
SOBA 4.3: CONSULTATIONS OF FISHERS ON FISHERY RESOURCES AND LIVELIHOODS IN THE AYEYARWADY BASIN

AYEYARWADY STATE OF THE BASIN ASSESSMENT (SOBA)

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Prepared by:

Eric Baran, Khin Myat Nwe, Tint Swe, Saw Hanshein, Phn
Keomonyneath, Ros Sokvisal, Zau Lunn, Pelle Gätke

Disclaimer

"The Ayeyarwady State of the Basin Assessment (SOBA) study is conducted within the political boundary of Myanmar, where more than 93% of the Basin is situated."

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Dr. Win Zaw, Yangon University

Dr. Naing Zaw Oo, Dagon University

Dr. Thida Ei, Yangon University

Dr. Saw Malar Than, Yangon University

Dr. Khin Thuzar Win, Yangon University

U Win Ko Ko, DoF

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LIST OF ABBREVIATIONS

DoF	Department of Fisheries
m	metres
MIMU	
SOBA	State of the Basin Assessment

EXECUTIVE SUMMARY

Given the insufficiency of fisheries studies covering the entire Ayeyarwady Basin and the absence of extensive data, fisherman consultations were undertaken throughout the basin. Questions focused on main fishery resources, exploitation patterns, livelihood, sustainability issues, and recommendations for the sector at the local level. Below we present the results of these consultations.

METHODOLOGY

The consultations were conducted in 14 districts across 5 zones. The selection of districts was based on the population density in each zone, while integrating northern zones with low population and high biodiversity.

ABUNDANCE AND ECONOMIC ROLE OF SPECIES

MOST ABUNDANT SPECIES BY ZONE

Delta: According to the fishers consulted, shrimp (either marine or freshwater) and crab (i.e., arthropods) are dominant species in the delta, particularly in the Labutta District. Marine species are dominant in Pathein. Estuarine species, such as mullets or *sciaenids*, are also dominant in catches all over the delta. Catfish and hilsa are among the top ten most abundant species in the delta.

Lower and Middle Ayeyarwady: In terms of fish abundance, Pyay belongs to the delta, and Magway seems to belong to the Middle Ayeyarwady group; the latter also includes Myitkyina in the highest abundance in the Upper Ayeyarwady. Magway, in particular, has a large abundance of species common in aquaculture systems. Catfish are present in all these districts. Catfish *Wallago attu* is a sensitive and very valuable species that is part of the top ten most abundant species in the Magway and Shwebo, indicating good fishery conditions.

Upper Ayeyarwady: Putao features dominant species that are unique. It also has endemic species (e.g., *Neolissochilus* genus) and species typical of rapid rivers (*Garra* sp.).

Chindwin: This zone features several large catfish (*Wallago*, *Bagarius*, and *Sinonia*) that are typical of healthy rivers.

Overall dominant species in catches: *Puntius chola*, *Labeo stolizkae*, *Parambassis ranga*, *Oreochromis niloticus* (tilapia), *Catla catla*, *Macrobrachium rosenbergii* (shrimp), *Mystus cavasius*, *Mystus vittatus*, *Pangasius pangasius*, *Salmostoma sardinella*, *Wallago attu*, *Osteobrama belangeri*, *Rita* sp., and *Tenulosa ilisha* (hilsa).

ECONOMICALLY DOMINANT SPECIES FOR FISHERS BY ZONE

Delta: Crab and shrimp are economically important in coastal districts. Of fish, hilsa and catfish (*Silonia silondia*, *Wallago attu*, and *Sperata* sp.) are considered the most economically important fish. Other commercially important species include mugils, threadfins, and croakers; silver pomfret (*Pampus argenteus*); and false trevally (*Lactarius lactarius*).

Lower and Middle Ayeyarwady: *Silonia silondia*, *Wallago attu*, and *Sperata* sp. remain the most important commercial species. Freshwater shrimp, *Macrobrachium rosenbergii*, are also very important to the income of fishers in this zone, followed by featherbacks (e.g., *Notopterus notopterus*).

Upper Ayeyarwady: Catfish are the most economically significant species for fishers, although species differ in the Middle or Lower Ayeyarwady. Tilapia *Oreochromis niloticus* is considered to be one of the top three

species. Species economically dominant in Putao are unique and reflect the unique biodiversity of this zone. Shrimp are not among the economically dominant species.

Chindwin: Common and valuable catfish (*Silonia silondia*, *Wallago attu*, and *Sperata sp.*) remain economically dominant. Both Myitkyina and Monywa are characterized by the significant economic role of the Sardinella razorbelly minnow *Salmostoma sardinella*.

SPECIES BECOMING RARER

Species hit: Species vanishing in the delta are valuable species, such as eel, hilsa, freshwater shrimp, and *Wallago* catfish. Shrimp as well as marine and coastal fish species (hilsa, *Polynemus sp.*, and sea bass) are vanishing despite being more resilient than freshwater species. Further up the basin, large catfish, such as *Silonia silondia*, *Sperata sp.*, and *Wallago attu* (size up to 1.8 metres [m] - 2.4 m), are among the top declining species. They are followed by smaller, commercially valuable catfish species. In the Upper Ayeyarwady, results are more site-specific.

Periods of decline: In the delta, the last decade is the most often cited as the beginning of the decline of a given species. Up to Pyay, 2012 to 2016 seem to be characterized by an accelerated decline for a number of species. No generic timing patterns appear in the other districts.

SPECIES INCREASING IN CATCHES

As opposed to the previous declining species, a few species seemed to have increased in catch. Among those are tilapia *Oreochromis niloticus*; catfish *Pangasius pangasius* (resistant to electrofishing); and catfish *Mystus leucophasis* (of low commercial interest).

MIGRATORY FISH SPECIES

Interviews with fishers led to the identification of 47 migratory fish species. A migratory species are species that need to move from one habitat in one season to another habitat in another season. Such patterns of short migration applies to snakehead *Channa striata*, mrigal carp *Cirrhinus mrigala*; climbing perch *Anabas testudineus*, and coastal mullet *Mugil cephalus*. Among species indisputably migratory are hilsa *Tenualosa ilisha*; catfish *Pangasius pangasius*, *Rita sp.*, *Silonia silondia*, *Catla catla*, and *Wallago attu*; mrigal carp *Cirrhinus mrigala*, and sea bass *Lates calcarifer*. Twenty-eight other species are identified by fishers as being migratory but only in one interview out of 14.

FISH-BASED LIVELIHOODS

FISHING AS AN OCCUPATION

According to fishers consulted in the riverine environment, the proportion of full-time fishers in the delta reaches approximately one-quarter of the population, ranging between one-tenth in Labutta and one-half in Maubin. The population of full-time fishers represents only one-tenth of the total riverine population in the Lower and in the Middle Ayeyarwady and represents approximately 1% in the Upper Ayeyarwady and in the Chindwin Basin. According to the same fishers, the proportion of part-time fishers in the delta and the Lower Ayeyarwady is approximately one-fifth of the population, with a high variability between districts. Involvement in part-time fishing is around one-tenth of the riverine population in other places of the Lower and Middle Ayeyarwady and is said to be limited in Putao and in the Chindwin sub-basin.

DEPENDENCY UPON MIGRATORY SPECIES

Every participant consulted in the Lower, Middle, and Upper Ayeyarwady as well as nearly every group in the Chindwin sub-basin state that, as fishers, they depend primarily on migratory fish species. In the delta, roughly half of the groups express their dependency on migratory species, but with high variability. Overall, migratory fish are essential to fishery livelihoods in the north and less so in the south of the basin.

DESIRABLE, SUSTAINABLE, AND ALTERNATIVE LIVELIHOODS

In the delta, all included groups agree that fishing is not a desirable livelihood. Three primary reasons for this opinion are: 1) fishing is a dangerous activity, 2) better income can be obtained elsewhere, and 3) people do not want to kill fish for religious reasons. These reasons also apply to the Chindwin sub-basin and to some extent in the Lower Ayeyarwady. The consulted fishers consider fishing to be a desirable livelihood in the Middle and Upper Ayeyarwady. In these places, fishing is still seen as a good, traditional livelihood.

“Sustainability,” understood as “long-term involvement,” is considered a characteristic of fishing by almost all groups in the delta and Lower Ayeyarwady Region because of its history as a traditional occupation or because of limited ability to invest in other jobs. Fishers in the Chindwin sub-basin and the Middle and Upper Ayeyarwady Regions suggest that fishing is not a sustainable activity because of fish decline or because they would like to invest in other opportunities.

Alternative livelihoods mentioned fall under four main categories, each with similar frequency. These include waged labor, agriculture, livestock farming, and services. Fish trade falls in a fifth category that is less often cited (specifically in the Lower Ayeyarwady). In the delta, waged labor is the livelihood option most often highly considered, followed by livestock farming (usually poultry), and services (selling food or driving a taxi). Districts of the Middle Ayeyarwady, as well as Monywa and Myitkyina, are characterized by an almost exclusive focus on agriculture that is complemented by livestock farming. The two most remote districts stand out by mentioning very limited livelihood alternatives. Taxi driving and casual labor were only mentioned in Putao, and dead wood gathering was mentioned in Kale.

AQUACULTURE

Most groups of fishers consulted (except in Putao) see aquaculture already playing a dominant role in fish supply. Fishers also recognize that the role of aquaculture in the future will be dominant or at least significant. Overall, aquaculture fish are welcome and already widely consumed because of their lower cost as compared to wild fish, chicken, and pork, and because it is seen as a better option than wild fish for religious reasons.

ISSUES IN FISHERIES AND THE ENVIRONMENT

Almost every group consulted recognizes and is concerned that fish, like shrimp and prawns, are decreasing in abundance. Destruction of aquatic habitats and reduced fish reproduction rates were raised as critical issues. Electrofishing is the fourth most commonly mentioned issue, followed by fish poisoning (from agriculture or intentionally), gold mining, and organizational or land sharing issues in leasable fisheries.

Fishers recognize that overfishing, destructive fishing (electrofishing and fishing using pesticides), and fishing during spawning seasons are main causes of fish species decline. The causes of aquatic habitat destruction include deforestation, erosion, gold and sand mining, extension of farms into floodplains, and clearing of natural vegetation that normally benefit fish in floodplains and wetlands. Electrofishing and the use of pesticides also give rise to reduced fish reproduction rates, as does restrictions by farmers to leasable

fisheries in floodplains. Other causes include the demand for multiple uses of floodplains (fishing vs. farming) and rivers (fishing vs. mining) as well as some organizational aspects (timing in water management and licensing).

The included fishers listed four primary solutions to help solve the above issues:

- Improve law enforcement – There are already sufficient provisions for better management, but law enforcement is a problem in many cases (i.e., offshore vessels fishing inshore, unlimited destructive fishing, destruction of habitats). Better law enforcement is the most recurrent recommendation with more action from the Department of Fisheries (DoF).
- Limit pollution – Either by imposing restrictions (on the use of pesticide and on the release of pollutants) or by improving environmental awareness and education.
- Restrict destructive practices – Practices such as sand mining, waste dumping in rivers and floodplains, and the use of harmful pesticide, need to be restricted by upgrading and improving current laws and regulations.
- Improved organizational coordination between parties – either between fishers and the DoF to manage leasable fisheries or between fishers and farmers to reach compromises about land and water uses.

At the local level, some recommendations are more specific, including:

- Delta – Impose an effective ban on electrofishing, pesticide use as a poison, and cage farming in forested areas. Focus on mangrove reforestation.
- Lower Ayeyarwady – Impose an effective ban on electrofishing, pesticides use as a poison, and sand or gold extraction from rivers.
- Middle Ayeyarwady – Impose an effective ban on fishing during the breeding season (April to June). Allow for 3-year leases for more sustainable management of leasable fisheries as well as facilitated negotiation and compromise between farmers and fishers.
- Upper Ayeyarwady – Impose an effective ban on electrofishing and illegal fishing.
- Chindwin – Impose an effective ban on electrofishing and the use of poison. Focus on reforestation.

1 INTRODUCTION

Given the paucity of fisheries studies covering the whole Ayeyarwady Basin and in absence of extensive data, consultations of fishermen were undertaken throughout the basin as part of the State of the Basin Assessment (SOBA) project. Questions focused on main fishery resources, exploitation patterns, livelihood aspects, sustainability issues, and recommendations in the sector at the local level. In this document, we present the results of these consultations, while underlining that they reflect the perception of these stakeholders, rather than scientifically established facts and quantified figures. However, such consultations have proven an effective way to get a broad brush picture of a given resource, situation, or sector (Johannes, 1991 and 1993), especially in the case of:

- Fish species ecology and fisheries (Moller et al., 2004; Baird, 2006)
- Livelihoods (Bernard, 2000; Folke, 2004; Schirmer and Casey, 2005)
- Natural resources management (Baird and Overton, 2001; Dubois, 2005; Silvano and Begossi, 2012)

Stakeholder consultations in natural resources assessments and management are particularly relevant in the case of time-constrained or budget-limited assessments. Comparative studies have shown that they obtain large amounts of reliable information rapidly and at a minimal cost (Poizat and Baran, 1997; Ticheler et al., 1998; Garrison et al., 2006).

Last, gathering opinions about issues or proposed solutions also reflects social drivers and dynamics among stakeholders. These dominant perceptions, justified or not, drive people to make certain decisions that will affect the resource. They are, therefore, particularly relevant to the managers of that resource.

The conclusions of the present report will serve as inputs to the wider analysis of the *Ayeyarwady State of the Basin Assessment* chapter on Biodiversity and Fisheries. A companion report, *Consultations on Wildlife Resources and Livelihoods in the Ayeyarwady River Basin*, is more focussed on livelihood aspects and wildlife resources and complements the present analysis.

2 METHODOLOGY

The consultations were conducted in 14 districts across 5 zones. The selection of districts was based on the population density in each zone, while integrating northern zones with low population but high biodiversity (Figure 1). The selection resulted in the districts listed in Table 1.

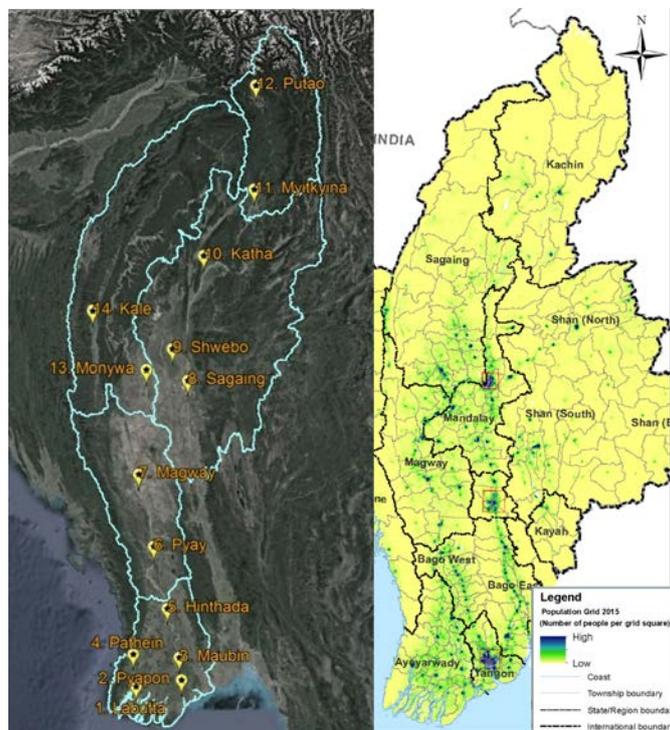


Figure 1 – Map of the 14 districts consulted within the 5 zones of the Ayeyarwady River Basin (left) and of the population distribution (right) MIMU 2015 map based on 2014 census data

Table 1 - Zones and districts surveyed

AYEYARWADY DELTA	LOWER AYEYARWADY	MIDDLE AYEYARWADY	CHINDWIN	UPPER AYEYARWADY
Maubin	Pyay	Sagaing	Monywa	Myitkyina
Pyapon	Magway	Shwebo	Kale	Putao
Patheingyi		Katha		
Labutta				
Hinthada				

The consultation was based on a protocol of local knowledge gathering already well established at the Department of Fisheries (DoF) (Baran et al., 2015b; Win Ko Ko et al., 2016). In each district, 5 to 6 experienced fishermen with at least 10 years of experience in the area were invited to DoF, and a standardized semi-open questionnaire was used. The prepared questionnaires were tested during a field trip to the Maubin District in the Ayeyarwady Delta. This testing allowed the field surveyors to familiarize themselves with the questions and to learn how the questions were perceived by the respondents. Following the field-testing, minor amendments were made to the questionnaires (see the final version in Annex I).

The results from the 14 interviews were entered directly in Excel spreadsheets and then reviewed by the surveyors for final validation. Results of the analysis are detailed below.

3 ABUNDANCE AND ECONOMIC ROLE OF SPECIES

3.1 Most Abundant Species by Zone

QUESTION #1: WHAT ARE THE 10 MOST ABUNDANT FISH SPECIES (RANKING) IN EACH ZONE?

Delta: According to fishers consulted, there is a dominance of shrimps (either marine or freshwater) and crabs (i.e., arthropods) species in catches in the delta, especially in the Labutta District. Marine species are dominant in catches in Pathein, a large commercially active city and a district with a long coastline. However, the abundance of arthropods and marine species in catches may largely reflect the landings of the marine fishery rather than local catches. Estuarine species, such as mullets or croakers, are also dominant in catches all over the delta, as expected. Catfish, belonging to different families, are part of all top ten species all over the delta too. Hilsa is part of the top 10 species all over the delta, although surprisingly not in Labutta.

Lower Ayeyarwady: There is a difference in most abundant catches between Pyay, in the south, and Magway, in the north. This difference may indicate a certain continuity between Hinthada, at the tip of the delta, and Pyay, but a discontinuity between Pyay and Magway. From a fish abundance perspective, Magway seems to belong to the Middle Ayeyarwady group.

Middle Ayeyarwady: This group of districts (including Myitkyina in the Upper Ayeyarwady) is characterized by the presence of tilapia (*Oreochromis niloticus*) among the six most abundant species. Magway has a large abundance of species present in its aquaculture systems. Catfish are present in all these districts. It is interesting to note that the catfish, *Wallago attu*, a sensitive and valuable species, is part of the top ten in both Magway and Shwebo, indicating good fishery conditions.

Upper Ayeyarwady: The Myitkyina and Putao Districts are clearly different in terms of their dominant species, with fish abundance patterns in Myitkyina putting this district in the Middle Ayeyarwady group. Putao features dominant species that are unique, and include in particular endemic species (e.g., *Neolissochilus* genus), and species typical of rapid rivers (*Garra* sp.).

Chindwin: This zone features several large catfish (*Wallago*, *Bagarius*, and *Silonia*) that are typical of healthy rivers.

Overall dominant species in catches: Table 2 details the fish repeatedly ranked among the top ten most abundant species, according to interviews of fishers conducted in the 14 districts surveyed all over the basin (the list is limited to species mentioned at least three times in the 14 top ten abundant species lists).

Table 2 – Most abundant species in the 14 districts surveyed as indicated by fishers during interviews

Species	Number of Occurrences Among Top Ten Species in 14 Districts	Family	Common Name
<i>Puntius chola</i>	7	Cyprinidae	Green barb, swamp barb, Nga-nyanma
<i>Labeo stolizkae</i>	6	Cyprinidae	Labeo
<i>Parambassis ranga</i>	6	Ambassidae	Glass perchlet
<i>Oreochromis niloticus</i>	5	Cichlidae	Tilapia
<i>Catla catla</i>	4	Cyprinidae	Now called <i>Gibelion catla</i> ; Nga gaung pwa/Nga-thaing
<i>Macrobrachium rosenbergii</i>	4	Freshwater shrimp	Freshwater shrimp
<i>Mystus cavasius</i>	4	Bagridae	Mystus catfish; Nga-zin-yaing
<i>Mystus vittatus</i>	4	Bagridae	Mystus catfish; Nga-zin-yaing-kyet-chay
<i>Pangasius pangasius</i>	4	Pangasiidae	Panga catfish
<i>Salmostoma sardinella</i>	4	Cyprinidae	Sardinella razorbelly minnow
<i>Wallago attu</i>	4	Siluridae	Wallago catfish; Nga-bat
<i>Osteobrama belangeri</i>	3	Cyprinidae	Manipur osteobrama
<i>Rita sp.</i>	3	Bagridae	Rita catfish
<i>Tenualosa ilisha</i>	3	Clupeidae	Hilsa; Nga-tha-lauk

Table 3 – Ten most abundant species (ranking) in the 14 districts surveyed

Region:	Delta	Delta	Delta	Delta	Delta
District:	Labutta	Pyapon	Maubin	Pathein	Hinthada
Site number	1	2	3	4	5
1	<i>Mystus vittatus</i>	<i>Macrobrachium rosenbergii</i>	<i>Otolithoides pama</i>	<i>Taenioides buchani</i>	<i>Pachypterus atherinoides</i>
2	<i>Scylla serrate</i>	<i>Mystus cavasius</i>	<i>Polynemus paradiseus</i>	<i>Cynoglossus lingua</i>	<i>Puntius chola</i>
3	<i>Coilia dussumieri</i>	<i>Chelon planiceps</i>	<i>Tenulosa ilisha</i>	<i>Penaeus merguensis</i>	<i>Rhinomugil corsula</i>
4	<i>Mugil cephalus</i>	<i>Sciaena coitor</i>	<i>Pangasius pangasius</i>	<i>Mystus vittatus</i>	<i>Rasbora daniconius</i>
5	Shrimp sp;	<i>Otolithoides pama</i>	<i>Macrobrachium rosenbergii</i>	<i>Catla catla</i>	<i>Parambassis ranga</i>
6	<i>Penaeus monodon</i>	<i>Scylla serrata</i>	<i>Rita sp.</i>	<i>Amblygaster clupeoides</i>	<i>Rita sp.</i>
7	<i>Macrobrachium rosenbergii</i>	<i>Mugil cephalus</i>	<i>Puntius chola</i>	<i>Stolephorus indicus</i>	<i>Pangasius pangasius</i>
8	<i>Clarias sp.</i>	<i>Lates calcarifer</i>	<i>Mystus vittatus</i>	<i>Epinephelus awoara</i>	<i>Labeo rohita</i>
9	<i>Lates calcarifer</i>	<i>Tenulosa ilisha</i>	<i>Osteobrama belangeri</i>	<i>Thunnus tonggol</i>	<i>Catla catla</i>
10	<i>Penaeus indicus</i>	x	<i>Channa punctata</i>	<i>Tenulosa ilisha</i>	<i>Macrobrachium rosenbergii</i>

Region:	Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
District:	Pyay	Magway	Sagaing	Shwebo	Katha
Site #	6	7	8	9	10
1	<i>Pangasius pangasius</i>	<i>Parambassis ranga</i>	<i>Labeo nandina</i>	<i>Parambassis ranga</i>	<i>Osteobrama cunma</i>
2	<i>Rita sp.</i>	<i>Puntius chola</i>	<i>Oreochromis niloticus</i>	<i>Labeo stoliczkae</i>	<i>Labeo stoliczkae</i>
3	<i>Gagata gagata</i>	<i>Salmostoma sardinella</i>	<i>Parambassis ranga</i>	<i>Chela sp:</i>	<i>Osteobrama belangeri</i>
4	<i>Salmostoma sardinella</i>	<i>Labeo stoliczkae</i>	<i>Gudusia variegata</i>	<i>Oreochromis niloticus</i>	<i>Oreochromis niloticus</i>
5	<i>Eutropiichthys vacha</i>	<i>Mystus cavasius</i>	<i>Mystus leucophasis</i>	<i>Puntius chola</i>	<i>Puntius chola</i>
6	<i>Silonia sp.</i>	<i>Oreochromis niloticus</i>	x	<i>Mystus vittatus</i>	<i>Parambassis ranga</i>
7	<i>Labeo stoliczkae</i>	<i>Labeo rohita</i>	x	<i>Wallago attu</i>	<i>Mystus vittatus</i>
8	<i>Labeo calbasu</i>	<i>Catla catla</i>	x	<i>Macragnathus zebrinus</i>	<i>Labeo calbasu</i>
9	<i>Mystus cavasius</i>	<i>Cirrhinus mrigala</i>	x	<i>Mystus leucophasis</i>	<i>Notopterus notopterus</i>
10	<i>Ompok pabo</i>	<i>Wallago attu</i>	x		<i>Channa striata</i>

Region:	Upper Ayeyarwady Region	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myitkyina	Putao	Monywa	Kale
Site #	11	12	13	14
1	<i>Labeo sp.</i>	<i>Chela laubuca</i>	<i>Labeo stoliczkae</i>	<i>Puntius chola</i>
2	<i>Salmostoma sardinella</i>	<i>Neolissochilus compressus</i>	<i>Cirrhinus mrigala</i>	<i>Osteobrama belangeri</i>
3	<i>Oreochromis niloticus</i>	<i>Neolissochilus sp. Putao</i>	<i>Wallago attu</i>	<i>Mystus vittatus</i>
4	<i>Puntius sp.</i>	<i>Semiplotus cirrhosus</i>	<i>Catla catla</i>	<i>Labeo stoliczkae</i>
5	<i>Mystus sp.</i>	<i>Garra nasuta</i>	<i>Pangasius pangasius</i>	<i>Silonia silondia</i>
6	<i>Ompok sp.</i>	<i>Garra notata</i>	<i>Mystus cavasius</i>	<i>Macrogathus zebrinus</i>
7	<i>Clupisoma sp.</i>	<i>Tor tambroides</i>	<i>Salmostoma sardinella</i>	<i>Sperator aor</i>
8		<i>Eutropiichthys burmannicus</i>	<i>Penaeus monodon</i>	<i>Wallago attu</i>
9	<i>Mastacembelus sp.</i>	<i>Raiamas quttatus</i>	<i>Parambasis ranga</i>	<i>Bagarius yarrelli</i>
10	<i>Tor sp.</i>	<i>Tor sp. Putao</i>	<i>Glossogobius giuris</i>	<i>Mystus gulio</i>

3.2 Economically Dominant Species for Fishers by Zone

QUESTION #2: WHAT ARE THE 10 FISH SPECIES CONTRIBUTING MOST TO THE INCOME OF FISHERS IN EACH ZONE?

Delta: Crabs and shrimps are economically dominant in Labutta and remain important in other coastal districts. Among fish, hilsa and catfish (*Silonia silondia*, *Wallago attu*, and *Sperata sp.*) are considered the most economically important fish. Other commercially important species include, mugils, threadfins, and croakers, which are common estuarine species. Some species stand out for their economic importance although they are not among the most abundant ones, such as silver pomfret, *Pampus argenteus*, and false trevally, *Lactarius lactarius*.

Lower Ayeyarwady: In this part of the river, the catfish already mentioned in the delta (*Silonia silondia*, *Wallago attu*, and *Sperata sp.*) are the most important commercial species. Freshwater shrimp, *Macrobrachium rosenbergii*, remain important to the income of fishers in this zone. Other species of economic importance are featherbacks (e.g., *Notopterus notopterus*) and some mid-size Cyprinids (Cirrhinus, Labeo). Pyay is the last place where hilsa remains economically dominant.

Middle Ayeyarwady: The patterns are roughly similar to that of the Lower Ayeyarwady.

Upper Ayeyarwady: Shrimp are not the dominant species any more. In Myitkyina, catfish are the most economically significant species to fishers, although the species involved are not the same as in the Middle or Lower Ayeyarwady. Tilapia *Oreochromis niloticus* is, surprisingly, considered one of the top-three species. The specific and endemic fauna at Putao highlighted in the section on most abundant species is also reflected in the list of species economically most important to fishers, as the two lists closely match.

Chindwin: The common and valuable catfish *Silonia silondia*, *Wallago attu*, and *Sperata sp.*, remain economically dominant in the Chindwin Sub-Basin. Other catfish, such as *Mystus*, play a dominant role in Kale. Both Myitkyina and Monywa are characterized by the significant economic role of the Sardinella razorbelly minnow *Salmostoma sardinella*.

Table 4 – Ten fish species contributing most to the income of fishers in 14 districts surveyed

Region:	Delta	Delta	Delta	Delta	Delta
District:	Labutta	Pyapon	Maubin	Pathein	Hinthada
Site #	1	2	3	4	5
1	<i>Scylla serrata</i>	<i>Macrobrachium rosenbergii</i>	<i>Silonia silondia</i>	<i>Tenualosa ilisha</i>	<i>Macrobrachium rosenbergii</i>
2	<i>Penaeus monodon</i>	<i>Tenualosa ilisha</i>	<i>Sperata seenghala</i>	<i>Lates calcarifer</i>	<i>Wallago attu</i>
3	<i>Macrobrachium rosenbergii</i>	<i>Lates calcarifer</i>	<i>Wallago attu</i>	<i>Silonia silondia</i>	<i>Sperator aor</i>
4	<i>Mystus vittatus</i>	<i>Penaeus monodon</i>	<i>Tenualosa ilisha</i>	<i>Wallago attu</i>	<i>Tenualosa ilisha</i>
5	<i>Tenualosa ilisha</i>	<i>Scylla serrata</i>	<i>Pangasius pangasius</i>	<i>Penaeus indicus</i>	<i>Notopterus notopterus</i>
6	<i>Mugil cephalus</i>	<i>Mugil cephalus</i>	<i>Macrobrachium rosenbergii</i>	<i>Macrobrachium rosenbergii</i>	<i>Ompok pabo</i>
7	<i>Coilia dussumieri</i>	<i>Mystus cavasius</i>	<i>Polynemus paradiseus</i>	<i>Pampus argenteus</i>	<i>Catla catla</i>
8	<i>Lates calcarifer</i>	<i>Otolithoides pama</i>	<i>Cirrhinus mrigala</i>	<i>Lactarius lactarius</i>	<i>Labeo rohita</i>
9	<i>Penaeus indicus</i>	<i>Sciaena coitor</i>	<i>Otolithoides pama</i>	<i>Scomberomorus gattatus</i>	<i>Cirrhinus mrigala</i>
10	<i>Polynemus indicus</i>	x	<i>Rita sp.</i>	<i>Penaeus merguinesis</i>	<i>Coilia macrognathos</i>

Region:	Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
District:	Pyay	Magway	Sagaing	Shwebo	Katha
Site #	6	7	8	9	10
1	<i>Sperator aor</i>	<i>Macrobrachium rosenbergii</i>	<i>Macrobrachium rosenbergii</i>	<i>Sperator aor</i>	<i>Labeo stolizkae</i>
2	<i>Wallago attu</i>	<i>Sperator aor</i>	<i>Shrimps</i>	<i>Macrobrachium rosenbergii</i>	<i>Wallago attu</i>
3	<i>Silonia silondia</i>	<i>Silonia silondia</i>	<i>Wallago attu</i>	<i>Silonia silondia</i>	<i>Osteobrama belangeri</i>
4	<i>Tenualosa ilisha</i>	<i>Wallago attu</i>	<i>Channa striata</i>	<i>Wallago attu</i>	<i>Sperator aor</i>
5	<i>Macrobrachium rosenbergii</i>	<i>Notopterus notopterus</i>	<i>Sperator aor</i>	x	<i>Channa striata</i>
6	<i>Ompok pabo</i>	x	<i>Cirrhinus mrigala</i>	x	<i>Notopterus notopterus</i>
7	<i>Mystus cavasius</i>	x	<i>Labeo stolizkae</i>	x	<i>Catla catla</i>
8	<i>Cirrhinus mrigala</i>	x	<i>Labeo calbasu</i>	x	<i>Puntius chola</i>
9	<i>Eutropiichthys vacha</i>	x	<i>Osteobrama alfredianus</i>	x	x
10	<i>Mystus gulio</i>	x	<i>Hemibagrus microphthalmus</i>	x	x

Region:	Upper Ayeyarwady Region	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myitkyina	Putao	Monywa	Kale
Site #	11	12	13	14
1	<i>Labeo sp.</i>	<i>Semiplotus cirrhosus</i>	<i>Labeo stolizkae</i>	<i>Wallago attu</i>
2	<i>Ompok sp.</i>	<i>Garra notata</i>	<i>Wallago attu</i>	<i>Silonia silondia</i>
3	<i>Oreochromis niloticus</i>	<i>Garra nasuta</i>	<i>Silonia silondia</i>	<i>Sperator aor</i>
4	<i>Mystus sp.</i>	<i>Chela laubuca</i>	<i>Cirrhinus mrigala</i>	<i>Osteobrama belangeri</i>
5	<i>Clupisoma sp.</i>	<i>Neolissochilus sp. Putao</i>	<i>Salmostoma sardinella</i>	<i>Macragnathus zebrinus</i>
6	<i>Mastacembelus sp.</i>	<i>Neolissochilus compressus</i>	x	<i>Mystus cavasius</i>
7	x	<i>Eutropiichthys burmannicus</i>	<i>Shrimp</i>	<i>Bagarius yarrelli</i>
8	<i>Salmostoma sardinella</i>	<i>Tor tambroides</i>	<i>Glossogobius giuris</i>	<i>Mystus gulio</i>
9	<i>Puntius sp.</i>	<i>Raiamas quttatus</i>	x	<i>Puntius chola</i>
10		<i>Tor sp. Putao</i>	x	<i>Mystus vittatus</i>

4 SPECIES BECOMING RARE IN CATCHES

QUESTION #3: WHAT ARE THE FISH SPECIES THAT HAVE BECOME RARE IN CATCHES IN EACH ZONE? PERIOD AND REASONS OF THEIR RAREFACTION?

Species hit: According to fishers surveyed, most species vanishing in catches in the delta are valuable species, such as eel, hilsa, freshwater shrimp, and *Wallago* catfish. It is worrying to see that shrimps and also marine and coastal species (i.e., hilsa, *Polynemus sp.*, and barramundi) are vanishing, since these species are usually more resilient than freshwater fish species. Further up in the basin, large catfish *Silonia silondia*, *Sperata sp.*, and *Wallago attu* (size up to 1.8 metres [m] - 2.4 m), are repeatedly mentioned among the top declining species. They are followed by other smaller but commercially valuable species, such as the catfish *Bagarius yarrelli*, *Heteropneustes fossilis*, *Clarias sp.*, and *Rita sp.* The Upper Ayeyarwady is characterized by a decline in more site-specific species, particularly medium cyprinids (*Cirrhinus cirrhosus*, *Osteobrama belangeri*, *Labeo dyocheilus*, and *Bangana devdevi*) and endemic species (*Eutropiichthys burmannicus*, *Garra notate*, *Garra nasuta*, and *Semiplotus cirrhosus*), particularly in Putao.

Periods of rarefaction: In the delta, the rarefaction of most species is considered to have started within the last decade, with 2007 standing out as the year most often cited, by far, as corresponding to the beginning of the decline of a given species. Many interviews underline the fact that rarefaction is due to mortality particularly during spawning seasons, which calls for a better control of fishing during certain periods of time. Up to Pyay, the last 5 years in particular (2012 to 2016) seem to be characterized by accelerated rarefaction for a number of species. Rarefaction of some species seems to have started more generically around 2004 in Sagaing and 2010 in Myitkyina. No generic timing pattern appears in the other districts. They seem to be more species-specific.

Causes of rarefaction: All over the basin, poisoning and electrofishing, two destructive and forbidden methods, are repeatedly identified as the main reasons explaining the decline of species. In coastal zones, overfishing and destruction of coastal habitats (mangroves) is also indicated as causes. Among the site-specific causes of rarefaction are illegal beach seine nets in Pyapon and Maubin, water pollution around Magway and Myitkyina, and sand mining in Monywa.

Table 5 – Top ten species getting rare in catches, beginning of their rarefaction period, and explanations given for rarefaction in the 14 districts surveyed

Delta Labutta			Delta Pyapon			Delta Maubin		
1			2			3		
<i>Tenualosa ilisha</i>	2008	Overfishing in marine areas (cannot move upstream in spawning season)	<i>Sciaena coitor</i>	2014	Poison with pesticide from the paddy fields	<i>Silonia silondia</i>	2007	Electrofishing
<i>Anguilla sp.</i>		Electrofishing and using pesticide as a poison	<i>Lates calcarifer</i>	2012		<i>Sperata sp.</i>	2010	
<i>Macrobrachium rosenbergii</i>			Electrofishing, using pesticide as a poison, overfishing in marine areas, and shrimp cage culture in forest areas (habitats were destroyed and juvenile fish were destroyed during shrimp harvesting time).	<i>Polynemus paradiseus</i>	1997	Overfishing with surrounding beach nets along the river		
<i>Lates calcarifer</i>		2007		<i>Tenualosa ilisha</i>	2012	Catching with pesticide as a poison	<i>Lepidocephalus bermorei</i>	2007
<i>Polynemus indicus</i>	2008	<i>Macrobrachium rosenbergii</i>	2014	<i>Macrobrachium rosenbergii</i>	2007		Pesticide used as poison	
<i>Otolithes pama</i>			x	x	x	<i>Tenualosa ilisha</i>	2010	Illegal beach seine nets
x	x	x	x	x	x	<i>Clarias sp.</i>	2012	Overfishing and poisoning with pesticide from paddy fields

Delta		
Pathein		
4		
<i>Lates calcarifer</i>	2007	Water pollution (plastic bag and waste from industry), electrofishing, using pesticide as a poison, overfishing in marine areas (cannot move upstream in spawning season)
<i>Sperator aor</i>		
<i>Tenualosa ilisha</i>		
<i>Silonia silondia</i>		
<i>Macrobrachium rosenbergii</i>	2012	Catching fish with pesticide as a poison.
x	x	x
x	x	x

Delta		
Hinthada		
5		
<i>Silonia silondia</i>	2014	Electrofishing and using pesticide as a poison, especially in spawning season
<i>Wallago attu</i>		
<i>Sperator aor</i>	2012	Electrofishing and using pesticide as a poison, especially in spawning season
<i>Pangasius pangasius</i>		
<i>Clarias sp.</i>		
<i>Heteropneustes fossilis</i>	2002	
<i>Tenualosa ilisha</i>	2007	Overfishing along the river.

Lower Ayeyarwady		
Pyay		
6		
<i>Sperator aor</i>	2014	Electrofishing, using pesticide as a poison, and water pollution
<i>Wallago attu</i>	2015	
<i>Tenualosa ilisha</i>	2005	Overfishing in river, especially in spawning season.
<i>Silonia silondia</i>	2012	Electrofishing
<i>Eutropiichthys vacha</i>	2015	
<i>Salmostoma sardinella</i>	2014	
<i>Cirrhinus mrigala</i>		

Lower Ayeyarwady			Middle Ayeyarwady			Middle Ayeyarwady				
Magway			Sagaing			Shwebo				
7			8			9				
<i>Tenulosa ilisha</i>	2009	Water pollution and electrofishing	<i>Sperator aor</i>	2004	Electrofishing	<i>Sperator aor</i>	2007	Electrofishing		
<i>Mystus leucophasis</i>	2011		<i>Hemibagrus microphthalmus</i>			<i>Labeo stolizkae</i>				
<i>Nemapteryx caelatus</i>	2012	Electrofishing	<i>Labeo calbasu</i>			<i>Wallago attu</i>				
<i>Channa striata</i>			<i>Cirrhinus mrigala</i>			<i>Silonia silondia</i>	2000			
<i>Otolithes pama</i>	2000	Spawning areas (bush) were destroyed by farmer to extend their farm areas.	<i>Labeo stolizkae</i>				<i>Mystus vittatus</i>		2012	
<i>Salmostoma sardinella</i>	1987	Electrofishing, especially in spawning season; habitats near leasable areas were destroyed; and water pollution.	<i>Silonia silondia</i>				<i>Macrobrachium rosenbergii</i>		2010	Catching with pesticide as a poison.
<i>Glossogobius giuris</i>	2012	Fish breeding in the lease area were connected with paddy fields that were destroyed by the farmers when they burned the bush near the lease and used pesticides in the paddy fields.	<i>Macrobrachium rosenbergii</i>		Catching with pesticide as a poison.	<i>Heteropneustes fossilis</i>	2014	Poison with pesticide from paddy field.		

Middle Ayeyarwady			Upper Ayeyarwady			Upper Ayeyarwady		
Katha			Myitkyina			Putao		
10			11			12		
<i>Mystus leucophasis</i>	2012	Electrofishing and using pesticide as a poison	<i>Wallago attu</i>	2010	Electrofishing, poisonous fishing, agricultural pesticide, and tissue banana plantation that uses a lot of pesticides.	<i>Tor sp. Putao</i>	2005	Electrofishing
<i>Bagarius yarrelli</i>	2007	Electrofishing and using pesticide as a poison, especially in spawning season.	<i>Cyprinus carpio</i>					
<i>Heteropneustes fossilis</i>			<i>Cirrhinus cirrhosus</i>					
<i>Clarias sp.</i>			<i>Osteobrama belangeri</i>					
<i>Xenentodon cancella</i>	2011		<i>Labeo dyocheilus</i>					
<i>Catla catla</i>	2007	Become shallow water depth and migrate to Ba Maw.	<i>Bangana dedevi</i>					
<i>Rita sp.</i>			<i>Labeo sp.</i>					
						<i>Eutropiichthys burmannicus</i>	2006	
						<i>Garra notata</i>	2014	
						<i>Garra nasuta</i>		
						<i>Semiplotus cirrhosus</i>		
						<i>Tor tambroides</i>		
						<i>Neolissochilus compressus</i>	2015	

Chindwin		
Monywa		
13		
<i>Lepidocephalus berdmorei</i>	1994	Using pesticide as a poison
<i>Bangana dedevi</i>	2000	Overfishing, especially in spawning season
<i>Gudusia variegata</i>		
<i>Tenuulosa ilisha</i>	2005	Electrofishing and habitats destroyed by digging for sand in river
<i>Sperator aor</i>	2007	
<i>Rita sp.</i>		
<i>Hemibagrus microphthalmus</i>		

Chindwin		
Kale		
14		
<i>Lates calcarifer</i>	2007	Electrofishing and using pesticide as a poison
<i>Nemapteryx caelatus</i>	2010	
<i>Channa marulius</i>		
<i>Osteobrama belangeri</i>	2013	Electrofishing
<i>Cirrhinus mrigala</i>	2012	
<i>Lepidocephalus berdmorei</i>	2000	Electrofishing and using pesticide in paddy fields
<i>Rasbora rasbora</i>	2014	

5 SPECIES INCREASING IN CATCHES

Question #4: What are the fish species whose catch has increased in each zone? Reasons?

As opposed to the previous declining species, a few species catches have increased, including:

- *Oreochromis niloticus* – Because these fish have a high reproduction rate, are resistant to electrofishing, and escape from aquaculture ponds into natural water bodies in the rainy season.
- *Pangasius pangasius* – Because of resistance to electrofishing.
- *Mystus leucophasis* – Because of resistance to electrofishing and because no one consumes that “trash fish.”

The case of Putao is unclear and possibly linked to increasing fishing pressure on an untapped stock.

Table 6– Species whose catch increased in the 14 districts surveyed and reasons given for the increase

Delta Patheingyi		Lower Ayeyarwady Magway		Middle Ayeyarwady Sagaing		Middle Ayeyarwady Shwebo	
4		7		8		9	
<i>Sardinella</i> sp:	Most people do not like this fish. Used in feed (chicken and pig)	<i>Oreochromis niloticus</i>	High reproduction rate and resistance to electrofishing	<i>Mystus leucophasis</i>	Cannot sell to the market. Most people do not like this fish.	<i>Mystus leucophasis</i>	No one consumes this fish.
x		<i>Mystus leucophasis</i>	Resistance to electrofishing and no one eats this fish	x		x	
		x					

Upper Ayeyarwady Myittha	
11	

Upper Ayeyarwady Putao	
12	
<i>Chela laubuca</i>	Because these are common indigenous fish species and local people do not use illegal fishing, such as electrofishing or dynamite fishing
<i>Neolissochilus compressus</i>	
<i>Neolissochilus</i> sp. Putao	

Chindwin Monywa	
13	
<i>Pangasius pangasius</i>	Resistance to electrofishing

6 MIGRATIONS AMONG FISH SPECIES

Question #5: What are the migratory fish in each zone? In which months do the fish migrate upstream and downstream?

Interviews of fishers in 14 districts led to the identification of 47 migratory fish species. However, these data should be carefully interpreted, because “being migratory” does not imply that the species undertake long distance migrations. Instead, migratory means that the fish needs to move from one habitat in one season to another habitat in another season (strict definition of fish migrations). Thus, snakehead *Channa striata* is identified several times as a migratory species, although this species clearly belongs to the “black fish” guild and only undertakes short distance movements between floodplains in the wet season and ponds in the dry season. The same pattern of short movements, often in search of breeding habitats, also applies to Mrigal carp *Cirrhinus mrigala* climbing perch *Anabas testudineus*; and coastal mullet *Mugil cephalus*. These species are also identified as migratory by fishers in our surveys, which leads to considering their responses with caution.

Among the species most often identified as migratory in the present interviews, in agreement with the scientific literature, include *Pangasius pangasius*, *Tenuulosa ilisha*, *Rita sp.*, *Silonia silondia*, *Catla catla*, *Cirrhinus mrigala*, *Lates calcarifer*, and *Wallago attu* (see details in Table 6).

Twenty-eight other species are identified by fishers as being migratory but only in one interview out of 14, and with the above words of caution. These species include *Amblygaster clupeioides*, *Anguilla sp.*, *Atule mate*, *Bangana devdevi*, *Clarias sp.*, *Coilia macrognathos*, *Corvina miles*, *Cynoglossus lingua*, *Eutropiichthys burmannicus*, *Eutropiichthys vacha*, *Garra nasuta*, *Garra notate*, *Hemibagrus microphthalmus*, *Heteropneustes fossilis*, *Labeo calbasu*, *Labeo rohita*, *Mastacembelus armatus*, *Macrognathus zebrinus*, *Mystus cavasius*, *Mystus gulio*, *Mystus leucophasis*, *Notopterus notopterus*, *Otolithoides pama*, *Parambasis ranga*, *Polynemus indicus*, *Semiplotus cirrhosus*, *Sperator aor*, and *Xenentodon cancila*.

The details of upstream and downstream migrations and their timing are given in Annex I.

Table 7 – Species most often cited as migratory and their frequency in the 14 surveys

Species	Number of mentions in 14 interviews	Note
<i>Pangasius pangasius</i>	7	Recognized migratory species
<i>Tenualosa ilisha</i>	6	Recognized migratory species
<i>Rita sp.</i>	5	Recognized migratory species
<i>Silonia silondia</i>	4	Recognized migratory species
<i>Catla catla</i>	3	Recognized migratory species
<i>Channa striata</i>	3	Usually not considered a migratory species
<i>Cirrhinus mrigala</i>	3	Recognized migratory species
<i>Lates calcarifer</i>	3	Recognized migratory species
<i>Labeo stolizkae</i>	3	Local migrations only
<i>Salmostoma sardinella</i>	3	Migrations not known
<i>Wallago attu</i>	3	Recognized migratory species
<i>Anabas testudineus</i>	2	Usually not considered a migratory species
<i>Macrobrachium rosenbergii</i>	2	Freshwater prawn
<i>Mugil cephalus</i>	2	Local migrations only
<i>Ompok pabo</i>	2	Presence in Myanmar doubtful according to Red List; migratory status unknown so far
<i>Osteobrama alfredianus</i>	2	Migratory status unknown so far
<i>Osteobrama belangeri</i>	2	Migratory status unknown so far
<i>Puntius chola</i>	2	Usually not considered a migratory species
<i>Mystus vittatus</i>	2	Usually not considered a migratory species

Table 8 – Top ten species identified as migratory in the 14 districts surveyed

Region:	Delta	Delta	Delta	Delta	Delta
District:	Labutta	Pyapon	Maubin	Pathein	Hinthada
Site #	1	2	3	4	5
1	<i>Mugil cephalus</i>	<i>Tenualosa ilisha</i>	<i>Pangasius pangasius</i>	<i>Lates calcarifer</i>	<i>Tenualosa ilisha</i>
2	<i>Lates calcarifer</i>	<i>Lates calcarifer</i>	<i>Tenualosa ilisha</i>	<i>Silonia silondia</i>	<i>Mystus gulio</i>
3	<i>Pangasius pangasius</i>	<i>Otolithoides pama</i>	<i>Anabas testudineus</i>	<i>Wallago attu</i>	<i>Rita sp.</i>
4	<i>Mystus vittatus</i>	<i>Mystus cavasius</i>	<i>Channa striata</i>	<i>Cynoglossus lingua</i>	<i>Pangasius pangasius</i>
5	<i>Polynemus indicus</i>	<i>Mugil cephalus</i>	<i>Clarias sp.</i>	<i>Catla catla</i>	<i>Bagarius sp.</i>
6	<i>Tenualosa ilisha</i>	<i>Corvina miles</i>	<i>Heteropneustes fossilis</i>	<i>Tenualosa ilisha</i>	<i>Salmostoma sardinella</i>
7	x	x	<i>Mastacembelus armatus</i>	<i>Amblygaster clupeioides</i>	<i>Osteobrama belangeri</i>
8	x	x	<i>Notopterus notopterus</i>	x	<i>Anabas testudineus</i>
9	x	x	<i>Xenentodon cancila</i>	x	<i>Channa striata</i>
10	x	x	<i>Ompok pabo</i>	x	<i>Bangana devdevi</i>

Region:	Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
District:	Pyay	Magway	Sagaing	Shwebo	Katha
Site #	6	7	8	9	10
1	<i>Pangasius pangasius</i>	<i>Pangasius pangasius</i>	<i>Wallago attu</i>	<i>Liza vaigiensis</i>	<i>Liza vaigiensis</i>
2	<i>Rita sp.</i>	<i>Cirrhinus mrigala</i>	<i>Sperator aor</i>	<i>Wallago attu</i>	<i>Cirrhinus mrigala</i>
3	<i>Coilia macrognathos</i>	<i>Catla catla</i>	<i>Hemibagrus microphthalmus</i>	<i>Silonia silondia</i>	<i>Silonia silondia</i>
4	<i>Eutropiichthys vacha</i>	<i>Rita sp.</i>	<i>Channa striata</i>	<i>Macrobrachium rosenbergii</i>	<i>Labeo rohita</i>
5	<i>Silonia sp.</i>		<i>Liza vaigiensis</i>	<i>Atule mate</i>	<i>Catla catla</i>
6	<i>Puntius chola</i>		<i>Labeo calbasu</i>	<i>Parambasis ranga</i>	<i>Macrobrachium rosenbergii</i>
7	<i>Mystus leucophasis</i>		<i>Cirrhinus mrigala</i>	<i>Puntius chola</i>	<i>Osteobrama belangeri</i>
8	<i>Ompok pabo</i>		<i>Osteobrama alfredianus</i>	<i>Mystus vittatus</i>	
9	<i>Anguilla sp.</i>		<i>Macrognathus zebrinus</i>	<i>Salmostoma sardinella</i>	
10	<i>Osteobrama alfredianus</i>		<i>Salmostoma sardinella</i>	x	

Region:	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myitkyina	Putao	Monywa	Kale
Site #	11	12	13	14
1	<i>Anguilla sp.</i>	<i>Semiplotus cirrhosus</i>	<i>Pangasius pangasius</i>	<i>Rita sp.</i>
2	<i>Ompok sp.</i>	<i>Garra nasuta</i>	<i>Tenualosa ilisha</i>	<i>Silonia silondia</i>
3	<i>Mystus sp.</i>	<i>Garra notata</i>	<i>Rita sp.</i>	<i>Pangasius pangasius</i>
4	x	<i>Eutropiichthys burmannicus</i>	x	x

7 BREEDING AMONG FISH SPECIES

Question #6: What are the fish species that breed in each zone and their breeding habitats?

The question about breeding sites of species did not harvest much information of interest, since most answers are too generic to reveal specific ecological patterns or inform river management. For instance, some species, such as hilsa, breed on certain sandy beaches (depending on depth or local currents). Some other species breed in certain deep areas of the river, corresponding to particular deep pools. Such details were not specified in the survey answers.

The resolution of answers is another constraint to the identification of breeding habitats of particular conservation value, and the generic terminology used by fishers (i.e., floodplains, creeks, river edges) is not specific enough to be useful. Thus, experience from the Mekong shows that among species breeding in floodplains, some only breed on a muddy substrate, while others breed in vegetated zones of these floodplains or on gravel beds (Baran et al., 2015a). Survey answers did not provide resolution.

Most answers are in line with what is already known of the breeding ecology of the species listed (see fishbase.org), but the time available for each survey, as well as its broad scope, did not allow detailing the features of the habitats referred to nor drawing maps of main breeding habitats in each zone. Such an undertaking would require specific surveys and a dedicated methodology, as done for 31 target species along the course of the Ayeyarwady River (Baran et al., 2015b; Win Ko Ko et al., 2016).

The answers from fishers about breeding among fish species listed is given in Annex III.

8 FISHING AS AN OCCUPATION

8.1 Percentage of Full-Time Fishers in Each Zone

QUESTION #7: WHAT IS THE PERCENTAGE OF FULL-TIME FISHERS IN EACH ZONE?

According to the fishers consulted, in their riverine environment, the proportion of FULL-TIME fishers in the delta is approximately one quarter of the population, with a variability between a tenth in Labutta and half in Maubin. This population of full-time fishers represents only one-tenth of the total riverine population in the Lower and Middle Ayeyarwady, and represents only approximately 1% in the Upper Ayeyarwady and in the Chindwin Basin. This reflects that full-time (i.e., professional) fishing is much more important in the south of the basin than in the north.

Table 9 – Percentage of full-time fishers in each zone surveyed

Delta	Delta	Delta	Delta	Delta	Lower Ayeyarwady	Lower Ayeyarwady
Labutta	Pyapon	Maubin	Pathein	Hinthada	Pyay	Magway
1	2	3	4	5	6	7
8%	19%	56%	22%	26%	9%	9%

Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
Sagaing	Shwebo	Katha	Myitkyina	Putao	Monywa	Kale
8	9	10	11	12	13	14
3%	6%	18%	0%	1%	1%	2%

8.2 Percentage of Part-Time Fishers in Each Zone

QUESTION #8: WHAT IS THE PERCENTAGE OF PART-TIME FISHERS IN EACH ZONE?

According to the fishers consulted in their riverine environment, the proportion of part-time fishers in the delta and the Lower Ayeyarwady is approximately a fifth of the population, with again a high variability between districts. The case of Maubin is interesting, as this zone features the highest proportion of professional fishers but supposedly no part-time fishers. Although a bit caricatural, this pattern may reflect the high intensity of fishing around Maubin, with people being either professionals in the fishery sector or involved in other activities. Fishers also consider that around a tenth of the riverine population is involved part-time in fishing in the Lower Ayeyarwady and hardly at all in Putao and in the Chindwin sub-basin. Katha stands out as a particular case in the Middle Ayeyarwady, with approximately one-fifth of the population supposedly involved part time in fishing.

Table 10 – Percentage of part-time fishers in each zone surveyed

Delta	Delta	Delta	Delta	Delta	Lower Ayeyarwady	Lower Ayeyarwady
Labutta	Pyapon	Maubin	Pathein	Hinthada	Pyay	Magway
1	2	3	4	5	6	7
9%	54%	0%	8%	23%	0%	33%

Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
Sagaing	Shwebo	Katha	Myitkyina	Putao	Monywa	Kale
8	9	10	11	12	13	14
6%	9%	0%	100%	10%	0.4%	3%

8.3 Percentage of Fishers Who Depend on Migratory Fish in Each Zone

QUESTION #9: WHAT IS THE PERCENTAGE OF FISHERS WHO DEPEND ON MIGRATORY FISH IN EACH ZONE?

Every participant consulted in the Lower, Middle, and Upper Ayeyarwady, as well as nearly every group in the Chindwin sub-basin state that, as fishers, they depend primarily on migratory fish. In the delta, roughly half of the groups express their dependency, but again, with a high variability and a particular or suspicious pattern in Maubin. Overall, migratory fish are essential to fishery livelihoods in the north and less important in the south of the basin.

Table 11 – Percentage of fishers who depend on migratory fish, each zone surveyed

Delta	Delta	Delta	Delta	Delta	Lower Ayeyarwady	Lower Ayeyarwady
Labutta	Pyapon	Maubin	Pathein	Hinthada	Pyay	Magway
1	2	3	4	5	6	7
48%	79%	1%	80%	6%	100%	100%

Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
Sagaing	Shwebo	Katha	Myitkyina	Putao	Monywa	Kale
8	9	10	11	12	13	14
100%	100%	100%	100%	100%	89%	100%

9 DESIRABLE, SUSTAINABLE, AND ALTERNATIVE LIVELIHOODS

9.1 Is Fishing a Desirable Livelihood Option and Why?

QUESTION #10: IS FISHING A DESIRABLE LIVELIHOOD? WHY?

In the delta, all the groups consulted agree that fishing is not a desirable livelihood for 3 main reasons: 1) this is a dangerous activity, 2) a better income can be obtained elsewhere, or 3) people do not want to kill fish for religious reasons. These reasons also apply in the Chindwin Basin and to some extent in the Lower Ayeyarwady. The fishers consulted consider that fishing is a desirable livelihood in the Middle and Upper Ayeyarwady. In these places, fishing is still seen as a good, traditional activity to support livelihoods. These results contrast with the quantitative involvement in fishing high in the delta and low in the north.

Table 12 – Answers by fishers responding to whether fishing is a desirable livelihood and reasons surveyed

Delta Labutta		Delta Pyapon		Delta Maubin		Delta Pathein		Delta Hinthada	
1		2		3		4		5	
No	Fishing is a dangerous job (storms and snakes).	No	Do not want to kill the fish.	No	Do not want to kill the fish, but income is better than other job.	No	Do not want to kill the fish.	No	Do not want to kill the fish.

Lower Ayeyarwady Pyay		Lower Ayeyarwady Magway		Middle Ayeyarwady Sagaing		Middle Ayeyarwady Shwebo		Middle Ayeyarwady Katha	
6		7		8		9		10	
Yes		Income is better than other job.		Yes	Their skill is fishing, and it is a traditional job.	Yes	Their skill is fishing, and it is a traditional job.	Yes	Their skill is fishing, and it is a traditional job.

Upper Ayeyarwady Myitkyina		Upper Ayeyarwady Putao		Chindwin Monywa		Chindwin Kale	
11		12		13		14	
Yes	Daily income can be obtained from fishing, unlike agriculture.	Yes	Fishing can support their livelihood.	No	Do not want to kill the fish.	No	Do not want to kill the fish.

9.2 Is Fishing a Sustainable Livelihood Option and Why?

QUESTION #11: IS FISHING A SUSTAINABLE LIVELIHOOD? WHY?

Results show that “sustainability” is understood by fishers as “long-term involvement.” From that perspective, almost all groups consulted in the delta and every group in the Lower Ayeyarwady considers that fishing is a long-term activity for two main reasons: 1) either fishing is a traditional occupation or 2) they have limited ability to invest in other jobs. As opposed to that, fishers in the Chindwin Basin and in the Middle and Upper Ayeyarwady reckon that fishing is not a sustainable activity because of fish rarefaction, or because they would prefer to invest in other job opportunities.

Table 13 – Answers by fishers responding to whether fishing is a desirable livelihood and reasons surveyed

Delta		Delta		Delta		Delta		Delta	
Labutta		Pyapon		Maubin		Pathein		Hinthada	
1		2		3		4		5	
Yes	Do not have choice for other jobs.	Yes	Do not have money to invest in other jobs.	No	Do not want to kill the fish.	Yes	Do not have other job.	Yes	Do not have choice (no other job).

Lower Ayeyarwady		Lower Ayeyarwady		Middle Ayeyarwady		Middle Ayeyarwady		Middle Ayeyarwady	
Pyay		Magway		Sagaing		Shwebo		Katha	
6		7		8		9		10	
Yes		Do not have money to invest for other job.		No	Fish species become rare.	No	Fish species become rare.	No	If there had money to invest in other jobs, they would change.

Upper Ayeyarwady		Upper Ayeyarwady		Chindwin		Chindwin	
Myitkyina		Putao		Monywa		Kale	
11		12		13		14	
No	Fish become rare. Fisheries in the area are declining prominently.	No	Fishing cannot get enough income. They will not let their children be fishers.	No	If there had money to invest in other jobs, they would change.	No	If there had money to invest in other jobs, they would change.

9.3 Livelihood Alternatives for Fishers

Question #12: What are the livelihood alternatives considered by fishers if they stop fishing?

Alternatives fall under four main categories, of similar frequency in overall answers: waged labor, agriculture, livestock farming, and services. Fish trade constitutes a fifth category, less often cited.

In the delta, waged labor is the option most often considered, followed by livestock farming (usually poultry), and services (selling food, taxi). Fish trading is cited as much as farming as an option in two districts. Fish trading is also considered in the Lower Ayeyarwady, together with livestock farming. The Middle Ayeyarwady is characterized by a stronger, almost exclusive, focus on agriculture, complemented with livestock farming. In fact, this group also includes Monywa and Myitkyina. The two most remote districts stand out as having very limited livelihood alternatives (i.e., taxi driving or casual labor only in Putao, and dead wood gathering in Kale).

Table 14 – Alternative livelihood options for fishers surveyed

Delta Labutta	Delta Pyapon	Delta Maubin	Delta Pathein	Delta Hinthada
1	2	3	4	5
Labour, livestock (pig, chicken, duck)	Livestock (duck), farmer, selling food	Motorbike taxi, daily wagger, fish trader (from aquaculture ponds)	Labour, fish trade, house shop	Labour, livestock (pig, chicken), farming crops (tomato, bean, maize, chili)

Lower Ayeyarwady Pyay	Lower Ayeyarwady Magway	Middle Ayeyarwady Sagaing	Middle Ayeyarwady Shwebo	Middle Ayeyarwady Katha
6	7	8	9	10
Fish trade, livestock (pig)	Fish trade, livestock (chicken, cow, and pig), and car taxi	Plantation farming and labor	Farmer and livestock (cow)	Farming paddy or crops (bean, sesame, mango, sugar cane)

Upper Ayeyarwady Myitkyina	Upper Ayeyarwady Putao	Chindwin Monywa	Chindwin Kale
11	12	13	14
Agriculture	Taxi driving (car, motorbike) and casual labor	Livestock (chicken, duck), farmer, plantation (Taiwan), and tea shop	Labor, livestock (pig), and selling firewood from the river

10 AQUACULTURE

10.1 Fishers’ Opinion Regarding the Role of Aquaculture Now for Fish Supply

QUESTION #13: WHAT IS THE ROLE OF AQUACULTURE NOW IN TERMS OF FISH SUPPLY?

Almost all groups of fishers consulted see aquaculture as already playing a dominant role in fish supply all over the basin, except in Putao, where this role is seen as minor. These results must be analyzed while keeping in mind the natural competition between the fishing and the aquaculture sectors, hence a possible bias among fishers in assessing the importance of a competitive sector.

Table 15 – Role of aquaculture now in terms of fish supply surveyed

Delta	Delta	Delta	Delta	Delta
Labutta	Pyapon	Maubin	Pathein	Hinthada
1	2	3	4	5
Significant role	Dominant role	Dominant role	Dominant role	Dominant role

Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
Pyay	Magway	Sagaing	Shwebo	Katha
6	7	8	9	10
Dominant role	Dominant role	Dominant role	Dominant role	Dominant role

Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
Myitkyina	Putao	Monywa	Kale
11	12	13	14
Dominant role	Minor role	Dominant role	Dominant role

10.2 Fishers’ Opinion Regarding the Role of Aquaculture in the Future for Fish Supply

QUESTION #14: WHAT DO FISHERS THINK ABOUT THE ROLE OF AQUACULTURE FOR FISH SUPPLY IN THE FUTURE?

The majority of fisher groups consulted reckon that the role of aquaculture in the future will be dominant, or at least significant, as it already is. Even fishers in remote places (e.g., Putao) think that aquaculture will become dominant.

Table 16 – Farmers’ opinion on the role of aquaculture in the future surveyed

Delta	Delta	Delta	Delta	Delta	Lower Ayeyarwady	Lower Ayeyarwady
Labutta	Pyapon	Maubin	Pathein	Hinthada	Pyay	Magway
1	2	3	4	5	6	7
Significant role	Dominant role	Dominant role				

Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
Sagaing	Shwebo	Katha	Myitkyina	Putao	Monywa	Kale
8	9	10	11	12	13	14
Dominant role	Dominant role	Dominant role	Dominant because wild fish is declining	Significant role	Dominant role	Dominant role

10.3 Other Remarks

Remarks provided by the people consulted underline three main aspects: 1) aquaculture fish is welcome and already widely consumed; 2) aquaculture fish is cheaper than wild fish, chicken, and pork; and 3) aquaculture fish is a better option than wild fish for religious donations (more acceptable or more affordable).

Table 17 – Miscellaneous remarks about aquaculture by the fishers in each district

Region:	Delta	Delta	Delta	Delta	Delta
District:	Labutta	Pyapon	Maubin	Patheingyi	Hinthada
Site number	1	2	3	4	5
Other remarks	There are many cage cultures (crab and shrimp) to export to China. Wild fish are enough for local consumption.	They can substitute wild fish with aquaculture fish for donations.	Aquaculture fish are cheaper than wild fish and it can be consumed the whole year.	Wild fish become rare.	75% of total households consume aquaculture fish. They can replace wild fish.

Region:	Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
District:	Pyaw	Magway	Sagaing	Shwepyithar	Katha
Site number	6	7	8	9	10
Other remarks	Most people consume aquaculture fish because wild fish become rare. Fishermen are interested in aquaculture.	Most people consume aquaculture fish because it is cheaper than chicken and pig.	Most people consume aquaculture fish because wild fish become rare. Fishermen are interested in aquaculture.	50% of total households consume aquaculture fish. They can replace wild fish.	50% of total households consume aquaculture fish. They are cheaper than chicken and pig. They can replace wild fish and are more appreciated for religious donations.

Region:	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myittha	Putao	Monywa	Kale
Site number	11	12	13	14
Other remarks	Fish is more important than chicken and pork because it is cheaper. Most of the community depends on fish for their nutrition.	Currently, no good situation for aquaculture because of practical aspects (rocky ground for fish ponds, weak knowledge on techniques, difficult to get water). But they believed that aquaculture will grow if supported by the government.	Most people consume aquaculture fish and it can be stocked in leasable fisheries to promote production.	They can substitute wild fish with aquaculture fish for donations. 80% of total households consume aquaculture fish because it is cheaper than wild fish.

11 ISSUES IN FISHERIES AND THE ENVIRONMENT

11.1 Most Important Issues in Fisheries and Environment

QUESTION #15: WHAT ARE THE FIVE MOST IMPORTANT ISSUES IN FISHERIES AND ENVIRONMENT IN EACH ZONE?

The systematic consultation of groups of fishers in 14 districts throughout the Ayeyarwady Basin helped identify and rank the five most important issues in each zone and overall.

Almost every group consulted reckons that fish have become less abundant. Approximately a third of fishers stated that the decrease in fish abundance was the most concerning issue of all. This is supplemented with the rarefaction of shrimps and prawns (7%).

The fishers identified the destruction of aquatic habitats and the reduced reproduction rate as critical issues (19% each). Destruction of aquatic habitats correspond to waters becoming shallower (a possible consequence of sedimentation or climate change), destructive exploitation of habitats (e.g., sand dredging and fires in wetlands), or loss of mangroves in coastal habitats. According to fishermen, reduced reproduction rates correspond to the production or survival of less juvenile fish (e.g., unsuitable conditions for growth or reduced access of fisheries to wild breeders).

Electrofishing is mentioned as an issue in approximately one-tenth of cases. Other issues, mentioned on a case-by-case basis, include poisoning from agriculture (use of pesticides that kill fish and juveniles), gold mining, management issues in leasable fishery operations, conflict between fishermen and farmers in floodplain areas, and increased difficulty to catch fish (which overlaps with rarefaction).

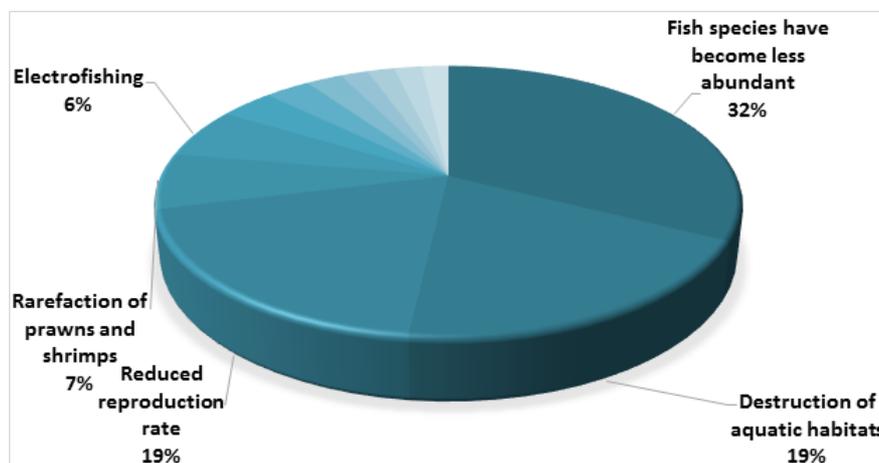


Figure 2 – Percentage of the issues ranked by the 14 districts surveyed

Table 18 – Ranking of the five most important issues in fisheries and environment in each zone surveyed

Region:	Delta	Delta	Delta	Delta	Delta
District:	Labutta	Pyapon	Maubin	Pathein	Hinthada
Site #	1	2	3	4	5
1	Habitats were destroyed. Water depth becomes shallow. Many juvenile fish were destroyed during shrimp harvesting.	Fish species have become rare.	Fish species become rare.	Decrease in reproduction and growth rate.	Fish species have become rare.
2	Decrease in reproduction and growth rate.	Less of mangroves and bush.	<i>Macrobrachium rosenbergii</i> has become rare.	Fish species have become rare.	Decrease in reproduction and growth rate.
3	Do not have enough catching areas.	x	Conflict among fishermen and farmers.	Catch fish has decreased.	Difficult to work the lease in time.
4	Fish species have become rare.	x	Decrease reproduction, production, and growth of fish species	x	x
5	Catch fish decreasing.	x	x	x	x

Region:	Lower Ayeyarwady	Lower Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady	Middle Ayeyarwady
District:	Pyay	Magway	Sagaing	Shwebo	Katha
Site #	6	7	8	9	10
1	Fish species have become rare.	Fish species have become rare.	Fish species have become rare.	Fish species have become rare.	Fish species have become rare.
2	Prawn and shrimp have become rare.	Spawning areas were destroyed (forest fire).	Habitats were destroyed.	Habitats were destroyed.	Decrease reproduction rate.
3	Difficult to catch the fish.	Decrease reproduction rate.	Water pollution	Shrimp and prawn have become rare	Water pollution
4	x	Decrease reproduction rate in leasable areas and they cannot pay back fishery revenue.	x	Decrease reproduction rate of fish species.	Leasable area becomes narrow.
5	x	Difficult to catch the fish in the leasable areas.	x	x	Habitats were destroyed.

Region:	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myitkyina	Putao	Monywa	Kale
Site #	11	12	13	14
1	Electrofishing	Electrofishing	Wild fish cannot swim upstream to breed in leasable areas (decrease of wild fish in leasable areas).	Fish species have become rare.
2	Agricultural poison	x	Habitats were destroyed.	Habitats were destroyed.
3	Gold mining	x	Fish species have become rare.	Decrease in juvenile fish.
4	River and wetlands become shallow. Fish habitats destroyed.	x	Decrease production rate in leasable areas.	x
5		x	x	x

Table 19 Grouping of dominant causes into main standard categories used in Table 20

Fish Species Have Become Less Abundant	Fish species have become rare.
	Catch fish have decreased.
Destruction of Aquatic Habitats	River and wetlands have become shallow. Fish habitats destroyed.
	Habitats were destroyed. Water depth becomes shallow. Many juvenile fish were destroyed in shrimp harvesting time and many juveniles fish were killed to alive their shrimp.
	Less mangroves and bush.
	Spawning areas were destroyed (forest fire).
	Habitats were destroyed.
Reduced Reproduction Rate	Decrease in reproduction and growth rate.
	Decrease reproduction rate in leasable areas and they cannot pay back fishery revenue.
	Wild fish cannot swim upstream to breed in leasable areas (decrease of wild fish in leasable areas).
	Decrease in juvenile fish.
Rarefaction of Prawns and Shrimps	Prawn and shrimp have become rare.
	<i>Macrobrachium rosenbergii</i> has become rare.
Electrofishing	Electrofishing
Water Pollution	Water pollution
Not Enough Catch Areas	Do not have enough catch areas.
	Leasable areas have become narrow.
Poisoning from Agriculture	Agricultural poison
Gold Mining	Gold mining
Issues with Lease Operation	Difficult to work the lease in time.
Conflict between Fishermen and Farmers	Conflict among fishermen and farmers.
Difficulty to Catch Fish	Difficult to catch the fish.

It can be noted that dam development (either hydropower or irrigation dams) was never mentioned during consultations as a possible threat to fish resources, although the negative impact of dams on fish production is well known to scientists, particularly in the neighboring Mekong. This can be attributed to the fact that 1) dam density is still relatively low in Myanmar, with low visibility at this stage; 2) dam impacts will be fully experienced after dam construction only (i.e., several years after decisions are made); and 3) people at the local level often do not perceive the diffuse or distant impacts of dams (e.g., in the case of reduced migration and breeding success), except in the vicinity of sites. This also underlines biases inherent to the consultation of local communities, and the need to complement people's perceptions with predictive scientific studies and lessons from other countries.

11.2 Most Important Causes of Fisheries Issues

QUESTION #16: WHAT IS THE CAUSE OF EACH ISSUE?

When interviewed about the causes of each issue, fishers give multiple explanations to the dominant issues (i.e., fish rarefaction, destruction of habitats, and reduced reproduction rates) and fewer explanations to secondary issues. Among the districts surveyed, fishers reckon that overfishing, destructive fishing (electrofishing and fishing using pesticides), as well as fishing in spawning seasons are the main causes of fish species rarefaction. Use of pesticides as a fishing method is also mentioned for the prawn and shrimp fishery.

The causes of the destruction of aquatic habitats include deforestation, erosion, gold and sand mining, extension of farms in floodplains, and clearing the natural vegetation that normally benefits fish in floodplains and wetlands. The causes of the reduction in reproduction rate include electrofishing, using pesticides, and access restriction by farmers to leasable fisheries in floodplains. Among other causes are the demand for multiple uses of floodplains (fishing vs. farming) and of the river (fishing vs. mining), and some organizational aspects (timing in water management, in licencing).

Table 20 – Causes of fisheries issues surveyed

Fish Species Have Become Less Abundant	Destruction of Aquatic Habitats	Reduced Reproduction Rate
Fishing in spawning season.	Deforestation (to cage culture of shrimp and crab in forest areas).	Electrofishing and using pesticide as a poison.
Catch by offshore fishing vessels in inshore areas	Extension of farm areas for farming.	Leaseholder cannot open barricade in the lease to let fish in because of prohibition from farmer.
Fishing with pesticide used as a poison and pesticide used in paddy fields.	Farmers clear bushes in their farm near the lease.	Farmer are using pesticide in paddy fields and throwing pesticide solution in leasable fisheries.
Overfishing	Deforestation, erosion, and sedimentation from digging gold in river.	Boats maneuvering in the lease area scare fish away
Water pollution (plastic bag and waste from industry), electrofishing, using pesticide as a poison, overfishing in marine areas, and access to the river in spawning season)	Erosion and reduction of water depth.	Using pesticide to clear the bush in paddy fields.
Electrofishing, especially in spawning season.	Digging sand in the river, especially in spawning season.	x
x	Gold mining and forest loss in the watershed. Fish cannot stay in their habitats.	

Issue	Rarefaction of Prawns and Shrimps	Not Enough Catch Areas	Difficulty to Catch Fish	Water Pollution	Electrofishing
Causes	Catching fish with pesticide used as a poison.	Using auction system in the river.	Water becomes shallow because of digging with machine for sand, stone and gold in the river.	Digging ground in the lease and filling with waste.	Fish cannot breed because of electric shock.
	Electrofishing and catching fish with pesticide used as a poison.	Farmer extended their land.	Pollution due to boat concentration in the lease area.	Diesel from oil vessel, excrement from industry, and pesticides from paddy fields.	Decrease in all fish species.

Issue	Conflict Between Fishermen and Farmers	Issues with Lease Operation	Poisoning from Agriculture	Gold Mining
Causes	Water management conflict (fishers want water in at the time of flooding, farmers want water in later).	Leaseholders cannot get permit in time for their lease operation.	Use of pesticides for agricultural use.	Water becomes turbid. Chemical pollution from gold mining.

11.3 Key Solutions to Fisheries Issues

QUESTION #17: WHAT ARE THE SOLUTIONS TO SOLVE EACH ISSUE?

According to the groups of fishers consulted, four main types of solution exist to help solve the above issues:

1. Improve law enforcement. There are already sufficient provisions for better management, but law enforcement is a problem in many cases (i.e., offshore vessels fishing inshore, unlimited destructive fishing, and destruction of habitats). Better law enforcement is the most recurrent recommendation, and more action is clearly expected from the DoF.
2. Limit pollution, either from imposed restrictions (i.e., on the use of pesticides or on the release of pollutants) or from better environmental awareness and education.
3. Restrict destructive practices (i.e., sand mining, dumping waste in rivers and floodplains, and use of pesticides) by upgrading and improving the current laws and regulations.
4. Better organizational arrangements between parties, either between fishers and the DoF about the management of leasable fisheries, or between fishers and farmers (reaching compromises about land and water uses).

Table 21 – Solutions to fisheries issues surveyed

Fish Species Have Become Less Abundant	Destruction of Aquatic Habitats	Reduced Reproduction Rate
Not to throw the waste in the river. (To control waste system from Development Committee.)	To have the Forest Department enforce the law.	To stop the use of pesticides in water and to improve leasable fishery laws from DoF (to restrict leasable areas).
Not to catch off-shore fishing vessel from inshore areas.	To replant mangroves and not to cut mangroves and bush around the water.	To have DoF enforce the law so the police force and administrators cooperate with one another.
To use other pesticides in paddy fields.	Not to do agriculture near leasable areas and not to clean the bush near leasable areas. They would like farmers to clear the bush after spawning season.	To have DoF, Agriculture Department, and the police force inform the people about the effect of pesticides in water. They would like it to be one of the laws.
To have DoF and the police force enforce the law by performing monthly checks along the river.	To have DoF and the police force enforce the law, especially in spawning season (not to clear the bush before spawning season).	x
x	To recover from deforestation.	
	To have the Transportation Department enforce the law.	

Issue	Rarefaction of Prawns and Shrimp	Not Enough Catch Areas	Difficulty to Catch Fish	Water Pollution	Electrofishing
Solutions	To close shops selling pesticide	To open fisheries and to issue catch permit licences with open fisheries.	To stop digging sandstone and gold in the river.	Not to dig and replace the waste. To control the waste system from the Development Committee.	Stop electrofishing with effective law enforcement.
	To have DoF enforce the law and stop using pesticides.	To open fisheries and to issue catch permit licences with open fisheries.	To forbid access to motor boats during harvesting time.	To transport diesel by car.	To take action in agreement with the fishery law by improving cooperation with relevant departments and organizations.

Issue	Conflict Between Fishermen and Farmers	Issues with Lease operation	Poisoning From Agriculture	Gold Mining
Solutions	To solve the problem thanks to DoF and Agriculture Department interventions.	To give lease permit in time and to give the chance to work at least 3 years on one lease.	Stop extensive use of poison.	Do not discharge used water from the gold mining into the river directly.

12 RECOMMENDATIONS

QUESTION #18: WHAT ARE THE TOP FIVE RECOMMENDATIONS TO THE GOVERNMENT FOR THE SUSTAINABILITY OF RIVER AND AQUATIC RESOURCES?

The recommendations given are in line with the issues and solutions identified. One of the most recurrent recommendations is the restriction of pesticides and electrofishing. Replanting mangroves and former forest areas are also recurrent recommendations as well as implementing the laws regarding fishing during spawning seasons and illegal fishing activities. We present below a more specific list of recommendations by zone:

Delta: Implement an effective ban on electrofishing and the use of pesticides as a poison, no cage farming in forested areas, and mangrove reforestation.

Lower Ayeyarwady: Implement an effective ban on electrofishing and the use of pesticides as a poison and no more sand, stone, or gold extraction from rivers

Middle Ayeyarwady: Ban fishing during the breeding season (April to June), provide 3-year leases for a more sustainable management of leasable fisheries, and facilitate negotiations and compromises between farmers and fishers.

Upper Ayeyarwady: Implement an effective ban on electrofishing and illegal fishing.

Chindwin: Implement an effective ban on electrofishing and the use of poison and complete reforestation activities.

Table 22 – Ranking of the top five recommendations surveyed

Delta Labutta	Delta Pyapon	Delta Maubin	Delta Pathein	Delta Hinthada
1	2	3	4	5
Not to do cage culture in forest areas (Forest Department to enforce the law).	To recover mangroves.	To stop the use of electrofishing.	Not to catch in the spawning season (DoF to enforce the law).	To stop electrofishing DoF to enforce the law).
To reforest through the Forest Department.	To stop selling and using pesticides in fishing and in the paddy fields.	To stop fishing with pesticide as a poison.	To stop electrofishing (DoF to enforce the law).	To stop using pesticide as a poison (DoF to enforce the law).
To stop using pesticide as a poison (DoF to enforce the law).	To give aquaculture technique and loan with less interest.	To stop overfishing along the river, especially in spawning season.	Not to throw the waste in the river (Development Committee).	To stop fishing in spawning season (DoF to enforce the law).
To stop electrofishing (DoF to enforce the law).	To contribute fingerlings for small scale aquaculture.	To have DoF enforce fisheries law, especially in spawning season.	No access of off-shore fishing vessels in inshore areas. To enforce the law from DoF, especially in spawning season.	To reforest through the Forest Department.
x	x	To demarcate leasable fisheries, open fishery areas, and have DoF inform people about the boundaries.	x	x

Lower Ayeyarwady Pyay	Lower Ayeyarwady Magway	Middle Ayeyarwady Sagaing	Middle Ayeyarwady Shwebo	Middle Ayeyarwady Katha
6	7	8	9	10
To stop electrofishing (DoF to enforce the law).	To stop electrofishing and close the battery shop (DoF, police, and administrator).	To close shops selling batteries, especially for fishing.	To stop electrofishing (DoF to enforce the law).	To stock fish seeds for local fish: Nga Khu (<i>Clarias sp.</i>), Nga gyi (<i>Heteropneustes fossilis</i>), Nga bet (<i>Wallago attu</i>), Nga gyin (<i>Cirrhinus mrigala</i>), Nga thayne (<i>Catla catla</i>) in the river (from wild breeders).
To stop digging sand, stone and gold in the river.	Not to catch the fish in close season (DoF, police, and administrator to enforce the law).	Not to throw waste into the river (water pollution).	To stop fishing, especially during spawning season (4, 5, and 6). DoF to enforce the law, especially in spawning season.	To recover from deforestation.
To close shops selling pesticide.	To stop digging sand in the river.	To stop fishing, especially during spawning season (4, 5, 6). DoF to enforce the law, especially in spawning season. To create alternative livelihoods for fishermen.	To control irrigation canal in cooperation with DoF and Irrigation Department.	To stop electrofishing (DoF to enforce the law).
x	No disposal of residues and pollutants in leasable fishery areas.	Allow operating leasable fisheries at least 3 years long to conserve aquatic resources.	To involve DoF and Department of Agriculture in order to solve conflicts between leaseholders and farmers	To clean up water pollution.
x	Faremers should not clear bushes and forests by fire	To replenish a lot of fish species to the river and recover from deforestation. Stop sand and gold mining in the river.	To stop using pesticide as a poison (DoF to enforce the law).	To control the breeding of tilapia (<i>Oreochromis niloticus</i>) in the river. This species dominates the other local fish species.

Region:	Upper Ayeyarwady	Upper Ayeyarwady	Chindwin	Chindwin
District:	Myitkyina	Putao	Monywa	Kale
Site #	11	12	13	14
1	To stop using illegal fishing methods, such as electrofishing and poison.	To take action against electrofishing in accordance with the Fishery Law; to help establish sustainable fisheries by involving relevant departments and organizations.	To stop electrofishing (DoF to enforce law).	To stop electrofishing (DoF to enforce law).
2	Implement effective law enforcement on illegal fishing.	x	To stop digging sand along the river.	To replant fish seeds to the river.
3		x	To recover from deforestation.	To recover from deforestation.
4		x	To reduce using pesticide in paddy fields and to stop using pesticide as a poison.	To stop using pesticide as a poison.

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ANNEX I QUESTIONNAIRE TO FISHERMEN ABOUT FISH RESOURCES

AIRBMP State of the Basin SOBA 4: Biodiversity and fisheries

Please read the introduction first

FORM A: SURVEY IDENTIFICATION

A1. Date:

A2. Region:

A3. District:

A4. Township:

A5. Village track:

A6. Village:

A7. Survey number (MonthDayQuestionnaire#):

A8. Who led the interview?

A9. Who entered fishermen's answers?

FORM B: FISH RESOURCES

B1: What are the dominant fish species in the area in terms of abundance in catches

- 1) Say that you focus on the most abundant species first
- 2) let fishers name species as they want
- 3) ask for ranking once at least 10 species are mentioned

Species (Myanmar name)	Species (Latin name)	Rank based on ABUNDANCE

B2: What are the dominant fish species in the area in terms of income for fishers

- 1) Say that you focus on the most abundant species first
- 2) let fishers name species as they want
- 3) ask for ranking once at least 10 species are mentioned

No role	Minor role	Significant role	Dominant role

C8. What do you think about the role of aquaculture in the future in terms of fish supply?

No role	Minor role	Significant role	Dominant role

C9. Other remarks?

FORM D: ISSUES AND TRENDS

D1. Please rank the 5 main issues in fisheries and aquatic environment in this zone

Issue	Rank	Cause	Solution

D2. What are your main recommendations to the government for the sustainability of river and aquatic resources?

Rank	Recommendation

FORM E: CONCLUSIONS

E1. Number of fishermen interviewed: _____

E2. Make sure to fill out the participant list with the names, occupations and contact information for each participant (see the separate participant list).

E3. What do the interviewers think about the quality of this interview? Good Average Poor

E4. Note the name and contact of a selected fisherman (key informant) in case additional information is required:

E5. Other remarks concerning the interview:

ANNEX II – MIGRATORY SPECIES AND MIGRATION MONTHS

Top species identified as migratory (column 1) and their months of migration upstream (column 2) and downstream (column 3) according to interviews in 14 townships

Delta Labutta			Delta Pyapon			Delta Maubin			Delta Pathein						
1			2			3			4						
<i>Mugil cephalus</i>	(12-1)	(3-4)	<i>Tenualosa ilisha</i>	Adult fish (7-8), small fish (11-12)	Adult fish (9-10), small fish (4-5)	<i>Pangasius pangasius</i>	10,11	4,5	<i>Lates calcarifer</i>	(7-8)	(9-10)				
<i>Lates calcarifer</i>	(5-6)	(9-10)	<i>Lates calcarifer</i>	(4-5)	(9-10)	<i>Tenualosa ilisha</i>	12,1	4,5	<i>Silonia silondia</i>	(6-7)					
<i>Pangasius pangasius</i>	(9-10)	(3-4)	<i>Otolithoides pama</i>	(11-12)	(2-3)	<i>Anabas testudineus</i>	(5-6)	(9-10)	<i>Wallago attu</i>						
<i>Mystus vittatus</i>	(8-9)	(12-1)	<i>Mystus cavasius</i>	4	(11-12)	<i>Channa striata</i>	5,6	9,10	<i>Cynoglossus lingua</i>						
<i>Polynemus indicus</i>	(3-4)	(7-8)	<i>Mugil cephalus</i>	(11-12)	(9-10)	<i>Clarias sp.</i>			5,6	9,10		<i>Catla catla</i>			
<i>Tenualosa ilisha</i>	(9-10)	(1-2)	<i>Chelon planiceps</i>			<i>Heteropneustes fossilis</i>						5,6	9,10	<i>Tenualosa ilisha</i>	
						<i>Mastacembelus armatus</i>					5,6			9,10	<i>Amblygaster clupeioides</i>
						<i>Notopterus notopterus</i>									5,6
						<i>Xenentodon cancila</i>									
						<i>Ompok pabo</i>									

Delta		
Hinthada		
5		
<i>Tenulosa ilisha</i>	(12-1)	No downstream
<i>Mystus gulio</i>	(1-12)	(1-12)
<i>Rita sp.</i>	(7-8)	(9-10)
<i>Pangasius pangasius</i>	(1-2)	No downstream
<i>Bagarius sp.</i>	(12-1)	(7-8)
<i>Salmostoma sardinella</i>	(7-8)	(9-10)
<i>Osteobrama belangeri</i>		
<i>Anabas testudineus</i>		
<i>Channa striata</i>		
<i>Bangana devdevi</i>		

Lower Ayeyarwady		
Pyay		
6		
<i>Pangasius pangasius</i>	(10-11)	No downstream
<i>Rita sp.</i>	Adult (10-11), small fish (3-4)	
<i>Coilia macrognathos</i>	(1-2)	
<i>Eutropiichthys vacha</i>	(2-3)	
<i>Silonia sp.</i>	(2-3)	
<i>Puntius chola</i>	(4-5)	(9-10)
<i>Mystus leucophasis</i>		
<i>Ompok pabo</i>		
<i>Anguilla sp.</i>		
<i>Osteobrama alfredianus</i>		

Lower Ayeyarwady		
Magway		
7		
<i>Pangasius pangasius</i>	(10-3)	No downstream
<i>Cirrhinus mrigala</i>	(10-4)	
<i>Catla catla</i>	(10-4)	
<i>Rita sp.</i>	11	

Middle Ayeyarwady		
Sagaing		
8		
<i>Wallago attu</i>	Adult (6-7)/small fish (9-10)	No downstream
<i>Sperator aor</i>		
<i>Hemibagrus microphthalmus</i>		
<i>Channa striata</i>		
<i>Liza vaigiensis</i>		
<i>Labeo calbasu</i>		
<i>Cirrhinus mrigala</i>		
<i>Osteobrama alfredianus</i>		
<i>Macrogathus zebrinus</i>		
<i>Salmostoma sardinella</i>		

Middle Ayeyarwady		
Shwebo		
9		
<i>Liza vaigiensis</i>	(10-11)	(7-8-9)
<i>Wallago attu</i>		
<i>Silonia silondia</i>		
<i>Macrobrachium rosenbergii</i>		
<i>Atule mate</i>		
<i>Parambasis ranga</i>		
<i>Puntius chola</i>		
<i>Mystus vittatus</i>		
<i>Salmostoma sardinella</i>		
x		

Middle Ayeyarwady		
Katha		
10		
<i>Liza vaigiensis</i>	(7-8)	(10-11)
<i>Cirrhinus mrigala</i>		
<i>Silonia silondia</i>		
<i>Labeo rohita</i>		
<i>Catla catla</i>		
<i>Macrobrachium rosenbergii</i>		
<i>Osteobrama belangeri</i>	(3-4)	
x		

ANNEX III – BREEDING SPECIES AND BREEDING PLACES

Region:	Delta	
District:	Labutta	
Site #	1	
1	<i>Mystus vittatus</i>	Floodplains, pools, creeks, and canals
2	<i>Mugil cephalus</i>	
3	<i>Channa striata</i>	
4	<i>Scylla serrata</i>	In marine areas
5	<i>Penaeus monodon</i>	
6	<i>Anguilla bicolor</i>	
7	<i>Lates calcarifer</i>	Mouth of rivers in deep water areas
8	<i>Plotosus canius</i>	
9	<i>Otolithoides pama</i>	
10	<i>Polynemus paradiseus</i>	

Delta	
Pyapon	
2	
<i>Oreochromis niloticus</i>	Canals and lakes
<i>Channa striata</i>	Creeks, canals, and paddy fields
<i>Macrobrachium rosenbergii</i>	Canals, creeks, and mangroves
<i>Tenualosa ilisha</i>	Brackish water
<i>Lates calcarifer</i>	Creek, mangroves, and paddy fields
<i>Mugil cephalus</i>	
<i>Chelon planiceps</i>	
<i>Mystus cavasius</i>	

Delta	
Maubin	
3	
<i>Sperata seenghala</i>	Borders and beds of rivers
<i>Silonia silondia</i>	
<i>Wallago attu</i>	
<i>Rita sp.</i>	Deep water areas
<i>Polynemus paradiseus</i>	
<i>Otolithoides pama</i>	
<i>Macrobrachium rosenbergii</i>	Bushes on shoreline of shallow water
<i>Notopterus notopterus</i>	Wetland areas, paddy fields, and pools
<i>Ompok pabo</i>	Wetland areas and paddy fields
<i>Clarias sp.</i>	

Region:	Delta	
District:	Pathein	
Site #	4	
1	<i>Amblygaster clupeioides</i>	Nearshore, marine coasts
2	<i>Siganus javus</i>	Floodplains, creeks, and flooded areas
3	<i>Macrogathus zebrinus</i>	
4	<i>Puntius chola</i>	
5	<i>Catla catla</i>	
6	<i>Heteropneustes fossilis</i>	
7	<i>Channa striata</i>	
8	<i>Wallago attu</i>	
9	<i>Parambassis ranga</i>	
10	<i>Mystus vittatus</i>	

Delta	
Hinthada	
5	
<i>Tenulosa ilisha</i>	In the river
<i>Mystus gulio</i>	Deep areas of the river and riversides
<i>Sperator aor</i>	
<i>Pangasius pangasius</i>	Deep areas of the river
<i>Wallago attu</i>	
<i>Rita sp.</i>	Along the river, bushes, riversides
<i>Catla catla</i>	Edges of floodplains
<i>Cirrhinus mrigala</i>	
<i>Channa striata</i>	
<i>Osteobrama belangeri</i>	

Lower Ayeyarwady	
Pyay	
6	
<i>Catla catla</i>	Rivers
<i>Labeo rohita</i>	
<i>Cirrhinus mrigala</i>	
<i>Ompok pabo</i>	Rivers and creeks
<i>Mystus cavasius</i>	
<i>Puntius chola</i>	
<i>Mystus leucophasis</i>	
<i>Osteobrama alfredianus</i>	
<i>Notopterus notopterus</i>	
<i>Labeo calbasu</i>	

Region:	Lower Ayeyarwady	
District:	Magway	
Site #	7	
1	<i>Sperator aor</i>	Rivers
2	<i>Wallago attu</i>	Floodplains, pools, and bushes
3	<i>Salmostoma sardinella</i>	Rivers
4	<i>Puntius chola</i>	Floodplains, pools, and rivers
5	<i>Oreochromis niloticus</i>	
6	<i>Cirrhinus mrigala</i>	
7	<i>Catla catla</i>	
8	<i>Osteobrama belangeri</i>	
9	<i>Mystus cavasius</i>	
10	<i>Notopterus notopterus</i>	

Middle Ayeyarwady	
Sagaing	
8	
<i>Trichogaster pectoralis</i>	Floodplains, pools, creeks, bushes
<i>Puntius chola</i>	
<i>Oreochromis niloticus</i>	
<i>Gudusia variegata</i>	
<i>Wallago attu</i>	Floodplains and rivers
<i>Sperator aor</i>	Valleys of rivers
<i>Labeo stoliczkae</i>	
<i>Hemibagrus microphthalmus</i>	
<i>Osteobrama alfredianus</i>	
<i>Cirrhinus mrigala</i>	

Middle Ayeyarwady	
Shwebo	
9	
<i>Oreochromis niloticus</i>	Floodplains and creeks
<i>Mystus leucophasis</i>	Floodplains
<i>Mystus vittatus</i>	
<i>Wallago attu</i>	Floodplains and rivers
<i>Liza vaigiensis</i>	Beaches
<i>Sperator aor</i>	Valleys of rivers
<i>Myatus gulio</i>	

Region:	Middle Ayeyarwady	
District:	Katha	
Site #	10	
1	<i>Labeo rohita</i>	Valleys of rivers
2	<i>Catla catla</i>	
3	<i>Silonia silondia</i>	
4	<i>Sperator aor</i>	
5	<i>Liza vaigiensis</i>	Paddy field, bush, shallow waters
6	<i>Macrobranchium rosenbergii</i>	
7	<i>Osteobrama belangeri</i>	
8	<i>Puntius chola</i>	
9	<i>Mystus vittatus</i>	
10	<i>Channa striata</i>	

Upper Ayeyarwady Region	
Myitkyina	
11	
<i>Labeo sp.</i>	Bush and standing water, no current
<i>Salmostoma sardinella</i>	
<i>Oreochromis niloticus</i>	
<i>Osteobrama belangeri</i>	
<i>Cyprinus carpio</i>	
<i>Ompok sp.</i>	
<i>Mystus sp.</i>	
<i>Acanthocobitis sp.</i>	

Upper Ayeyarwady	
Putao	
12	
<i>Chela laubuca</i>	Creeks and wetland areas
<i>Neolissochilus compressus</i>	
<i>Neolissochilus sp.</i>	
<i>Putao</i>	

Region:	Chindwin	
District:	Monywa	
Site #	13	
1	<i>Labeo stolizkae</i>	Corners and valleys of rivers
2	<i>Wallago attu</i>	Corners and valleys of rivers
3	<i>Puntius chola</i>	Floodplains, pools, creeks, and canals
4	<i>Cirrhinus mrigala</i>	Valleys of rivers
5	<i>Mystus cavasius</i>	Floodplains and pools
6	<i>Catla catla</i>	Floodplains and pools
7	<i>Parambasis ranga</i>	Floodplains and pools
8	<i>Silonia silondia</i>	Valleys of rivers
9	<i>Osteobrama belangeri</i>	Floodplains, pools, and rivers
10	<i>Macroglythys zebrinus</i>	Floodplains and pools

Chindwin	
Kale	
14	
<i>Osteobrama belangeri</i>	Valleys of rivers
<i>Wallago attu</i>	Creeks, canals, and floodplains
<i>Mystus vittatus</i>	Creek, canals, floodplains, and pools
<i>Macroglythys zebrinus</i>	Corners and valleys of rivers
<i>Puntius chola</i>	Creeks, canals, floodplains, and pools
<i>Labeo stolizkae</i>	Creeks, canals, floodplains, and pools
<i>Sperator aor</i>	Valleys of rivers
<i>Silonia silondia</i>	Shallow water areas of rivers
<i>Bagarius yarrelli</i>	Corners, shallow water areas of rivers
<i>Rita sp.</i>	Corners, shallow water areas of rivers