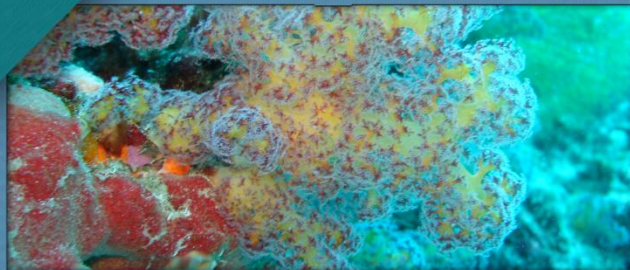




Bay of Bengal Large Marine Ecosystem Project



Distribution, migration and breeding of Hilsa (*Tenualosa ilisha*) in the Ayeyarwady system in Myanmar

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DISTRIBUTION, MIGRATIONS AND BREEDING OF HILSA (*TENUALOSA ILISHA*) IN THE AYEYARWADY SYSTEM IN MYANMAR



MYFish project: Improving research and development of Myanmar's inland and coastal fisheries



Distribution, migrations and breeding of Hilsa (*Tenualosa ilisha*) in the Ayeyarwady system in Myanmar

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September 2015



MYFish project: Improving research and development of Myanmar's inland and coastal fisheries.

Executive summary

Hilsa (*Tenualosa ilisha*) is a major fishery resource in the Bay of Bengal. In order to ensure the sustainability of this resource, through effective management measures, information is required on its distribution patterns, migration routes and breeding sites. This study fills these knowledge gaps in Myanmar's Ayeyarwady Delta. The findings are based on systematic gathering of local ecological knowledge among experienced fishers in thirty-two sites.

In the delta there is no fishing from July to August, which corresponds to the monsoonal or flooding season. In general, the greatest abundance and yield of Hilsa is from October to May. The coastal zone shows a consistently high yield throughout the year. This zone is characterized by adult fish rather than by juveniles. Juveniles are observed inland as well as large-sized individuals (probably breeders).

Along the Patheingyi River, abundance is highest and largely constant at the mouth of the river. Abundance decreases with distance from the sea, as does the size of individuals. Large individuals migrate upstream in the first half of the year, whilst smaller individuals migrate upstream during the second half.

Along the Ayeyarwady River, four patterns of Hilsa abundance and distribution were identified:

1. High abundance near the river mouths and in larger estuaries. Hilsa is found throughout the year in these areas.
2. Away from the coast and in smaller estuaries and rivers the abundance is low, and diminishes in proportion to the distance to the coast.
3. Dedaye and Twantay Townships feature a high abundance compared to other estuarine sites. The corresponding Toe River and Twantay Canal (linking the Toe River to the Yangon River) are two important migration routes.
4. Upstream of the confluence of the Ayeyarwady and Toe Rivers, Hilsa abundance is consistently high up to Hinthada, and then suddenly drops.

Hilsa breeding sites were identified in 15 out of 32 locations surveyed, with the largest breeding site found around Hinthada Township, which is located 230 to 310 km from the sea. The section centred on Hinthada and stretching from Zalun to Monyo is the most important Hilsa breeding zone in the Ayeyarwady system.

The study indicates that the Ayeyarwady mainstream is the most important migration route to upstream breeding sites. However, the important contribution of the Toe River and Twantay Canal should be noted. It is the convergence of these three migration routes that probably contributes most to breeding and sustainability of the stock.

This study is a preliminary step towards a better understanding of the Hilsa ecology and exploitation in Myanmar. A number of knowledge gaps still exist and further research is required, so that the DoF can implement protection and regulation measures to ensure a sustainable exploitation of the Hilsa fish resource in the future.

Recommendations

1. Given the importance of the convergence of the Toe River, Twantay Canal and the mainstream of the Ayeyarwady to migration and breeding of the Hilsa, this site should be a priority location for protection and regulation measures.
2. The section of the Ayeyarwady centred on Hinthada and stretching from Zalun to Monyo is the most important Hilsa breeding zone and should also be considered a priority location for protection and regulation measures.

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Acronyms used

BOBLME	Bay of Bengal Large Marine Ecosystem
BOBP	Bay of Bengal Programme
CDZ	Central Dry Zone
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
LOA	Letter of Agreement
RAP	Region Asia-Pacific

1. Introduction

Hilsa (*Tenualosa ilisha*) is a major fishery resource in the Bay of Bengal (Raja 1985). The stock of this migratory species is shared between multiple countries and this anadromous species breeds inland, where it migrates up to 1,200 km up rivers for spawning (Motwani *et al.* 1957, Karamchandani 1961).

Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project. Identifying distribution patterns, migration routes and breeding sites in each country, in order to implement adequate management measures is essential to the sustainability of the resource. According to BOBLME (2010), in Myanmar, *“there is limited information on the Hilsa fishery and no scientific studies on the species or its habitats were reported. Thus the knowledge base to undertake management of the fishery in Myanmar appears limited. This limits the scope of any management plan.”*

The present collaboration between BOBLME and WorldFish/Department of Fisheries (DoF)/MYFish will fill a knowledge gap about Hilsa in Myanmar. It is based on systematic and structured gathering of local knowledge, and focuses on seasonal abundance, geographic distribution and identification of inland Hilsa breeding sites in the Ayeyarwady Delta, along the Ayeyarwady River in the Central Dry Zone, and in adjacent rivers.

This research will contribute to Component 2 of BOBLME: Coastal/marine natural resources management and sustainable use, in particular its sub-component 2.3. Collaborative regional fishery assessments and management plans. It will also complement the project *“Procedures and methods for continuing assessment of the status of the Hilsa resources in Myanmar”* (BOBLME, 2014) by providing information on spawning sites and migration extent, which is not covered by the LOA/RAP/2012/36 project and is necessary to ensure access management at critical sites. Lastly, this research will contribute to a better understanding of connectivity between Hilsa marine stocks and inland reproduction sites ensuring the sustainability of these stocks.

This report details the methodology used; the Hilsa seasonal abundance and fish size patterns in 32 locations; the breeding sites in 12 townships; and the overall Hilsa migration patterns. Since this study is based on local ecological knowledge and the experience of fishers in each township, it does not include information about Hilsa when fishers do not fish, especially during the monsoon season.

This study will be updated during 2015 with the analysis of the migration patterns and breeding sites of 30 additional migratory species; the integration of additional study sites along the Yangon and Sittaung Rivers; and an analysis of factors that can explain the Hilsa migration and distribution patterns.

Hilsa in a nutshell

Tenualosa ilisha is found in marine, brackish and freshwater environments. This pelago-neritic fish is known for its long-distance anadromous migrations and its high commercial value. Hilsa's maximum length reaches 60 cm. It is distributed along the coasts of the Indian Ocean, from the Arabic peninsula to Thailand and Northern Indonesia.



***Tenualosa ilisha* and its distribution range (in red).** (Photo E. Baran and FishBase/Aquamaps)

Hilsa schools in coastal waters and ascends rivers for as much as 1200 km, although migration can be restricted by dams. This species is a fast swimmer, covering up to 70 km in one day. In the Ganges and other large rivers, there seems to be permanent river populations that do not descend to the sea any longer.

Hilsa breeds mainly in rivers, although younger fish may breed in the tidal zone of rivers. The main breeding season is during the southwest monsoon, and also during a shorter season, from January to February or March. The average length at maturity is 41.5 cm, but mature individuals of 36 cm, and sometimes 19 cm, have been found. Artificial propagation has been partially successful in India.

Hilsa feeds on plankton, mainly by filtering, but apparently also by feeding on muddy bottoms.

2. Methodology

2.1. Approach

The study's approach is recommended by Johannes (1981), Johannes *et al.* (2000), Rahman (2000) or Moller *et al.* (2004). This approach was conceptualized and methodologies were detailed for tropical fisheries in Johannes *et al.* (1989) and Haggan *et al.* (2003). Comparison of findings originating from local ecological knowledge questionnaires and from catch data were tested by Poizat and Baran (1997) and Ticheler *et al.* (1998); these authors conclude that fishers have a reliable knowledge of fish spatio-temporal patterns, and working with them allows for obtaining a large quantities of reliable data at a limited cost and can provide reliable information for more detailed or targeted assessments.

Ecological assessments based on fishers' knowledge were largely used in the Mekong (Chhuon Kim Chhea 2000, Baird and Overton 2001, Dubois 2005, Baird 2007, Chan Sokheng *et al.* 2008, Baran and Seng Sopheak 2011). Using fishers' knowledge was at the centre of a large-scale project implemented by the Mekong River Commission that aimed at identifying fish migrations throughout the Mekong Basin (Poulsen and Valbo-Jørgensen 1999, Poulsen *et al.* 2000, Valbo-Jørgensen and Poulsen 2000, Bao *et al.* 2001).

The methodology used for this study is largely derived from the methodology developed for the Mekong River Commission by Poulsen and Valbo-Jørgensen (2000). It was simplified to some extent since this study does not involve many species, nor systematic GIS mapping, nor market surveys. The detail of the methodology is detailed in **Appendix III**, the questionnaire in **Appendix IV**, and the flipcharts used during the survey (gears and species) are provided in **Appendix V** and **Appendix VI**.

2.2. Area studied

Upstream of the delta tip, the survey included:

- Katha on the Ayeyarwady River because Hilsa had been recorded up to Mandalay (during a July 2013 MyFish scoping mission)
- Kalewa on the Chindwin River because fishers in Mandalay mentioned the presence of Hilsa in that River

Thus, three main migration routes were covered: Patheingyi River, Ayeyarwady River in the delta, and Ayeyarwady River in the Central Dry Zone (the latter including a section of the Chindwin River; **Figure 1**).

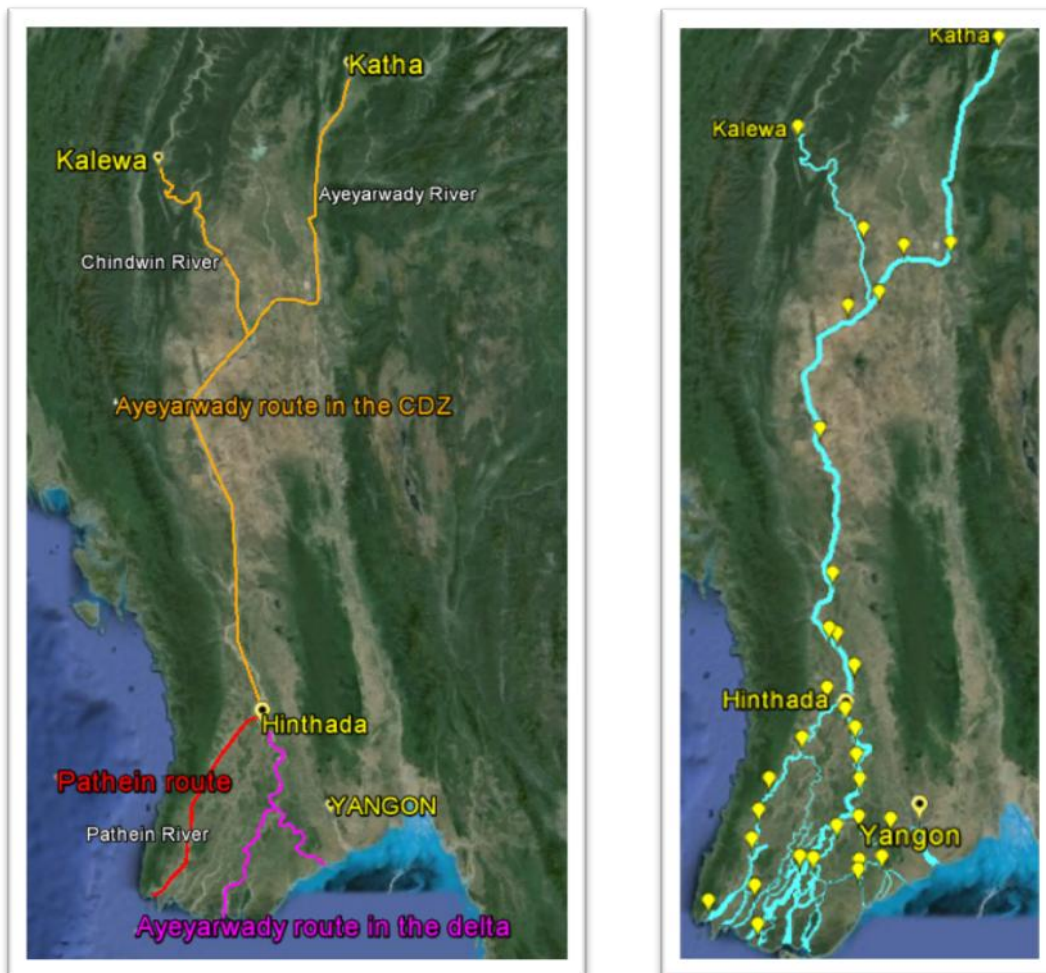


Figure 1 Migration routes surveyed and survey sites

Thirty-two sites covering all the major rivers of the delta and the main rivers of the Central Dry Zone were surveyed between December 2013 and December 2014 (**Figure 2** & **Figure 3**).

The number of sites sampled is a compromise between an extensive coverage of the delta and the budget available. In each township or site, the survey was conducted only once. It did not have to be seasonally repeated since fishers reported generic annual migration patterns and locations of breeding sites that do not substantially change over years.

The information collected was entered using digital tablets, a novel methodology that resulted in a peer-reviewed publication (Tezzo *et al.* 2014).

2.3. Fishers survey

In each site, the survey was organized through the local DoF. Interviewees were senior fishers with at least 10 years' fishing experience and 5 years' residence in the site surveyed. Each fisher received US\$ 5 to cover time and transportation costs to the interview place. Each interview was conducted with a panel of 5 to 8 fishers, using the questionnaire in **Appendix IV**, and a total of more than 200 fishers were surveyed for the study. When fishers disagreed, the consensus response agreed by most participants was recorded.



Figure 2 Study sites in the Ayeyarwady Delta



Figure 3 Study sites in the Central Dry Zone

2.4. Migration maps

The intensity of migrations in each of the surrounding river mouths or streams was illustrated during each interview using 1, 2 or 3 arrows. This information was presented in a map in Section 3.2 , **Figure 10**.

The number of surveys allowed overlapping answers and cross-checking of the gathered information, in particular in adjacent townships. The overlap about migration patterns in information zones is illustrated in **Figure 4**.



Figure 4 Area of Hilsa migration covered in each survey in the delta

Figure 5 provides background information about the environment surveyed, in particular the width and depth of the different rivers of the delta.

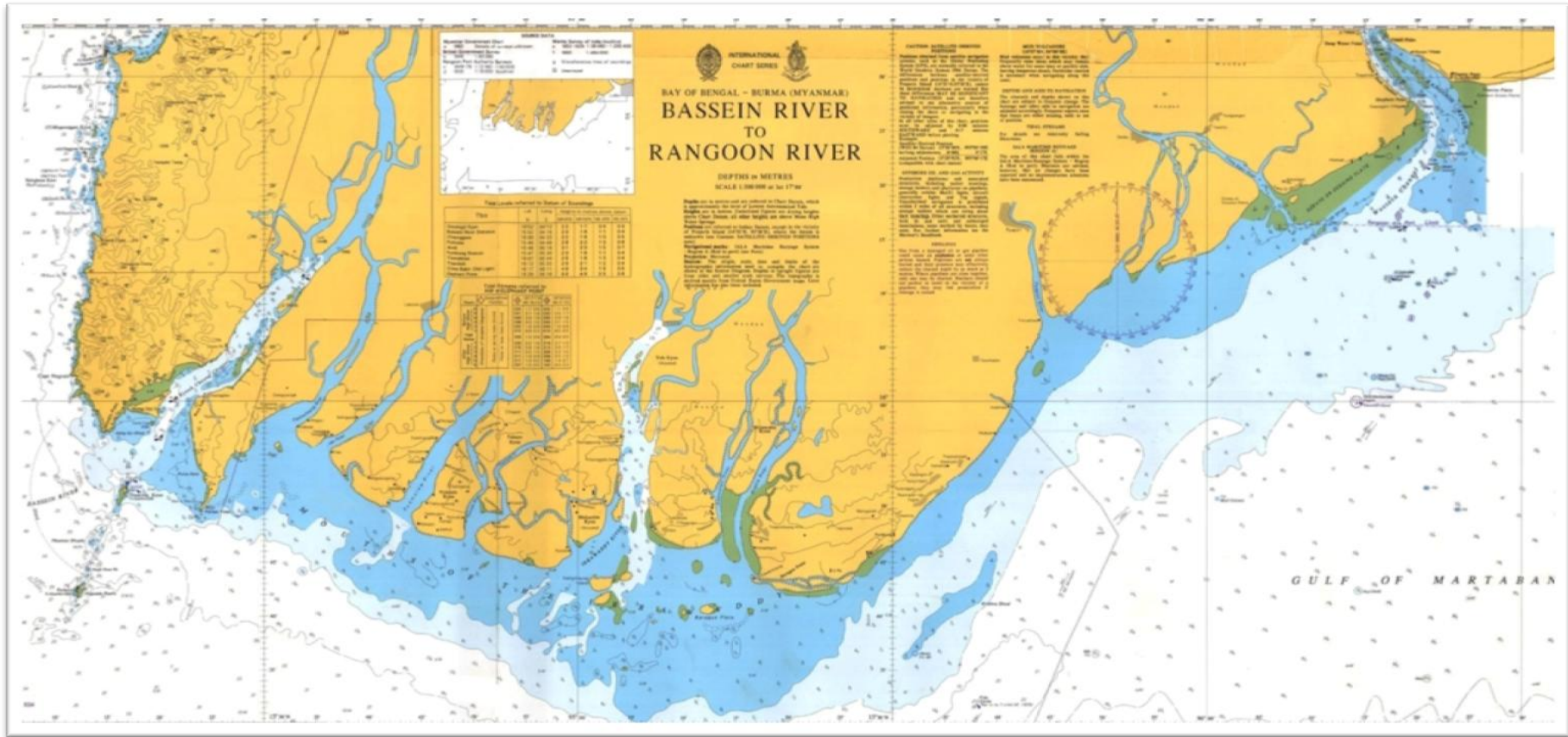


Figure 5 Water depth in Ayeyarwady River

Source: excerpt of an International Chart Series navigation map.

2.5. Data analysis

Abundance data are expressed in “viss”, the local weight unit used by all fishers that equals 1.6 kg. Thus, abundance data plotted correspond to viss per fisher and per month. These values reflect the data from past year, and integrate the catch variability among the different fishers taking part in each interview. The year starts in January, although many fishers in the delta consider that the fishing year starts around August or September, after the rainy season. From that perspective, the fishing year could also be seen as spanning from August to July, which would better reflect the December-January continuity.

Averaging was sometimes necessary for the display of fish sizes. During interviews, some fishers stated that two size classes were caught in a given month. In such cases, two points are plotted for that month on the histogram of fish sizes, but the length of the fish icon is adjusted to the average distance between these two points (the two data points remaining part of the graph, see **Figure 6**). Representing two fish classes per month has proven graphically not readable, but the drawback of the alternative representation mode chosen is that two size classes are represented by one fish of an average size, which tends to misrepresent the information available in data. The direction of the fish represents the direction of migration. When this is unknown, it is represented by a question mark, yet the fish icon is placed upwards, which might also influence the reading.

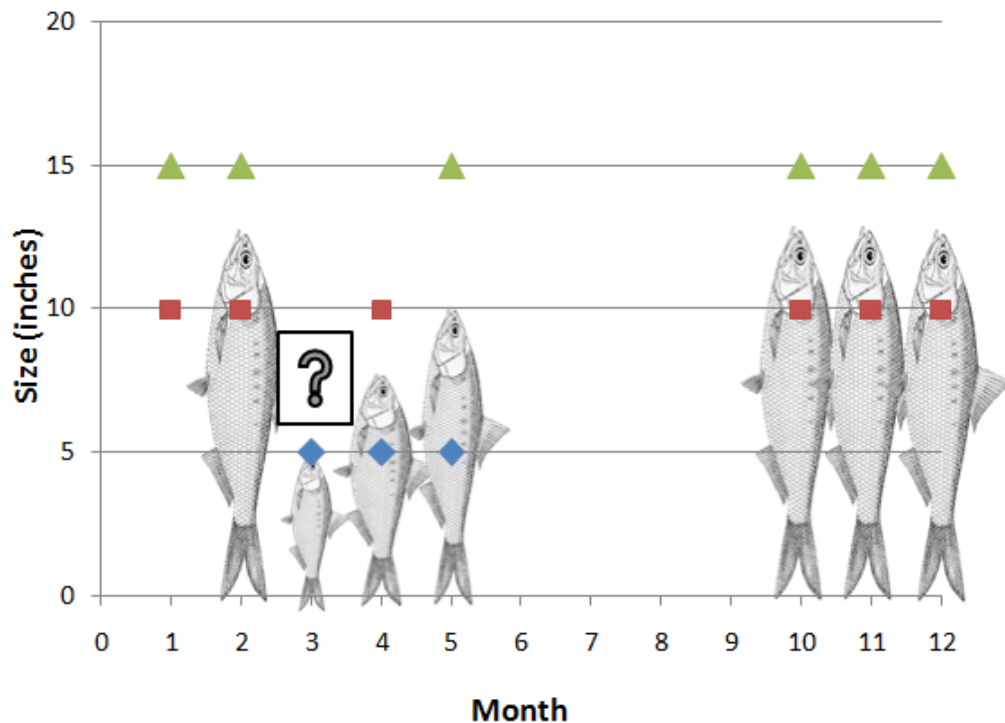


Figure 6 How fish sizes are plotted and illustrated by a fish icon

2.6. Limitations and possible biases of the study

Self-assessment of yield

The validity of self-assessment of catch per month, as reported by fishers during interviews, was not tested during the course of this study. It is a planned activity of the MyFish project during 2015. However, the data is understood to be relatively accurate since: i) answers were anonymous, and catches are not subject to taxes per kilo (it is the gears that are taxed); ii) fishers do know the amount they catch since all the Hilsa catch is sold to middlemen and weighted; iii) questions are about the **daily** catch each month, which does not require integration nor calculation; and iv) experience in the Mekong shows that weight estimates among fishers' households are often quite

precise (Garrison *et al.* 2006). Furthermore, the present study is not focused on absolute yields, but on a comparison of locations and on relative patterns. Therefore, under the assumption that the bias is constant, the comparisons remain valid.

Variable fishing effort

The study involves questions about the catch per month, expressed in viss (a local weight unit commonly used in Myanmar; 1 viss = 1.6 kg). However, the amount caught is a combination of fish density and of fishing gear used; it reflects not only the fish abundance but also the dominant fishing gear – and their size – in a given area. Since the fishing capacity per fisher is not constant throughout the study (fishers by the sea tend to be more professional and have more equipment), the variable fishing effort is an uncontrolled variation factor between surveys, and may bias the comparison of catches throughout the study area.

3. Summary of results

We propose below a graphic presentation of results, with a succinct commentary for each migration route. Detailed analyses of catches and migrations can be found in **Appendix I**.

Common to all sites is that the July–August flood season is characterized by no fishing. From the data and from fishers' interviews, it is difficult to determine whether the lack of fishing is due to the absence of fish, to their low catchability, or to environmental conditions that do not allow fishing at that time of the year.

Fishing resumes in October (considered as the beginning of the fishing season) and is active until June, although there is large variability of these months depending on location. Overall, October–May has the greatest abundance and yield of Hilsa.

3.1. Hilsa abundance patterns along the Pathein route

Along the Pathein route (i.e. Pathein River, also called Ngawun River), Hilsa abundance is extremely high at the mouth of the river, where fishers catch up to 1,400 kg per day. This pattern can be explained by the larger boats that fish at sea and operate at a larger scale than those in the rest of the delta. In the river mouth, the abundance of Hilsa is almost constant year round (except in July–August).

Abundance decreases with the distance from the sea, where Hilsa abundance is ten times lower inland than at the mouth of the river (**Figure 7**). Approximately 30 kg/fisher/day are caught during more than half of the year in Ngapudaw, compared with only a few kg/fisher/day during three months around Ingapu (which is located 350 km away from the sea).

Hilsa occurrence patterns also change with distance from the sea: the species is quasi-permanent in the mouth of the river and becomes progressively limited toward the September–November period.

The pattern of fish sizes along the Pathein River indicates a permanent presence of adults at the mouth, a concentration of larger individuals around Pathein (to be confirmed by a complementary survey), and then a restriction to small individuals and juveniles upstream of Pathein (**Figure 8**).

Fishers indicate that large individuals migrate upstream when the water level is high, but cannot migrate back in the dry season because the river is then too shallow. Interviewees assume that these large individuals migrate back downstream by the Ayeyarwady route.

Overall, that data indicates that large individuals migrate upstream in the first half of the year, whilst smaller individuals migrate upstream during the second half.

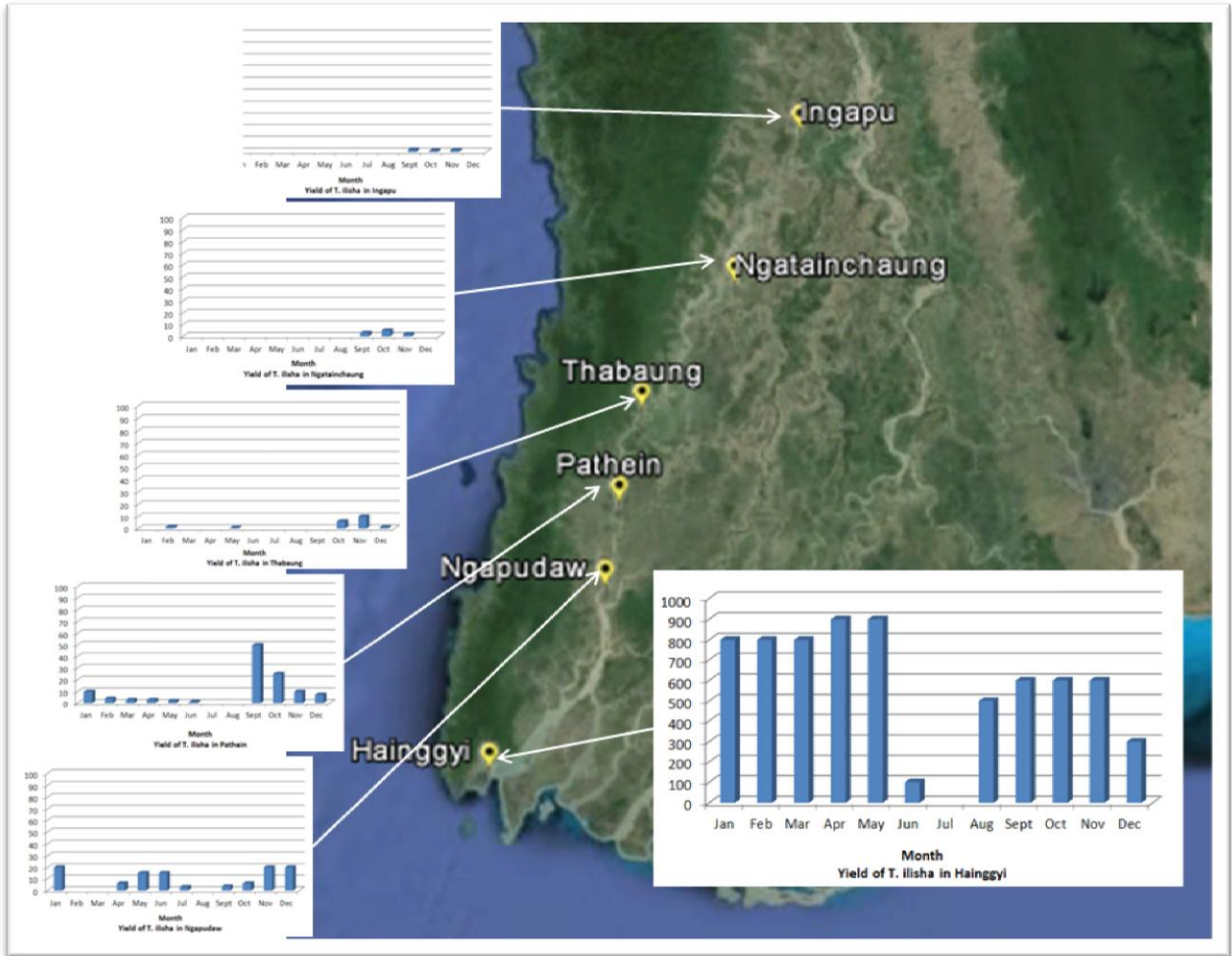


Figure 7 Spatio-temporal patterns of Hilsa abundance along the Patheingyi River

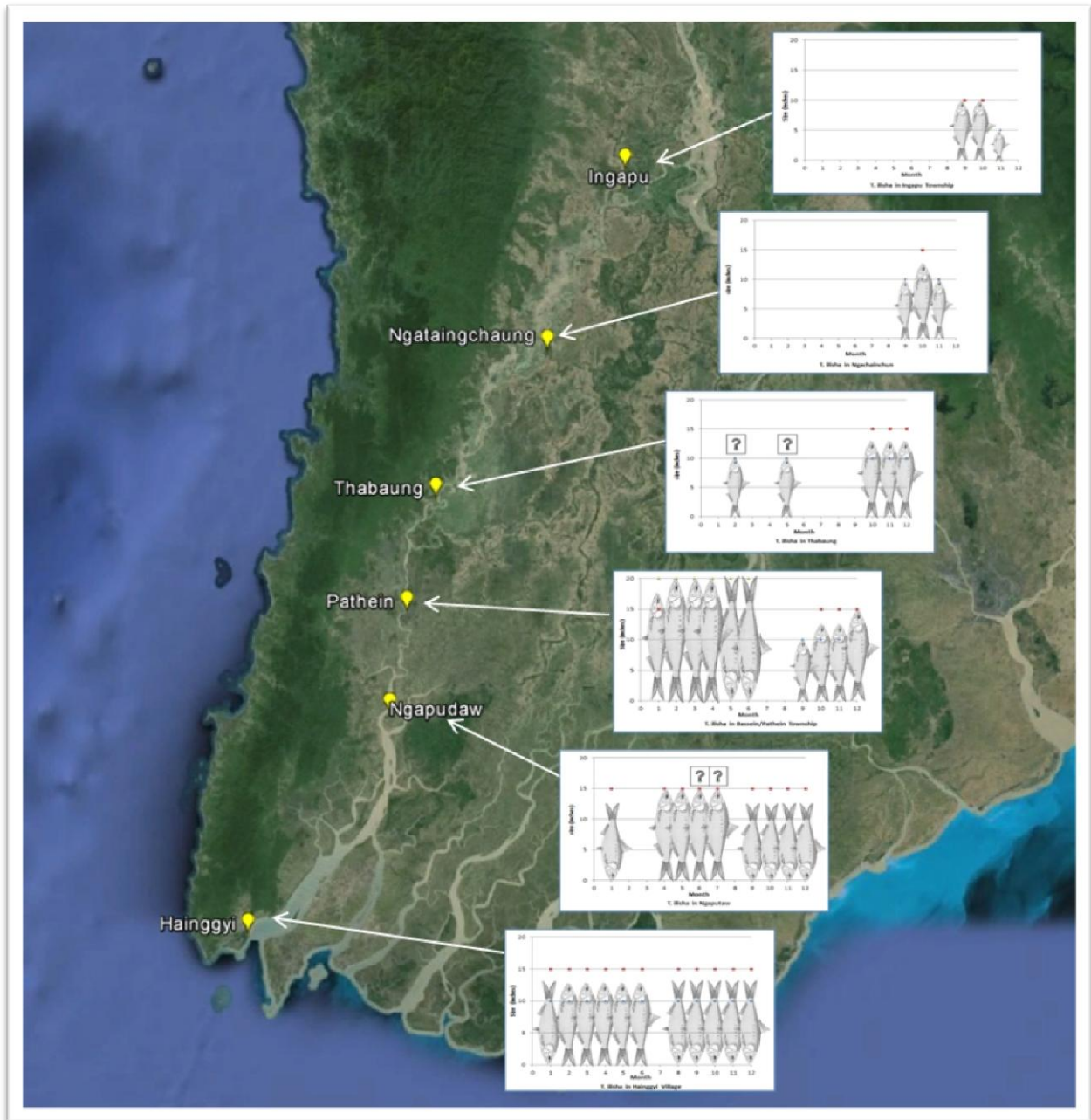


Figure 8 Spatio-temporal patterns of Hilsa size and migration direction along the Patheingyi River

3.2. Hilsa abundance patterns along the Ayeyarwady route in the delta

In the delta, four patterns of Hilsa abundance and distribution were identified (Figure 9):

- A. Relatively high abundance along the coast and in estuaries those are large and close to the river mouths. This applies to Pynzalu, Labutta, and Bogale (the latter site being 60 km away from the coast and the most distant of the three sites). In these sites, Hilsa is found either year round (in Pynzalu, the site closest to the sea), or more specifically in January–April and September–December. In all these sites, fish are not found/caught during the wet season (June–July).
- B. In sites that are not on the coast and located along smaller rivers, the abundance is low, and diminishes in proportion to the distance to the coast (and possibly due to the narrowness of the river). This is the case in Mawgyun and Wakema (respectively on Myngagon and Shwelaung Rivers), but also in Pyapon and Kyailat (both on the Pyapon River, known for its

limited fish abundance). In these sites, the relationship between fish abundance or occurrence and river size and discharge is to be explored further, when detailed hydrological data become available.

- C. Two sites display high and specific Hilsa abundance patterns: Dedaye (on the Toe River) and Twantay, linked to the Yangon River by the Twantay Canal. In these sites, the fish abundance is 2–4 times higher than in the other estuarine sites close to the sea (and in Dedaye in particular, the species is present and caught year round). Fishers indicate that the Toe River and Twantay Canals are two important migration routes that contribute to the abundance of fish in the Ayeyarwady River upstream of Yandoon.
- D. Upstream of the confluence of the Ayeyarwady and Toe Rivers (i.e. Yandoon, Danubyu, Zalun), Hilsa abundance is consistently high up to Hinthada, then suddenly drops (see abundance patterns in the CDZ). This pattern confirms the fishers' claim that Hilsa fish migrating up the Ayeyarwady River (the largest and deepest of all rivers of the delta, see **Figure 5**) are joined by other fish coming from the Yangon River via the Twantay Canal, and from the Gulf or Martaban via the Toe River. Along this Ayeyarwady route, fish tend to be more abundant from October to March–April, and are absent during the wet season.

Maubin is an outlier. The convergence of the Ayeyarwady and Toe Rivers results in a rather steady abundance pattern at Maubin. The species is caught nine months out of twelve, which is more than in most other inland sites. However, this site was expected to reflect the abundance of fish found in Twantay and Dedaye, but in fact Hilsa abundance in Maubin is not high. This calls for a re-assessment of Hilsa abundance patterns in Maubin.

Overall, the Ayeyarwady mainstream, complemented with the Toe River, is the main migration route for Hilsa up to Hinthada. The most common temporal pattern is the presence of Hilsa from September to January (extending, depending on location, up to April or May).

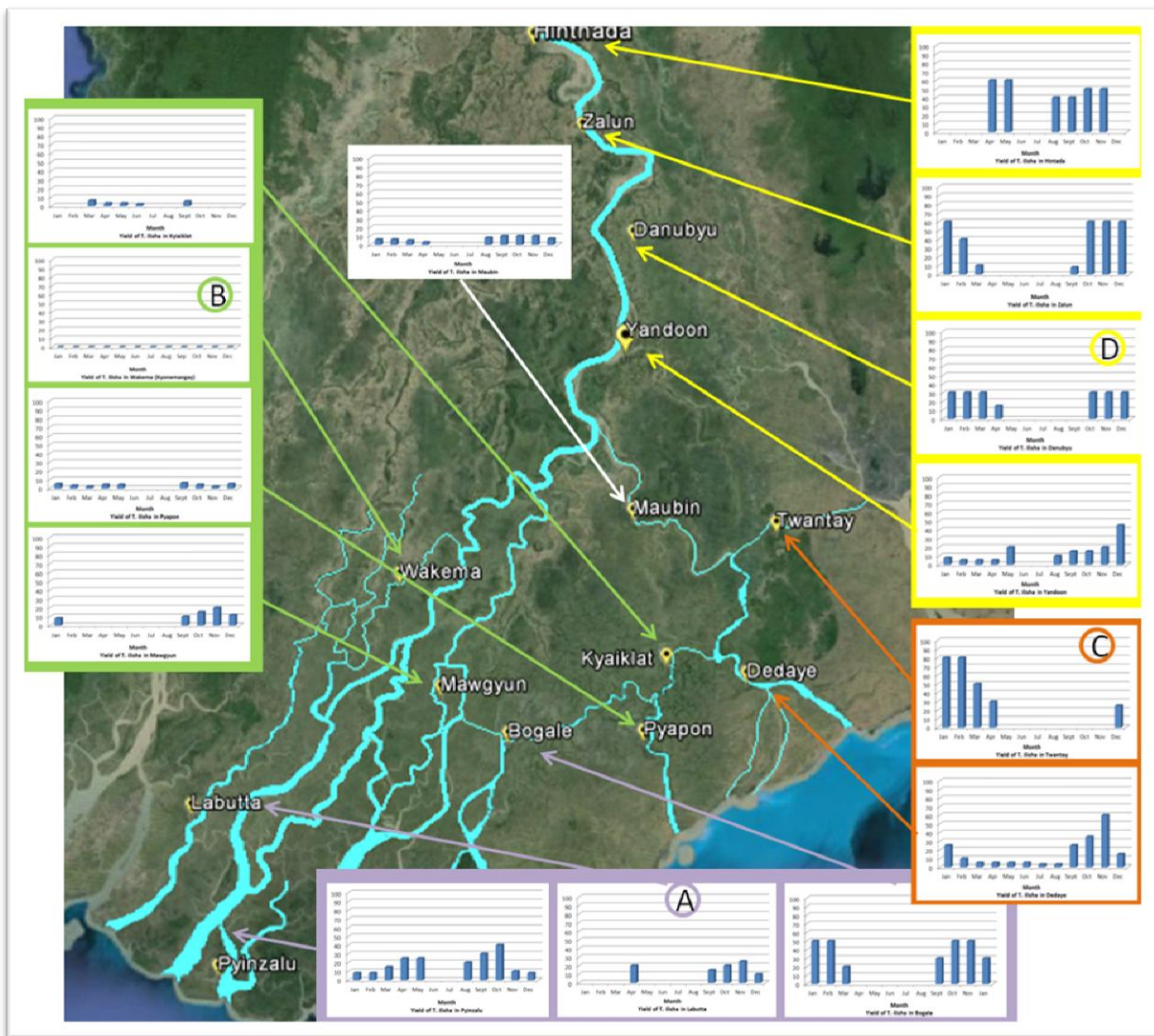


Figure 9 Spatio-temporal patterns of Hilsa abundance along the Ayeyarwady route in the delta

3.3. Hilsa fish sizes along the Ayeyarwady route in the delta

When fish sizes and directions of migration are examined in relation to the four patterns of Hilsa abundance and distribution described in Section 3.2 above, patterns are less clear. Only a few survey sites allowed the identification of juveniles, although fishers do identify breeding sites and the seasonal presence of small young fish in multiple locations. The absence of juveniles in data might reflect a fishery selectivity issue.

The main patterns of fish size along the Ayeyarwady route are (Figure 10):

- a quasi-permanent presence of young adults along the coastal zone (Pyinza, Dedaye), like in Hainggy in the Patheingyi River. These fish tend to migrate upstream between September and March, and downstream during the rainy season;
- smaller sizes of fish (i.e. juveniles) towards the centre of the delta, possibly in relation to the smaller size of rivers;
- the special importance of the Ayeyarwady River between Yandoon and Hinthada, with the number of adults and breeders higher than in other parts of the delta, and a concentration of young adults around Yandoon and Danubyu. Yet, like in Patheingyi River and in the rest of the delta, the size of fish seems to diminish as one moves upstream.
- in all cases, fish tend to move upstream between September and April–May.

- Maubin is again an outlier that exhibits a pattern of fish sizes that does not match either the downstream or the upstream patterns.

These observations call for a deepening of the study in Maubin, but also its extension to the Yangon and Sittaung Rivers (numerous fishers mention the Sittaung River as being significant to Hilsa migrations in Myanmar).

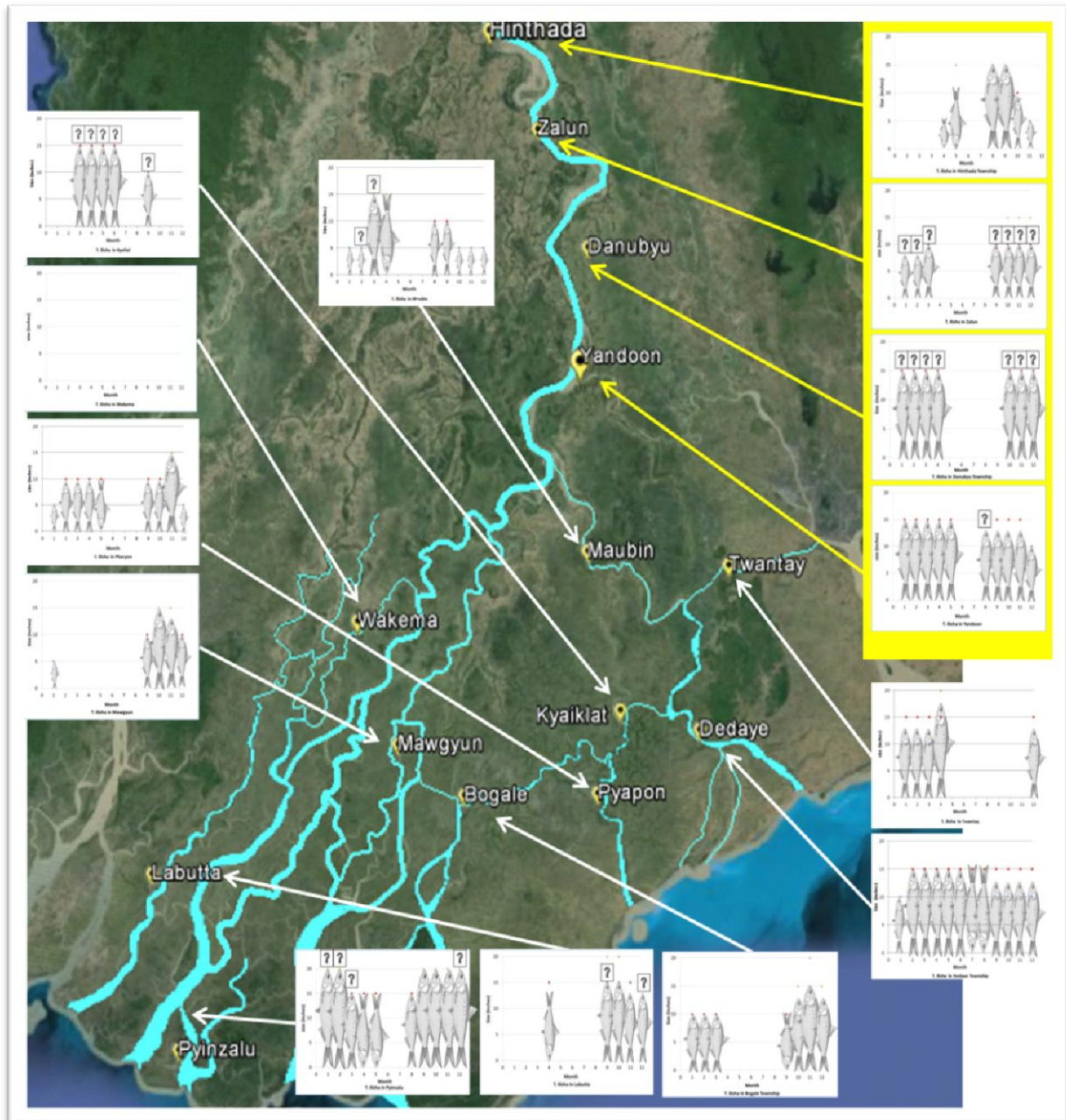


Figure 10 Spatio-temporal patterns of fish size and migration direction along the Ayeyarwady River in the delta

3.4. Hilsa migrations abundance patterns and fish sizes along the Ayeyarwady route in the Central Dry Zone

Two peaks of abundance, one in September–October, and the other one in March–April, characterize the latter site, like many other sites of the delta (**Figure 11**). A contradiction can be noted between the substantial Hilsa abundance in Myanaung and the quasi-absence of that species in Kyangin, although the two sites are only 10 km apart. This may be related to the presence of Hilsa breeding sites in Myanaung but not in Kyangin, or to different access rights among fishers.

In other sites, Hilsa is present but is only an incidental catch and not subject to a specific fishery. Although limited all over the upper part of the Central Dry Zone, Hilsa abundance and the number of months of presence are higher downstream than upstream.

The analysis of fish sizes does not exhibit clear patterns, which might reflect either the rarity of that fish (not enough individuals to constitute significant size cohorts) or a more limited ecological knowledge about a species that is not very common. The direction of migration is also unclear, with a few indications of fish moving upstream of Pyay and Pakokku, and a lot of uncertainty among answers (illustrated by a question mark in graphs) (**Figure 12**).

Based on the claims of some fishers, one can hypothesize the existence of a – limited – freshwater population of Hilsa that would complete its life cycle within the Central Dry Zone. This hypothesis is credible given the existence in Bangladesh of several sub-populations (Rahman and Naevdal 2000). The “inland” population would temporarily meet, in October–December and February–May, between Hinthada and Kyangin, a second population of migratory individuals coming from the sea and ascending the delta. This would be reflected in our data by the presence of larger and more frequent individuals in Kyangin and Monyo at that time of the year.

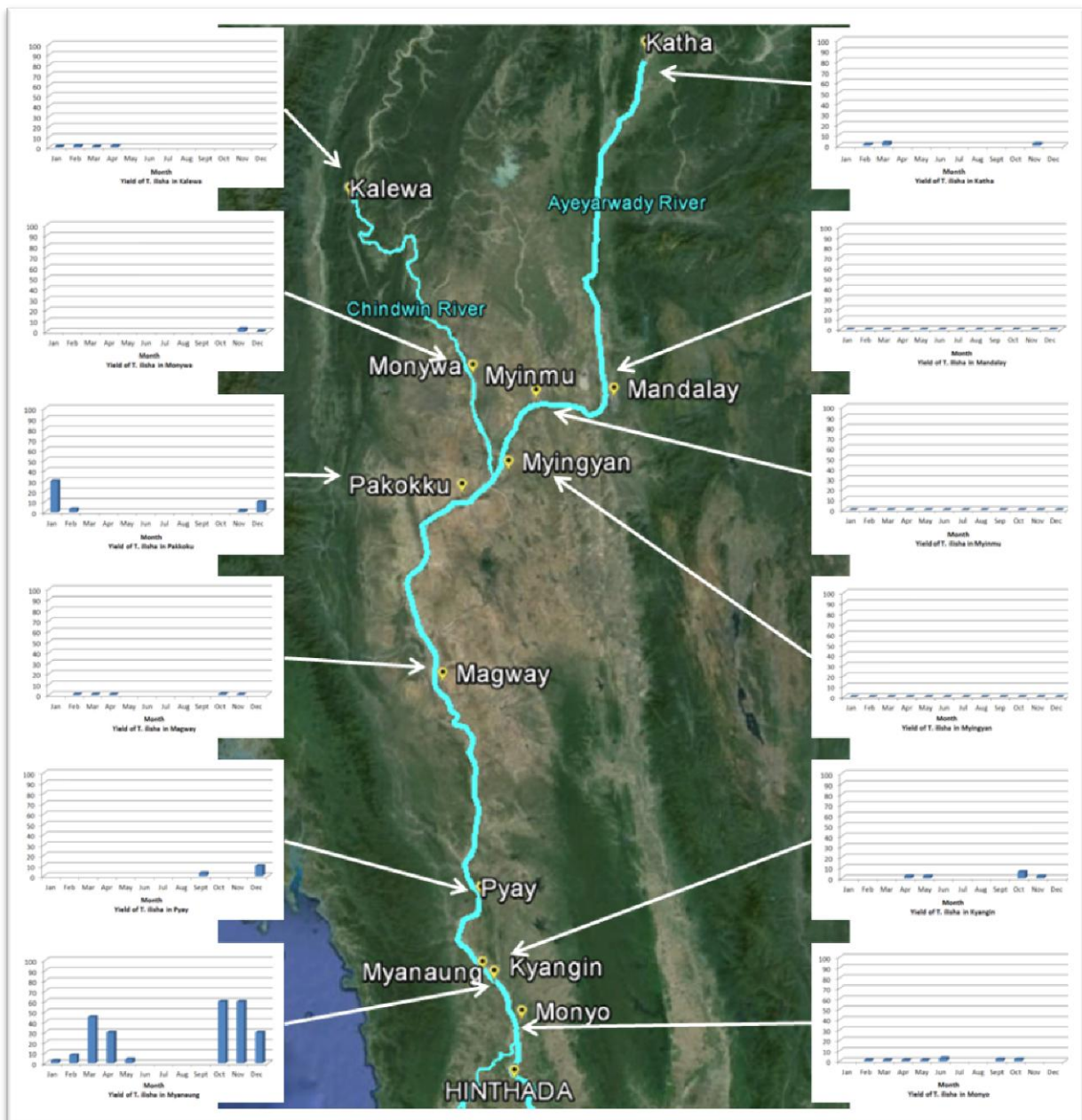


Figure 11 Spatio-temporal patterns of Hilsa abundance along the Ayeyarwady and Chindwin Rivers in the Central Dry Zone

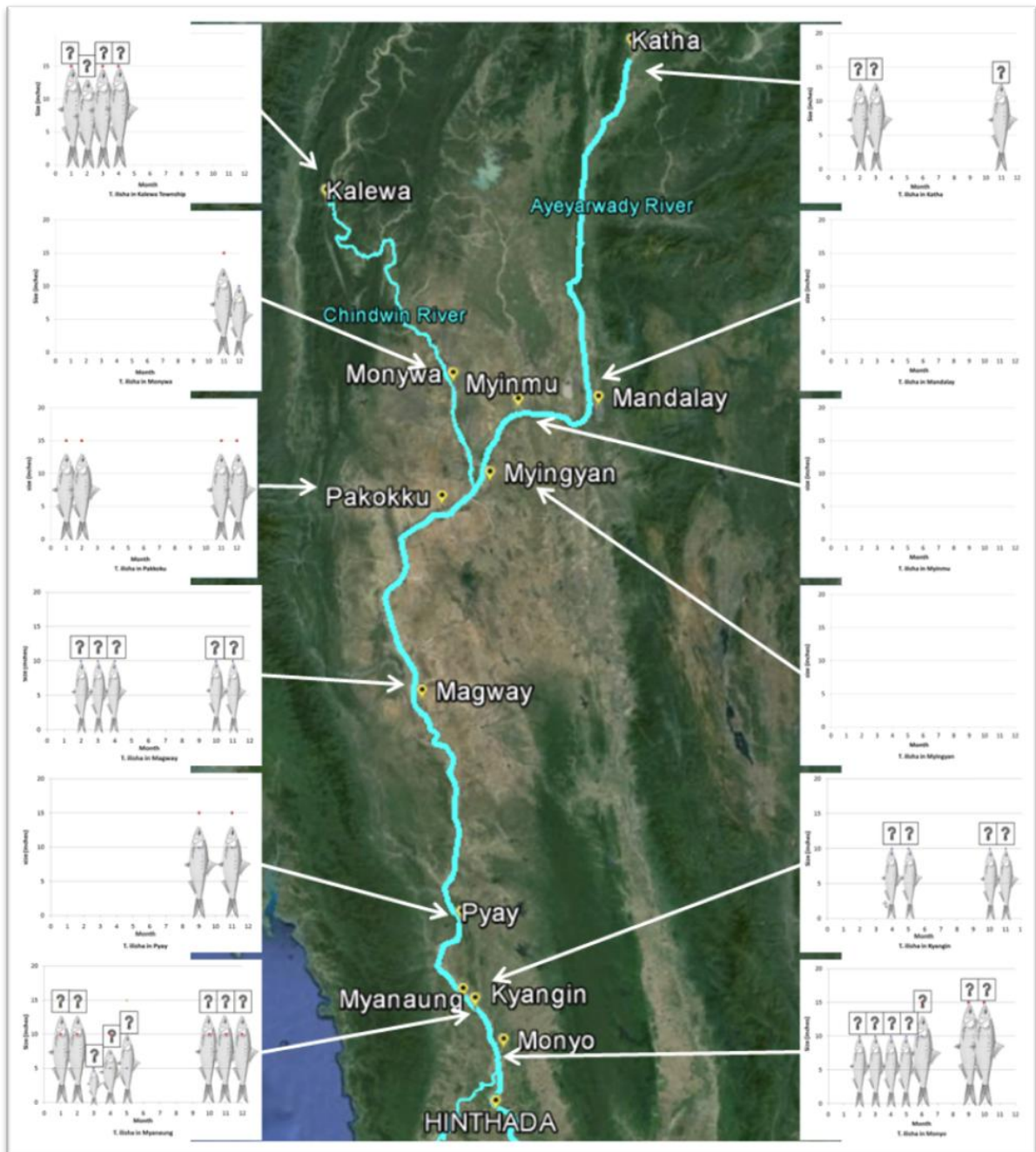


Figure 12 Spatio-temporal patterns of Hilsa fish size and migration direction along the Ayeyarwady and Chindwin Rivers in the Central Dry Zone

3.5. Hilsa breeding sites in the Ayeyarwady system

Hilsa breeding sites were identified in 15 out of 32 locations surveyed (Figure 13). In the Ayeyarwady system, Hilsa breeding sites are found:

- in the centre of the delta, 25 to 130 km from the sea, in Wakema, Labutta and Yandoon Townships;
- along the Toe River, in Twantay and Maubin Townships;
- along the Pathein River, in Thabaung and Yegyi (Ngatainchaung) Townships;
- along the Ayeyarwady mainstream, in a large continuum centred on Hinthada and stretching over 80 km, from Zalun to Monyo Townships and including Ingapu;
- in the Central Dry Zone, in small and disconnected sites located in Myanaung, Magway, Pakokku and Monywa Townships.

The largest breeding site is found around Hinthada Township. It is located 230 to 310 km from the sea, stretches over 80 km and includes shallow sand banks in the mainstream and nearby floodplains. This zone is also a breeding area for 10 other species: *Catla catla*; *Cirrhinus mrigala*; *Gudusia variegata*; *Hemibagrus microphthalmus*; *Labeo calbasu*; *Pangasius pangasius*; *Rita rita*; *Silonia silondia*; *Sperata aor* and *Wallago attu*.

Interviewees indicated that Hilsa breeding takes place in March–April in 10 out of the 15 locations in which breeding sites were identified. In Wakema, Zalun, Pakokku, and Myanaung, breeding is said to happen in January–February. Ingapu is the only site where Hilsa breeding is supposed to take place in December–January. These discrepancies need to be explored further.

After this exploratory assessment, it is recommended to undertake specific studies in the sites identified in order to confirm or adjust the information gathered, and to check the timing of breeding.

At this stage, it is clear already that the Ayeyarwady section centred on Hinthada and stretching from Zalun to Monywa is the most important Hilsa breeding zone in the Ayeyarwady system; it is also significant to several other migratory species. This area should be considered a priority for resource management and protection initiatives.

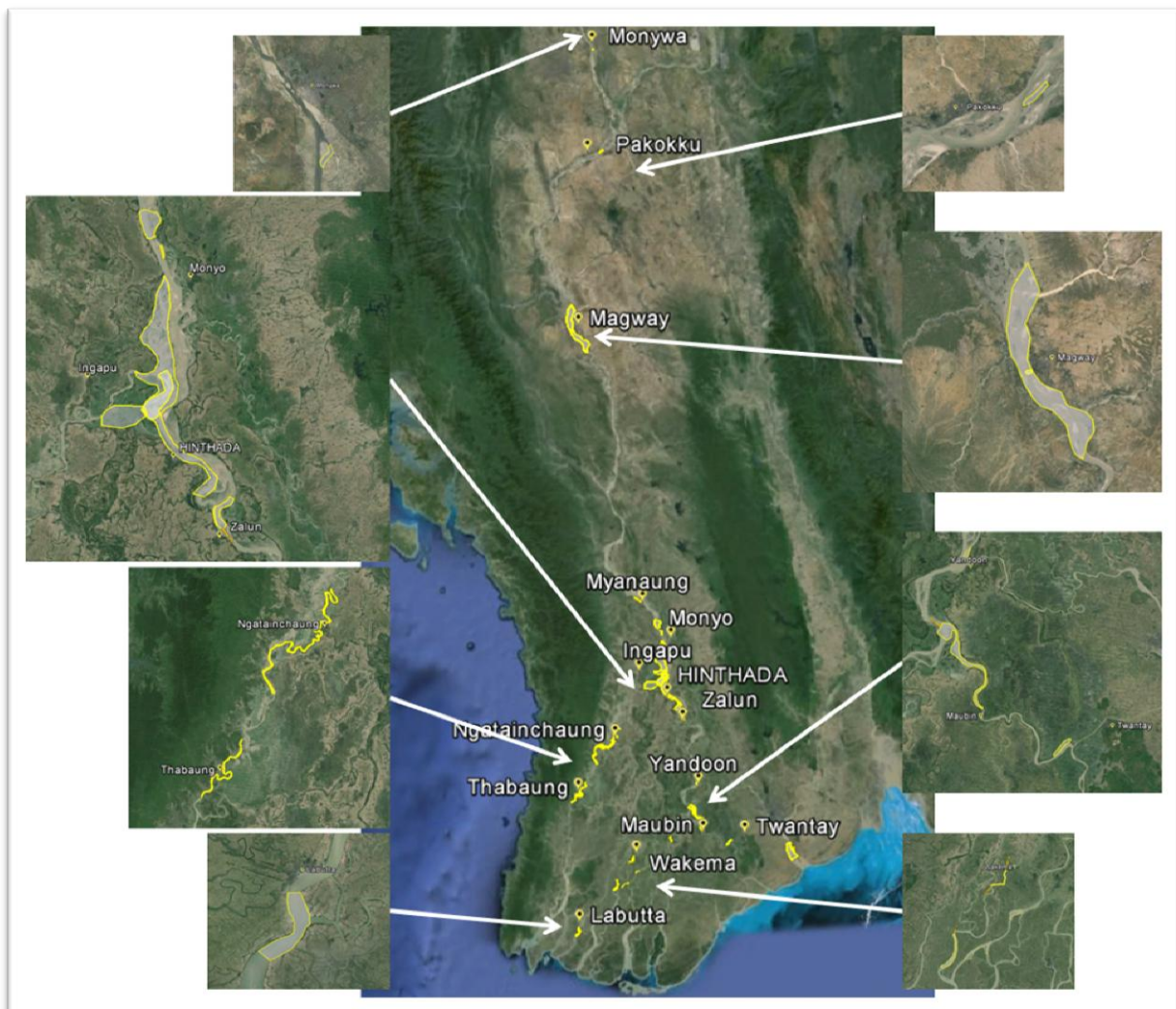


Figure 13 Distribution of Hilsa breeding sites along the Ayeyarwady system (highlighted in yellow)

3.6. Overview of Hilsa migrations in the Ayeyarwady Delta

A combination of the local and relative migration maps described in and in **Appendix I** allows generating a composite qualitative map of migration intensity in the delta.

According to the descriptions of fishers in the various sites of the delta, Hilsa migrations are most intense in the Ywe River, Pyamlaw River, Ayeyarwady River, Bogale River and Toe River (**Figure 14**). They are also important, although less intense, along the Thet Kethaung, Donyan and Thandeik Rivers. Pyinzalu and Pyapon Rivers are not important migrations routes. Hilsa fish are most abundant along the coastal zone at the mouth of the Pathein River, but inland migrations do not seem to be proportional to the abundance of coastal fish, and the intensity of these migrations progressively diminishes upstream (yet a number of fish seems to reach the Ayeyarwady confluence).

The Ayeyarwady River is described as a place of intense migrations and this can be related to the fact that this river is the largest and deepest of all (see **Figure 5**). Discharge most likely plays an important attraction role, but we did not assess hydrological data for the different rivers of the delta.

The survey did not allow for distinguishing migration details upstream of the Ywe, Pyamlaw and Pyinzalu Rivers, but in the area defined by these rivers it seems that Hilsa migrations quickly diminish upstream, in particular when the streams become narrow. This is a point to be clarified, but a couple of migration “dead-ends” around Bogale and Pyapon may confirm it.

The Toe River is an important source of migratory Hilsa for the upper part of the delta. Fish are said to come from the mouth of the Sittaung and Yangon systems, and a more detailed study of Hilsa migration in Myanmar should definitely cover these two estuaries.

Fish migrating from the Ywe, Pyamlaw and Pyinzalu Rivers join those coming from the Toe River and Yangon River via the Twantay Canal, making the Ayeyarwady River between Yandoon and Hinthada a major migratory route. Hinthada is also an important breeding zone for multiple species, including Hilsa (see Section **6.6** in **Appendix I**). Upstream of Hinthada, migrations are very limited and patterns are unclear.

The present analysis does not cover downstream migrations, since fishers are most often unclear about them, and could not indicate detailed downstream migration patterns. Reports indicate in particular cases of simultaneous upstream and downstream migrations in August and September (see Section **6.2** in **Appendix I**).

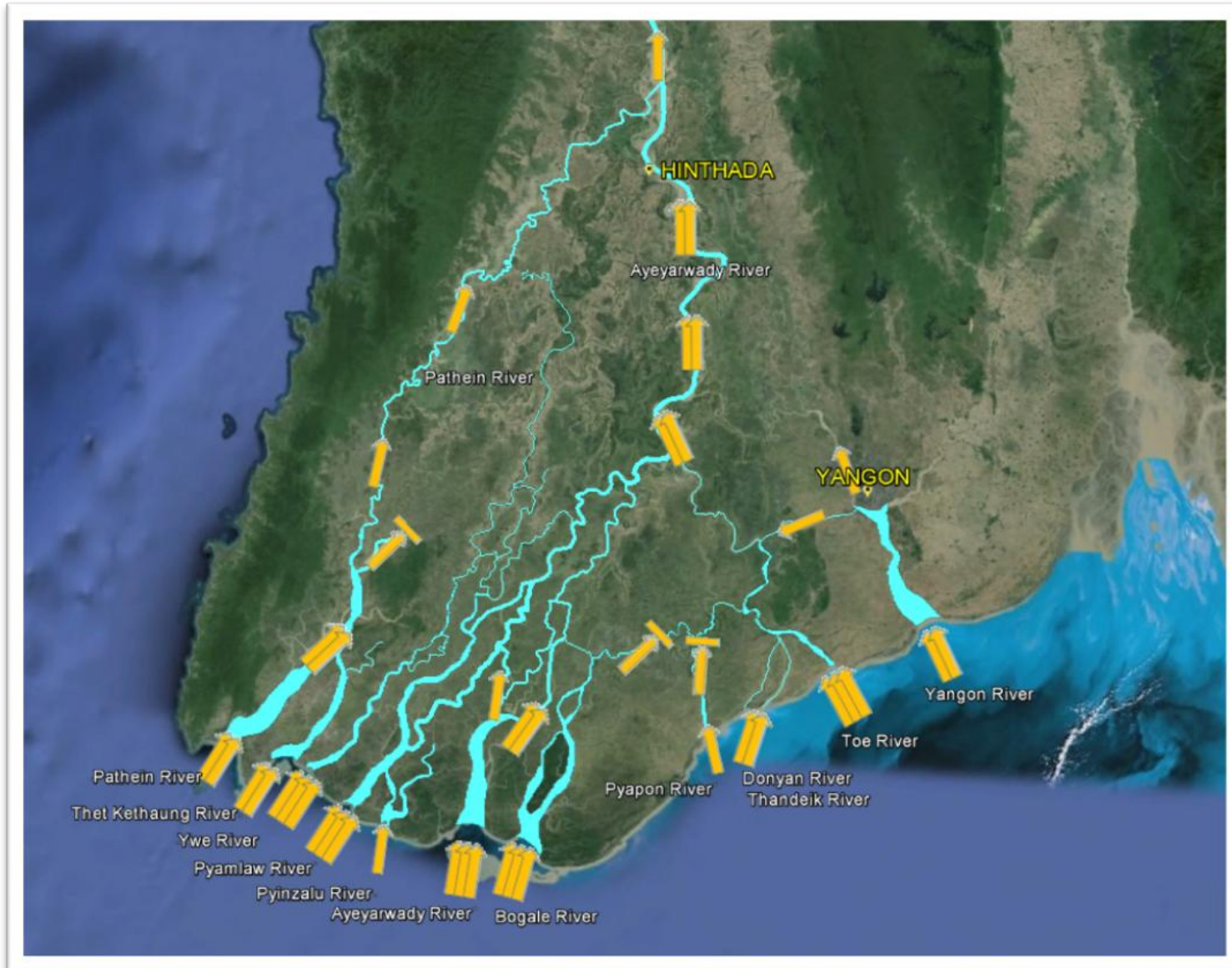


Figure 14 Summary of fish migrations in the Ayeyarwady Delta, according to fishers' responses to the questionnaire

4. Conclusions and recommendations

The study provides initial information about the spatio-temporal distribution and migration of Hilsa (*Tenualosa ilisha*) in the Ayeyarwady Delta. The coastal zone shows a consistently high yield throughout the year except during the monsoon season (June–August). This zone is characterized by adult fish rather than by juveniles. It is inland, in the delta, that juveniles are observed, as well as large individuals (probably breeders). The presence of breeders in some locations is to be confirmed by an additional study; this would complement the identification of breeding sites and support the definition of target conservation zones.

The study does not clearly distinguish whether Hilsa, in some locations, migrates once or twice upstream for breeding. This would require an additional study to monitor the presence of breeders (i.e. individuals with sperm or eggs), for instance on markets or among fish mongers in target locations.

In several instances, the methodology of the study, which surveyed fishers, did not allow for clearly assessing the direction of Hilsa migration; once again, a complementary field study would allow for the identification of the direction of migration in some target sites.

The study indicates that the Ayeyarwady mainstream is the most important migration route to upstream breeding sites. However, the important contribution of the Toe River and Twantay Canal should be noted. It is the convergence of these three migration routes that probably contributes most to breeding and sustainability of the stock.

The study also identified the Yangon River and the Sittaung River as additional sites to be surveyed with the same methodology, since they appear to contribute substantially to the migration patterns and to the overall abundance of Hilsa in the coastal zone.

This study is a preliminary step towards a better understanding of the Hilsa ecology and exploitation in Myanmar. The proposed research would help clarify some points and fill knowledge gaps, so that the DoF can implement protection and regulation measures to ensure a sustainable exploitation of the Hilsa fish resource in the future.

Recommendations

1. Given the importance of the convergence of the Toe River, Twantay Canal and the mainstream of the Ayeyarwady to migration and breeding of the Hilsa, this site should be a priority location for protection and regulation measures.
2. The section of the Ayeyarwady centred on Hinthada and stretching from Zalun to Monyo is the most important Hilsa breeding zone and should also be considered a priority location for protection and regulation measures.

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Appendix I Detailed results

1. Fishing gears used

A review of fishing gears used to catch Hilsa indicates that drift nets are by far the dominant gear (**Table 1**). This gear is used in rivers, but also in paddy fields and in floodplains, when water levels are high enough. Beach seine nets are also used along river banks, in particular to catch juvenile Hilsa fish.

Table 1 Fishing gear used to catch Hilsa

Habitat type	Habitat name	Gears used
Flood plains	Bogale River	Drift net
	Toe River	Drift net
Paddy field	Pyapon Township	Drift net
	Toe River	Drift net
River	Ayeyarwady River	Beach seine net
		Drift net
	Chindwin River	Drift net
	Nga Wann River	Drift net
		Beach seine net
	Toe River	Drift net
	Yangon River	Drift net
	Yarzudaing River	Drift net
	Ywe River	Drift net
	Pyapon River	Drift net

2. Overall directions of migration

A review of the months of beginning and end of upstream and downstream migrations gives the following results (**Table 2**):

Table 2 Months of upstream and downstream migration

Starts migrating upstream	Stops migrating upstream	Starts migrating downstream	Stops migrating downstream
Mar; Aug–Dec	Nov–Jul	Apr–May; Jul–Sep	Jan; May–Jun; Aug–Sep

An illustration of the above table indicates two periods of upstream migration: one in the dry season, around March, and one in the wet season, until the end of the year (August to December) (**Figure 15**). Downstream migration also features two periods: in the dry season, from April to May, and during the wet season, from July to September. Thus, it seems that the wet season, in particular the months of August and September, is characterized by two opposite migration movements. This unclear pattern is not explained and should be confirmed.

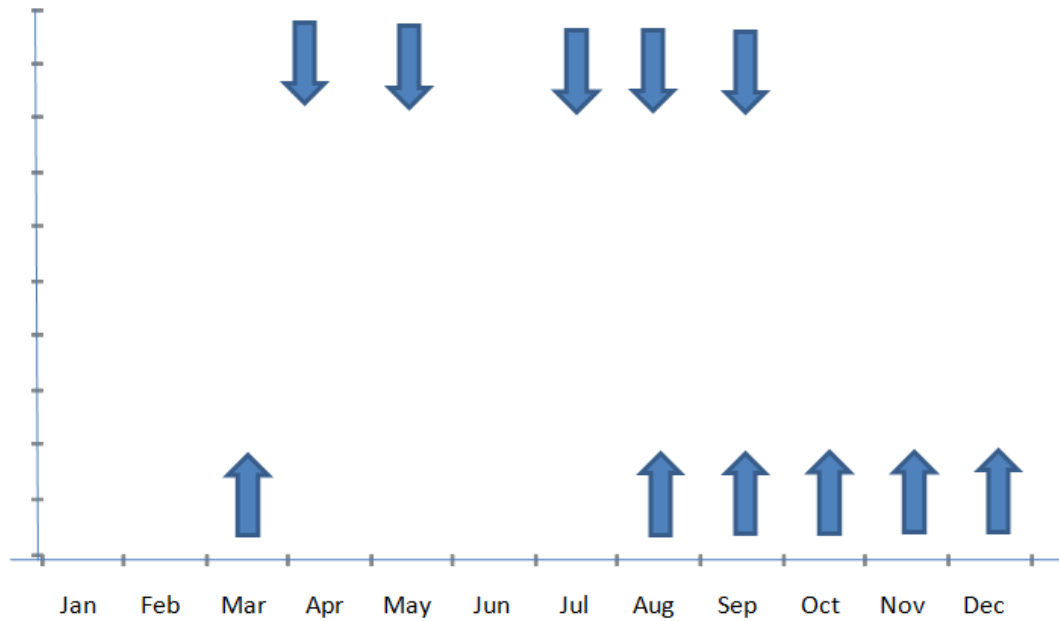


Figure 15 Months of upstream and downstream migration

3. Pathein migration route

3.1. Hainggyi Township

The West Coast Zone is represented by Hainggyi Township. This zone is very interesting because of the **very high yield of Hilsa almost throughout the year**. The township is located in the river mouth. Hilsa is the main target species in this area. These fishers follow fish and fishing areas vary from the Pathein/Ngawun River¹ mouth to the Yangon River mouth. Among the various river mouths of the Ayeyarwady Delta, fishers say that **the Pathein/Ngawun river mouth is where Hilsa schools are most abundant**, with a catch rate higher than in other river mouths.

Hilsa is harvested from August until June of the following year. **The harvest per fisher reaches 100 to 900 viss (160–1,440 kg)**. The harvest peaks in **April and May (1,440 kg)** and sharply decline to 100 viss (160 kg) in June. There is no reported fishing activity in July. The fish caught in Hainggyi are 5–10 inches (13–25cm) and 10–15 inches (25–38 cm) in size. Since the species can still grow up to 20 inches (51 cm), this indicates that the fish caught is likely to be young adults. Fishers report that **Hilsa migrates upstream from February to April** and downstream during other months (**Figure 16**).

¹ Ngawun River is the other name of the Pathein River, and is a name used by most local people.

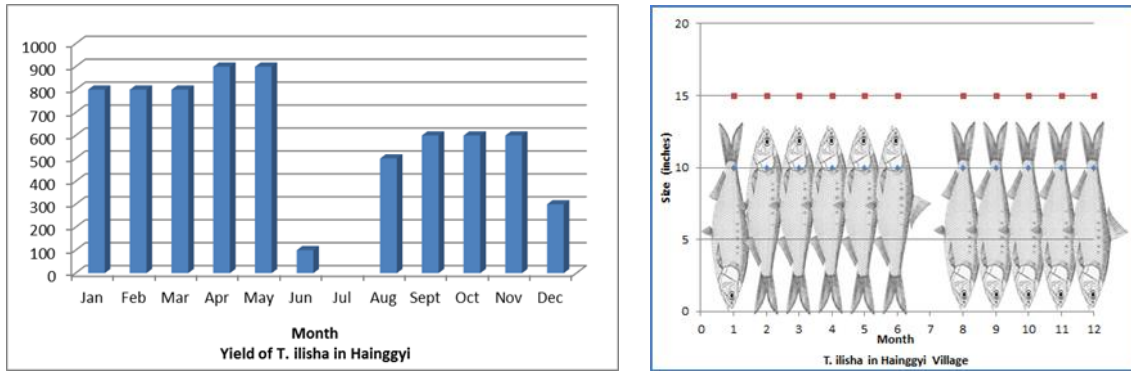


Figure 16 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Hainggyi Township

The relative density of Hilsa migrations around Hainggyi is described in Figure 17:



Figure 17 Relative density of Hilsa migrations around Hainggyi according to fishers' statements

3.2. Ngapudaw Township

The fishing ground is located in the open fisheries area, and corresponds to a brackish zone between February and June (salinity between 2 and 8 ppt). The depth of the river is 8–10 m during summer and 15–18 m during rainy season. Hilsa is the main target species. There are at least 500 fishers operating in this area. **Hilsa is harvested from April to July and from September to January (Figure 18). There two annual peaks in catches: from November to January and in May-June, with a yield ranging between 3 and 20 viss/fisher/month (5 to 32 kg/fisher/month) and the highest yields between November and January. The size of the fish ranges from 10 to 15 inches, the large ones (10–15 inches or 25–38 cm) migrating upstream in April–May, whereas smaller fish (13–25 cm) migrate downstream between September and January. Fishers consider that Hilsa migrate upstream for spawning before the rainy season (June and July). The direction of fish is observed based on the way the fish got entangled in the nets.**

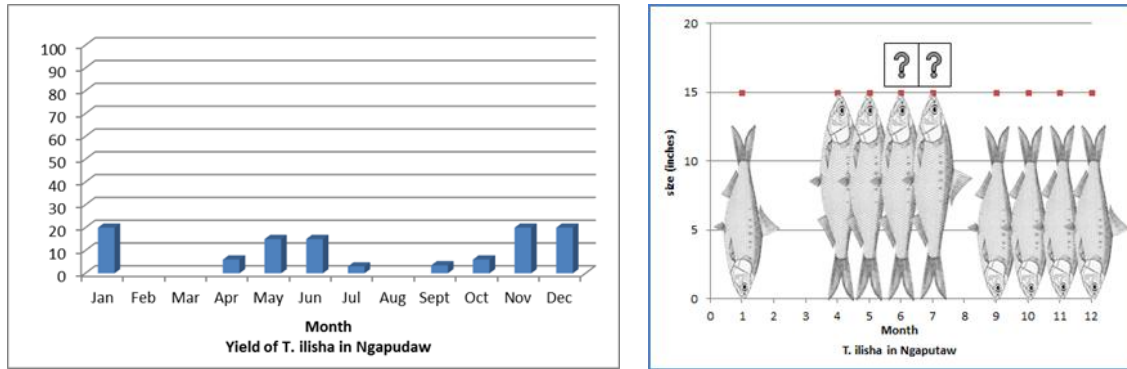


Figure 18 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Ngapudaw

3.3. Pathein Township

In Pathein, Hilsa is fished between September and June. **Fishing starts suddenly in September** (with an average 50 viss/fisher/month = 80 kg/fisher/month) **and continues from January to June**. The yield fluctuates between 1–50 viss/fisher/month (1.6 to 80 kg/fisher/month). The **peak harvest (around 80 kg/fisher/month) is in September** and slowly declines until June (1.6 kg/fisher/month; **Figure 19**). The data also indicates that **most fish caught in September are juveniles or young adults**; thus, the month of highest catch is also the month of smallest individuals. **The largest individuals (15 to 20 inches or 38 to 51 cm) are caught from February to June**, which are most likely breeders. Most of the species caught in the month of September range from 5 to 10 inches (13 to 25 cm which are young adults). According to the fishers, **Hilsa is migrating upstream between September and April**. They observed that **migration during May and June is towards the coastal area (downstream)**.

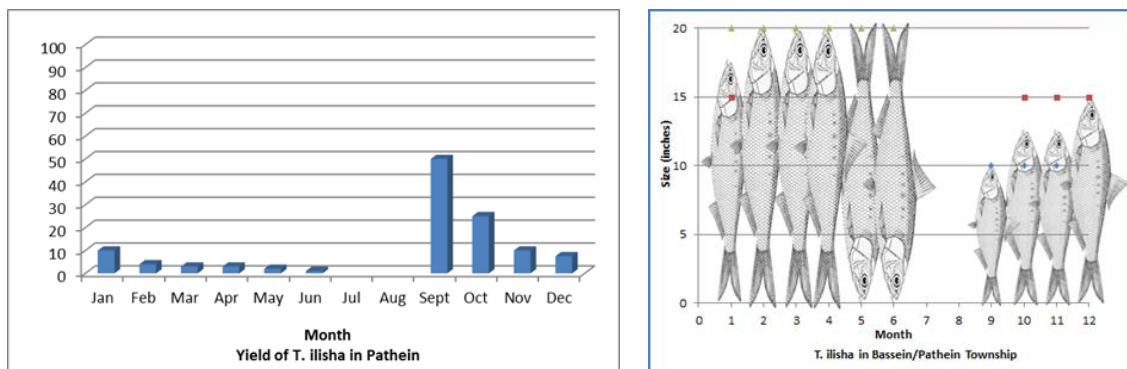


Figure 19 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Pathein Township

The relative density of Hilsa migrations around Pathein is described in **Figure 20**:

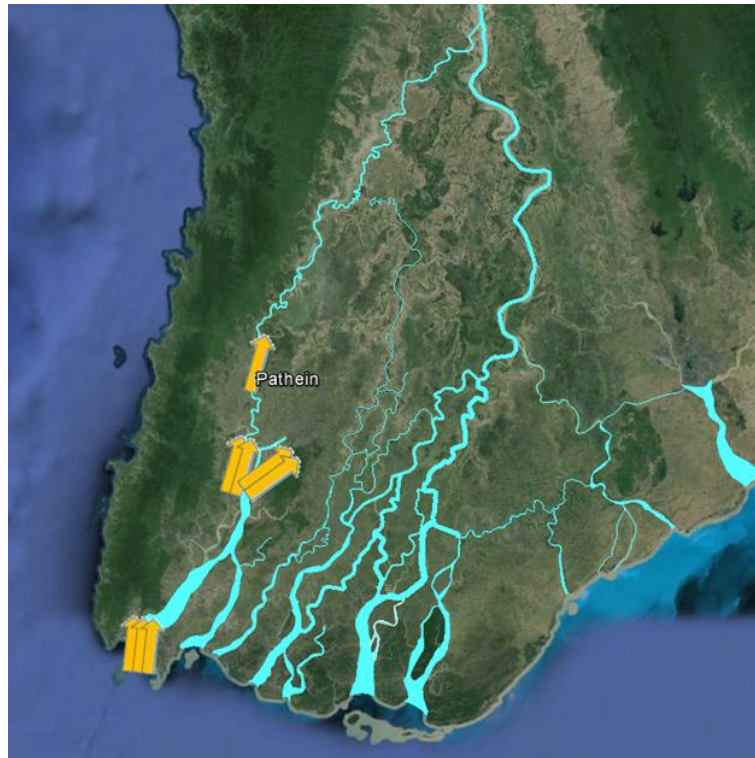


Figure 20 Relative density of Hilsa migrations around Pathein according to fishers’s statements during interviews

3.4. Thabaung Township

Hilsa is harvested in **Thabaung Township between October and December**, although it is also found in **February and May**, but in very small quantities (0.5 to 1 viss or 0.8 to 1.6 kg/fisher/month) (Figure 21). It is not found in the other months.

The **highest catch is during October–November** after which it abruptly decreases in December. The **largest individuals (10 to 15 inches = 25 to 38cm) are also caught between October and December**. In February and May; these are smaller individuals that get caught (5 to 10 inches = 13 to 25cm). Fishers think that **the upstream migration spans from October to January** but are unsure about the direction of the February and May movements.

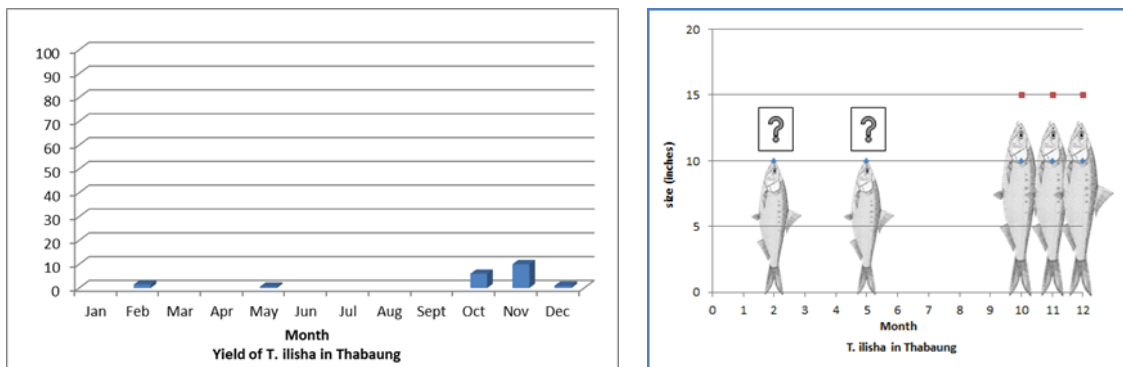


Figure 21 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Thabaung Township

The relative density of Hilsa migrations around Thabaung is described in **Figure 22**:

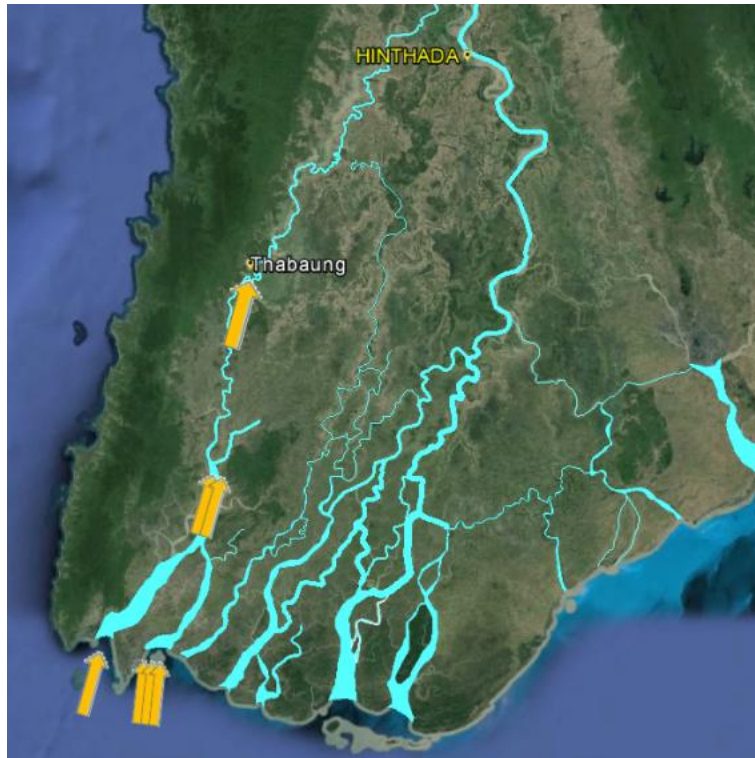


Figure 22 Relative density of Hilsa migrations around Thabaung according to fishers' interviews

3.5. Ngatainchaung/Yegyi Township

In Ngatainchaung, Hilsa is fished during the rainy season, between September and November (Figure 23). The yield then ranges between 30–60 viss/fisher/month (48 to 96 kg/fisher/month). The harvest peak is in October. The average size of the fish harvested ranges from 5 to 15 inches (13 to 38 cm). The fish caught in the months of September and November is generally smaller (13 cm). The migration direction during these months is not clearly known. Juvenile Hilsa are caught on sand beaches along the river. Currently, the schools of migrating fish are getting smaller than in the past, which fishers explain by the fact that the Pathein/Ngawun River is getting shallower.

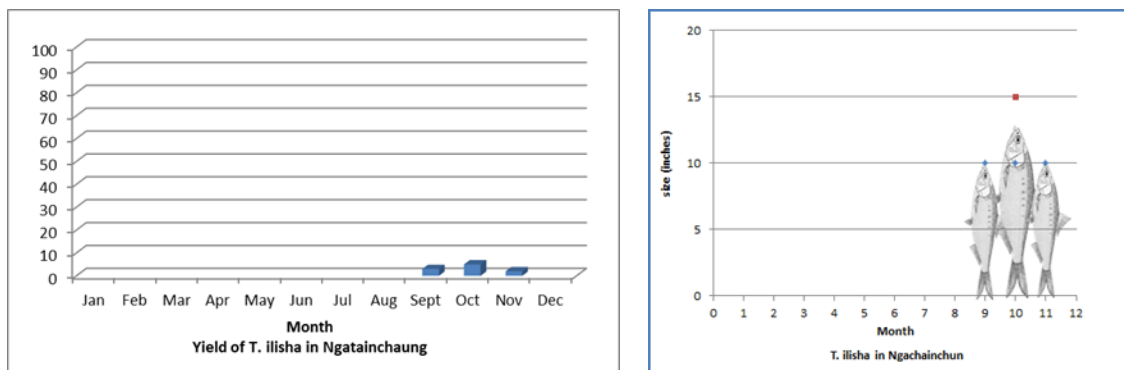


Figure 23 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Ngatainchaung Township

The relative density of Hilsa migrations around Ngatainchaung is described in **Figure 24**:

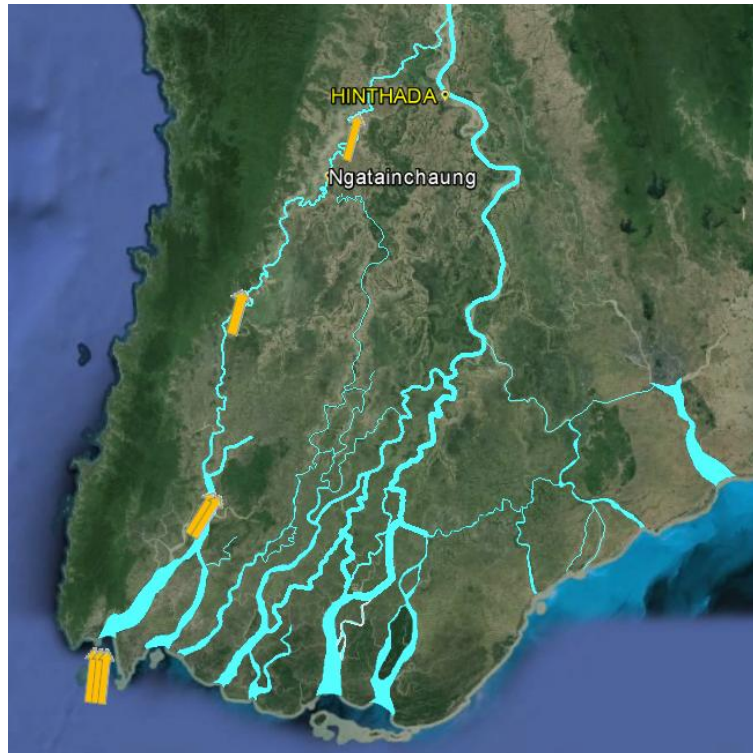


Figure 24 Relative density of Hilsa migrations around Ngatainchaung according to fishers' interviews

3.6. Ingapu Township

The fishers do not fish in August because at that time the water current is very strong. **Hilsa migrate upstream from the Pathein/Ngawun River towards the Ayeyarwady River during high water levels**, but could not migrate back downstream the same way, because the Pathein/Ngawun River later becomes very shallow. **Fishing of Hilsa in Ingapu is reported only between September and November (Figure 25)**. The fish catch is limited to 1 to 2 viss/fisher/month (2–3 kg/fisher/month). **The peak fish catch is in September (3 kg/fisher/month)**. The fish size ranges from 5–10 inches (13–25 cm). **Large fish are caught during September–October**. Most fish caught in November are smaller (<5 inches or < 13 cm); these are considered the offspring of the breeders that migrated to this area. **Hilsa breed in shallow waters on sandbanks in Ingapu.**

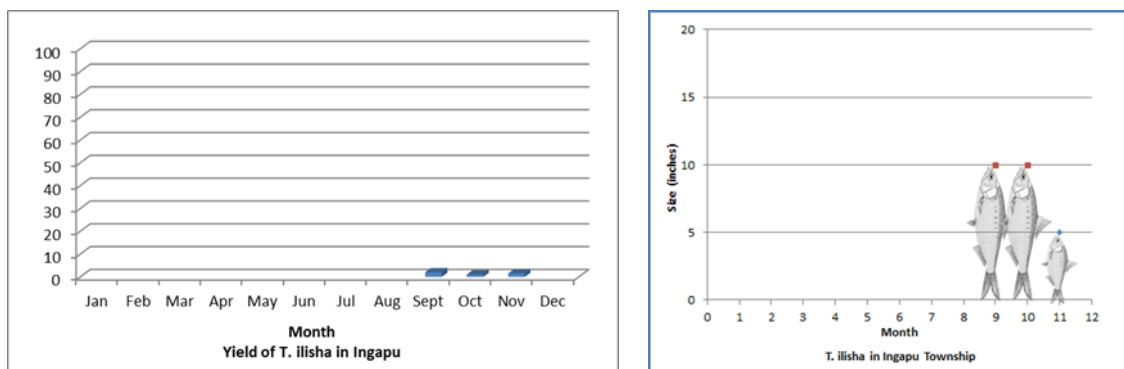


Figure 25 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Ingapu Township

The relative density of Hilsa migrations around Ingapu is described in **Figure 26**:



Figure 26 Relative density of Hilsa migrations around Ingapu according to fishers' interview

4. Ayeyarwady migration route in the delta

4.1. Labutta Township

There are about 40 fishers in this area, most of them using trammel drift net (*Thone-htat-hmyaw-pike*). Hilsa is the main target species. The fishing ground is in the open fishery area and the river depth ranges between 8 and 10 m. The fishing area lies in the brackish zone (salinity between 2 and 20 ppt during November–May). The salinity of the area decreases during June–October. **Hilsa is harvested between September and December, and in April (Figure 27)**. The yield of Hilsa ranges from 10 to 25 viss/fisher/month (16 to 40 kg); it **starts in September and reaches its peak in November (40 kg) then declines in December**. There is no catch in the following months except in **April where the respondents report a high catch of 32 kg/fisher**. The size of fish caught ranges from 5 to 20 inches (15 to 51 cm). **The largest fish (51 cm) are caught in September and October. From October, the species is reported to be migrating upstream, particularly during high tide. The downstream migration is reported in April.** Hilsa migration in September and December is not clear.

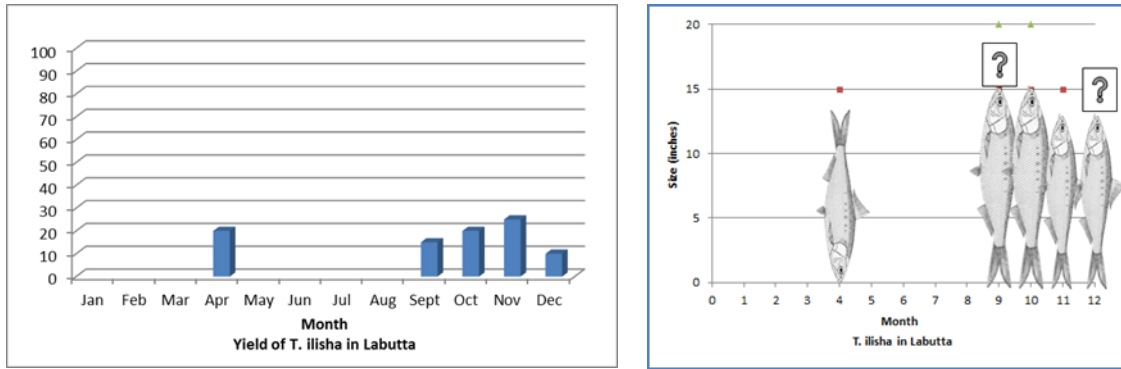


Figure 27 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Labutta Township

4.2. Pyinzalu (in Labutta Township)

The fishing ground is located in the open fishery area where about 500 fishers operate. Fishers **operate in this area throughout the year except in June–July**. The area is brackish from January to June (salinity between 5 and 10 ppt). The water depth is 8–10 m in summer and rises to 10–15 m during the rainy season. Hilsa is the main target species although the fishers also catch *Hilsa keele* (the latter being caught only from February to April). Hilsa is **harvested in Pyinzalu between August and May (Figure 28)**. There is no fishing activity for this species during the rainy season (June–July). The abundance peak is in October, with **around 40 viss/fisher/month (64 kg/fisher/month)** and quickly decreases the following months down to around 6 viss/fisher/month (10 kg per fisher/month). **The largest individuals (15 to 20 inches = 38 to 51 cm), probably breeders, are caught between September and February**. Individuals of 10–15 inches (25 to 38cm) (adults) are caught each month of occurrence. However, smaller (5 to 10 inches = 13 to 25cm) individuals, presumably juveniles, are caught between March and May. The **upstream migration of Hilsa takes place from August to November** (as identified from direction in nets and presence of eggs). **Downstream migration is from April to May**. The migration is not clear between the months of December and March.

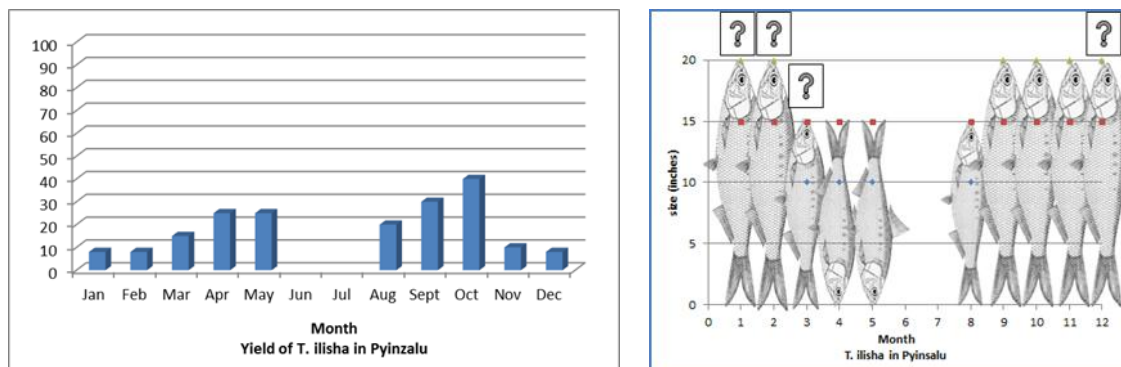


Figure 28 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Pyinzalu Township

The relative density of Hilsa migrations around Pyinzalu is described in **Figure 29**:



Figure 29 Relative density of Hilsa migrations around Pyinzalu according to fishers' statements

4.3. Bogale Township

The fishing ground is in the open fishery area. The water depth varies between 8 and 12 m. During March to May, the water is slightly brackish (salinity is 2–5 ppt during the high tide period). **In Bogale, Hilsa is harvested from September until March (Figure 30). There is no fishing between April and August.** The catch varies from 20 to 50 viss/fisher/month (32–80 kg/fisher/month), with the lowest catch in March (20 viss/32 kg/fisher/month) and **peak harvest is from October to February (50 viss/80 kg/fisher/month).**The largest fish are collected in November. Fish caught from January to March and in September are juveniles and young individuals (5–10 inches or 13-25 cm). The species is reported to be migrating upstream between October and March; Hilsa caught in September are migrating downstream.

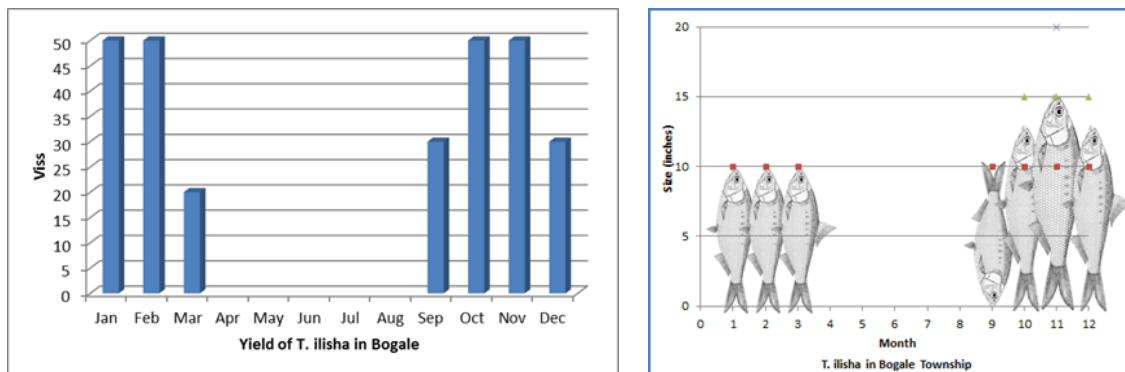


Figure 30 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Bogale Township

The relative density of Hilsa migrations around Bogale is described in **Figure 31**:

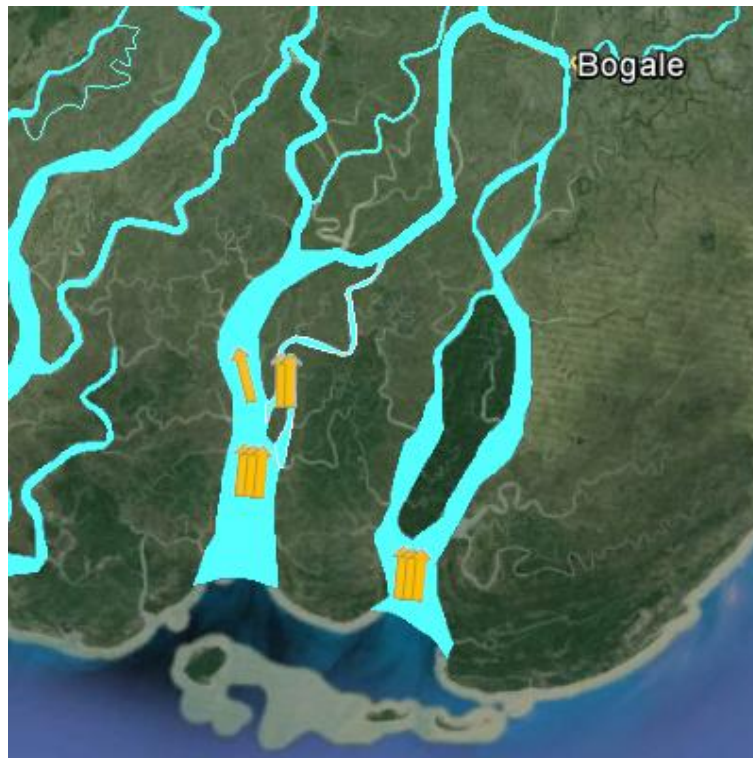


Figure 31 Relative density of Hilsa migrations around Bogale according to fishers' statements

4.4. Mawlamyinegyun (Mawgyun) Township

The fishing ground is in the open fishery area of Mawlamyinegyun (Ayeyarwady River) and the depth in this area ranges between 10–12 m. Hilsa is the main target species, and is caught **between September and January (Figure 32)**. The fish caught ranges from 8 to 20 viss/fisher/month (13–32 kg/fisher/month). **Fish capture peaks in November (32 kg/fisher/month)**. The fish yield starts to decline in December and January in the following year is the lowest production (13 kg). The fish range from 5 to 15 inches (13 to 38 cm). **The largest fish are caught in October (38 cm)**. The fish size caught is smaller in December and January. The fish caught in December are reported to be migrating upstream. There are conflicting reports as to the direction of the migration of this species; the fishers interviewed indicate that **Hilsa migrate upstream from the sea from September to March**, but their return (downstream) migration is unknown to fishers. **Fishers could catch Hilsa only during September–January** and catch other fish species during the other months. The fish caught in October could be breeders.

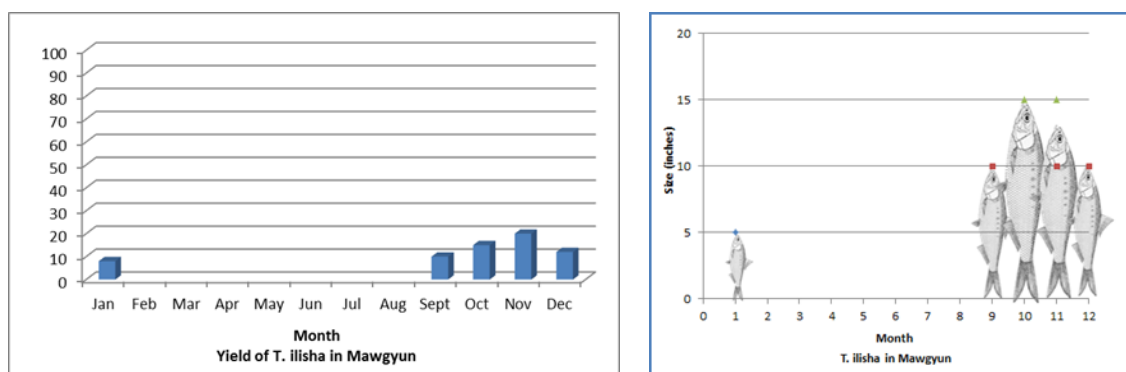


Figure 32 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Mawlamyinegyun (Mawgyun) Township

4.5. Wakema Township (Kyonemangay site)

Hilsa is found in Kyonemangay site in Wakema Township, but only incidentally, as a by-catch, and is not subject to a specific fishery. Its abundance in yield is subsequently considered nil. There are Hilsa breeding sites in Kyonemangay (see companion report), but since the catch is considered nil, no diagram of fish size could be generated. The only Hilsa species found seems to be *Hilsa kelee*.

4.6. Pyapon Township

Fishing of Hilsa in Pyapon is conducted from September until May (Figure 33), and there is no fishing from June to August. The yield of Hilsa is low and ranges from 2 to 6 viss/fisher/month (3-10 kg/fisher/month). The yield is highest in September (6 viss or 10 kg/fisher/month) but the monthly pattern is irregular, with less fish in October–November, a second peak in December–January, a second decline in February–March then a third minor peak in April–May.

Juvenile individuals (size: 0–5 inches or <13 cm) are found in December–January, following the appearance of large size individuals (possibly breeders) migrating upstream in November. In fact, **December and January are month of high abundance, but the yield is not the highest since fish are small at that time.** The fish caught from February to May are bigger than in January (5–10 inches or 13–25 cm) and could be the growing adults. **The fish are reported to migrate upstream between the months of September and April and downstream in May.**

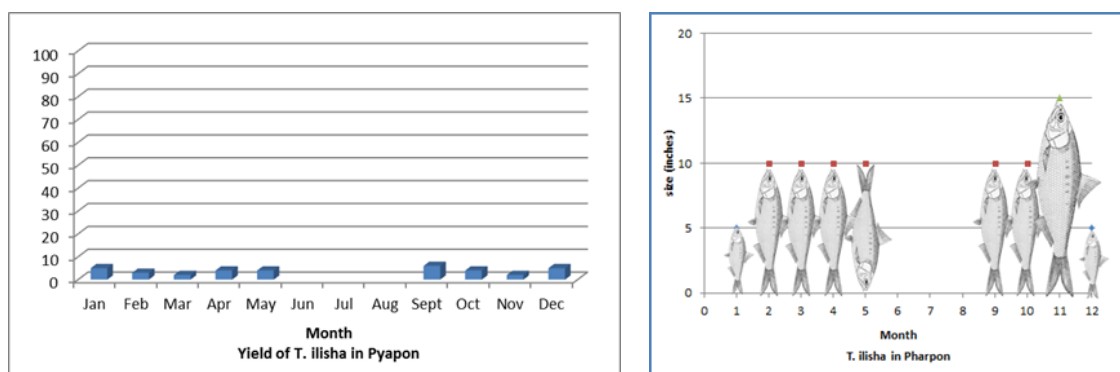


Figure 33 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Pyapon Township

4.7. Kyaiklat Township

Kyaiklat's fishing area is in the open fishery area and in the freshwater zone. Fishers use trammel drift nets. The water depth in Kyaiklat ranges between 6–8 m during summer and increases to 7–10 m during rainy season. Most fishers in this area actually **operate in other fishing areas, in particular in Pyapon River mouth, during April to June and in September (Figure 34).** Fishers operate in Kyaiklat only in March. The fish catch ranges from 2 to 6 viss/fisher/month (3 to 10 kg/fisher/month); **the peak is in March (10 kg/fisher/month)** and gradually declines until June. Good catch is also reported in September. The sizes of individuals range between 5–15 inches (13-38 cm). In March, the fish size is around 10–15 inches (25–38 cm) but in September, individuals are smaller (5–10 inches, 13–25cm). **The fish are assumed to migrate upstream from March to June.** However, the direction of migration of this species is unclear.

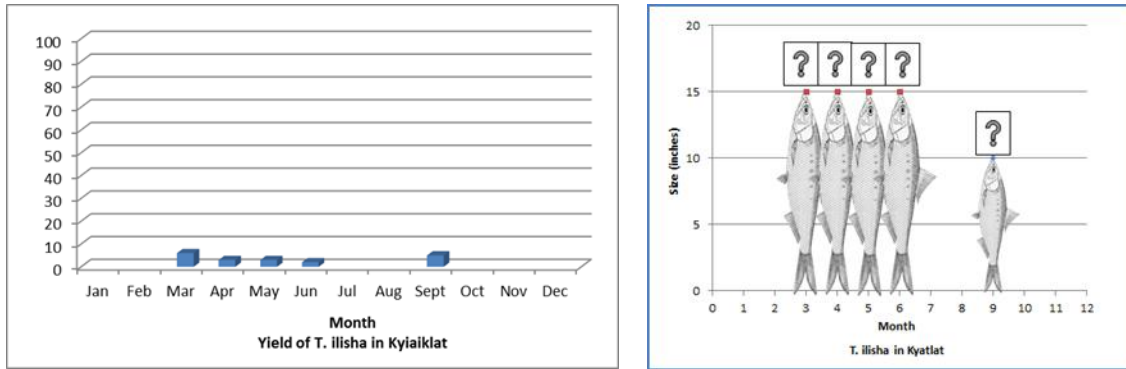


Figure 34 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Kyauklat Township

4.8. Dedaye Township

The Toe River flows into the Andaman Sea through three tributaries: the Toe, Than-Deik and Don-Yan Rivers; Dedaye is located on the Toe River. Fishing is conducted in the open fishery water. The water depth where Hilsa fishing occurs reaches 6–8 m during summer and 7–10 m during the rainy season. The Toe River is brackish with a salinity ranging between 5 and 15 ppt from December to May. From June to November, the river is fresh. **Fishing of Hilsa is conducted throughout the year (Figure 35). The peak yield is in November (60 viss/fisher/month) and then drops from February to August (3–10 viss/fisher/month).**

The largest individuals are caught from February to June (10–15 inches or 25–38 cm) while they migrate upstream and in July–August as they migrate downstream (at that time, the fish's body shape is flat and thin). Fishers report that individuals caught in January are juveniles, and after spawning upstream these fish move downstream in July–August.

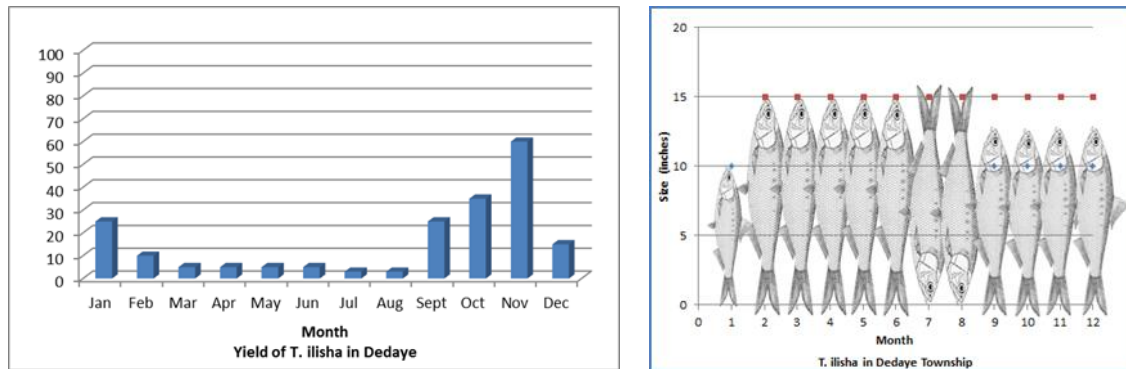


Figure 35 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Dedaye Township

The relative density of Hilsa migrations around Dedaye is described in **Figure 36**:



Figure 36 Relative density of Hilsa migrations around Dedaye according to fishers' statements

4.9. Twantay Township

In Twantay, there are 300 to 400 fishers targeting Hilsa with trammel drift nets (*Thone-htat-hmyaw-pike*) in the open fishery water zone (depth up to 8 m). This is also a brackish water zone (salinity between 5 and 8 ppt) from January to May. **Fishing of Hilsa takes place during five months, from December to April (Figure 37)**. There is no fishing activity between May and November. **The largest individuals (15 to 20 inches = 38 to 51 cm) are caught only in April** (this is also one of the months with the lowest yield) at a time when they migrate upstream. The **highest abundance is during January and February** (80 viss = 128 kg/fisher/month). During these months, two size ranges are being caught: 5 to 10 inches (13 to 25 cm) and 10 to 15 inches (25 to 38 cm).

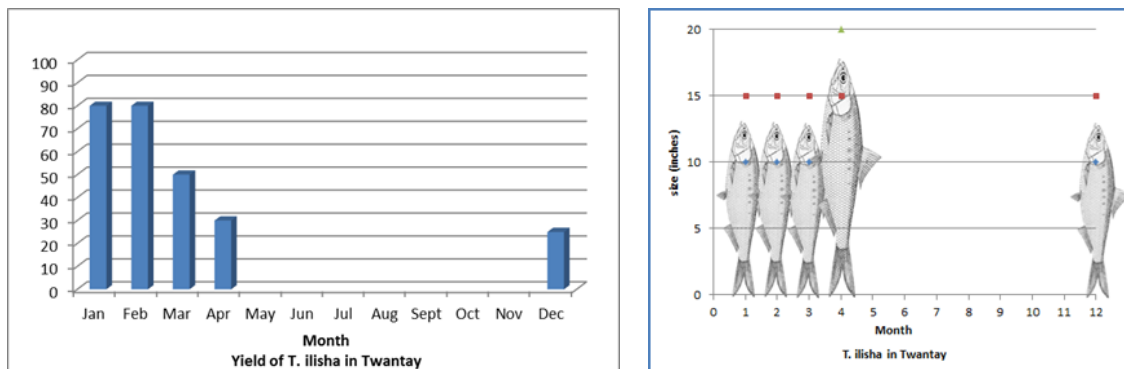


Figure 37 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Twantav Township

The relative density of Hilsa migrations around Twantay is described in **Figure 38**:

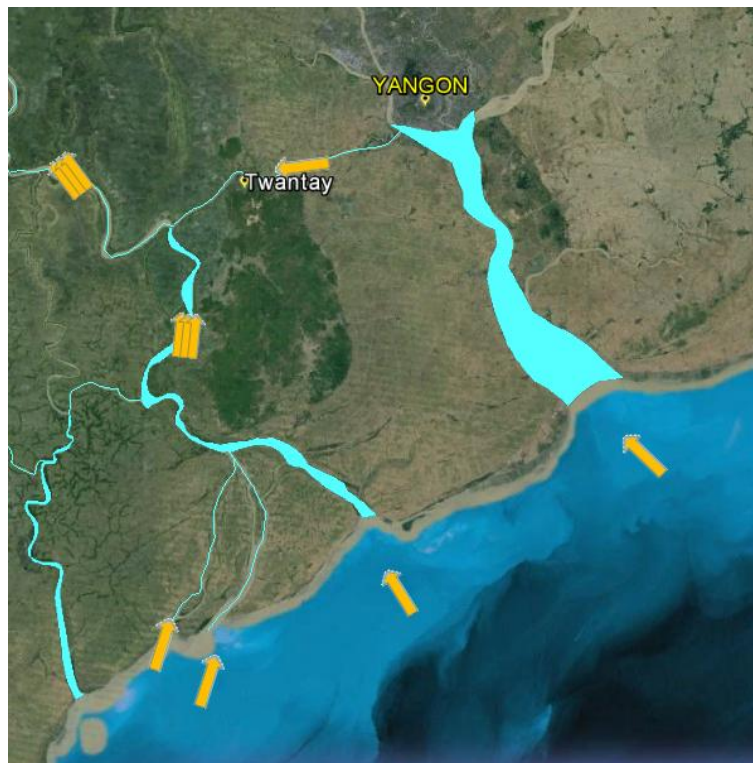


Figure 38 Relative density of Hilsa migrations around Twantay according to fishers' interviews

4.10. Maubin Township

Fishers use the trammel drift net (*Thone-htat-hmyaw-pike*) to target Hilsa and other fish. The fishing ground is in the open fishery water. The water depth in this fishing ground ranges between 14 and 20 m. Brackish or saltwater of the Toe River reaches up this area. Hilsa is the main target species.

Fishing takes place between August and April of the following year (**Figure 39**). There is no reported fishing between May and July. The yield ranges from 3 to 10 viss/fisher/month (5 to 16 kg/fisher/month). **The peak spans from September to November** then gradually declines until April of the following year. The fish ranges between 5 and 15 inches (13–38 cm). Most fish caught in September to February are smaller fish (5–10 inches or 13–25 cm) while **the biggest fish (25–38 cm) are caught in March–April**. Hilsa is reported to migrate upstream between August and January. Migration during February and March is not clear, but **in April, Hilsa migrates downstream towards the sea**. Fishers say that **Hilsa spawns in the shallow sandbanks along the Toe River from January to February**. Juvenile Hilsa measuring 1–1.5 inches are found along the Toe River bank in March.

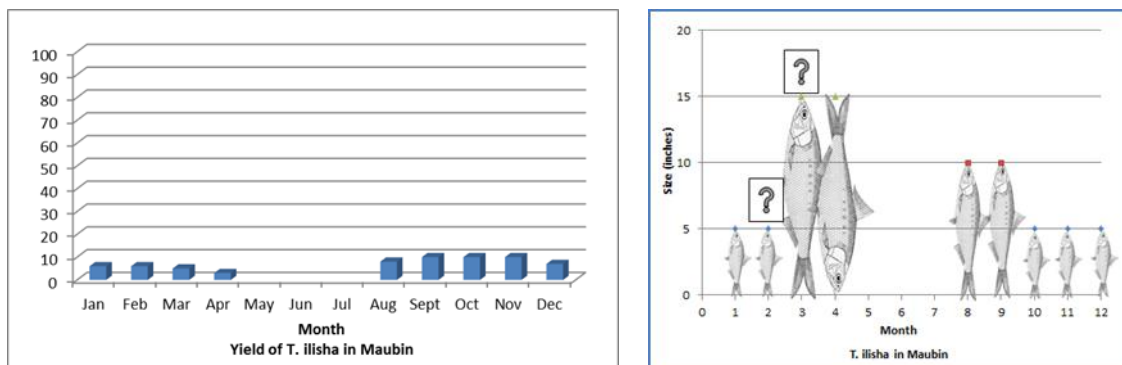


Figure 39 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Maubin Township

4.11. Yandoon (in Nyaungdon Township)

This fishing ground lies in the open fishery area, in the freshwater zone, with depth of between 7 m in the dry season and 12 m in the rainy season. Fishers mainly use trammel drift net (*Thone-htat-hmyaw-pike*) and the main target species is Hilsa. **Hilsa is harvested around Yandoon between August and May (Figure 40).** According to respondents, there is no fishing during June and July. Fishers start yielding 10 viss/fisher/month (16 kg/fisher/month) in August, and the catch increases until a **peak yield in December, at 72 kg/person/month.** The **lowest catch is between February and April** at 5 viss/fisher/month (8 kg/fisher/month). These months correspond to large sized fish, implying that only a few individuals are caught. Two size categories are caught in Yandoon: **10–15 inches fish (25–38 cm) from January to May** and **5–10 inches individuals (13–25 cm) from August to December.** **Juvenile Hilsa (as small as 0.75 inches = <13cm) are found in shallow waters along sand beaches between March and April.** It is interesting to note that **in December, only small sized fish are caught, but they provide the highest yield of the year.** There are mixed reports on the migration of Hilsa. Some fishers reported that **Hilsa migrate upstream between the months of September and May,** as inferred from the way they are entangled in nets. The downstream migration pattern of Hilsa is not known.

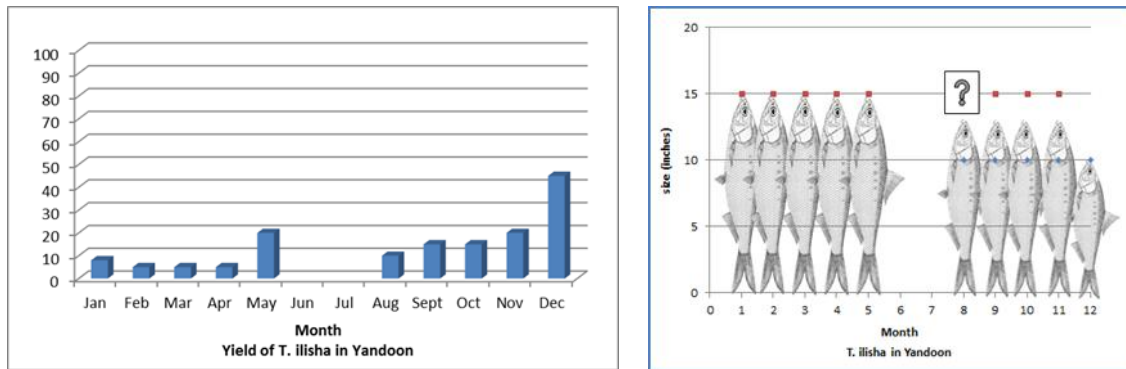


Figure 40 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Yandoon

The relative density of Hilsa migrations around Yandoon is described in **Figure 41**:



Figure 41 Relative density of Hilsa migrations around Yandoon according to fishers' statements

4.12. Danubyu Township

In Danubyu, the average depth of the river is approximately 16 m and varies between 10 m in the summer season and 20 m during the rainy season. **Fishing of Hilsa is conducted between October and April (Figure 42).** There is no fishing between May and September. **The yield is the highest and constant between October and March (30 viss or 48 kg/fisher/month)** and drops in April. It is adult individuals (10–15 inches, 5–38 cm) that are caught from October to April. Migrations of the species are not so clear to fishers, and they believe that **Hilsa permanently resides in the area.**

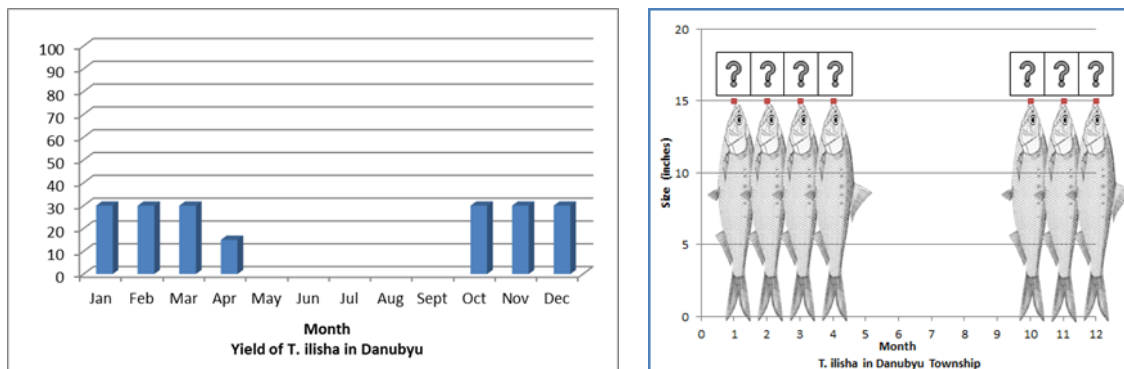


Figure 42 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Danubyu Township

4.13. Zalun Township

Hilsa is the main species targeted by fishers, yet there is no fishing activity between April and August. **Hilsa is usually fished between September and March (Figure 43).**The abundance is at first low (7 viss = 4 kg/fisher/month) but increase quickly (up to 58 viss = 93 kg/fisher/month) until January, then decreases again until March (9 viss = 14 kg/fisher/month). **The largest individuals (10-15 inches or 25–38cm) are caught from October to March.** Respondents say that during January and February, two sizes are caught; those which are <5 inches (<13cm) and that could be juveniles

and those between 5–10 inches (13–38 cm). According to respondents, **the migration of this species is not clear** and they believe that **Hilsa is a permanent species in this area**. Small size fish (approximately 0.75 inches) are found near the shallow sandy beaches in the river from January to February.

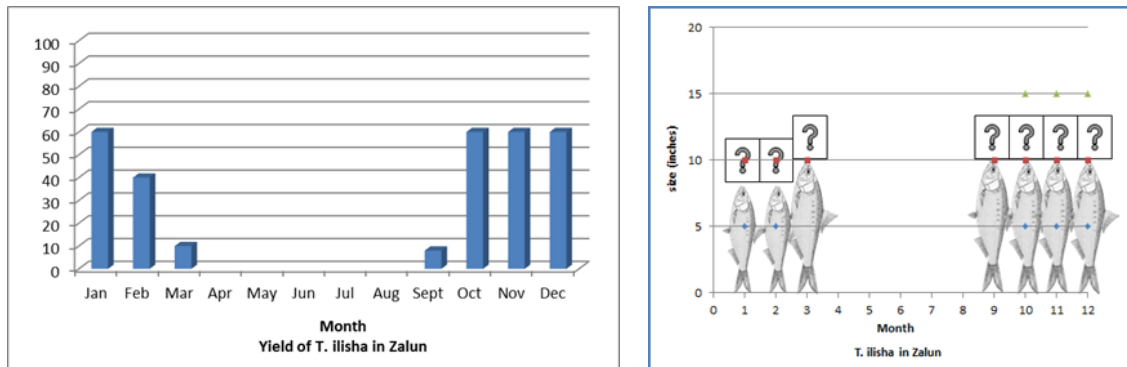


Figure 43 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Zalun Township

4.14. Hinthada Township

Hilsa is the main target species in this area. **Hilsa is caught in April–May and from August to November**. The harvest peak is in April–May (Figure 44). There is no reported fishing activity in June–July and from December to March. **Hilsa has eggs and a fat body shape, and migrates upstream from August to November** and back, down to the sea, between April and May. **Bigger fish are caught in August–September (10–15 inches or 25–38 cm)**. Hilsa caught during November and April are juveniles (size <5 inches = <13cm). Hilsa are found in shallow waters by sand beaches, lagoon and river banks.

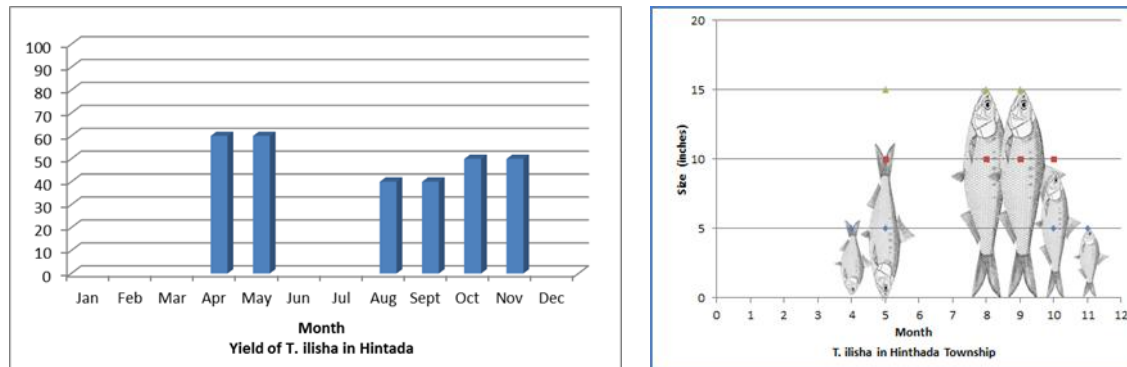


Figure 44 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Hinthada Township

The relative density of Hilsa migrations around Hinthada is described in **Figure 45**:

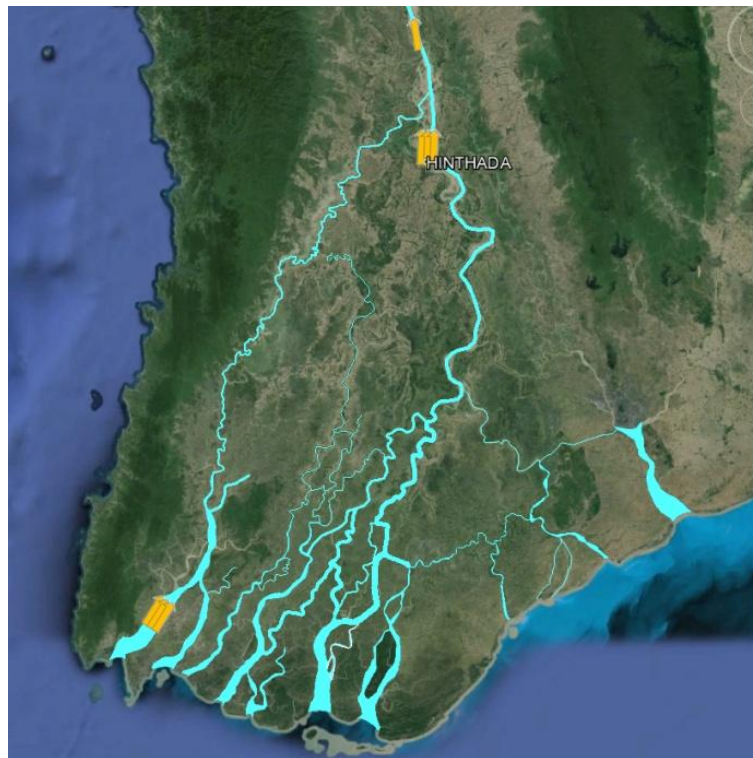


Figure 45 Relative density of Hilsa migrations around Hinthada according to fishers' statements

5. Ayeyarwady migration route in the Central Dry Zone

5.1. Monyo Township

The water depth of this fishing area is approximately 3 m. **Fishing of Hilsa takes place from February to June and in September–October (Figure 46).** The yield of fish catches ranges from 1 to 3 viss/fisher/month only (2–5 kg/fisher/month). There is a **sudden increase in yield in the month of June (5 kg/fisher/month)** but there is no reported harvest in July to August. Fishing resumes in September to October with a low yield (2 kg/fisher/month). The fish caught in Monyo range from 10 to 15 inches (13–38 cm). **The fish caught in February to April are still juvenile** and start to grow in May. **The bigger (38 cm) fish sizes are caught in September–October;** these fish could be breeders. **The fish caught from February to April are juveniles.** Fishers are not clear about the direction of fish movements. Small Hilsa fish (approximately 1.5–2 inches) are observed in this area along the river bank and sand beaches; they are caught using beach seine nets.

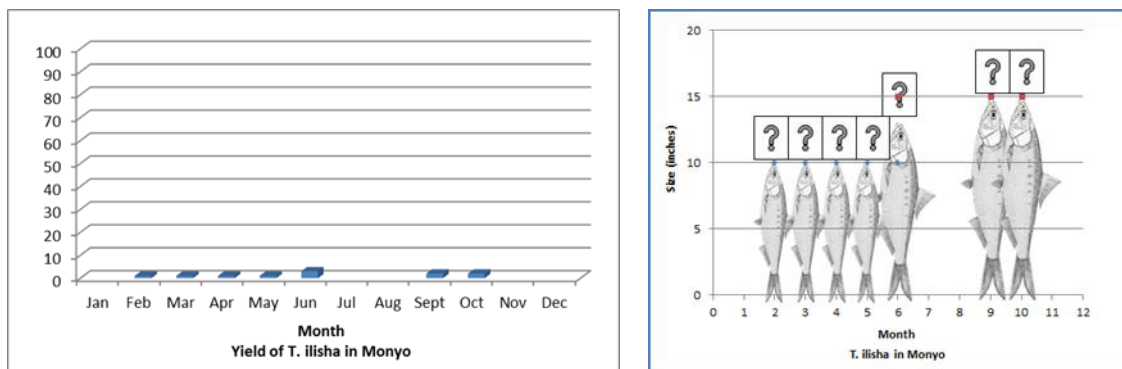


Figure 46 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Monyo Township

5.2. Myanaung Township

Hilsa is the main target in this location. The species is found from January to May and October to December (**Figure 47**). The **peak period is in October–November**; at that time, the catch reaches **96 kg/fisher/month**. There is a second peak in March, with 72 kg/fisher/month. The lowest catch is in January, with only 4 kg/fisher/month. The size of fish ranges from **5 to 12 inches**, but the direction of migration is unknown.

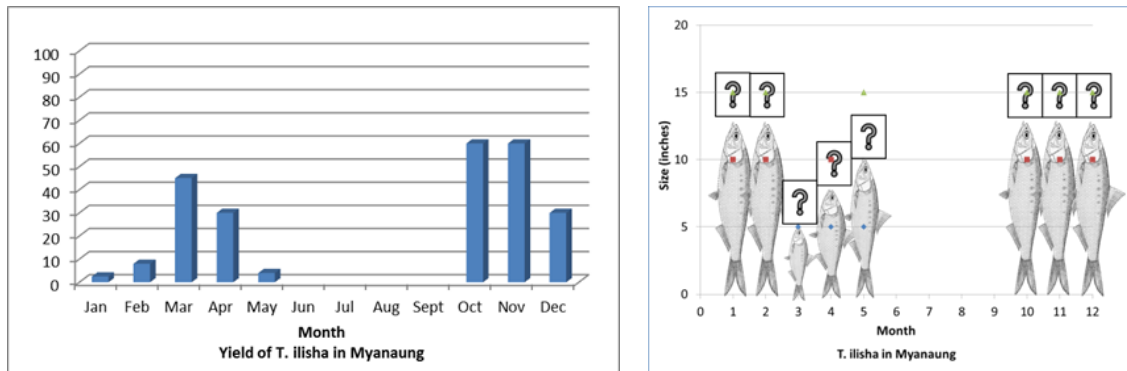


Figure 47 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Myanaung Township

5.3. Kyangin Township

The total number of fishers in this area is 30, and the river is around 6 m deep. Hilsa species is caught in this area although it is not fishers’ main target catch, because of the low abundance. The catch takes place in **April–May (3 kg/fisher/month)** and **October–November (10 kg and 3 kg/fisher/month respectively)**; the fish size is up to **10 inches** and the direction of migration is unknown (**Figure 48**).

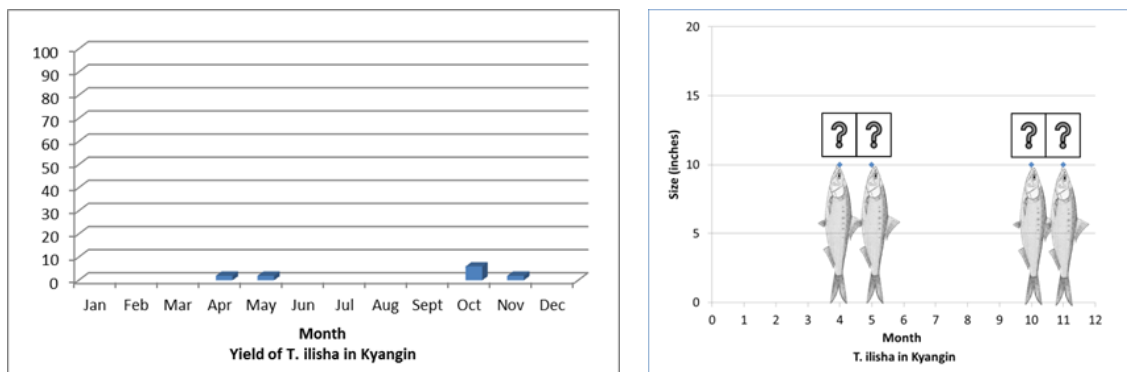


Figure 48 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Kyangin Township

5.4. Pyay Township

About 60 fishers operate in this area, but in the past 12 years, Hilsa could not be found here. Hilsa were caught again in 2013–2014, by fishing nets and only during **September (4.8 kg/fisher/month)** and **December (16 kg/fisher/month)** (**Figure 49**). However, the species is considered rare. The size of fish caught at that time is **12 inches**.

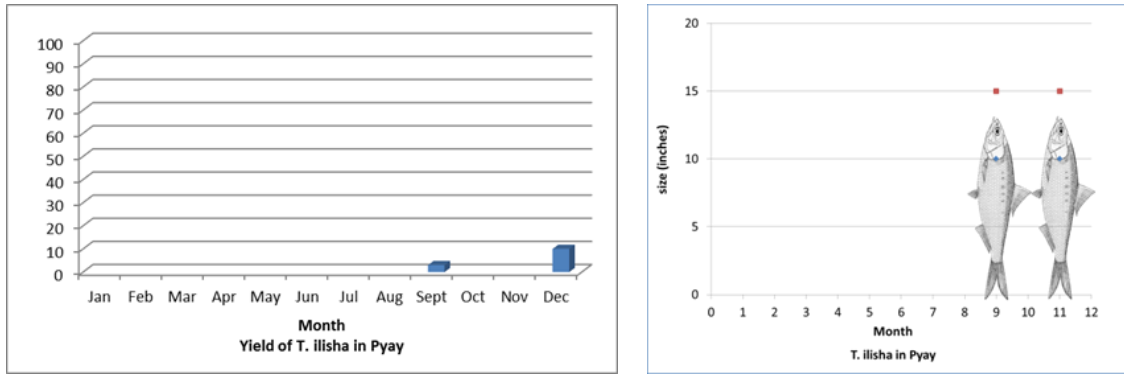


Figure 49 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Pyay Township

5.5. Magway Township

In the past years, Hilsa used to be fishers’ main target species, but this is not the case now because of its rarity. Hilsa is caught from October–November and February to April, but the yield does not exceed **1 kg/fisher/month** (Figure 50). The size of fish caught is around **10 inches**, and Hilsa fry (1 inch) is found near sandbanks from February to March. The direction of migration is unknown.

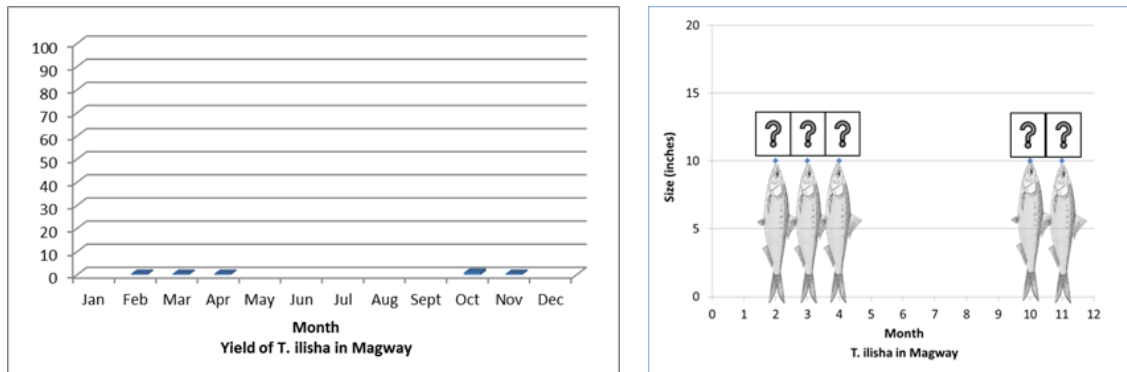


Figure 50 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Magway Township

5.6. Pakokku Township

In this area, Hilsa is not a target species, yet fishers think that Hilsa migrates upstream from the sea during November–February and migrate back downstream in April. The catch occurs in January (**48 kg/fisher/month**—highest abundance) and February and then in November and December (**16 kg/fisher/month**—lowest abundance) (Figure 51). Within these four months, the fish size is **12 inches**.

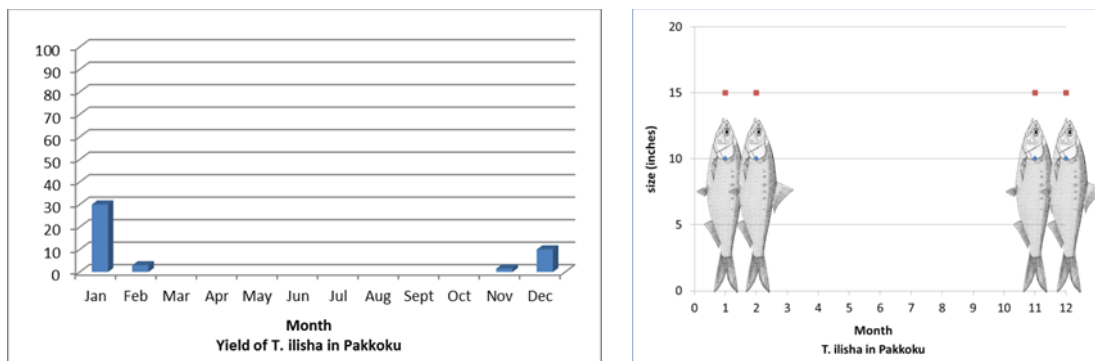


Figure 51 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Pakokku Township

5.7. Myingyan Township

In this area, fishing activities are not developed and only a few Hilsa individuals are caught every year, in particular in January. Despite their low abundance, fishers report that Hilsa does migrate from the sea to Myingyan.

5.8. Myinmu Township

Myinmu, like in Mandalay, is a leasable fishery area distinct from the Ayeyarwady River. The water depth in this fishing area ranges between 5 and 10 m. Here Hilsa is not a target species. Only a few Hilsa individuals (less than 10) get caught each year, as by-catch.

5.9. Mandalay

The fishing area surveyed is a leasable fishery (i.e. located in a floodplain) distinct from the Ayeyarwady River. The depth of that area ranges between 4 and 12 m. Hilsa is not a target species and is rather rare. A few fish are caught each year (e.g. a few large 7 inch fish are caught from December to January), but their quantity is not significant enough to be accounted for as a yield.

5.10. Katha Township

The fishing ground is a leasable fishery distinct from the Ayeyarwady River, and its depth varies between 4 and 12 m depending on the season. Fishers commonly use beach seine net (*Thaung-Swei-Pike*). Hilsa is not a target species. After an absence of several years, Hilsa was caught again during the past 2 years, in particular near the shore, with beach seine nets. When present, Hilsa is found in February–March and November. The abundance is very low in Katha Township, and reaches approximately **2.4–4.8 kg/fisher/month in March and November (Figure 52)**. At that time, the size of individuals caught reaches **12 inches**.

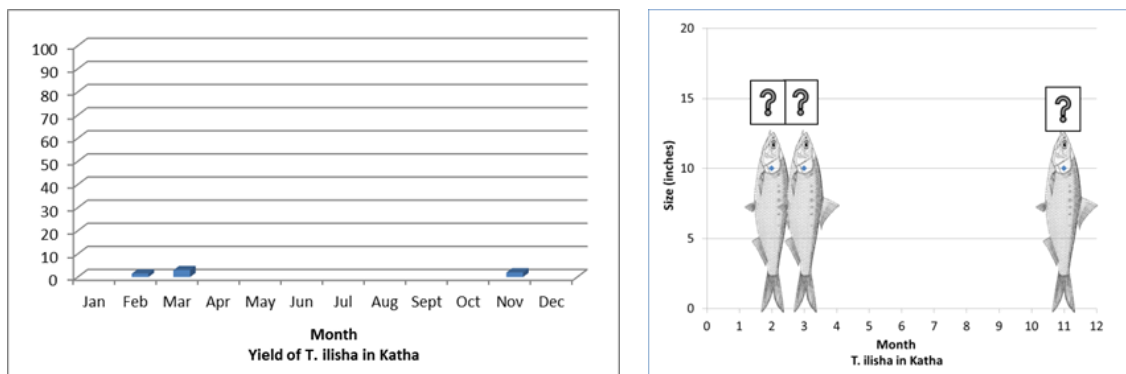


Figure 52 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Katha Township

5.11. Monywa Township (Chindwin River)

This fishing ground is a leasable fishery area (i.e. floodplain) distinct from the Chindwin River, and its depth varies between 3 and 8 m. Hilsa is not a target species. Hilsa had not been caught in this area for ten years; Hilsa was caught again during the past 2 years. It was caught in November and December by fishers using drift gill nets (Figure 53). The catch ranged between **1 and 4.3 kg/fisher/month** and the size of fished caught ranged between **10 and 12 inches**.

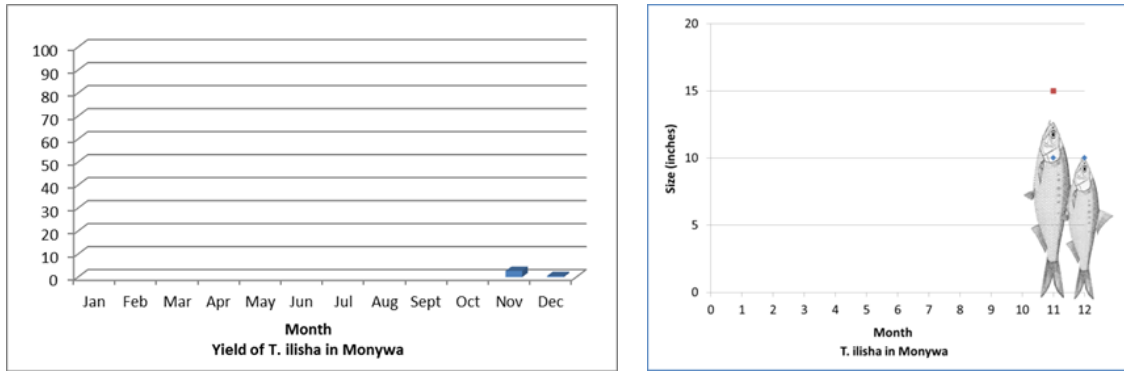


Figure 53 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Monywa Township

5.12. Kalewa Township (Chindwin River)

This fishing ground is a leasable fishery (floodplain) distinct from the Chindwin River. The water level varies between 5 and 14 m depending on the season. Hilsa is not a target species. Hilsa had not been caught in this area for many years, but was caught again during the past 3 years. It was caught by trammel drift nets (*Thone-htat-hmyaw-pike*), from January to April (**Figure 54**). The catch was then very small (**1–2 kg/fisher/month**), but the size of fish is rather large (between **12 and 15 inches long**).

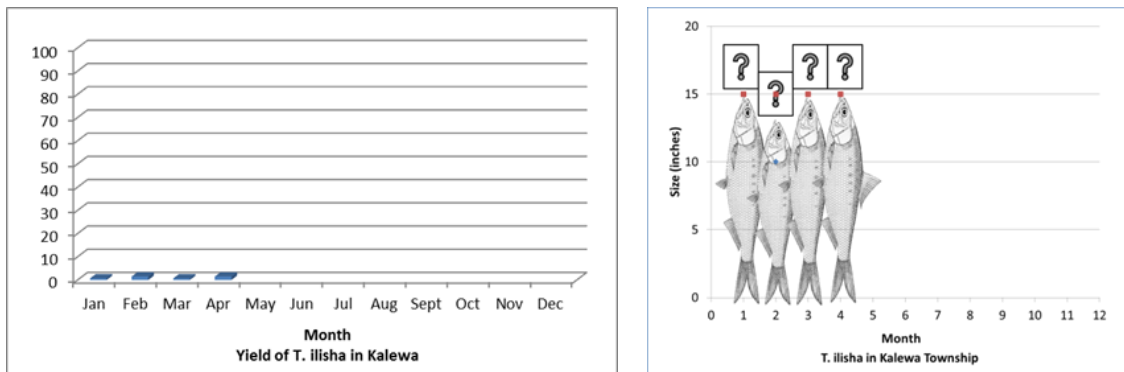


Figure 54 Monthly abundance of Hilsa (in viss = 1.6 kg), fish sizes and migration direction in Kalewa Township

6. Hilsa breeding sites in the Ayeyarwady system

Pathein migration route

6.1. Thabaung Township

According to the fishers interviewed, Hilsa breeds along the Pathein River in Thabaung Township between March and April. The breeding site is in the mainstream river and stretches over 30 km; no particular feature such as sandy beach can be identified (**Figure 55**). It is actually unclear whether it is a breeding site or a site where larvae are found. According to the migration survey, the upstream migration of adults spans from October to January. It is unclear how larvae in March–April are related to the main migration of adults in October–December, given their limited presence in February.



Figure 55 Extent of Hilsa breeding sites in Thabaung Township

6.2. Ngatainchaung/Yegyi Township

Hilsa breeding in Ngatainchaung is recorded along the Pathein River, in a 65 km long river stretch (**Figure 56**). That stretch includes a few sandy beaches. The migration survey indicates that the peak yield of Hilsa is in October, and juveniles are found by the sandy beach, like in Thabaung, between March and April.



Figure 56 Extent of Hilsa breeding sites in Ngataingchaung (Yegyi Township)

Ayeyarwady migration route

6.3. Labutta Township

Labutta is characterized by a small Hilsa breeding site, located in the Ywe River, which is about 7 km long (Figure 57). Juvenile Hilsa fish, 1 to 2 inches long, are found in this site in March and April. Available maps do not allow identifying any specific feature for this site located 25 km away from the sea.

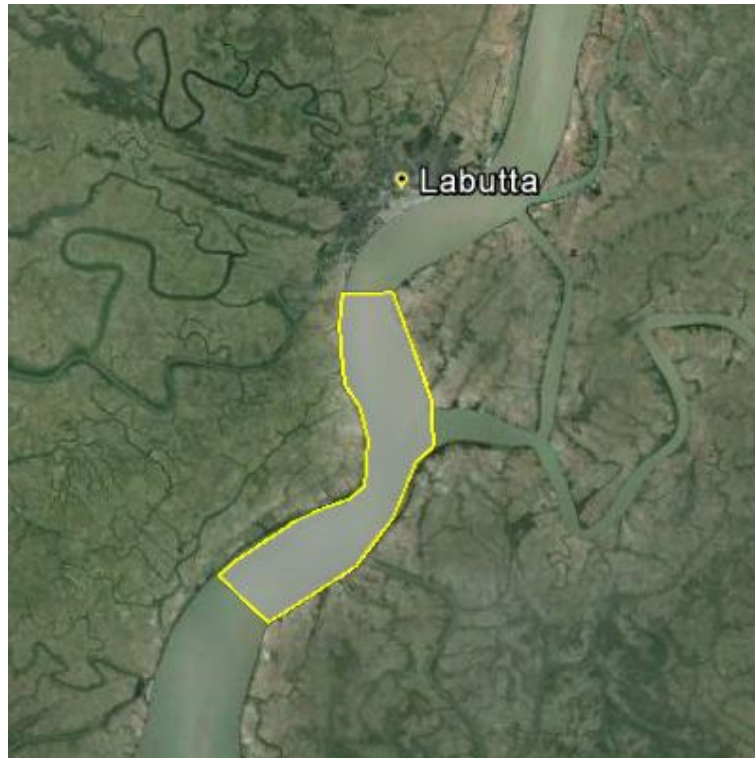


Figure 57 Extent of Hilsa breeding sites in Labutta Township

6.4. Wakema (Kyonemangay) Township

This area, in the middle of the delta, features several small breeding sites located about 90 km away from the coast (Figure 58). These sites do not display salient or specific features; it is also unclear whether they are connected to other sites nearby or not. Juvenile Hilsa are found in those sites in January–February.



Figure 58 Extent of Hilsa breeding sites in Wakema Township

6.5. Twantay Township

Along the Toe River, a breeding site in Twantay stretches in floodplains over 6 km, on the left bank of the river, just before the turn towards Twantay Canal (**Figure 59**). This site is 60 km away from the sea. Hilsa is known to breed there in March and April. Soon after, 1–1.5 inches long juveniles are found.



Figure 59 Extent of Hilsa breeding sites in Twantay Township

6.6. Maubin Township

Hilsa breeds over 28 km along the Toe River in Maubin Township. Sandy islands are apparent near the Ayeyarwady River (**Figure 60**). Juvenile whose size ranges between 1 and 1.5 inches are found in March along the river bank. Fishing takes place between August and April, except from May to July.



Figure 60 Extent of Hilsa breeding sites in Maubin Township

6.7. Yandoon Township

In Yandoon, the breeding area consists of one small spot made of sandy beaches and floodplains on the left bank of the Ayeyarwady River (**Figure 61**). This area stretches over 4 km. Fishers indicate that breeding takes place in March and April; the size of fish ranges then between 0.75 and 3 inches. The fishers say that the fishing takes place all year round, except in June and July. Thus, there is no apparent correlation between the abundance of adults and that of juveniles.



Figure 61 Extent of Hilsa breeding sites in Yandoon Township

6.8. Hinthada /Zalun/Ingapu/Monyo Townships

Hinthada is characterized by a large continuum of Hilsa breeding sites starting in Zalun Township and stretching up to Myanaung (although the latter is a small one, and most of the continuum actually goes up to Monyo) (**Figure 62**). Zalun Township is characterized by a small Hilsa breeding site stretching over 5 km. This site is located on the right bank of Ayeyarwady River. Adult fish spawn in shallow sandy beaches in January and February. The size of the juveniles found there at that time of the year is 0.75 inches. Migration reports indicate that fish abundance is high between October and January, but fishers believe that Hilsa is a permanent species in this area.

There are three Hilsa breeding sites along the Ayeyarwady River in Hinthada Township. One is a 9 km long and shallow spot. The second is 38 km long, found on the right bank and includes floodplains. The third area stretches from the river into floodplains over 11 km, and is close to Zalun. In this area, fishers indicate that Hilsa prefers spawning on the shallow and sandy river banks rather than along steep banks. Juveniles are found in May, their size is then 1.5 inches. Interviews indicate that Hilsa individuals bearing eggs migrate upstream from August to November. The species migrates back, down to the sea, between April and May.

North of Hinthada, in Ingapu, Hilsa breeds in shallow waters on the west side of the river, at the confluence between the Ayeyarwady River and the Pathein River. The site is 35 km long and 9 km wide and mainly consists of shallow floodplains with numerous sandy beaches. Fishing of Hilsa in Ingapu is reported only from September to November, and juveniles are found in December and January. At that time, their size ranges between 0.5 and 1 inch. The Ingapu breeding site is actually part of a continuum with the Hinthada breeding sites (described above). Monyo and Myanaung also include a couple of smaller breeding sites.

Upstream of Ingapu, a breeding site is also found in Monyo, but it is not connected to the previous ones. This site consists of three-kilometre long sandy beaches along Ayeyarwady River. Small fish (around 1.5 to 2 inches long) are found in May and June, and caught by beach seine nets. Fishing of Hilsa takes place from February to June and in September–October. Fishers claim that there is a sudden increase in yield in June, but it is unclear how the small fish found in May–June are related to the high yield in June.

Overall, the continuum of breeding sites for Hilsa and multiple other species around Hinthada is remarkable, from a resource management perspective, and deserves special attention.



Figure 62 Extent of Hilsa breeding sites in Hinthada /Zalun/Ingapu/Monyo Townships

6.9. Myanaung Township

A Hilsa breeding site was identified in Myanaung Township. It is located upstream of the Zalun-Monyo suite of breeding sites, but is disconnected from these. The 6 km long site is located just upstream of Myanaung city, on the right bank of the Ayeyarwady River, in a shallow and sandy area (Figure 63). One inch long Hilsa fish are found in this zone in March.



Figure 63 Extent of Hilsa breeding sites in Myanaung Township

6.10. Magway Township

This township features a Hilsa breeding site stretching at least 35 km along the Ayeyarwady River (**Figure 64**). Breeding takes place in March. Only Hilsa is known to breed in this site. This site is not characterized by any abundance of Hilsa, nor by the presence of large breeders or juvenile; thus, information should be double-checked.



Figure 64 Extent of Hilsa breeding sites in Magway Township

6.11. Pakokku Township

The most upstream Hilsa breeding site identified on the Ayeyarwady River is located in Pakokku Township, about 700 km from the sea. Yet this site is only 3 km long (**Figure 65**). It is located in the mainstream, in shallow sandy areas. Breeding takes place in this zone in February.



Figure 65 Extent of Hilsa breeding sites in Pakokku Township

6.12. Monywa Township

The last Hilsa breeding site identified during our survey is located on the Chindwin River, in Monywa Township, more than 800 km from the coast. This site is a shallow sandy area. The core breeding zone is only 2 km long (Figure 66), but the extent of the zone upstream and downstream is unknown. Breeding takes place here in March–April.



Figure 66 Extent of Hilsa breeding sites in Monywa Township

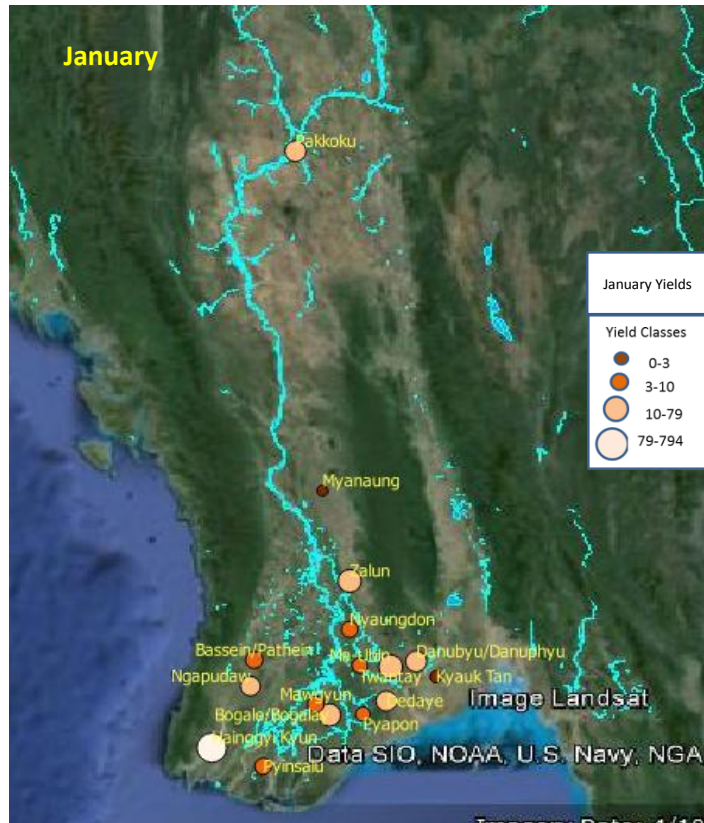
7. Conclusion

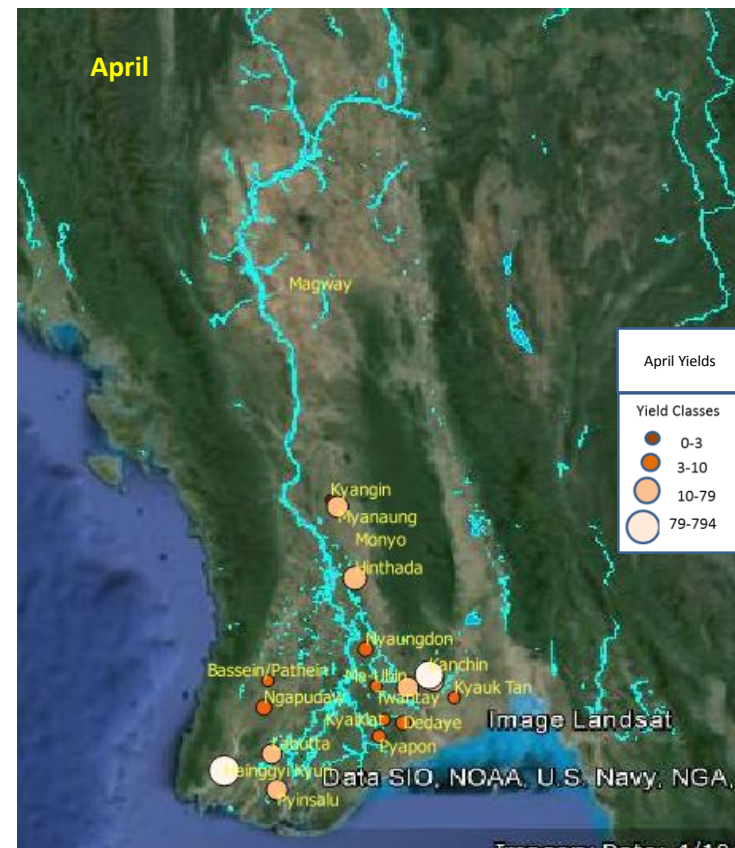
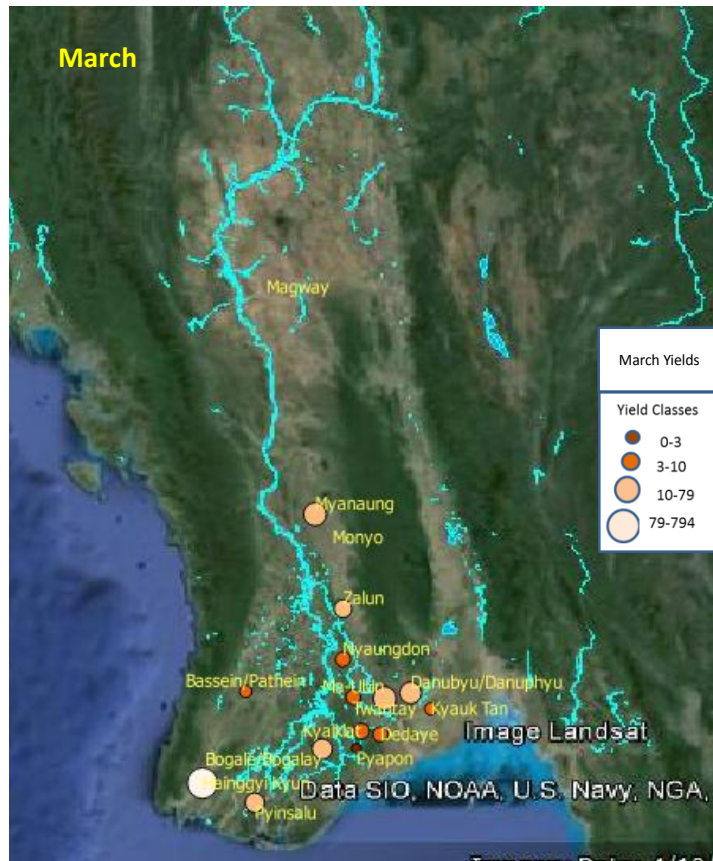
The survey of 32 sites using local knowledge identified 15 townships featuring Hilsa spawning sites. Based on these findings, it is recommended to undertake complementary field surveys that could check the fishers' claims and confirm the timing of breeding.

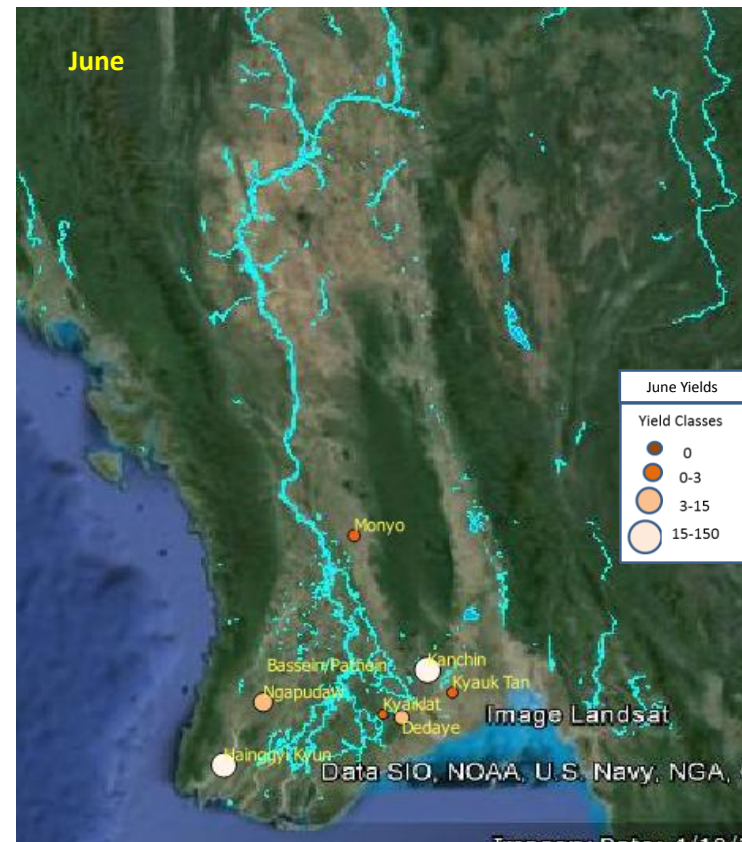
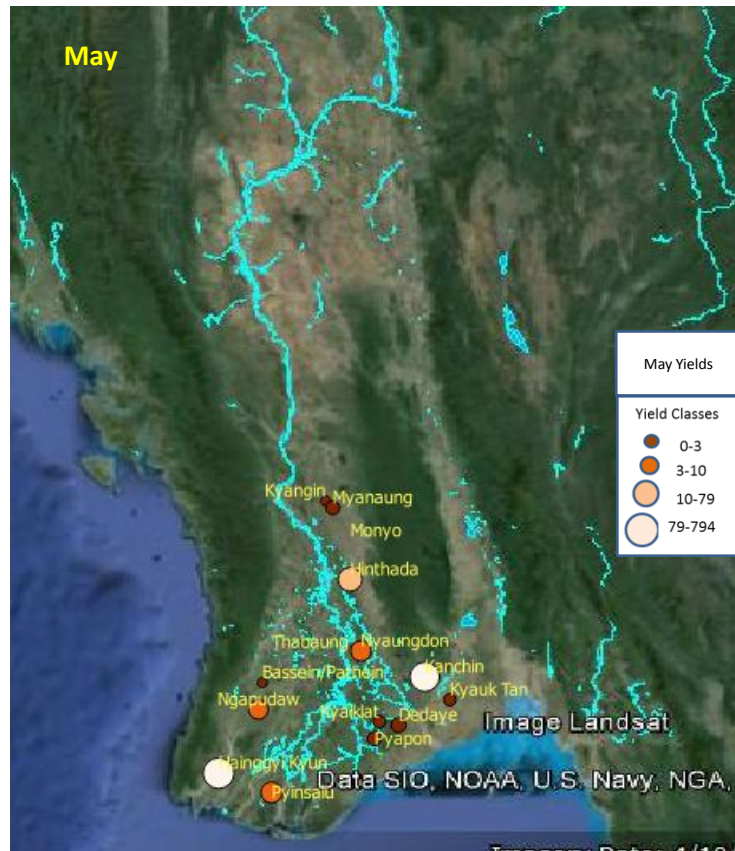
The Ayeyarwady section centred on Hinthada and stretching from Zalun to Monyo is the most important Hilsa breeding zone in the Ayeyarwady system; this area is to be considered as a priority for resource management and protection initiatives.

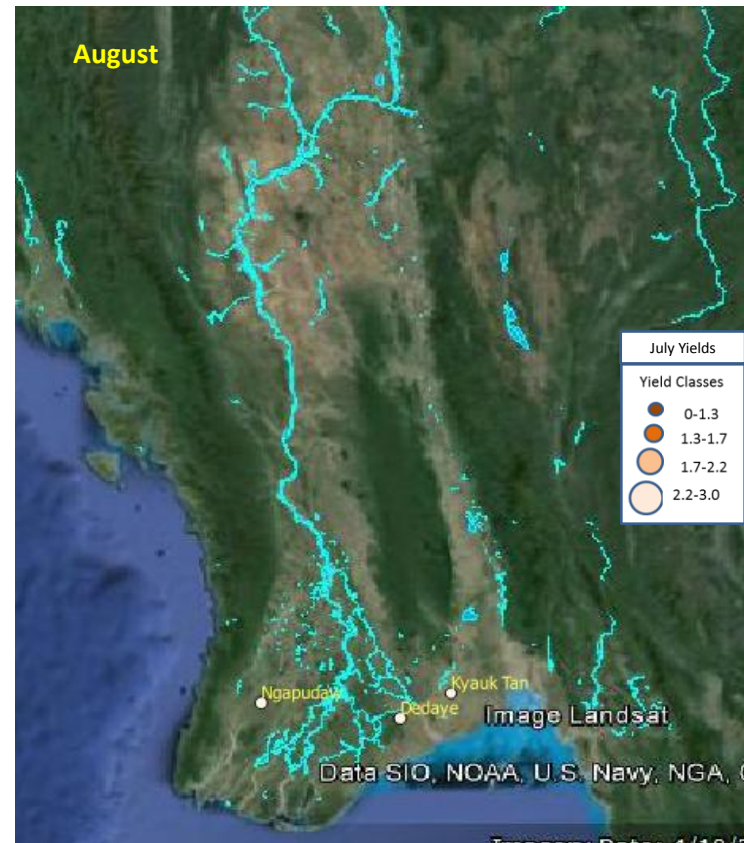
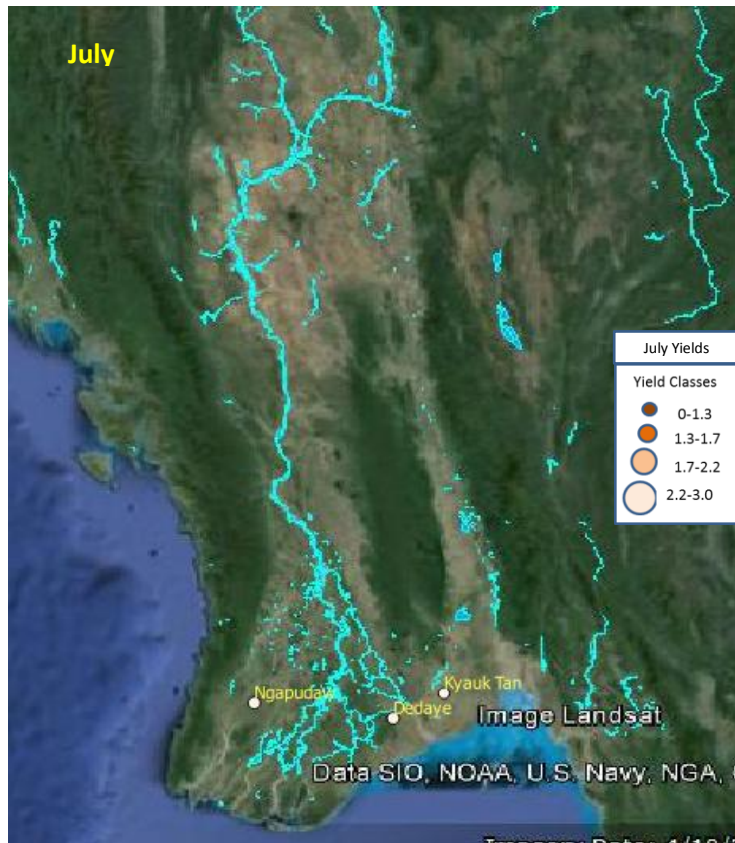
Appendix II Overview of catches per month

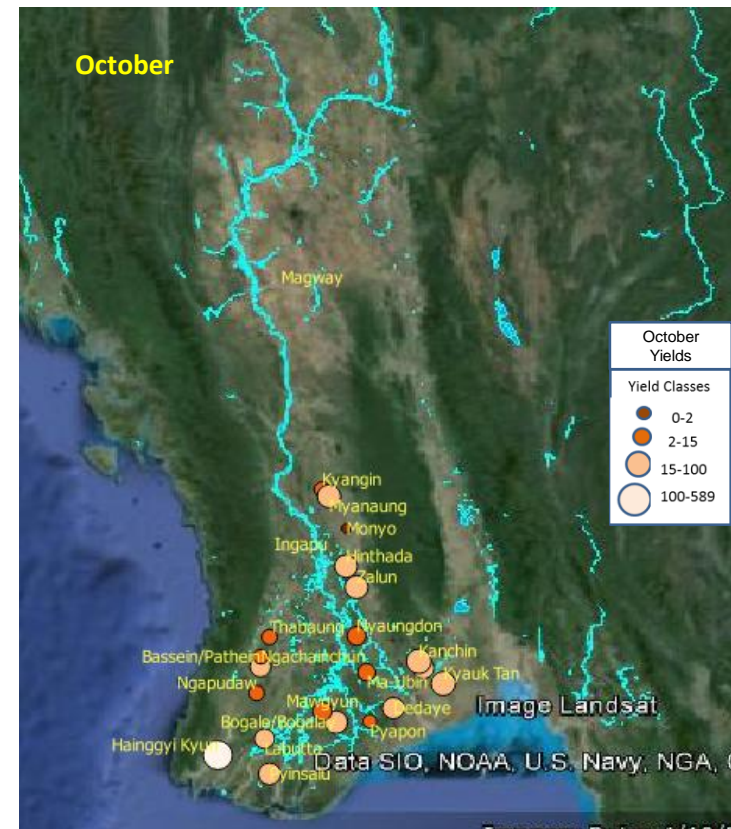
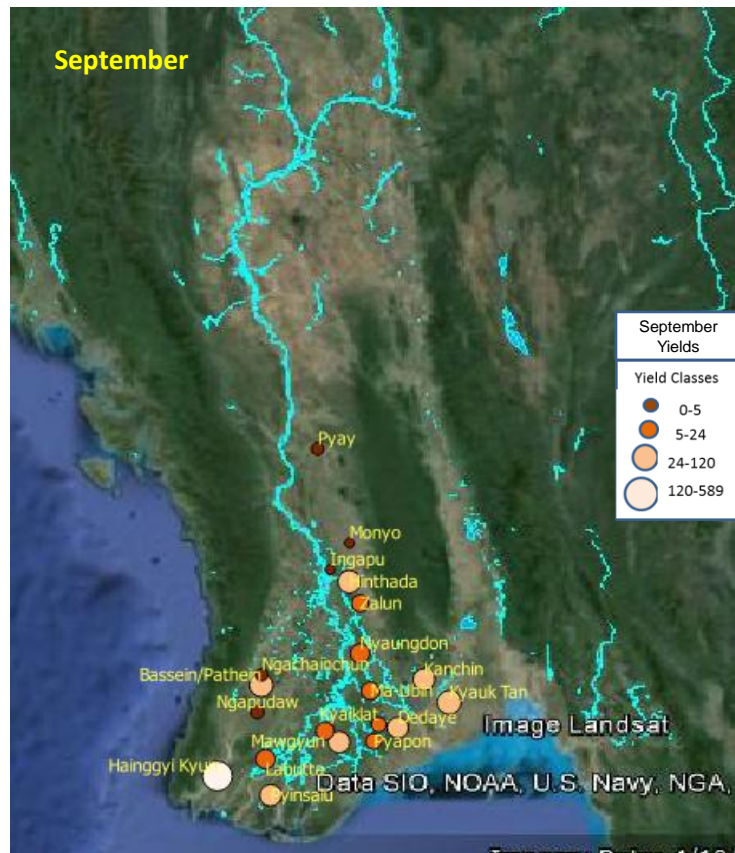
Units: viss (1.6 kg) per fisher and per month

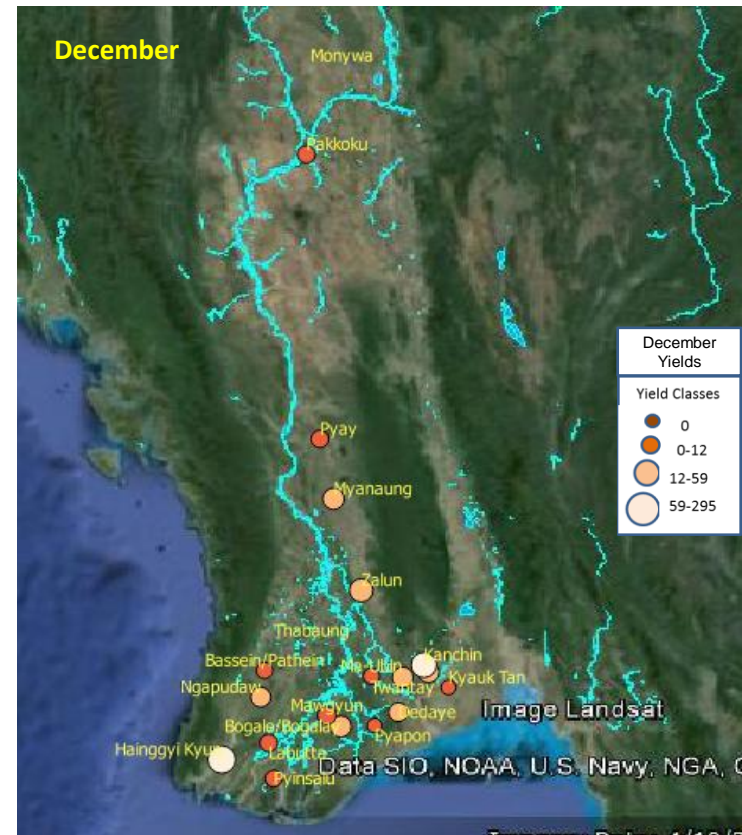
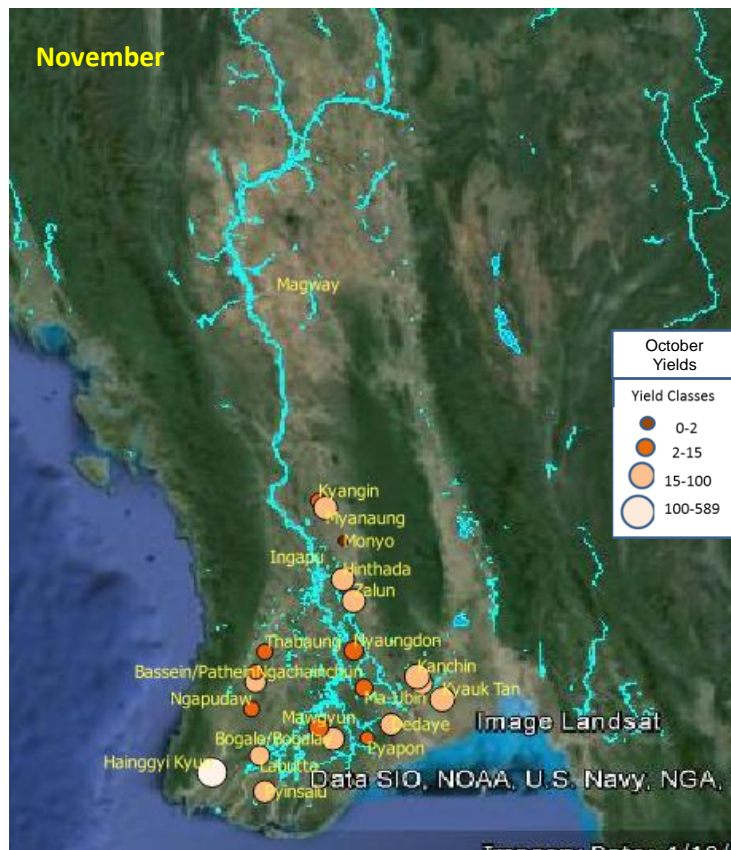












Appendix III Survey methodology

1. Overview

The present methodology is an adapted version of the survey manual produced by the Mekong River Commission for the use of local fishers' knowledge in the study of fish migrations and spawning in the Mekong River basin (Poulsen and Valbo-Jorgensen 1999). Its text largely reflects the original text, but was reduced in scope (no Markets component), simplified and modified to reflect in particular the use of Google Earth tools not available in 1999.

The overall approach of the survey is to gather specific information focussing on three main perspectives of local knowledge:

1. **Taxonomic:** All information given should be related to a specific and verifiable taxonomic species and a local name should be given to that species (and its scientific name established).
2. **Spatial:** All information given for a particular species should be related to a specific fishing ground (and therefore to a specific habitat).
3. **Temporal:** Information on occurrence of a particular species at a particular place should be correlated with timing (seasonal as well as diurnal).

The main tool during the local knowledge survey will be a photo flipchart of 31 species selected for detailed interviews on occurrence, size range, spawning etc. (see later) based on their importance in fisheries (according to anecdotal indications as well as observations by project staff).

The methodology consists of two sections:

1. Pre-survey guidelines, and
2. Survey manual

The Pre-survey guidelines have some built-in flexibility because, in certain situations (e.g. fishers selections), judgement and experience of the data collector/interviewer are relied upon. The survey manual is rather rigid and detailed in its design. This reflects the fact that very specific data/information is required from the interviews. An overview of the whole survey, including the pre-survey guidelines and survey manual is shown in Figure 67.

2. Pre-survey guidelines

The survey consists of a “multiple-step” approach, which leads the interviewer to the fishers that should be interviewed (see Figure 67).

2.1. Preparations at the office

For the full-scale survey, a list of fishing grounds to be covered in each country was prepared. Use Google Earth and Google Maps for this, for each planned location to be surveyed. Prepare maps at 2 altitudes: 70 km eye altitude in Google Maps (based on Google Earth) and 40 km eye altitude in Google Earth. Print maps in A3 format and prepare an outline of each map for fishers to complement. Based upon this, a work plan for the survey covering the Mekong mainstream was developed. Appointments for meetings between the data collectors/interviewers and district officials in the concerned districts should be made based on the work-plan. Maps of the area in question should be collected and taken to the field.

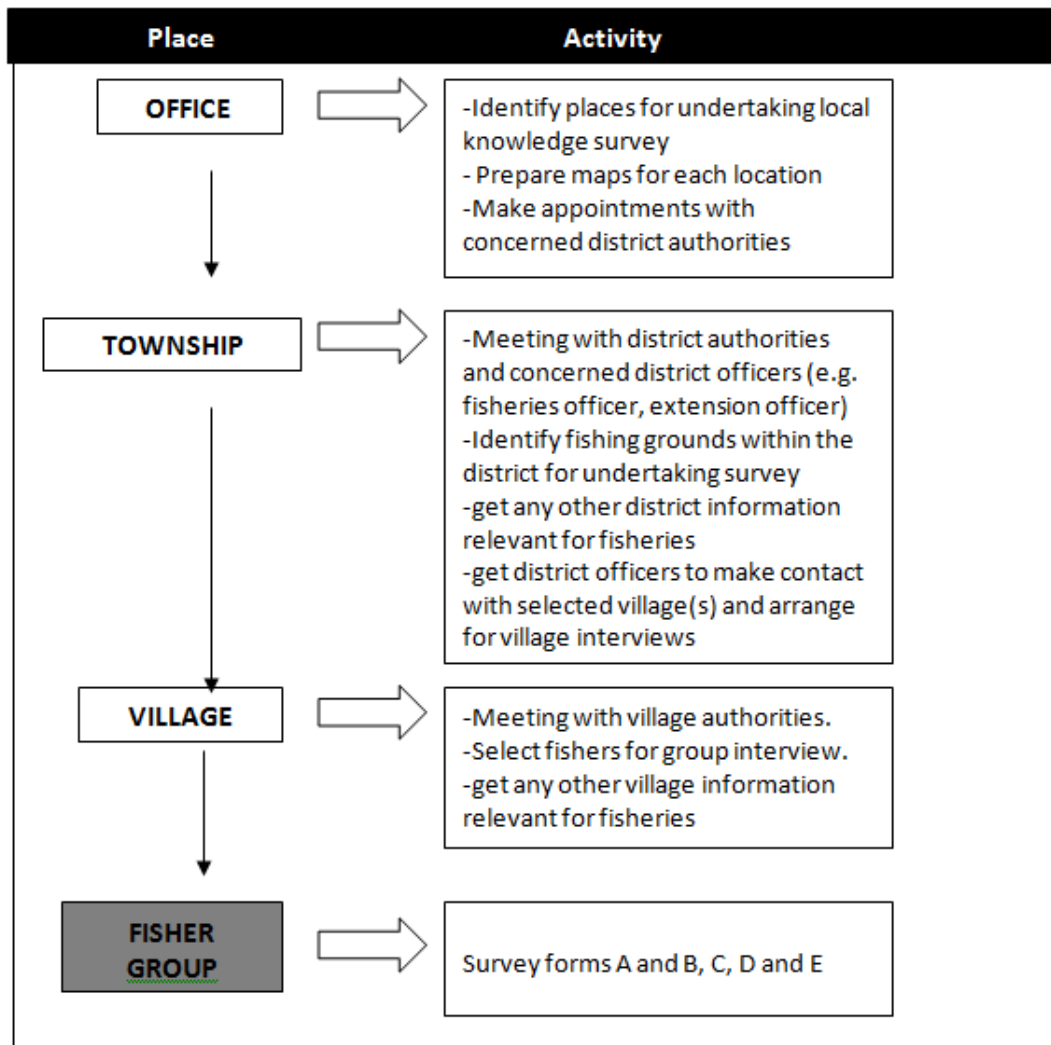


Figure 67 Overview of the survey process. white boxes refer to pre-survey guidelines, grey boxes refer to the survey manual

2.2. District meeting

The main objective of the district meeting is to identify fishing grounds in the district and to select places/villages for carrying out fisher interviews.

Prior to visiting the district, the type of fishing ground (habitat) to be surveyed has already been decided (e.g.: “we want to find a fisher in the Mekong mainstream”). Therefore, the main task during the district visit is to identify places where there is a good selection of experienced fishers in a particular type of fishing ground. Conditions vary considerably from district to district. There is currently no formal survey form or questionnaire for the district meeting. The following are minimum tasks to be carried out during the district visit:

1. Meeting with relevant person(s), e.g. chief of district, fisheries officers, extension officers etc. During this meeting, the district staffs are introduced to the project and its purpose and objectives explained. Room is left for questions.
2. A map is used as a focal point for discussion and on it are marked all mentioned fishing areas and habitats. All fishing grounds should be related to a name, either of the fishing ground itself or that of a nearby village.
3. Other fishery-related information that is provided by district officers should be noted (often, the district has a substantial amount of data on record in note books etc.).

4. Based on the information obtained, a decision is made regarding which fishing ground to focus on and which village(s) to visit for fishers interviews.
5. Finally, the district officers are asked if they can assist in the fieldwork in their district. They are asked to make contact with the selected village (chief or other representative of the village) to organise a meeting and to prepare the “good fishers in town” for a visit from the project. If there are any problems in getting access to fishers at certain times (e.g. if they are busy in the rice field), another date and time more convenient for village and fishers should be selected.

2.3. Village meeting

The village (or villages, if more than one village has been selected) near the selected fishing ground is then visited on the agreed time and date. The following are minimum tasks to be carried out after arriving at the village:

1. Meeting with the village authorities (e.g. village chief), where the project is introduced and the reason for visiting the village explained.
2. Confirm the information obtained from the district (e.g. in relation to fishing ground), for example by using the same map as used during the district visit.
3. Other fishery related information provided by the village should be noted.
4. Selection of fishers for fisher group interview.

The selection of fishers for fisher group interview (Form B: Species list; see below) is the most important outcome of the village chief meeting. Work only with fishers who have been fishing for at least five years in the village. However, it is very difficult to give strict guidelines for this. In some cases, the village chief will have pre-selected a group (which may not always be the best fishers in the area). In other cases, the survey team may be referred to another place or village.

The most important thing is that the fishers selected are experienced and currently fishing at the selected fishing ground. Inevitably, some fishers will be selected who may not be very experienced and trustworthy regarding knowledge on fish ecology. However, one of the objectives of the group interview (apart from getting information on species occurrence and local names) is to evaluate the knowledge of each of the group members and select the best fishers within this group for individual interviews (see later).

Ideally, 3–4 fishers should be selected for a group interview. If more fishers are available, one more group interview should be carried out rather than including more fishers in one group.

When a fisher group has been selected, the actual survey can begin. This is described in the survey manual below.

3. Survey Manual

3.1. Overview

A survey team always consists of two experienced researchers. During the whole survey, one of these data collectors/interviewers is “doing the talking” (interviewing), whereas the other is noting down the data as they appear during the interview (data collecting). In the following, reference is made to (i) the person doing the interviewing as the “*Interviewer*”, or *IV*, and (ii) the person noting down the data on the form as the “*Data Collector*”, or *DC*.

The advantage of this approach is that it makes the interview more conversational. If the same person is both interviewing and filling in the forms, the fisher may feel it more like an interrogation and will probably lose interest. The whole interview should be like a “talk between friends with a common interest”! This requires a substantial amount of skill from the interviewer, both in terms of conversational skills as well as knowledge and interest in the subject. It is important that persons

with such skills are selected as interviewers and that these persons will then be doing the survey from start to finish.

The survey consists of four forms:

- Form A: Survey identification
- Form B: Species list
- Form C: Migrations, spawning
- Form D: Conclusions

In the following, each survey form will be presented in detail. The numbers in brackets (e.g. [1]) refer to the corresponding entry numbers on the survey form. The abbreviations *IV* and *DC* appear several times. These refer to the activities to be carried out by the *Interviewer (IV)* and *Data Collector (DC)*, respectively. For example, if it says: “*DC*: enter the date when the group interview was carried out”, it means that it is the job of *the Data Collector (DC)* to do that.

3.2. Form A: Survey Identification

Start by reading the following text to the group:

My name is _____. I am here as a researcher studying migrations of some species from the sea up to the Central Dry Zone.

Our study is jointly conducted by the Department of Fisheries, the Bay of Bengal Large Marine Ecosystem Project and WorldFish.

Our questions cover fish ecology (fish abundance, fish sizes, etc.) and fishing (when you catch these species, in what conditions, etc.).

Participation is completely voluntary: if you do not want to be interviewed, you can simply refuse.

If you agree to participate you will receive 5,000 Kyat each for the time you spend with us. However be aware that this is a complex survey that will take between 1 and 2 hours. What we expect is commitment from you to carefully and patiently answer questions until the end of the questionnaire.

Also you are free to ask questions at any time if you are not clear.

Be aware of the following:

- The information we gather will be used for this study only; it will not be used by the government to control your activities or to tax you;
- The information we gather will not be shared with province, district or commune officials either;
- Neither your name nor those of your family members will be used in the results of this study;
- This information will NOT be used by donors to implement a development project in your area.

Thank you in advance.

[A1] Survey form number

DC: The survey form number consists of a six-number sequence consisting of the juxtaposition of month/day/questionnaire number on that day (e.g. 120301 = month 12 date 03 questionnaire 01 = questionnaire 01 of day 03 of month 12).

[A2] Date, [A3] Who led the interview? [A4] Who entered data?

[A5] Region, [A6] Township Name, [A7] Village tract Name

[A8] Village P Code

The GPS coordinates will be automatically provided by the tablet. The P code should be entered manually. This can be done at any convenient time, for example while **IV** is facilitating the mapping exercise (see [13] below).

[A9] Habitat name

DC: Enter habitat name using the following list of habitats:

[A9] Habitat code

Enter habitat code using the following list of habitats and codes:

Habitat type	Code
Permanent river	01
Seasonal river	02
Permanent creek	03
Seasonal creek or oxbow	04
Permanent canal	05
Seasonal canal	06
Floodplain grassland (max 20 cm high)	07
Floodplain swamp/marsh (20 cm–1 m)	08
Floodplain trees/shrubs (1 m and more)	09
Natural lake	10
Natural wetland/swamp/marsh	11
Manmade reservoir	12
Manmade aquaculture pond	13
Rain fed rice field	14
Irrigated rice field	15
Floodplain rice field	16

[A11] Mapping

The objectives of the mapping exercise are:

1. to assist in focusing the attention of fishers
2. to get detailed information about nearby fishing and breeding grounds.

The map developed during this exercise will be based on the maps prepared at the office, complemented with inputs from fishers used later if the fisher has any information about spawning grounds for particular species.

Equipment: Google Earth background for the township of the location, paper, marker pens.

Sequence of mapping exercise:

1. **IV:** introduce the fisher group to the map concept by showing the map of the area and, together with the fishers, find their village on the map.
2. **IV:** Ask the group to identify, as precisely as possible, the fishing grounds for different species. Initially, interfere as little as possible and let the fishers decide what should be included on the map. Then, get them to point out and write down on the map: **a)** the location of the village in relation to the fishing ground, **b)** exact place(s) for fishing activities on the fishing ground (which gears are used where), **c)** width (for riverine fishing grounds), **d)** depth, **e)** bottom conditions, **f)** vegetation, **g)** seasonality. If the group have any additional ideas about things to put on the map, they should feel free to do so.

3.3. Form B: Species List

Equipment: Photo flipchart

[1] Survey form number

DC: The survey form number consists of a six-number sequence consist of the juxtaposition of month/day/questionnaire number on that day.

At this stage the actual group interview begins.

The data collectors/interviewers present the fisher group with the photo flipchart of selected species from the Mekong basin. Each photo (species) in the photo flipchart has a code number assigned.

1. **IV:** Ask the fisher group if they can identify photo (species) number one (code number 1) in the flipchart and state if the species occurs at the concerned fishing ground.
2. **IV:** If the fisher group does not recognise the fish and/or state that it does not occur at the particular fishing ground: continue with photo (species) number 2.
3. **DC:** If the group identifies species number 1 as occurring at the fishing ground, the code number 1 is entered in the first box in column [14]. Then, go to [15].

Notes:

The species should be based on the 31 selected species only.

1. *It is important that fishers are not encouraged to identify "as many species as possible". When using the flipchart, the answers: "we don't know this species" or "this species does not occur at our fishing ground" provide valuable and precise information.*
2. *If the group is in doubt about the species on the photo, the interviewer should facilitate by pointing out the main characters for the species (the main characters for each species are listed in the "Guidelines to the photo flipchart", which is attached to the flipchart. The interviewer must be familiar with all main characters for all concerned species!).*

[15] New local name

IV: If species number 1 does occur at the fishing ground, ask the fisher group to give the local name of the species.

DC: Enter the name in the first box in the corresponding space.

[17] Remarks

DC: If there are any remarks, they should be entered here. An example could be, if one of the fishers shows special interest in a particular species (he may be a specialist in catching it), it should be noted under 'Remarks'. Another remark could be, if the interviewers for some reason doubt the information given.

Note:

Very often during the species list interview, other people will gather around the group and will inevitably provide comments as the group interview proceeds. If a person outside the fisher group demonstrates equal, or better, knowledge about certain species than the members of the fisher group, he/she should be considered for individual interview (Form C and D; see below).

3.4. Form C: Migration, spawning

Survey form number

DC: The survey form number consists of a six-number sequence consist of the juxtaposition of month/day/questionnaire number on that day.

Species

Start with species 1.

Month

Fishers usually refer to the first month of the season, but the beginning of the season varies from place to place. Write down the name of each month in full.

Abundance when fishing

Is it, overall, a month of high or low abundance?

If it is a month during which the species is not caught, ask if the fishers fish.

Indicate when the fisher does not know about the abundance of the species in a given month.

Size range in inches

Material: four segments of ruler of respectively 5 inches, 10 inches, 15 inches and 20 inches. Use these plastic segments to illustrate the size of fish.

Indicate, for each month, the average size of fish using the above categories. This allows distinguishing juveniles from adults.

Yield

Indicate the monthly number of viss per fisher during that month (1 viss = 1.6 kg). Help the fishers calculate the yield per day or per week before calculating the yield per month.

If the catch is small or limited to big individuals, use the column per piece.

Peak duration days

Ask the fisher if, within the high occurrence period, there are shorter peak periods and, if yes, how many days they last.

Note

Any relevant comment.

Fishing gear used

Enter the code of the main gear used and in which the above species is caught, using the table below.

Gear-type	Code
Gill-net, stationary	01
Gill-net, drifting	02
Trawl	03
Dai, small	04
Dai, large	05
Purse seine	06
Beach seine, brush park	07
Beach seine, no brush park	08
Cast-net	09
Lift-net, small	10
Lift-net, large	11
Scoop-net, small	12
Scoop-net, large	13
Long-line	14
Hook & line	15
Spear	16
Spear-gun	17
Barrages	18
Lee trap	19
Other trap	20
Pond trap	21
Collection	22

Period of fishing

Focus on the gear used to catch the species described.

Detail when that gear is first used in the year and until when (first month of use in the year and Last month of use in the year).

Predictability of the catch

Ask if the peak of the catch can be related to a predictable event such as high tides, full moon, new moon, first rains, etc.

Time of the catch

Ask the fisher, what time of the day the fisher normally catches the species.

3.4.1. Migration

Do you consider this species to be migratory?

So far, we have not asked the fisher about migration, only about occurrence. However, in relation to migration we would like to know about the direction of the migration. Some fishers may have made observations that help them to conclude the direction of a migration.

IV: ask the fisher, if he/she considers this species migratory.

If yes, which month does the migration start going upstream?

If species is considered migratory, ask the fishers which months the migration starts going upstream.

Ask how fishers can tell that the fish are migrating and the direction of the migration (for confirmation of the information); *if they cannot explain, consider that they do not know.*

If yes, which month does the migration stops going upstream?

If yes, which month does the migration start going downstream?

If species is considered migratory, ask the fisher which months the migration is downstream.

If yes, which month does the migration stops going downstream?

How can you tell the fish are migrating and the direction of the migration?

Ask how fishers can tell that the fish are migrating and the direction of the migration (for information confirmation); *if they cannot explain, consider that they do not know.*

Any other information concerning the migrations of this species?

Note any additional information about migrations of this species that came up during the interview which could not be entered anywhere else.

3.4.2. Spawning

[3] Do you know where this species spawns?

[4] If yes, do you know from personal observation that this place is a spawning ground?

IV: If the answer was yes for the previous question, ask the fisher whether he knows about the spawning of this species from his personal observation.

Spawning habitat type

Enter Habitat code using the following list of habitats and codes:

Habitat type	Code
Permanent river	01
Seasonal river	02
Permanent creek	03
Seasonal creek or oxbow	04
Permanent canal	05
Seasonal canal	06
Floodplain grassland (max 20 cm high)	07
Floodplain swamp/marsh (20 cm–1 m)	08
Floodplain trees/shrubs (1m and more)	09
Natural lake	10
Natural wetland/swamp/marsh	11
Manmade reservoir	12

Manmade aquaculture pond	13
Rain fed rice field	14
Irrigated rice field	15
Floodplain rice field	16

Spawning habitat name

In case the spawning habitat has a special name in Burmese language.

Month of spawning in this habitat

Additional information

Note any additional information about the spawning habits of this species that came up during the interview which could not be entered anywhere else.

Mapping of the spawning site

Draw with the fishers a map of the spawning site and note on the map physical and biological characteristics of the site, such as depth, current, bottom conditions, vegetation etc. This exercise can be carried out either by:

- Letting the fisher use the map already produced in the Survey identification form (Form A).
- Letting the fisher draw a new map.

Note: At this stage the interview about this particular fish species is over. Although a lot of specific data is needed, it is important that the species interview is carried out as a conversation with the fishers. The Interviewer should therefore be so familiar with the form and the questions that he/she is able to carry out the interview (i.e. conversation) without referring to the forms.

3.5. Form D: Conclusions

Number of fishers interviewed

Quality of this interview

Assess the quality, in your opinion, of this interview and of the information provided by the fishers.

Contact persons

If some specific fishers are particularly knowledgeable and motivated, ask if he/she is interested in continuing to cooperate with our project and can be contacted for further information and note their telephone number.

Other remarks concerning the interview

Appendix IV Survey questionnaire

Please read the introduction first

Form A: Survey details

A1. Survey form # (month day questionnaire#):

A2. Date:

A3. Who led the interview?

A4. Who entered data?

A5. Region:

A6. Township:

A7. Village tract:

A8. Village P code:

A9. Habitat name:

A10. Habitat code:

A11. Draw a map of the specific fish habitats in the area and indicate special characteristics of the environment.

Form B: Migratory species present

Tick if the species is present locally at least some time in the year and these years.

01 *Tenualosa ilisha*: ငါးသလောက် [Netalaw] New local name:
 Remark:

02 *Tenualosa toli*: ငါးသလောက်ယောက်ဖ [Netalowyopah] New local name:
 Remark:

03 *Hilsa kelee*: ငါးသလောက် [*Netalow*; like *Tenualosa toli*] or [Ngakular]
 New local name:
 Remark:

04 *Anodontostoma chacunda*: ငါးဝမ်းပူ [Nga-tay-mee (?)] or No wumbu
 New local name:
 Remark:

05 *Ilisha megaloptera*: မျက်ဆံကျယ် [Nyesandje] New local name:
 Remark:

06 *Gudusia variegata*: ငါးလဘိဘေးကျား [Ngalapidja] New local name:
 Remark:

07 *Monopterus cuchia*: ငါးရှဉ့် [Ne'shiin] New local name:
 Remark:

08 *Anguilla anguilla*: ငါးလင်ဘန်း [Nalienbenh] New local name:
 Remark:

09 *Anguilla bicolor bicolor*: ငါးဟောက် [Nahaw] New local name:
 Remark:

10 *Pangasius pangasius*: မြစ်ငါးတန် [Nie'natha] New local name:
 Remark:

11 *Pangasianodon gigas*: ငါးမြင်း [Nam myen] New local name:
 Remark:

12 *Pangasius conchophilus*: New local name:
 Remark:

13 *Pangasianodon hypophthalmus*: မွှေးငါးတန် [Muynadingh] New local name:
 Remark:

14 *Pangasius larnaudii*: New local name:
 Remark:

- 15 *Wallagoattu*: ငါးဘတ် [Ne phet] New local name:
Remark:
- 16 *Hemibagrus microphthalmus*: ငါးအိုက် [Na at] New local name:
Remark:
- 17 *Rita rita*: ငါးထွေ [Na thuey] New local name:
Remark:
- 18 *Sperata aor*: ငါးရောင်: [Na tchao] New local name:
Remark:
- 19 *Cyclocheilichthys apogon*: ငါးခုံးမ [Ngakomah] New local name:
Remark:
- 20 *Chaca burmensis*: ငါးကျောက်ဖား [Na djao pa] New local name:
Remark:
- 21 *Raiamas guttatus*: ငါးလဝါ [Nalawa] New local name:
Remark:
- 22. *Cirrhinus cirrhosus* or *Cirrhinus mrigala*: ငါးချင်းဖြူ [Nadjinphyu] New local name:
Remark:
- 23 *Macrogathus zebrinus*: ငါးမြေထိုးဆေးကျား [Nomwelubeja] New local name:
Remark:
- 24 *Mastacembelus armatus*: ငါးမြေနဂါး [Nomweynagaa] New local name:
Remark:
- 25 *Silonia silondia*: ငါးမြင်း [Nam myen] New local name:
Remark:
- 26 *Bagarius bagarius*: ငါးမောင်းမ [No maw ma] New local name:
Remark:
- 27 *Bagarius yarrelli*: ငါးမောင်းမ [No maw ma, same name as *Bagarius bagarius*]
New local name:
Remark:
- 28 *Catla catla*: ငါးခေါင်းပွဲ [Kambwa] New local name:
Remark:
- 29 *Labeo calbasu*: ငါးနက်ပြာ [Ngenepya] New local name:
Remark:
- 30 *Lates calcarifer*: ကကတစ် [Kagati] New local name:
Remark:

□31 *Pristis microdon*: လွင်္ဂါးမန် [Luongaman] New local name:

Remark:

Summary: How many species known?

Next page:

Form C: Migration, spawning

Species:

Month	Abundance when fishing			Don't fish	Don't know	Size Range in inches				Yield (viss)	Yield (pieces)	Peak duration (days)	Note
	High	Low	None			0-5	5-10	10-15	15-20				
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

GEAR used for the catch of this species: code

First month of use in the year: Last month of use in the year:

Are periods of peak occurrence predictable from any (natural) event? Yes No

If yes, which event?

Which time of the day do you normally catch this species? Early morning) Day Evening Night All periods

Migration

Do you consider this species to be migratory? Yes No Don't know

Upstream migration

Which month does the migration start going upstream? Month of beginning of upstream migration

Which month does the migration stop going upstream? Month of end of upstream migration

Don't know

Downstream migration

Don't know

Which month does the migration start going downstream? Month of beginning of downstream migration

Which month does the migration stop going downstream? Month of end of downstream migration

How can you tell the fish are migrating and the direction of the migration?

Additional information concerning the migration of this species:

Spawning

Do you know where this species spawns? Yes No

If yes, do you know from personal observation that this place is a spawning ground? Yes No

Spawning habitat type: Code

Spawning habitat name:

Which months does this species spawn there?

Do you have any other information concerning the spawning of this species?

Please draw a map of the spawning site and indicate special characteristics of the environment.

Form D: Conclusions

Number of fishers interviewed:

Was the quality of this interview? Good

Average

Poor

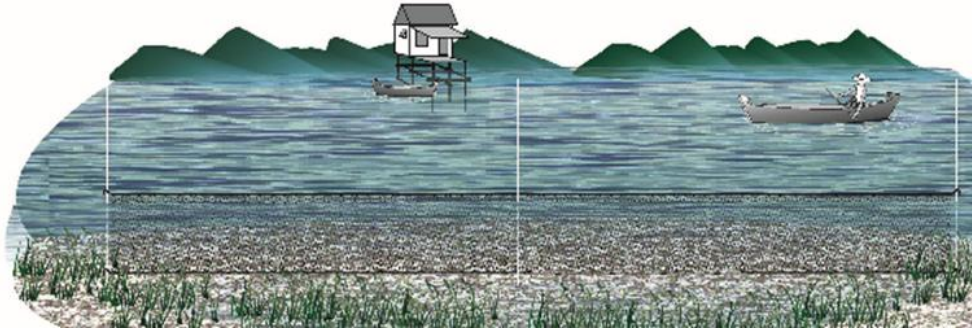
If good, contact of a person for coming back:

Other remarks concerning the interview:

Appendix V Flip chart of fishing gears

Fixed gill net

English Name - **Set Gill Net**
မြန်မာအမည် - တားပိုက်။
ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ။
ဖမ်းဆီးသည့်နေရာ - မြစ်၊ ချောင်း။
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ပဲခူး၊ ရန်ကုန်၊ ကရင်၊ မွန်။

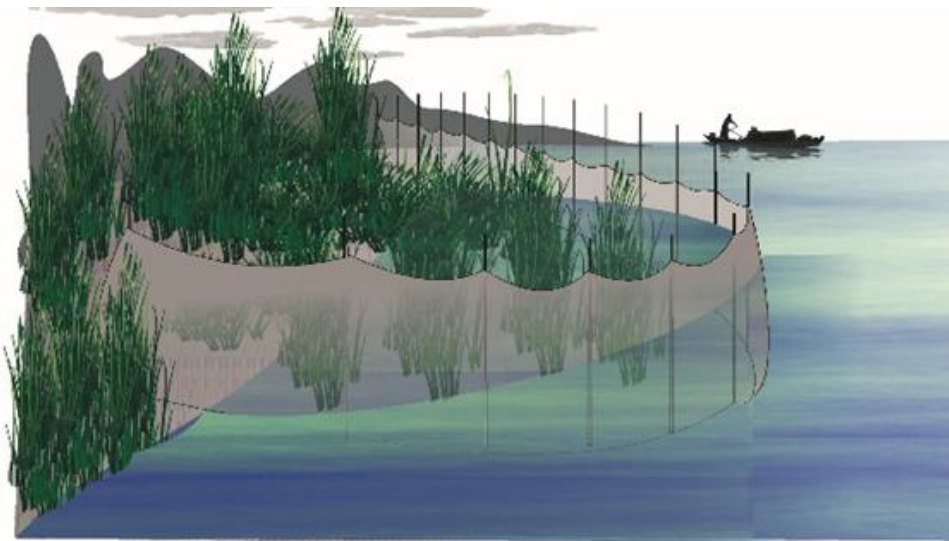


Drifting gill net

English Name - **Drift Net**
မြန်မာအမည် - ညှောပိုက်။
ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ။
ဖမ်းဆီးသည့်နေရာ - မြစ်၊ ချောင်း။
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ပဲခူး၊ ရန်ကုန်၊ ကရင်၊ မွန်။



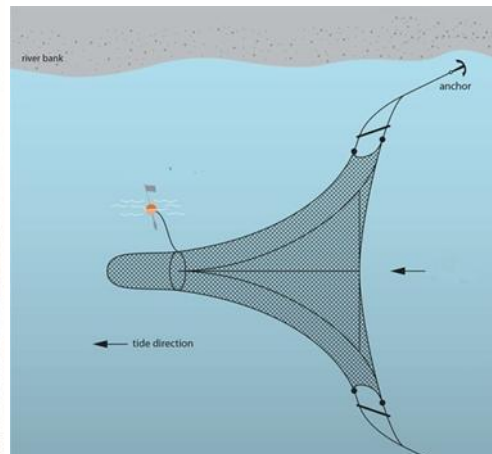
Surrounding net



English Name - **Beach Surrounding Net**
 မြန်မာအမည် - ပိုက်ဘဝင်း။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ။
 ဖမ်းဆီးသည့်နေရာ - ချောင်း၊ မြစ်။
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ မွန်၊ ကရင်၊ ပဲခူး၊
 ရန်ကုန်၊မန္တလေး။

Bag net, stow net

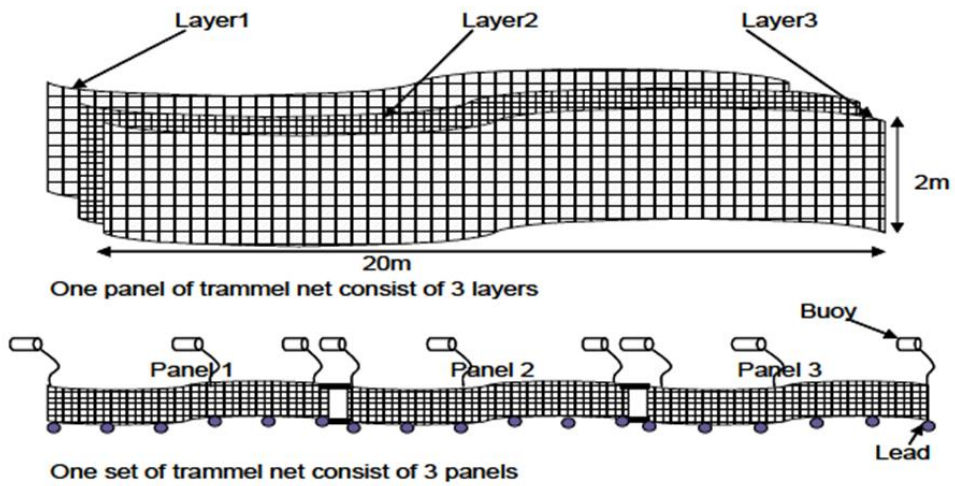
English Name - **Bag Net**
 မြန်မာအမည် - ကျားပိုက်/ကျားပါးစပ်
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ
 ဖမ်းဆီးသည့်နေရာ - ချောင်း၊ မြစ်။
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ရခိုင်၊ မွန်၊ ကရင်
 ပဲခူး၊တနင်္သာရီ။



Fixed trammel net



Drifting trammel net



Beach seine net

English Name	Beach Seine Net
မြန်မာအမည်	- သောင်ဆွဲပိုက်
ဖမ်းဆီးသည့်ငါးအမျိုးအစား	- ငါးမျိုးစုံ။
ဖမ်းဆီးသည့်နေရာ	- မြစ်။
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)-	ရန်ကုန်၊ ပဲခူး၊ ဧရာဝတီ၊ မန္တလေး။



Stationary fish filter trap

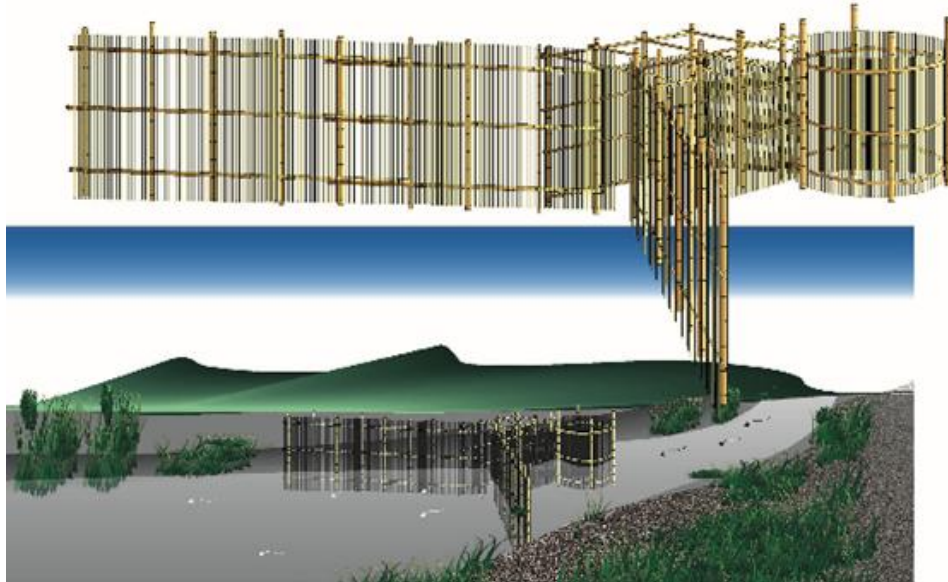
English Name	Stationary Bamboo Fish Filter Trap
မြန်မာအမည်	- မြင်းဝန်းဆည်/ လျှားဆည်။
ဖမ်းဆီးသည့်ငါးအမျိုးအစား	- ပုစွန် နှင့်ငါးမျိုးစုံ။
ဖမ်းဆီးသည့်နေရာ	- အင်းချောင်း။
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)-	ဧရာဝတီ၊ ပဲခူး၊ ရန်ကုန်၊ ကရင်၊ မွန်။



Shallow bamboo stake trap

English Name - **Shallow Bamboo Stake Trap**

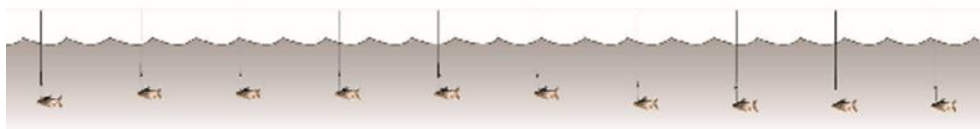
- မြန်မာအမည် - ဘုံလုံဆည်။
- ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ပုစွန်နှင့်ငါးမျိုးစုံ။
- ဖမ်းဆီးသည့်နေရာ - အင်း၊ အင်းချောင်း။
- တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ပဲခူး၊ ရန်ကုန်၊ ကရင်၊ မွန်။



Line and hooks

English Name - **Long Line/ Hook & Line**

- မြန်မာအမည် - ငါးမျှားတန်း
- ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ။
- ဖမ်းဆီးသည့်နေရာ - ချောင်း၊ မစ်။
- တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ရန်ကုန်၊ ပဲခူး၊ ဧရာဝတီ၊ မန္တလေး။



Cast net

English Name	- Cast net
မြန်မာအမည်	- လက်ပစ်ကွန်။
ဖမ်းဆီးသည့်ငါးအမျိုးအစား	- ရေချိုငါးမျိုးစုံ။
ဖမ်းဆီးသည့်နေရာ	- ရွှေငါး၊ မြစ်။
တွေ့ရှိရာဒေသ (ပြည်နယ်/တိုင်း)-	- ရှေးဝင်္ကဲ၊ ပဲခူး၊ ကရင်၊ ခန္တလေး။
	ရန်ကုန်၊ ဖွန်။



Spear gun



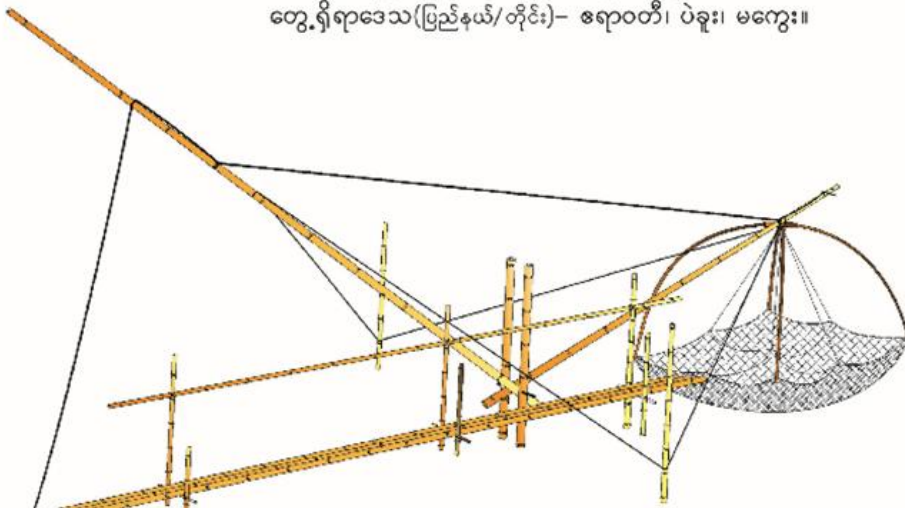
Portable lift net



- | | |
|------------------------------|-------------------------------|
| English Name | - Potable lift net |
| မြန်မာအမည် | - ကဏန်းထောင်ဒိုင်းဝန်း။ |
| ဖမ်းဆီးသည့်ငါးအမျိုးအစား | - ရွံကဏန်း |
| ဖမ်းဆီးသည့်နေရာ | - လယ်ကွင်း၊ ချောင်း၊ မြစ်။ |
| တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း) | - ဧရာဝတီ၊ ရခိုင်၊ ဗွန်တနသာရီ။ |

Stationary lift net

- | | |
|------------------------------|------------------------------|
| English Name | - Stationary Lift net |
| မြန်မာအမည် | - ရကွင်းကြီး/စက်ကဝါ။ |
| ဖမ်းဆီးသည့်ငါးအမျိုးအစား | - ငါးဖယ်အောင်း၊ ငါးနုသန်း။ |
| ဖမ်းဆီးသည့်နေရာ | - ချောင်း၊ မြစ်။ |
| တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း) | - ဧရာဝတီ၊ ပဲခူး၊ မကွေး။ |

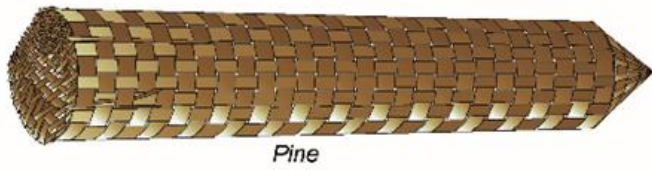


Push net

English Name	- Man Push net
မြန်မာအမည်	- ရင်းတွန်း/ ကျွဲကော်
ဖမ်းဆီးသည့်ငါးအမျိုးအစား	- ငါးမျိုးစုံ၊ ပုစွန်
ဖမ်းဆီးသည့်နေရာ	- လယ်ကွင်း၊ ချောင်း၊ တူးမြောင်း၊ မြစ်။
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)-	ရန်ကုန်၊ ပဲခူး၊ ဧရာဝတီ၊ ကရင် မွန်၊ ခန္တလေး။



Eel traps



English Name	- Eel trap
မြန်မာအမည်	- ငါးရှဉ့်ပိုင်/ ငါးရှဉ့်ပုံး
ဖမ်းဆီးသည့်ငါးအမျိုးအစား	- ငါးရှဉ့်
ဖမ်းဆီးသည့်နေရာ	- လယ်ကွင်း၊ ချောင်းစပ်၊ အိုင်များ
တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)-	ဧရာဝတီ၊ ရန်ကုန်၊ ပဲခူး၊ မွန်။

Fish traps



English Name - Fish trap
 မြန်မာအမည် - ငါးမွေခိုးဖြိုး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမွေခိုး။
 ဖမ်းဆီးသည့်နေရာ - လယ်ကွင်း၊ အိုင်၊ ချောင်း၊
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ပဲခူး။



English Name - Fish trap
 မြန်မာအမည် - ဖင်ထောင်ဖြိုး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးမျိုးစုံ။
 ဖမ်းဆီးသည့်နေရာ - လယ်ကွင်း၊ အင်းအိုင်၊ ချောင်း၊
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ပဲခူး၊ မန္တလေး။



English Name - Fish trap
 မြန်မာအမည် - ငါးလေးဖြိုး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးခုံး၊ ငါးဖျင်း၊ ငါးလက်။
 ဖမ်းဆီးသည့်နေရာ - လယ်ကွင်း၊ အင်းအိုင်၊ ချောင်း၊
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ပဲခူး(ထန်းပင်ကုန်း)။

Upright fish traps



English Name - Upright fish trap
 မြန်မာအမည် - ငါးစုပုံး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးခွ၊ ငါးရုံ၊
 ဖမ်းဆီးသည့်နေရာ - လယ်ကွင်း၊ ချောင်းစပ်
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ရန်ကင်း၊ ပဲခူး။



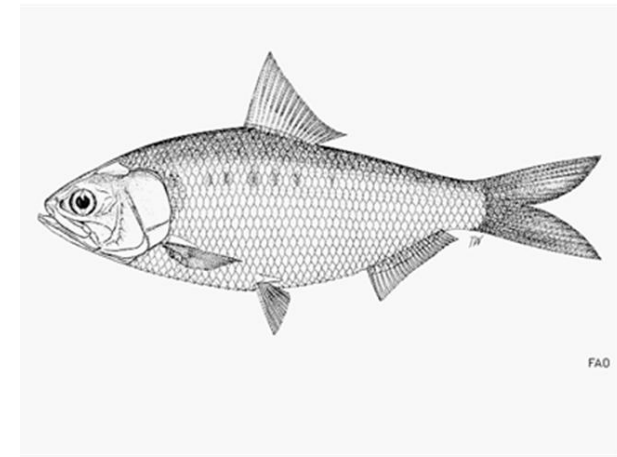
English Name - Upright fish trap
 မြန်မာအမည် - ငါးစုပုံး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးခွ၊ ငါးရုံ၊ ဖမ်းဆီးသည့်နေရာ
 - လယ်ကွင်း၊ ချောင်းစပ်
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ဧရာဝတီ၊ ရန်ကင်း၊ ပဲခူး(ပေါ)။



English Name - Upright fish trap
 မြန်မာအမည် - ငါးလေးဖြိုး။
 ဖမ်းဆီးသည့်ငါးအမျိုးအစား - ငါးခုံး၊ ငါးရုံ၊ ငါးစု
 ဖမ်းဆီးသည့်နေရာ - လယ်ကွင်း၊ ချောင်းစပ်
 တွေ့ရှိရာဒေသ(ပြည်နယ်/တိုင်း)- ရှမ်း(အင်းလေး)။

Appendix VI Flip chart of species studied

01

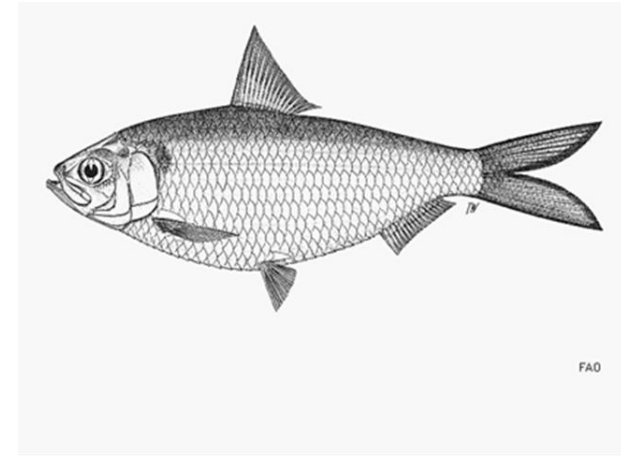


Tenulosailisha

Name in Myanmar language: ငါးသလောက် [Netalaw]

Schooling in coastal waters and ascending rivers for as much as 1200 km (usually 50–100 km). Migration though is sometimes restricted by barrages. Hilsa far up the Ganges and other large rivers seem to be permanent river populations. Feeds on plankton, mainly by filtering, but apparently also by grubbing on muddy bottoms. Breeds mainly in rivers during the southwest monsoon (also from January to February to March). Artificial propagation has been partially successful in India. Known to be a fast swimmer, covering 71 km in one day.

02

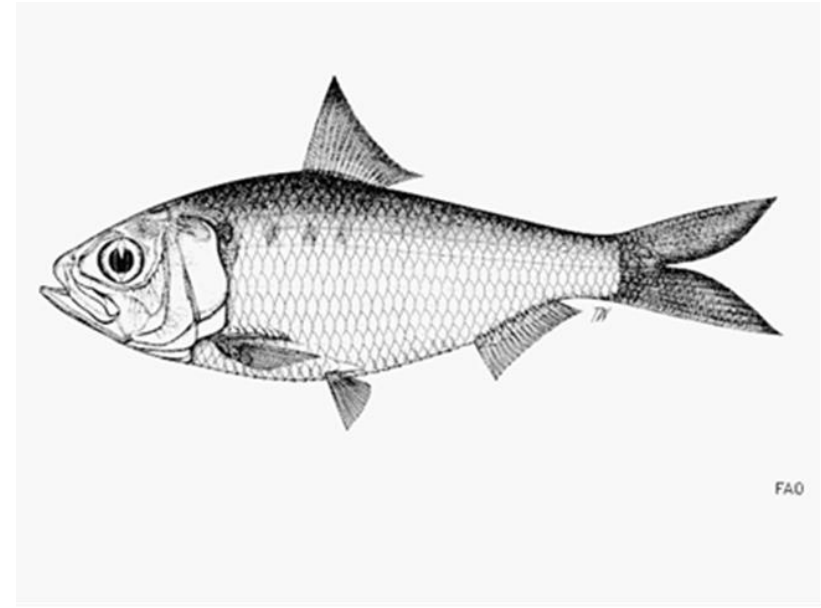
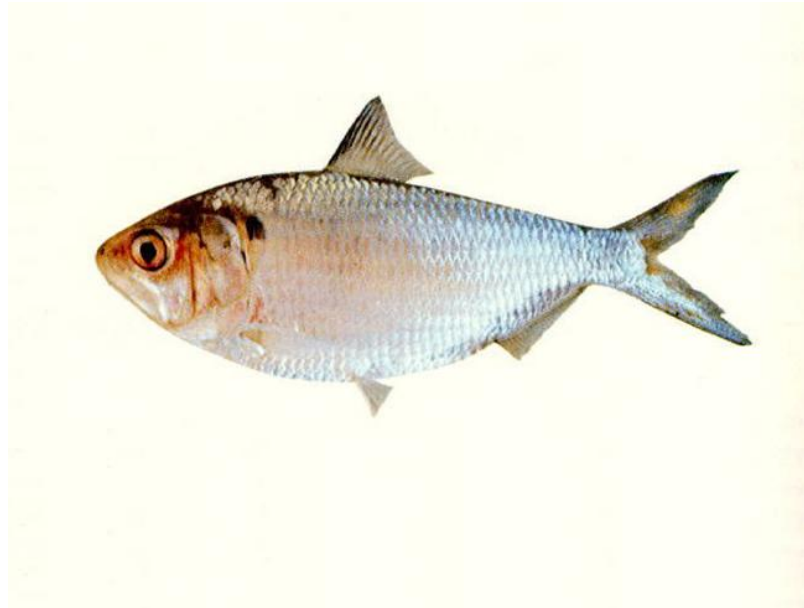


Tenulosatoli

Name in Myanmar language: ငါးသလောက်ယောက်ဖ [Netalowyopah]

Inhabits fast-flowing, turbid estuaries and adjacent coastal waters. Schooling in coastal waters, euryhaline and perhaps anadromous, ascending rivers to breed (but in some areas fishery workers claim that it does not). Presumably, its biology is similar to that of *T. ilisha*, but the fewer gill rakers suggest that it takes larger food organisms. Reported to feed on zooplankton. More data needed especially since it is not always distinguished from *T. ilisha*, especially at juvenile stages. Dark spot: at most, a dark diffuse mark behind gill opening, but no other spots on flank (unlike *Hilsa kelee*).

03



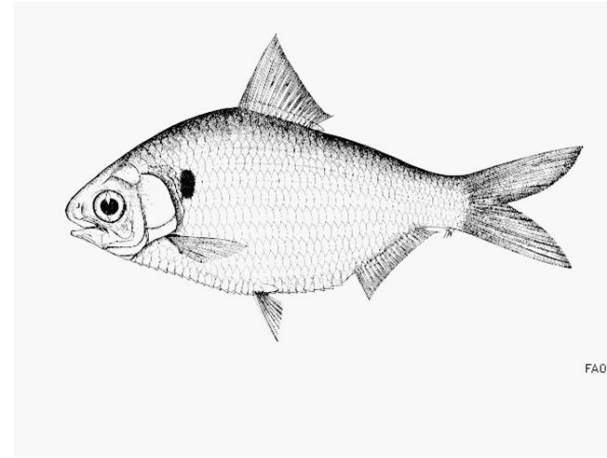
Hilsa kelee

Name in Myanmar language: ငါးသလောက် [*Netalow*; same name as *Tenualos atoli*]

Found in coastal waters, enters estuaries and able to tolerate quite low salinities (7 ppt). Feeds chiefly on phytoplankton (mainly diatoms, also dinoflagellates), but also copepods, molluscs and crustacean larvae, prawns, amphipods and polychaetes. Spawns (at least in Godavari estuary) around February.

A black spot behind gill opening; usually 10 spots along flank.

04

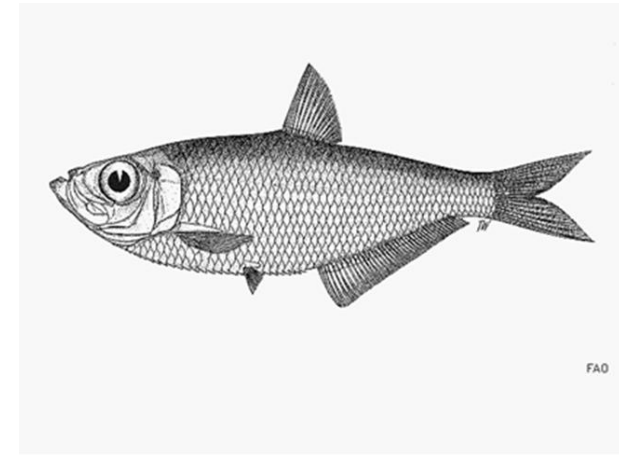


Anodontostoma chacunda

Name in Myanmar language: ငါးဝမ်းပူ [Nga-tay-mee (?) or No wumbu]

Usually marine coastal, but ascends rivers to the upper tidal zone. Occurs inshore and also in estuaries. Feeds on diatoms, radiolarians, molluscs, copepods, and crustaceans (in that order of importance, at least in the Godavari estuary). Breeds from November to February, mainly in the later part (Godavari estuary). Marketed fresh, frozen, dried, dried-salted or boiled.

05

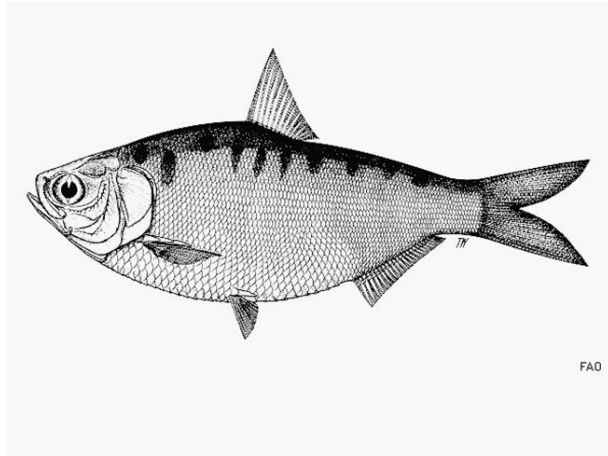


Ilisha megaloptera

Name in Myanmar language: မျက်ဆံကျယ် [Nyesandje]

An inshore species, but apparently occurs also in rivers (Ganges at Allahabad and rivers of eastern Uttar Pradesh). Ascends into the upper end of the tidal zone .feeds on fish, crustaceans, amphipods, occasionally polychaetes, tunicates and small amounts of algae and diatoms. Big eye.

06



Gudusia variegata (Burmese river shad)

Name in Myanmar language: ငါးလဘီခေးကျား [Ngalapidja]

Asia: rivers of Myanmar (chiefly the Irrawaddy, but perhaps others). Occurs in the middle and upper reaches of rivers. More data needed.

07

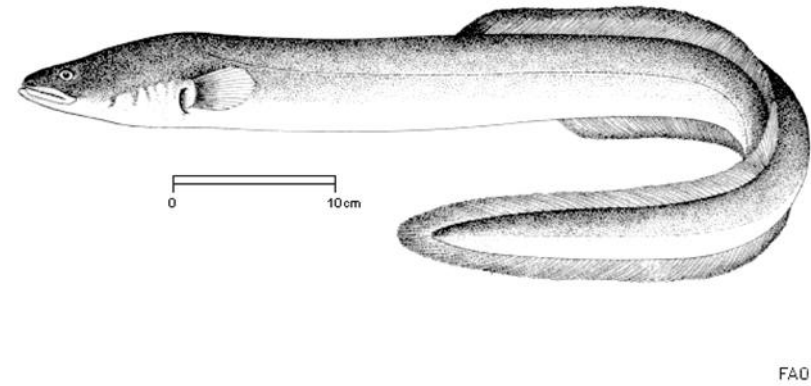


Monopterus cuchia

Name in Myanmar language: ငါးရှဉ့် [Ne'shiin]

Adults known to hibernate in mud during cold season. Feed mainly on small fish, tadpoles and aquatic insects. The male guards and builds nest or burrow.

08



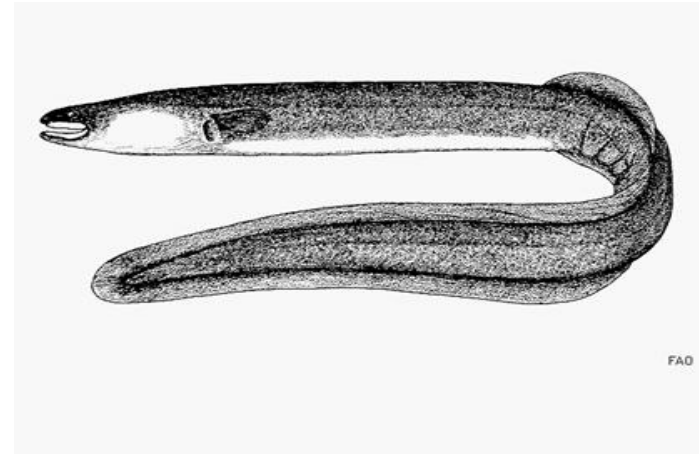
FAO

Anguilla Anguilla

Name in Myanmar language: ငါးလင်ဘန်: [Nalienbenh]

Inhabits all types of benthic habitats from streams to shores of large rivers and lakes. Naturally found only in water bodies connected to the sea. Territorial and solitary species; 'schools' of young eels which are observed from time to time are a mass response to outward conditions and not of active assembling.

09



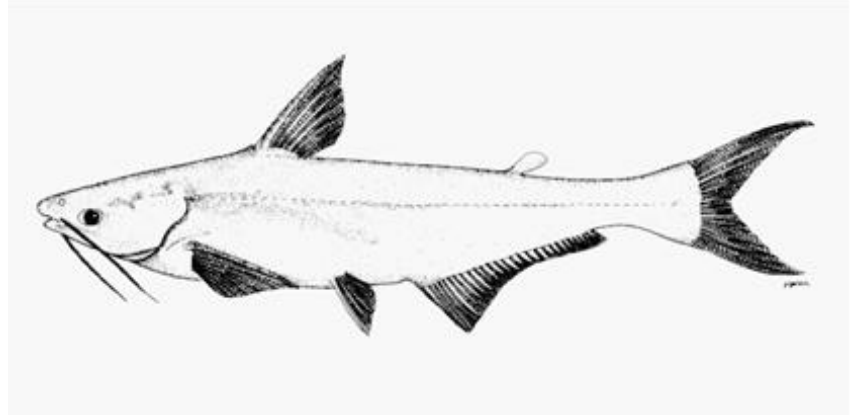
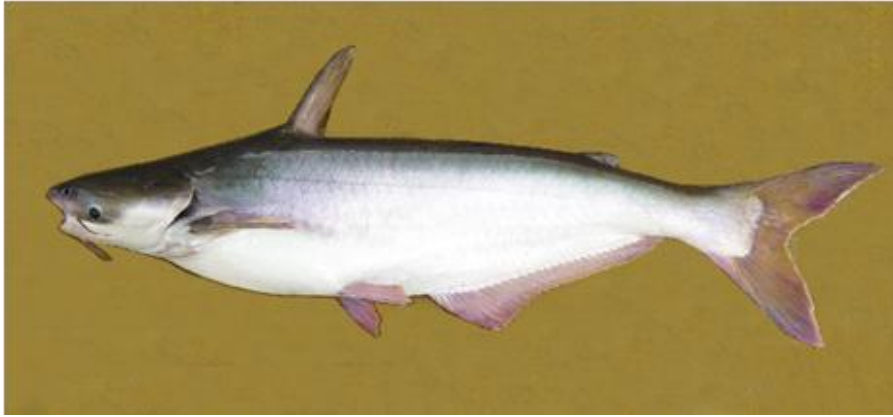
Anguilla bicolor bicolor

Name in Myanmar language: ငါးဟော့ [Nahaw]

Migratory species which breeds in the ocean. Lives in fresh water areas as an adult, in estuaries and seas as young. Descends to the sea to spawn. Inhabits freshwater streams and pools, preferring marshy habitats. Found in rivers and creeks, commonly over rock bottoms and in deeper pools. Seldom occurs in large rivers. Restricted to lowland (coastal) reaches of river systems. Feeds on small fish, crustaceans and molluscs. Reported to breed east of Madagascar; the south equatorial current probably carries the eel larvae and elvers towards the east coast of Africa where local coastal currents guide the elvers to suitable rivers which they invade and they stay there until sexually mature, when they return to their breeding grounds.

Different from *Anguilla anguilla* because head is bigger and 2 colours: Olive to dark bluish-brown dorsally, lighter ventrally from jaw to anus.

10

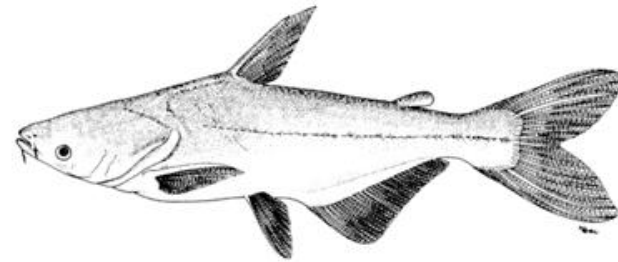


Pangasius pangasius

Name in Myanmar language: မြစ်ငါးတန် [Nie'natha]

Found in large rivers and estuaries. Occurs in high estuary (freshwater tidal zone) as juveniles, moving to brackish water as sub-adults, and finally as adults to river mouths and inshore areas. Longevity given as 10 years but appears too low. Feeds on snails, other molluscs and plants. Reared for consumption in Thailand, Cambodia and Vietnam; excellent food fish with very white fine grained sweet flesh.

11

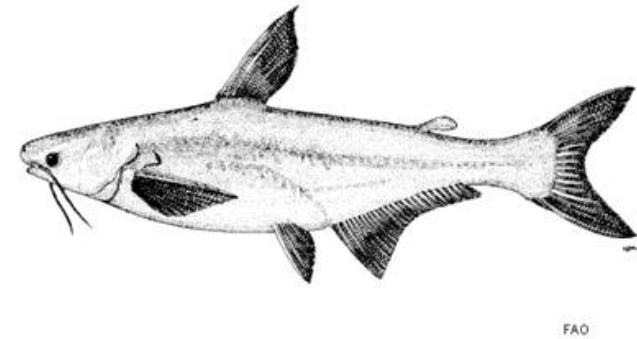


Pangasianodon gigas

Name in Myanmar language: unknown

A migratory species which occurs in medium to large-sized rivers. Feeds on detritus and algae on the bottom; feeds only on vegetation in the river but takes other food in captivity; little is known on its general pattern of life and migratory journeys for spawning. Shows one of the fastest growth rates of any fish in the world, reaching 150 to 200 kg in 6 years. Cited in the Guinness Book of Records as largest freshwater fish. Maximum length of 300 cm needs confirmation. Threatened due to over-harvesting and habitat loss.

12

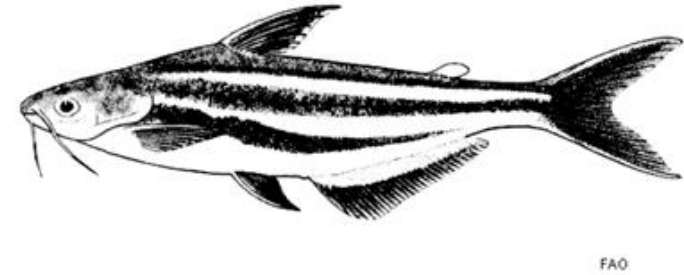


Pangasius conchophilus

Name in Myanmar language: unknown

Occurs in large rivers and enters flooded forests. Found in rapids and in deep slow reaches. Juveniles feed on prawns and insects; sub-adults and adults on prawns, insects and particularly mollusks which are more predominant in stomach contents than in any other *Pangasius* species and on plants. Migrates as water levels and turbidity begin to increase. Reproduces early in the flood.

13

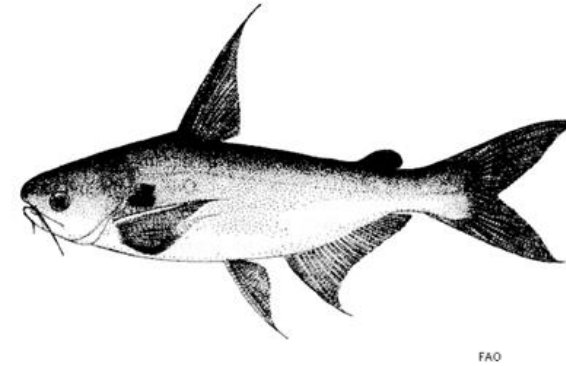


Pangasianodon hypophthalmus

Name in Myanmar language: မွှေးငါးတန် [Muynadingh]

Inhabits large rivers. Omnivorous , feeding on fish and crustaceans as well as on vegetable debris. South of the Khone falls, upstream migration occurs from October to February, with peak in November–December. Aquarium keeping: in groups of 5 or more individuals; not recommended for home aquariums; minimum aquarium size >150 cm.

14



Pangasius larnaudii

Name in Myanmar language: unknown

Occurs in medium to large rivers. Inhabits deep pools in the river. Found in rapids and riffle. Enters flooded forest. Artificially reared fry of 3.5 mm at 12 hours, 8.4 mm at 4 days, 8.8 mm at 8 days and 23 mm at 18 days. Larval teeth present in 12-hour and 4-day larvae. Feeds on shrimps, small fish, gastropods and plants. Migrates into floodplains and spawns at the beginning of the flood season.

15



Wallago attu

Name in Myanmar language: ငါးဘဝံ [Ne phet]

Found in large rivers, lakes and tanks. A large, voracious and predatory catfish which thrives in heels with grassy margin; mostly hides under holes in river banks and canals. Associated with deep, still or slow-flowing water with a mud or silt substrate. Sluggish and stays on muddy or silty bottom in search of food. Juveniles feed mainly on insects; adults feed on smaller fish, crustaceans, and molluscs. Oviparous, distinct pairing possibly like other members of the same family. Abundant during the warm season; a pre-monsoon summer breeder. In the Mekong, it is reported to migrate to smaller streams, canals and to the floodplain during the flood season. When the water level in the Mekong drops and the flood recedes, it moves to the Mekong or larger tributaries, where it stays in deep pools until the next inundation period.

16



Hemibagrus microphthalmus

Name in Myanmar language: ငါးအိုက် [Na at]

Occurs in deeper rocky areas and tree roots. Species caught throughout the year. Enters flooded forest during the months of high water (July-October). Feeds on fish, shrimps and crabs.

17



Rita rita

Name in Myanmar language: ငါးစေ့ [Na thuey]

Inhabits rivers and estuaries, preferably muddy to clear water. Prefers backwater of quiet eddies. Feeds on insects, molluscs, shrimps and fish.

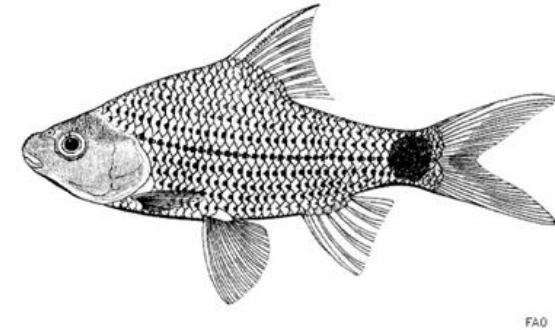
18



Sperata aor

Name in Myanmar language: ငါးတျာင်း [Na tchao]

19



Cyclocheilichthys apogon

Name in Myanmar language: ငါးခုံမ [Ngakomah]

Inhabits small streams, reservoirs, lakes, canals, ditches, and generally areas with slow moving or standing water. Occurs in medium to large-sized rivers. Stomach contents are composed of fish and insect remains. Typically found around surfaces, such as plant, leaves, branches and tree roots where it browses for small plankton and crustaceans. Moves into flooded forests and non-forested floodplains. Reported to breed late during high-water season from September to October as water levels peak and begin to decline.

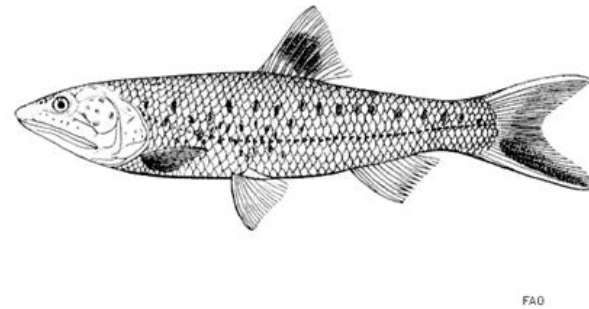
20



Chaca burmensis

Name in Myanmar language: ငါးကျောက်ဖား: [Na djao pa]

21

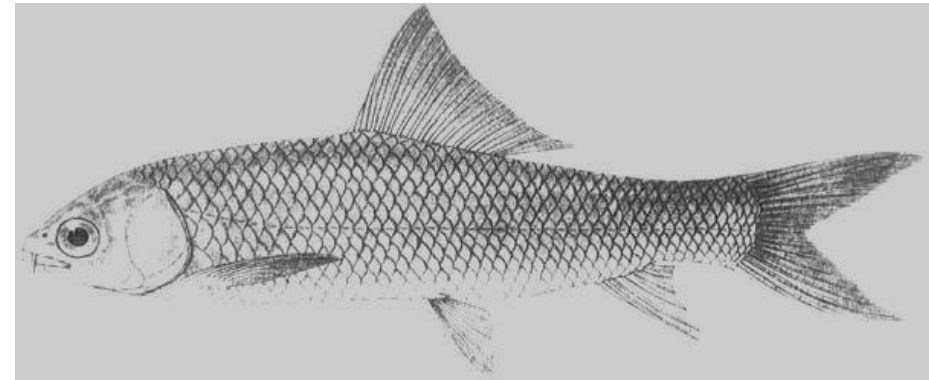


Raiamas guttatus (Burmese trout)

Name in Myanmar language: ငါးလှော် [Nalawa]

Inhabits shady areas and muddy bottoms in deep hill streams. Adults usually collected in clear water with moderate to swift currents, juveniles in quiet pools further downstream. Found in medium to large rivers, flooded fields and rapid-running mountain streams.

22



Cirrhinus cirrhosus* or *Cirrhinus mrigala

Name in Myanmar language: ငါးချင်းဖြူ [Nadjinphyu]

Freshwater; demersal. Tropical. Red tail when wild, white tail when from aquaculture. Adults inhabit fast flowing streams and rivers. Can tolerate high levels of salinity. Juveniles are omnivorous to about 5 cm TL, adults are almost entirely herbivorous. Feed on plankton, but also grazes on algae. Spawning occurs in marginal areas of the water body with a depth of 50–100 cm over a sand or clay substrate. A 6 kg female can lay a million eggs (of 1 mm diameter). Widely cultured in India but fails to breed naturally in ponds, thus induced breeding is done. Fishery harvests 40 cm fish weighing 1000 g and of about 3 years. A very active fish that thrives in ponds but spawns in swift rivers. Fingerlings are in great demand for stocking ponds between July and November.

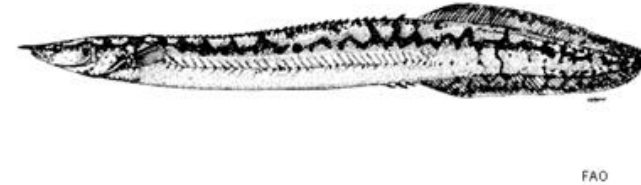
23



Macrognathus zebrinus

Name in Myanmar language: ငါးမြေထိုးဘေးကျား [Nomwelubeja]

24



Mastacembelus armatus

Name in Myanmar language: ငါးခြေနဂါး [Nomweynagaa]

Adults live in highland streams to lowland wetlands. Usually found in streams and rivers with sand, pebble, or boulder substrate. They seldom leave the bottom except when disturbed. Also occur in still waters, both in coastal marshes and dry zone tanks. Sometimes stays partially buried in fine substrate. Enter flooded forest. Reported to occur in areas with rocky bottoms in the Mekong mainstream during the dry season, but enter canals, lakes and other floodplain areas during the flood season. Forages at night on benthic insect larvae, worms and some submerged plant material.

25



Silonia silondia

Name in Myanmar language: ငါးမြင်း [Nam myen]

Inhabit rivers. Occur in shoals. Adults ascend from estuaries into large rivers for breeding during monsoons. After the water level recedes, they often get stranded in small pools. Oviparous, eggs are unguarded.

26

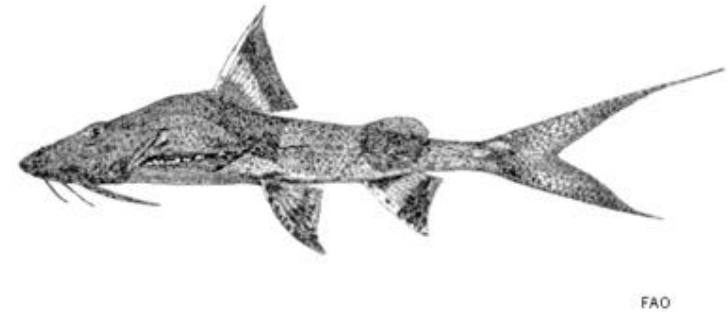
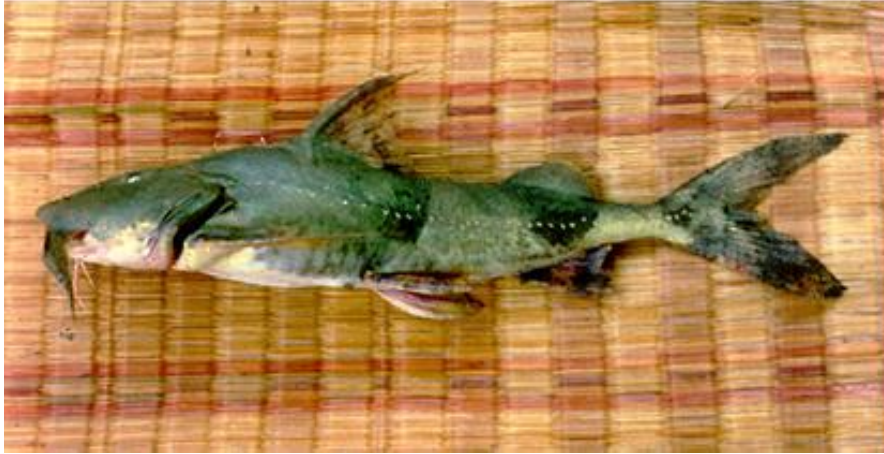


Bagarius bagarius

Name in Myanmar language: ငါးမောင့်မ [No maw ma]

Adults inhabit rapid and rocky pools of large and medium rivers. Feed on insects, small fish, frogs and shrimps. Breed in rivers prior to the beginning of the annual flood season. Marketed fresh. Important as a food fish, but the meat spoils rapidly and can cause illness. Reported length of 200 cm.

27



Bagarius yarrelli

Name in Myanmar language: ငါးမောင့်မ [No maw ma, same name as *Bagarius bagarius*]

Adults occur in large rivers on the bottom, even with swift current. They never enter small streams. Found among boulders, often in the white water of the rapids where it apparently is indifferent to the strong current. Feed primarily on prawns but will take small fish and aquatic insects. Spawn in rivers before the rainy season. Migrate in schools. Reported to migrate to follow its prey. Apparently the main upstream migration begins close to the peak of flood when the current is very strong and the water is turbid.

28



Catla catla

Name in Myanmar language: ကံဘွား [Kambwa]

Adults occur in rivers, lakes and culture ponds. Mature individuals breed in rivers. Surface and mid-water feeders, mainly omnivorous with juveniles feeding on aquatic and terrestrial insects, detritus and phytoplankton.

29

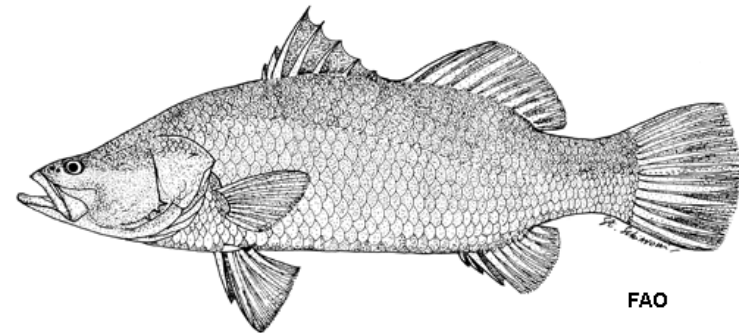


Labeo calbasu

Name in Myanmar language: ငါးနက်ပြာ [Ngenepya]

Adults occur in rivers and ponds; in slow-moving waters of rivers and feed on plants, filamentous algae and diatoms. Fecundity of 2 specimens (38.8–40.5 cm) ranged between 193,000 and 238,000.

30

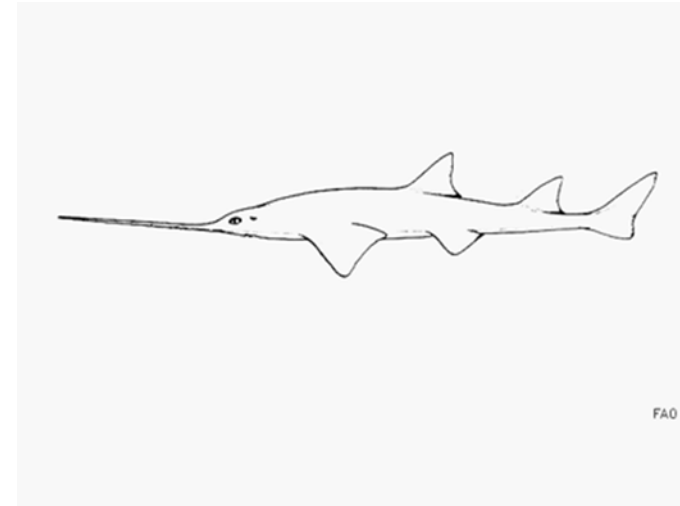
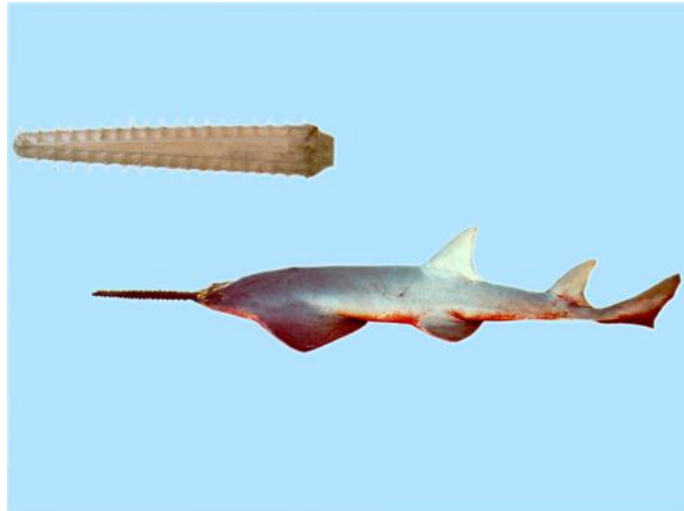


Lates calcarifer

Name in Myanmar language: ကကတစ် [Kagati]

Found in coastal waters, estuaries and lagoons, in clear to turbid water. A diadromous fish, inhabiting rivers before returning to the estuaries to spawn. A protandrous hermaphrodite. Larvae and young juveniles live in brackish temporary swamps associated with estuaries, and older juveniles inhabit the upper reaches of rivers. Have preference for cover on undercut banks, submerged logs and overhanging vegetation (Ref. [44894](#)). Feed on fish and crustaceans. They reach 1500–3000 g in one year in ponds under optimum conditions. Juveniles also eat insects.

31



Pristis microdon

Name in Myanmar language: လွငါးမန်း [Luongaman]

Inhabits sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths, and freshwater rivers and lakes. Usually found in turbid channels of large rivers over soft mud bottoms. Adults usually found in estuaries and young ascend into fresh water. Large adults can also be found in fresh water, but are rarely caught. Feeds on benthic animals and small schooling species. Ovoviviparous. Found in rivers, ponds, lakes, channels and reservoirs. Predatory, adults feed on small fish and worms. Oviparous, distinct pairing possibly like other members of the same genus. Freshwater. Demersal. Tropical.



Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project to lay the foundations for a coordinated programme of action designed to better the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The Food and Agriculture Organization (FAO) is the implementing agency for the BOBLME Project.

The Project is funded principally by the Global Environment Facility (GEF), Norway, the Swedish International Development Cooperation Agency, the FAO, and the National Oceanic and Atmospheric Administration of the USA.

For more information, please visit www.boblme.org



Food and Agriculture
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