted.

5.1 Length of *Henicorhynchus* spp.

The length for *Henicorhynchus* spp., range of 5.3-6.5 mm that estimated 4-6 days old larvae; If assumed that these larvae drifted passively with water flows 0.55 m/s, then larvae of *Henicorhynchus* spp. drifted approximately 237km from the sampling sites (upper Mekong). Then its spawning areas would be in Kratie province

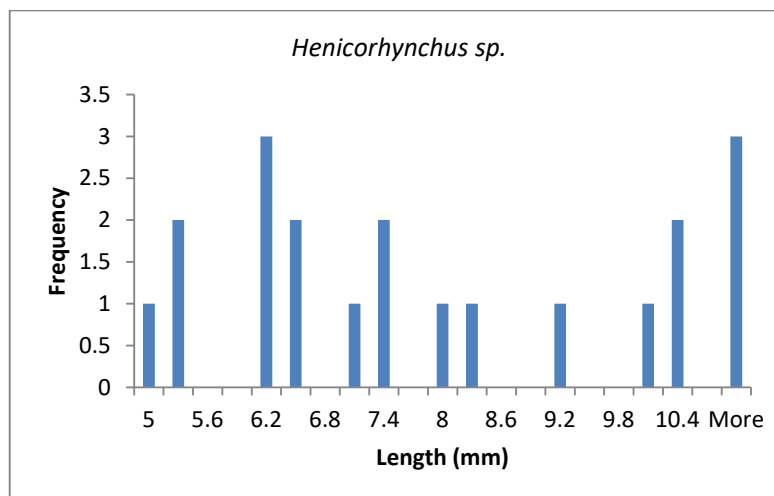


Figure 12 Length of *Henicorhynchus* spp

5.2 Length of *Pangasianodon hypophthalmus*

The length of *P. hypophthalmus* most frequent 11mm, it estimated 7-9 days of age. Assuming that these larvae drifted passively with a water flow of 0.55 m/s, the larvae could have drifted approximately 427-500 km. In this case, the predicted spawning area would be between Kratie and Stung Treng provinces

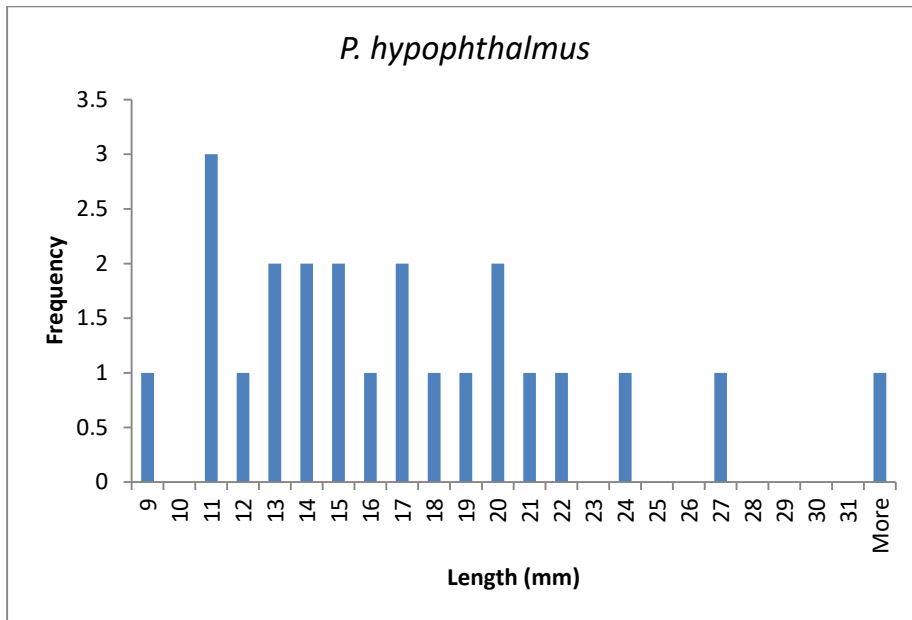


Figure 13 Length of *Pangasianodon hypophthalmus*

5.3 Length of *Barbonymus altus*

The length of *Barbonymus altus* ranged 10-11 mm that would be 12-15 days of age so this species may spawn around the Kratie province.

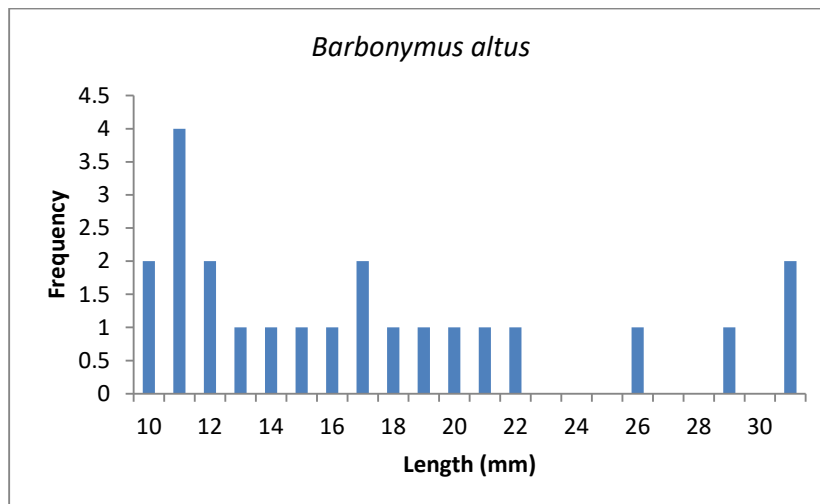


Figure 14 Length of *Barbonymus altus*

5.4 Length of *Barbonymus gonionotus*

The length frequency of *Barbonymus gonionotus* ranged 11-21 mm that would be a 27-31 days of age. This species larva could have drifted approximately 297km from sampling sites, so the spawning sites in Kraties province

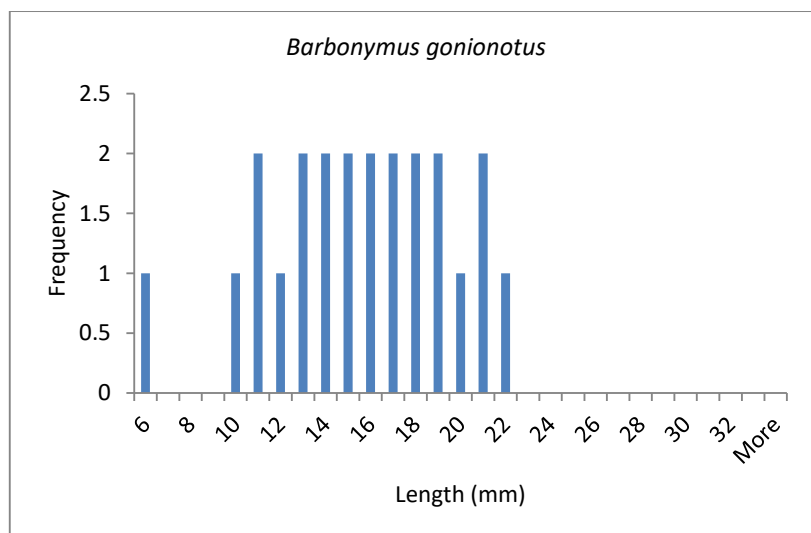


Figure 15 Length of *Barbonymus gonionotus*

5.5 Length of *Channa striata*

The length frequency of *Channa striata* ranged 31 mm

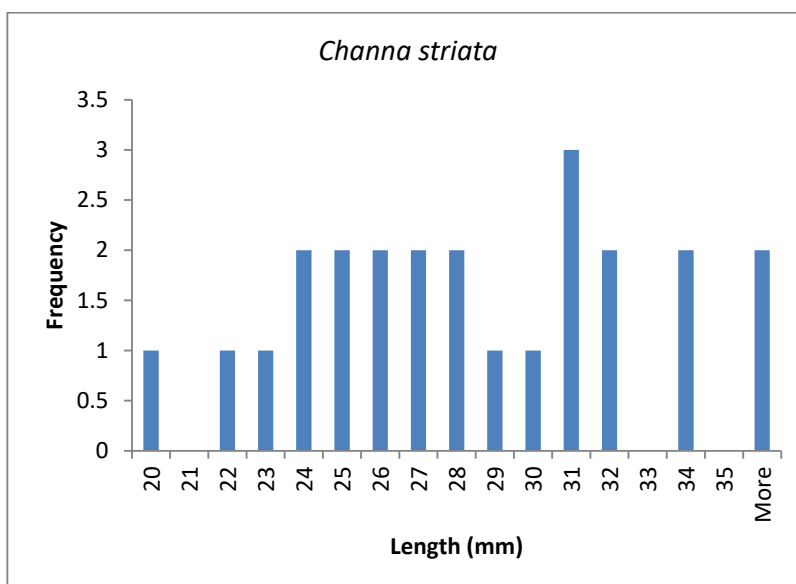


Figure 16 Length of *Channa striata*

6. Discussion

In term of larvae quantity, samples taken during the daytime was more abundant than night-time occurred in September and October 2020 in the Mekong and Tonle Sap Rivers. *Henicorhynchus spp* was the most abundant species contributed 56.24% in the Mekong and 67.38% in the Tonle Sap Rivers. Species diversity in the Mekong more divers than Tonle Sap River in term of quantity of species. The similarity between the Mekong and Tonle Sap rivers combining at 75.39% in terms of relative abundance and species

7. Conclusion

Species diversity in the Mekong more divers than Tonle Sap River in term of quantity of species. The similarity between the Mekong and Tonle Sap rivers combining at 75.39% in terms of relative abundance and species. *Henicorhynchus spp.*, follow *Pangasianodon hypophthalmus* was the most abundant species in the Mekong and Tonle Sap rivers

8. Recommendation

Yearly sampling in the Mekong and Tonle Sap rivers in Phnom Penh should be continues to monitoring. Sampling of larval fish in the Mekong of Kratie and Stung Treng provinces should carry out but daily sampling no necessary, sample 2 times per month and 5 days per time from June to September. Flow meter must clean before and after every sampling to get accurate larvae density.

9. References

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10. Appendices

Appendix 1 Species Diversity in the Mekong and Tonle Sap Rivers

Species name	Mekong	Tonle Sap
<i>Achiroides melanorhynchus</i>		1
<i>Amblyrhynchichthys truncatus</i>	1	
<i>Barbichthys nitidus</i>		15
<i>Barbonymus altus</i>	140	132
<i>Barbonymus gonionotus</i>	317	86
<i>Botia modesta</i>	1	
<i>Catlocarpio siamensis</i>	1	
<i>Channa gachua</i>		1
<i>Channa striata</i>	112	67
<i>Cirrhinus jullieni</i>		1
<i>Cirrhinus microlepis</i>	2	
<i>Clarias cataractus</i>	1	
<i>Clupeichthys aesarnensis</i>	343	27
<i>Clupeoides borneensis</i>	899	1107
<i>Coilia lindmani</i>	12	33
<i>Corica laciniata</i>	160	362
<i>Cosmochilus cardinalis</i>	2	
<i>Cosmochilus harmandi</i>	6	9
<i>Crossocheilus reticulatus</i>	1	
<i>Cyclocheilichthys enoplos</i>	2	3
<i>Cynoglossus microlepis</i>	1	
<i>Cyprinidae Mixed Thai Mkt</i>	5433	56370
<i>Danio albolineatus</i>	1	
<i>Dermogenys siamensis</i>	18	
<i>Eleotris fusca</i>	7	2
<i>Eleotris melanosoma</i>	1	
<i>Epalzeorhynchus frenatum</i>	2	
<i>Escualosa thoracata</i>	10	
<i>Gyrinocheilus pennocki</i>	1	
<i>Helicophagus waandersi</i>		21
<i>Henicorhynchus siamensis</i>	1	
<i>Henicorhynchus sp.</i>	16528	
<i>Hyporhamphus limbatus</i>	7	25
<i>Hypsibarbus lagleri</i>	1	4
<i>Hypsibarbus malcolmi</i>		13
<i>Hypsibarbus pierrei</i>		1
<i>Hypsibarbus sp.cf. vernayi</i>		4
<i>Kryptopterus kryptopterus</i>	2	
<i>Kryptopterus dissitus</i>	11	
<i>Kryptopterus micronema</i>		2

<i>Kryptopterus palembangensis</i>	2	
<i>Labeo rohita</i>		3
<i>Labiobarbus lineata</i>	1486	
<i>Lalides longibarbis</i>		1
<i>Lutjanus russellii</i>	1	
<i>Lycothrissa crocodilus</i>	12	1
<i>Micronema cheveyi</i>	1	
<i>Mystacoleucus atridorsalis</i>	3	1
<i>Mystacoleucus marginatus</i>		3
<i>Mystus albolineatus</i>		1
<i>Notopterus notopterus</i>	1	
<i>Oxyeleotris marmorata</i>		10
<i>Pangasianodon hypophthalmus</i>	1460	23022
<i>Pangasius bocourti</i>	689	14
<i>Pangasius conchophilus</i>	1	
<i>Pangasius macronema</i>	27	260
<i>Pangasius polyuranodon</i>		1
<i>Pangasius sp.</i>	1418	1338
<i>Parachela oxygastroides</i>		2
<i>Parachela siamensis</i>	1	
<i>Paralaubuca typus</i>	11	8
<i>Parambassis apogonoides</i>		3
<i>Parambassis siamensis</i>		3
<i>Parambassis wolffi</i>	22	19
<i>Polynemus melanochir</i>	2	25
<i>Pseudomystus siamensis</i>	1	
<i>Puntioplites proctozysron</i>	48	486
<i>Puntius brevis</i>		1
<i>Rasbora aurotaenia</i>	39	28
<i>Rasbora myersi</i>	12	60
<i>Rasbora tornieri</i>	35	
<i>Rhizoprionodon acutus</i>	7	
<i>Scaphognathops stejnegeri</i>		6
<i>Setipinna melanochir</i>		2
<i>Sikukia stejnegeri</i>	55	57
<i>Stolephorus indicus</i>		7
<i>Thryssocypris tonlesapensis</i>	26	8
<i>Toxotes chatareus</i>	5	
<i>Trichopsis vittata</i>	1	