



WWF GREATER MEKONG - CAMBODIA COUNTRY PROGRAMME

FISH ABUNDANCE SURVEY

and Installation of Fish Catch Monitoring System for the Srepok River

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FISH ABUNDANCE SURVEY

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Consultancy Report



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ACRONYMS AND ABBREVIATIONS

FiA	Fisheries Administration
IFReDI	Inland Fisheries Research and Development Institute
WWF	World Wide Fund for Nature

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Executive SUMMARY

The Srepok River is one of the major tributaries to the Mekong River in Cambodia. This river is an important habitat and breeding ground for a variety of fish species, including those migrating from the Mekong River during the wet season. So far, there has been very limited or no assessment and documentation of fish species diversity and abundance in the Srepok River. Much of what is known is anecdotal. An important issue is whether better understanding about the above knowledge can yield a better return for these limited resources.

To study the current situation of the Srepok River, this survey assesses fish species diversity and abundance, fish habitats, fishing methods, fish catch and consumption, and fisheries management in four selected villages along the Srepok River (Koh Myeul Leu, Koh Myeul Krom, Chi Met and Nong Bor villages). Findings are based on nearly 80 semi-structured interviews carried out with fishers' households, experienced fishers, and village chiefs. This study was jointly conducted with WWF staff, local fisheries officers, and community representatives who were trained by IFReDI researchers in the field. Furthermore a fish catch monitoring system and plan was developed to support fish catch monitoring activities in the above four selected villages along the Srepok River. Besides the training provided to the community representatives, the follow up activities for fish catch monitoring were conducted by IFReDI researchers in order to check quantity and quality of data and information collected by the ten selected community representatives in the four surveyed villages.

The Srepok River and its tributaries provide important habitats for the reproduction, nursery and growth of many fish species, supporting fisheries both within the basin and throughout the country. Deep pools (some with a depth of more than 14.5 meters in the dry season), rocky bottoms covering much of the river, rapids, flooded forests, and a low human population density all contribute to the high productivity of Srepok fisheries. Fish migrate between the Srepok River and much of the flooded areas within the basin via its tributaries. Villagers along the Srepok River reported that the migration of fish from the river up into the tributaries and vice versa is extremely sensitive to water levels. It is recommended that protection and conservation of these aquatic habitats, particularly deep pools and rapids, and fish migration routes between the Srepok mainstream and its major tributaries are crucial for sustainable fisheries in the basin.

People in all surveyed villages are extremely dependent on fisheries resources; at the same time, the aquatic ecosystem is fragile, governance with regards to fisheries resources is very weak, and any kind of development is likely to impact natural resources, particularly fisheries, which are very important for rural poor livelihoods. It is commented that a fisheries impact assessment should be conducted before any kind of infrastructure development is planned. Participatory management and development of fisheries resources in the Srepok River should involve local communities.

The Srepok River has high fish species diversity: there were at least 193 fish species belonging to 32 families and 84 genera detected in the Srepok River in February 2008. The most dominant family is Cyprinidae or carps (38%), followed by catfish species (23%), and the family Cobitidae (7%). These figures are similar to those found in the Cambodia Mekong basin and the Tonle Sap basin. A variety of fishing gears such as stationary gillnet, drift gillnet, cast-net, hook long line, single hook, plunge basket, trap, and bamboo/nylon net barrage are commonly used to catch these fish species. Fish catch per unit of effort or per household have decreased by 30-50 per cent over the past few years leading to a decreased fish catch rate or fish catch per household or per gear. This has, on one hand, resulted from the use of illegal and unsustainable fishing gears such as electro fishing, dynamite

fishing and barrage fishing methods (with the protection of local authorities) and from the high fishing pressures practiced in the basin. On the other hand, the water levels have fluctuated over the years, particularly from year 2000 to 2007 due to Vietnamese upstream hydropower dam development, affecting fish inundated habitats, also negatively impacting fish biomass/abundance in the Srepok River basin. Therefore the degree of decline in natural stocks of the above fish species, particularly the large-sized fish species (i.e. *Catlocarpio siamensis*, *Probarbus jullieni*, *Probarbus labeamajor*, *Probarbus labeaminor*, *Pangasianodon gigas*, *Pangasianodon hypophthalmus*, *Pangasius djambal*, *Pangasius krempfi*, *Boesemania microlepis*, *Wallago attu*, and *Wallago leerii*) is alarming, and the protection and conservation of these stocks is urgently needed. It is also recommended that a feasibility study on aquaculture should be conducted before aquaculture is introduced into the communities of the rural poor near the Srepok River. This would aid in assessing the potential of aquaculture in enhancing food security and generating household income in these communities.

High internal and external fish demands lead to high fishing pressures (i.e. over-fishing) and the use of illegal and unsustainable fishing gears in the basin. These pressures result in the unsustainable utilization of fisheries resources within the basin. Local demands for Srepok fish are supplied by local fish traders who buy fish from fishers along the Srepok River to sell in both Ratanakiri and Mondolkiri provincial and district markets, while foreign demands for fish are supplied by Vietnamese traders who come to buy fish from the Srepok fishers to sell in Vietnamese markets. It is recommended that livelihoods of poor communities along the Srepok River should be improved through fostering equitable access to markets and creating incentives for more effective governance of intra-regional trade of fish in the Mekong region.

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1

INTRODUCTION

1.1 General introduction

The Srepok River, rising in Viet Nam, is one of the major tributaries of the Mekong River and is one of the larger rivers in Cambodia. It flows down through Mondulakiri, Ratanakiri, and Stung Treng provinces and then joins the other large tributary, the Sesan River, and then the Sesan joining the Sekong River, about 10 km upstream from the Mekong River.

The total area of the Srepok River basin is about 29,450 km², of which 11,250 km² are located within Cambodia (Mekong Secretariat, 1971). Approximately 144 villages lie within the Cambodia Srepok River basin, which stretches from the Ratanakiri province town of Banlung to the Mondulakiri province town of Semonorom (Perter et al 2006).

Koh Myeul Leu, Koh Myeul Krom, Chi Met, and Nong Buor villages are located on the river bank of the Srepok River. These villages belong to Nong Khi Lik commune of the Koh Nhek district, Mondulakiri province. All villages have different ethnic groups who have been living in these villages for years. These ethnicities include Khmer, Lao, Tompuon, Jarai, Kreung, Kroal, and Phnong, but most of the population is Phnong (34%). People in all villages are extremely dependent on natural resources, but their main occupations are rice growing and fishing. Access to these villages is very difficult. In the dry season, the main means of transportation are boats, motorbikes and car (from Lumphat district, Ratanakiri province); an alternative route is from Koh Nhek, Mondulakiri province by motorbike or car and by motorbike all year round. In the wet season, only boat can be used in this area. Koh Myeul Leu and Koh Myeul Krom villages are located on the upper stretch of the Srepok River (Figure 1.1 & 1.2).

In the early 1970s, the Khmer Rouge relocated people in order to expand lowland rice production (Swift et al 2006). Other than along the Srepok River itself and in a few other villages, throughout the basin lowland rice had not been cultivated before this time. Villages along the Srepok River in Mondulakiri

province, where people had already been cultivating lowland rice, were relocated to Koh Nhek District in 1970 to expand lowland rice production along the O Chbar, one of the largest tributaries of Srepok River. Eventually, almost all people living in Mondulakiri province were relocated to this area, which was possibly the only area in the province aside from the Srepok River itself where people had cultivated lowland rice in the past.

After the overthrow of the Khmer Rouge regime in 1979, some people began to slowly return to their original villages as did former inhabitants of Koh Myeul Leu, Koh Myeul Krom, Chi Met, and Nong Buor villages.

So far, there has been very limited or no assessment and documentation of fish species biodiversity and abundance or a fish catch monitoring system for the Srepok River. Much of what is known is anecdotal. An important issue is whether better understanding about the above knowledge can yield a better return for these limited resources. Study of fish species diversity and abundance will allow development of policy recommendations for improving current harvesting and management regimes of fish stocks in the Srepok River in order to utilize these limited resources sustainably.

1.2 Objectives

In light of the little information and data concerning fish in the Srepok River, the overall objectives of this research are to generate meaningful primary and baseline information and data of fish species biodiversity and abundance in the Srepok River. This research has important implications for developing policy and business decisions relating to the importance, utilization and management of fisheries resources in the Srepok River.

The specific objectives of the research are to:

1. Provide training to selected community representatives along

the Srepok River on basic principles of fish ecology and appropriate fish survey tools;

2. Conduct a baseline fish survey together with the trained community representatives; and
3. Identify and install an appropriate fish catch monitoring system in the area.

2

RESEARCH METHODOLOGY

2.1. Literature reviews

The study used secondary information from government, research institute and other sources to complement primary data and observations. Literature was extensively reviewed regarding fish species diversity and abundance, fisheries and livelihoods, fish migrations, deep pool and rapid fish and fisheries, community fisheries establishment, resource use and management, and downstream impacts of development projects in Northeastern Cambodia as well as in other countries of the Mekong River basin (i.e. Laos, Thailand and Vietnam).

2.2. Hands-on training

The training was conducted for four days from 28/01/08 to 31/02/08 in Koh Myeul Krom village, Nong Ky leak commune, Koh Nheak district, Mondulkiri province. The main objective of the training was to train local community representatives and WWF field staff to know how to conduct fish abundance baseline surveys and fish catch monitoring. The outline of the training is presented in Annex 2.1. Nineteen persons participated in the above training, two persons coming from WWF and seventeen persons from the four target villages along the Srepok River (Koh Myeul Leu, Koh Myeul Krom, Chi Met, and Sre Chrey villages). The list of participants is attached in Annex 2.2. There were also several practical sessions on (1) how to interview using the developed questionnaires, (2) evaluation of the data and information obtained by conducting field interviews; (3) how to record fish catch data and information (including measuring, weighing, and identifying fish species), and (4) evaluation of the recorded data and information handed over to the trainees. Ten good trainees were selected to become local community trainers through conducting a final test and regular monitoring and

evaluation of the trainees during the training course. Of the ten selected trainers, three trainers were from Sre Chrey village, three from Koh Myeul Krom village, three from Koh Myeul Leu village, and one from Chi Meat village to be involved in fish catch monitoring activities. The names of the ten selected trainers are detailed in Annex 2.3. Each of the trainers received a photo flipchart, twelve log books, a measuring board, a calculator, a weighing scale/balance and a pencil for performing fish catch monitoring activities.

2.3. Field survey

The baseline survey was conducted in the dry season from 09 February 2008 to 14 February 2008. The approach used in this survey included village chief interviews, focus group discussions with experienced fishers, and individual household interviews in four selected villages, Koh Myeul Leu village, Koh Myeul Krom village, Chi Met village, and Nong Bor village, again, all located along the Srepok River (Figure 1.1 & 1.2).

Village chief interview: By using a developed questionnaire (Annex 2.4), data was collected by conducting interviews with village chiefs of Koh Myeul Leu village, Koh Myeul Krom village, Chi Met village, and Nong Bor village. The information and data collected from the interviews included (1) village history, (2) condition of geography, (3) farmland, (4) education and culture, (5) temporary people living in the village, (6) livelihoods and ownerships, (7) rice fields, (8) farming systems, planting gardens, fishing activities, and fisheries management situations in the Srepok River basin.

Focus group discussions: These were conducted by interviews with a group of 5-10 experienced fishers in each of the above four targeted villages using a developed questionnaire (Annex 2.5). The collected data and information included (1) physical setting of the river, (2) fish species diversity, (3) fish distribution, (4) fish occurrence, (5) fish migrations, and (6) fishing activities and methods.

Individual household interviews: These were carried out for four days in four targeted villages (Koh Myeul Leu village, Koh Myeul Krom village, Chimeat village and Nong Bor village), and 73 fishers' households were interviewed, 25 fishers' households in Koh Myeul Leu village, 22 in Koh Myeul Krom village, and 26 in Chi Meat and Nong Bor village using a developed semi-open questionnaire (Annex 2.6).

Additionally, developed questionnaires were used to collect field information and data and a photo flipchart, containing 209 Mekong fish species, was used for the above field surveys. The

chart was an upgraded version of those used by Fisheries Ecology, Valuation and Mitigation (FEVM) Cambodia, Lao PDR, and the Thailand and Vietnam Project of the MRC Fisheries Program. All fish species in the photo flipchart were grouped according to family. Each species had a local name, maximum length, and a corresponding scientific name, which was used later while preparing reports.

In addition to the above surveys, Fishfinder 250/250C was used to search for and study deep pools along the Srepok River in the above four targeted villages.

2.4 Fish catch monitoring

Training on fish catch monitoring was given to community representatives from the four targeted villages, WWF staff, and fisheries officers. First, a fish catch monitoring plan was developed for local communities to implement. The plan included the following activities:

1. WWF staff and local fisheries officers will monitor daily fish catch data recorded by the 10 selected trained community representatives into the given IFREDI fish catch monitoring form (Annex 2.7).
2. The record of daily fish catch will be conducted for one year;
3. IFReDI will cooperate with WWF staff and local fisheries officers to check the quality of data and information collected by the above community representatives.
4. IFReDI will provide the other hands-on training on data entry, analysis and data management to WWF staff and local fisheries officers.
5. In the second year, the 10 selected trainers will train village fishers in the four targeted villages to record daily fish catch and this will be monitored by the trainers in collaboration with WWF staff and local fisheries officers

who been trained by IFReDI and IFReDI if necessary. The training manual on fish catch monitoring is attached in Annex 2.8.

6. The 10 trained community representatives will be trained by WWF staff and local fisheries officers in order to analyze, utilize, and manage data, records, and information collected in the four target villages.

A part from the training provided to the community representatives, follow up activities for fish catch monitoring were conducted by IFReDI researchers in order to check the quantity and quality of data and information collected by the ten selected community representatives in the four surveyed villages.

2.5 Data analysis

Data collected from the field were checked for accuracy before being entered onto computers in the database software programme Excel®. Outliers, missing data and other data problems were checked before the data were analyzed using Excel® and simple statistical tools including means, percentages, and frequency distribution. The baseline survey results are presented in the next chapter.

3

RESULTS AND DISCUSSIONS

3.1 Water regime

The Srepok River has a lot of tributaries and some tributaries are very large such as Ou Chbar, Ou Leav, and Ou Tang. They have permanent water. The Srepok River and its various tributaries are covered with rocks on the bottom, flooding forests, deep pools, sandbanks, and rapids that are all very important for fish habitats. These features also make transportation on the river difficult.

All respondents reported that the water levels of the Srepok River in the four target villages (Koh Myeul Leu village, Koh Myeul Krom village, Chimeat village and Nong Bor village) seasonally vary. The water levels in the Srepok River start to rise up in May to a maximal level in August and recede from September to a minimal level in April. It was reported that all the four targeted villages were flooded in 2007. According to respondents, this event has never happened in the past years.

3.2 Flooded forests

The Srepok River is the major tributary of the Mekong River in Cambodia and is unlike the other major tributaries of the Sekong and Sesan River. The Srepok River and its major tributaries (e.g. Ou Chbar, Ou Leav and Ou Tang) are rich in flooded forests, which are very important for fish habitats by serving as fish refuges and feeding, nursing and spawning grounds (Figure 3.1). The majority of respondents (95%) reported that flowers of flooded forests (e.g. Daem An-deng in Khmer, see Figure 3.2) are used for human food consumption as well as fish feed. Most of the flooded forests in the Srepok River are grown in rapid areas and are covered by water in the wet season.



Figure 3.1 Flooded forests and rapid area in the Srepok River



Figure 3.2 The flooded forest *daem an-deng*, photo taken in the study area

3.3 Rapid areas

There are many rapid areas, which served as very important spawning and nursing grounds for many fish species in the Srepok River (Figure 3.1). Fishermen along the Srepok River reported that some white large fish species of Pangasiid catfishes and small white fish species of carps (e.g. *Henicorhynchus*) have released eggs in these rapid areas. The below table shows some important rapid areas detected in the studied area of Srepok River.

Table 3.1 Location of rapid areas in the studied area

No	Location name	Location	
		48 P	UTM
1	Sen Khanh Nha	0748145	1472694
2	Keng Meng	0748481	1472316
3	Ror Vich	0749856	1472180
4	Ka Leum	0753813	1471896
4	Keng Tam Poan	0756055	1466579
5	O Bok	0743032	1470911
6	Keng Sun	0733815	1473462

3.4 Deep pools

The importance of dry season refuge habitats for fish in floodplain rivers has long been recognized and described. Most fish move from floodplain habitats back to the main river channel and into deep pools during the dry season and settle in different habitats along its length, distributing according to depth, bottom-type, and vegetation cover. This movement may cover short or long distances, depending on the availability of

appropriate dry season habitats within the river channel associated with deep pools. The destruction of flooded forests in deep pools results in the silting up of deep pools. Therefore deep pools in Cambodia are very important habitats for protecting and conserving for a number of fish species, particularly white (longitudinal or long-distant migratory) and grey (lateral or short-distant migratory) fish species (So et al., 2006).

By using FishFinder, nine major deep pools were detected in the study area of the Srepok River during the dry season. Table 3.2 shows the details of each deep pool and the distribution of fish biomass associated with each deep pool. The depth of these pools ranged from 4 m to 15 m in the dry season. This reflects the recent study by Swift (2006) that also found numerous natural deep pools along the Srepok River. The deepest pool in the Srepok River is An Long Phtel located in Sre Ang Krong commune, Kon Mum district, with the estimated depth of 45 m and length of 500 m in the dry season. According to the table below, no fish were found in five out of the nine detected deep pools. The majority of respondents reported that the main reasons for this include the use of electro-and dynamite fishing, high fishing pressures, and siltation (making deep pools becoming shallower) in the area. The latter has resulted from reduction in water flow rates in the wet season over the past years, probably due to hydropower dam development in the Srepok upstream area in Vietnam.

Table: 3.2 Location of deep pools and its fish abundance in the study area

No	Name	Depth	Locations				Fish abundance
			Start		End		
			48 P	UTM	48 P	UTM	
1	O Chpar	10.6 m	0749816	1472397	0750099	1472544	No fish
2	Lum Phok	6 m	0750122	1472175	0750556	1472304	Many fish in 3 m depth
3	O Tang	9 m	0752631	1473255	0753277	1473153	Many fish in 7 m depth
4	Ka Leum	11 m	0754658	1471618	0755036	1471398	Many fish in bottom
5	O Lav	9.4 m	0756405	1469289	0756662	1468918	No fish
6	O Lev Ver	14.5m	0755812	1465928	0755884	1465777	Many fish in 11 m depth
7	Nhor Pong	6 m	0744260	1478388	0744242	1478596	No fish
8	O Bok	4 m	0742691	1478806	0742460	1478646	No fish
9	Keng Noi	8.2 m	0733863	1472760	0733800	1473436	No fish

3.5 Fishing gears

There are at least 150 types of fishing gears known in Cambodia (Deap et al., 2003). The people in the four target villages (Koh Myeul Leu village, Koh Myeul Krom village, Chimeat village and Nong Bor village) used a variety of gears to

catch fish and were according to the seasons and fish migrations. There were eight types of fishing gears found to be used in the four targeted villages. The names of these fishing gears are detailed in Table 3.3. However, fish traders employed local fishers to harvest fish in small streams of the Srepok River by using barrage and the other seven types of fishing gears already used by the local fishers.

Table 3.3 Types of fishing gears used in the study are

No.	Fishing gear name (English)	Khmer name (local)	% of surveyed households using different types of fishing gears	No. of fishing gears used per household (min-max)
1	Stationary gillnet	Moung Kaing	93	3 (1 - 10)
2	Drift gill net	Moung Bandeth	7	2 (1 - 4)
3	Cast net	Sam Nanh	74	1 (1 - 4)
4	Hook long line	Santoch Ronoung	56	4 (1 - 15)
5	Single hook	Santoch	45	30 (3 - 200)
6	Plunge basket or Cover Pot	Anroth	11	1
7	Trap	Lop	15	4 (1 - 22)
8	Barrage (bamboos + nylon nets)	Yor (Oun)	NA	NA

Note: stationary gillnet with length of 35 - 45 m and mesh size of 1.5 - 15 cm; drift net with length of 35 - 45 m and mesh size of 5 - 15 cm; hook long line with 10 - 20 hooks per long line. NA = Not Applicable

3.5.1 Stationary gillnet

Stationary gillnet is the most common type of fishing gear used in all scales of fishing and it is very popular in Cambodia. In the four targeted villages, stationary gillnet (Figure 3.3) was the

most common and important type of fishing gear used by local fishers, with the mesh size ranging from 1.5 cm to 15 cm with a length of 35 m to 45 m (Table 3.3). Each fisher's household owned, on average, three sets of stationary gillnets. The fishers can set the net in many fishing habitats, including the Srepok mainstream, tributaries, lakes, ponds and rice fields.



Figure 3.3 Fishers collecting fish from their stationary gillnets operated in Srepok River

The stationary gillnet was operated all year round in the study area. Frequency of the gear operations varied seasonally/ monthly according to water levels (Figure 3.4). This gear was highly operated in April when water level is minimal and in November when water is receding. In contrast, this gear was least operated in July when water levels start rising. The fishing practice by local fishers using stationary gillnet with the above mesh size and length can be regarded as good fishing practice based on the revised Law of Fisheries of Cambodia.

3.5.2 Drift gillnet

Drift net was not commonly used in the four targeted villages, and only 7% of the surveyed fishers used drift gillnet (Table 3.3). The common mesh size of the drift gillnets ranged from 5 to 15 cm with a length of 35 m to 45 m. Drift gill net could be set in the Srepok mainstream only.

The majority of respondents reported that drift gillnets could not be used all year round (i.e. from April to December). The time of operation was dependent on the water current, fish migration, and the professional skills of the fishers. These fishers reported that drift gillnet operation times in the Srepok River were highest in August when river water level is maximal and in October when water is receding.

3.5.3 Cast net

The cast nets were used all year round and were the second most common fishing gear type (74%) used in the surveyed villages along the Srepok River (Table 3.3). On average, each fisher's household owned one cast net. The higher operation times of this gear were from February to April when water levels are low. The cast net operation times were dependent on water current, levels of fish migrations, and the professional skills of the fishers. Cast nets were used in different habitats (e.g. river channels, rapids, ponds and rice fields) to catch many fish species. This fishing practice can be considered good practice for the sustainable utilization of fisheries resources in the Srepok River.

3.5.4 Hook long line

Hook long lines were used all year round and were the third most common fishing gear type used in the surveyed villages of the Srepok River (Table 3.3), being used by approximately 60% of the surveyed fishers. On average, each fisher's household owned four

hook long lines. Higher operation times of this gear were from February to April when water levels are lower, while lower operation times were from June to September when water levels are higher in the year. Similarly, hook long line operation times depended on water current, fish migrations, and the professional skills of the fishers. This gear could be used to catch many fish species in different fishing habitats including rivers, streams, ponds, and rice fields. This fishing practice can also be considered as good practice for the sustainable utilization of fisheries resources in the Srepok River.

3.5.5 Single hook and line

Single hook and line could be used all year round (Figure 3.4) in different fishing habitats (rivers, streams, ponds, and rice fields). It was the fourth most common type of fishing gear used in the surveyed villages. Approximately 50% of surveyed fishers fished with this gear. On average, 30 single hooks were used per fisher's household with the number of this gear used not differing significantly among the surveyed villages. Higher operation times of this gear were from October to March when water levels are lower in the



Figure 3.4 Single hook and line used in the study area

river, while lower operation times were from July to August when river water levels are higher. Single hook and line operation time depended on the water current, fish migration, and the professional skills of the fishers. This practice is also considered to be good fishing practice.

3.5.6 Plunge basket or Cover Pot

Plunge baskets or Cover Pots were used nearly all year round in the surveyed villages. Approximately 10% of the surveyed fishers used this gear and on average each fisher's household owned one plunge basket. This gear was usually used by a group of full time experienced fishers to catch fish, particularly black fish in ponds and rice fields. The peak operation time of this gear was in April when water level is minimal. This is a very traditional and small scale gear, which provide a very good implication for fisheries resources in the villages.

3.5.7 Trap

Trap fishing gear (e.g. tru, tom, chhneang, or/and leuy in Khmer) was used all year round with the highest operation time of this gear in November when water levels start receding. Only 15% of the surveyed fishers used this gear from April to May when water levels are very low. On average, each fisher's household owned four sets of trap. The operation times of the gear were dependent on the water levels in the river and the professional skills of the fishermen. The gear was commonly set in streams and rivers to trap many fish species. It is also a very traditional and small-scale fishing gear and is not considered a destructive fishing gear.

3.5.8 Barrage fishing

Barrage fishing consists of a wooden/bamboo barrage associated with nylon nets and is installed across a river. In the Khmer language this fishing gear is called Yor or Oun. Oun was operated by outsiders in some tributaries of the Srepok River such as on the O leav, O lao, O lvea Te, and O Phlay to catch fish migrating downstream from floodplains to the

Srepok River. There were only four sets of barrage found in the study area, which were owned by fish traders coming from Lumphat and Bokeo in Ratanakiri and Koh Nhek in Mondulakiri. The operation times of this gear were from August to January (Figure 3.12). Local fishers in two of the targeted villages (Koh Myeul Leo, Koh Myeul Krom) complained about the use of Oun as being very destructive, unsustainable and caught, not only big-sized fish species, but also small-sized fish species. All small-sized or low value fish species are discarded back into the river causing the water to smell very bad. Barrage fishing is not a sustainable fishing method and is an illegal fishing gear that harvests all sizes and species of fish migrating from the stream and its floodplain to find refuge in the Srepok River.

3.6 Migrating fishing

Migration fishing is a fishing method operated by a group of people with three or four boats and many types of fishing gears such as stationary gillnet, cast net, hook long line and types of illegal fishing gears (mainly electric shockers) along the Srepok River, particularly in deep polls and rapids (Figure 3.5). These fishers come from different villages to fish and stay along the Srepok River bank for two to four weeks and sell their fish to fish traders coming from Banlung and Lumphat in Ratanakiri offering the price of Riel 5,000 - 6,000/kg. This fishing method is practiced in both the dry and wet seasons by many people from a number of villages near Lumphat district in Ratanakiri and the four surveyed villages of Koh Myeul Leo, Koh Myeul Krom, Chi Met, Nong Bor. Migration fishing was found to be practiced more in the dry season than in the wet season. They caught about 0.5 to 22 kg fish per boat per day.

Swift (2006) reported that the peak operation time of this method is at the water recession period, when they catch fish that leave the tributaries to enter the river. During the dry season fish can be caught in the deep-water pools in the river, where they congregate; they also congregate to a lesser extent in pools in the tributaries, but boats cannot get up into tributaries at this time and people travel overland to fish there. At the beginning of the rainy season, fish can be caught as they migrate up into the tributaries. Fish movements at this time are extremely dependent on water levels, and fish can be caught easily only if the water level of the river is rising (prompting fish migrations) - and then only if it rises above previous levels that year. Otherwise fish catches are extremely low because fish have left the deep-water pools but are not moving much. When the water level gets higher, in July and August, specialized gillnets can be floated down the river and for a few days each month those people with these nets can record their biggest daily catches of the year. By September water levels in the river are too high, and there is too much debris floating down river, for gillnets or other gears to be used in the river. September is also the peak of the rice planting season and villagers ordinarily do not spend a lot of time for fishing; fishing at this time is primarily in the streams and rice fields.



Figure 3.5 Tamping fishing in the study area

3.7 Fish species diversity

The freshwater of Cambodia are predominantly those of the Mekong basin, the largest river in Southeast Asia and one of the great rivers of the world. The Mekong River in Cambodia has a lot of tributaries that flow water in the Mekong. The freshwater fish in Cambodia are approximately 500 species (Rainboth, 1996). Some fish migrate several hundreds of kilometers from Great Lake to the upper stretch of the Mekong. At least 193 fish species were detected in this survey, belonging to 32 families

and 84 genera. A detailed list of fish species found in the Srepok River is shown in Annex 3.1. The most dominant family was Cyprinidae (carps), comprising 74 fish species (38%), followed by the catfish families (i.e. Bagridae, Bagriichthidae, Pangasiidae, Siluridae and Sisoridae) with 45 species (23%), and the family Cobitida (i.e. loaches).

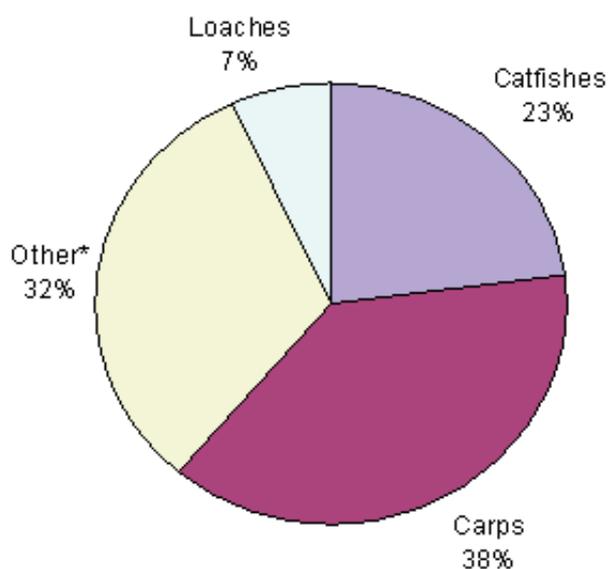


Figure 3.6 Fish species composition detected in the surveyed area

*See Annex 3.1 for the detailed fish family names

Respondents reported that of the fish species found, nine species were rare at present time and sixteen of the species were thought to have disappeared from the river (Table 3.4).

Table 3.4 Species considered rare and disappeared detected in the Srepok River

No.	Rare fish species	Disappeared fish species
1	<i>Anguilla marmorata</i>	<i>Megalops cyprinoides</i>
2	<i>Coilia lindmani</i> <i>Arius</i>	<i>argyropleuron</i>
3	<i>Coilia macrognathos</i>	<i>Arius caelatus</i>
4	<i>Garra cambodgiensis</i>	<i>Arius maculates</i>
5	<i>Megalops cyprinoides</i>	<i>Arius venosus</i>
6	<i>Pangasianodon gigas</i>	<i>Boesemania microlepis</i>
7	<i>Pangasius djambal</i>	<i>Botia sidthimunki</i>
8	<i>Pangasius</i>	<i>Catlocarpio siamensis</i>
9	<i>Rasbora amplistriga</i>	<i>Clarias nieuhofi</i>
10		<i>Hemiarus stormii</i>
11		<i>Heteropneustes kemratensis</i>
12		<i>Himantura signifer</i>
13		<i>Plotosus canius</i>
14		<i>Polynemus borneensis</i>
15		<i>Tenualosa thibaudeaui</i>
16		<i>Toxotes microlepis</i>

3.8 Fish migrations

The characteristics of the Srepok River and its tributaries associated with deep pools, rapid areas, flooded forests, rocks, and sand-banks provide important habitats for the reproduction of fish stocks, supporting fisheries both within the basin and throughout country. Important fish migration routes were found in all areas between the Srepok River and Mekong River and between the Srepok River and much of the upland area within the basin

via its major tributaries. Many fish species migrate upstream in the early wet season (May-June) when water levels rise up and downstream fish migrations were found in the early dry season (October-November) when water levels start receding. Some downstream fish migrate from tributaries of the Srepok River to find refuge in deep pools within the Srepok River. This starts from November to December with other fish species migrating downstream to the Mekong River from December-January. These migration patterns are similar to the ones reported in Sokheng CHAN (2000). Key migratory fish species important to local Srepok fisheries are shown in Table 3.5.

Table 3.5 Key migratory fish species important to local Srepok fisheries

Scientific name	Khmer name
<i>Hypsibarbus malcolmi</i>	Chhpin
<i>Hypsibarbus laglari</i>	Chhpin
<i>Hypsibarbus pierrei</i>	Chhpin
<i>Hypsibarbus wetmorei</i>	Chhpin
<i>Cirrhinus siamensis</i>	Riel
<i>Cirrhinus lobatus</i>	Riel
<i>Labeo chrysophekadion</i>	Kaek
<i>Bangana behri</i>	Pawa moukpi
<i>Channa mruloides</i>	Om boung
<i>Wallago attu</i>	San Day
<i>Pangasius conchophilus</i>	Kae
<i>Pangasius larnaudii</i>	Po

Baird (1995) reported that, in general, more fish species migrate upstream from the Mekong River to the Srepok and Sekong Rivers than to the Sesan River (even before the construction of the dam on the Sesan). One reason is that the Sekong and Srepok are generally deeper than the Sesan. Another reason is that there are large floodplains in the upper reaches of the Srepok that are believed to be important spawning and feeding grounds for some species of fish, particularly within the WWF Conservation Zone. However, a further study should be conducted to identify the specific locations of these important spawning grounds. The Sekong and Srepok also have more rocky habitats than the Sesan, which serve as important habitats for many species of fish. The importance of the Srepok River to fisheries outside of the basin is considerable, but assessment of this is beyond the scope of this survey. However, Baird and Flaherty (2004) have described how medium-sized cyprinids migrate between the Sesan, Sekong and Srepok Rivers and the Mekong River in southern Laos. Also, Baird et al. (2003) have described how small cyprinids migrate between the Tonle Sap River and Great Lake and the Mekong, Sekong, Sesan and Srepok Rivers in northeast Cambodia and southern Laos. Furthermore Baird et al (2004) have described the large migrations of catfish species between Cambodia and Laos at the beginning of each dry season.

3.9 Fish trade

All respondents reported that fish sale was the major source of family income in the villages along the Srepok River. Most fish were sold to fish traders who mostly came from Bokeo town who sell their fish at Bokeo town market as the road to Bokeo is better than the roads to Koh Nhek and Lumphat districts. In the past, fish caught from the Srepok River were sold in Koh Nhek and Lumphat districts. The detailed trading routes for fish caught from the Srepok River, particularly the upper Srepok River, are shown in Figure 3.7. At the very upper reaches of the

Srepok River (from O Lmit to the Vietnamese border), traders from Viet Nam came by boat to buy fish from the Cambodian fishers who fish along the river with the intent to sell in Viet Nam [1]. They do this throughout the year. Some traders (including policemen) came by jeep from Mondulkiri provincial town, and several by motorcycle from villages near Koh Nhek district town, to buy fish in this area to sell in Mondulkiri provincial town and Koh Nhek district town, respectively [2]. They do this from November to June. Fish traders from Lumphat also came by boat to buy fish at the upper stretches of the river, O Phlay (on the border with Viet Nam) and at the lower stretches of the river near Lumphat to sell fish in Lumphat to fish traders from Banlung (the provincial town of Ratanakiri) [3]. They do this as long as there is enough water to drive their boats upstream. Fish from Lumphat and nearby Dei Lo also were sold to Banlung. It is concluded that the Srepok River fish could not meet the demands of local markets in Ratanakiri and Mondulkiri because some aquaculture fish species have been imported, such as the red bellied pacu (*Piaractus brachyomus*) from Viet Nam and the hybrid catfish and the sutchi catfish (*Pagasianodon hypophthalmus*) from Phnom Penh and Viet Nam via Kratie province. In other words, fish demand is higher than the fish supply being provided by the Srepok River.

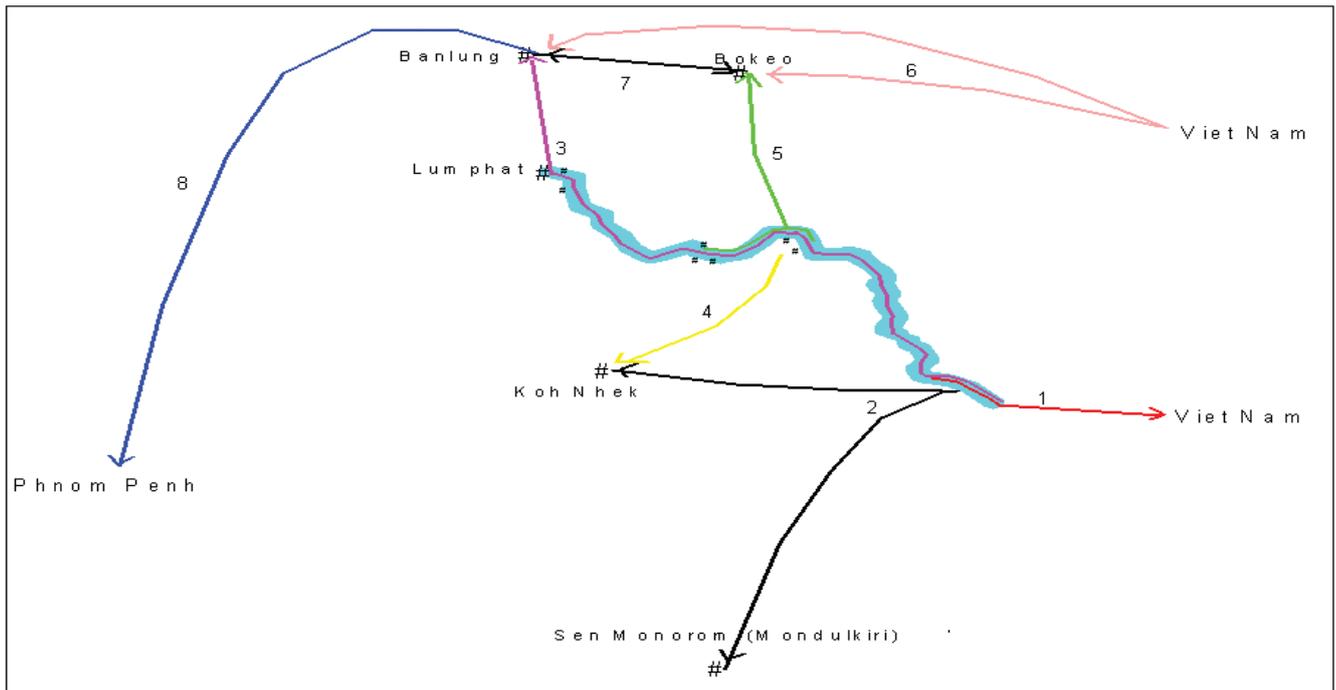


Figure 3.7 Market chain for the Srepok River fish trade

3.10 Aquaculture

Aquaculture is a mode of production, which is part of a larger fisheries food production system. This larger system is both socio-economic and biophysical in nature. Aquaculture is more accessible to poor rural people than has been generally realized and a range of technological options now exists. However, aquaculture development is apparently not practiced as of yet in the surveyed villages of the Srepok River or anywhere in the Srepok River basin. This reflects the findings of Swift (2006). Although they do not have any knowledge of fish culture, some of the respondents in the four surveyed villages would like to practice fish culture in order to both secure their household fish consumption, particularly during lean fishing periods, and to generate additional household income to improve their livelihoods. Further investigation on the feasibility and cost effectiveness of promoting aquaculture in the area should be conducted.

3.11 Fish catch and consumption

Fish is an important part of people's diet throughout the Srepok River basin, but

just how important is dependent on the season. Based on this study, fish consumption was dependent on the fish catch per day or season of fishing. For example, they caught a lot of fish so they would, as a result, eat a lot of fish. On the other hand, they made fish paste (Prahok in Cambodian) and dried fish from their bulk catch. These fish processed products were consumed during rice growing periods. Therefore fish and fish products were very important nutritious foods in the daily diets of villagers living along the Srepok River. Swift (2006) reported, that compared with other animal proteins, fish is the most important protein source for villagers along the Srepok River.

All respondents reported that villagers ate fish all year round. Villagers easily caught a lot of fish in the dry season, particularly in April, as majority of the fish migrate from the flooded areas to the river and then into deep pools. At the end of the wet season, when water levels are receding, fishers caught and ate a lot of fish as well when the fish migrated downstream. This downstream migration occurs particularly in November, the peak fish consumption month.

3.12 Fisheries management

All respondents reported that they were not familiar with fisheries officers for the past two decades. In most cases, it has been the rangers of the Lumphat Wildlife Sanctuary supported by the international NGO, WildAid, that have cracked down on illegal fishing gears being operated. However, community fisheries were established in March 2008 by the Fisheries Administration (FIA) in cooperation with WWF to take responsibility for participatory fisheries management at the village or commune level in the Srepok River basin.

4 CONCLUSION AND RECOMMENDATION

The Srepok River and its tributaries provide important habitats for the reproduction, nursery, and growth of many fish species, supporting fisheries both within the basin and throughout the country. Deep pools (some with a depth of more than 14.5 meters in the dry season), rocky bottoms covering much of the river, rapids, flooded forests, and a low human population density all contribute to the high productivity of Srepok fisheries. Fish migrate between the Srepok River and much of the flooded areas within the basin via its tributaries. Villagers along the Srepok River reported that migrations of fish from the river up into the tributaries and vice versa are extremely sensitive to water levels. It is recommended that protection and conservation of these aquatic habitats (particularly deep pools and rapids) and fish migration routes between the Srepok mainstream and all its major tributaries are crucial for sustainable fisheries in the basin.

People in all surveyed villages are extremely dependent on fisheries resources; at the same time, the aquatic ecosystem is fragile, governance with regards to fisheries resources is very weak, and any kind of development is likely to have an impact on natural resources, particularly fisheries, which are very important for rural poor livelihoods. It is commented that a fisheries impact assessment should be conducted before any kind of infrastructure development is planned. Participatory management and development of fisheries resources in the Srepok River should involve local communities.

There were at least 193 fish species belonging to 32 families and 84 genera detected in the Srepok River in February 2008. The most dominant family was Cyprinidae or carps (38%), followed by catfish species (23%), and the family Cobitidae (7%). The family Cyprinidae (e.g. *Hypsibarbus malcolmi*, *Hypsibarbus laglari*, *Hypsibarbus pierrei*, *Hypsibarbus wetmorei*, *Cirrhinus siamensis*, *Cirrhinus lobatus*, and *Labeo chrysophekadion*) and catfish species (e.g. *Bangana behri*, *Wallago attu*, *Pangasius conchophilus*, and *Pangasius larnaudii*) were the most important to local livelihoods. A variety of fishing gears such as stationary gillnet, drift gillnet, cast-net, hook long line, single hook, plunge basket, trap, and bamboo/nylon net barrage were commonly used to catch these fish species. The fishing methods of stationary and drift gillnets, cast net and hook long line are considered good fishing practices and number of each type of fishing gear owned by each fisher's household was reasonable for supporting Srepok household livelihoods and the future of Srepok fisheries. Furthermore, using traditional and small-scale fishing gears such as single hook, plunge basket and trap by local fishers should be widely encouraged and promoted as these fishing practices are sustainable fishing methods.

However, use of the barrage fishing method by outsiders has negative impacts on fisheries and fish stocks and should be

discouraged and banned as it is a destructive and unsustainable fishing method. Fish abundance has decreased over the past few years leading to a decreased fish catch rate or fish catch per household or per gear. This has, on one hand, resulted from the use of illegal and unsustainable fishing gears such as electro fishing, dynamite fishing, and barrage fishing methods (with the protection of local authorities) and from the very high fishing pressures in the basin. On the other hand, the water levels have changed over the years, particularly from the year 2000 to 2007, also negatively impacting fish abundance in the Srepok River basin. Therefore the decline in the natural stocks of the above fish species, particularly the large-sized fish species, is alarming, and protection and conservation of these stocks is urgently needed. It is recommended that the feasibility and cost effectiveness of doing aquaculture in this study area should be investigated before promoting aquaculture development in attempts to reduce fishing pressures on national stocks, to provide an alternative activity to enhance fish food and nutrition security, and to generate additional household income for the Srepok poor.

High demands for fish locally and internationally have led to high fishing pressures and the use of illegal and unsustainable fishing gears in the basin. Local demands for Srepok fish are supplied by local fish traders who buy fish from fishers along the Srepok River to sell in both Ratanakiri and Mondulkiri provincial and district markets, while foreign demands for fish are supplied by Vietnamese traders who come to buy fish from Srepok fishers to sell in Vietnamese markets. It is recommended that livelihoods of poor communities along the Srepok River should be improved through fostering equitable access to markets and creating incentives for the more effective governance of intra-regional trade of fish in the Mekong region.

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Annex 2.1 Outline of the training on Fish Abundance Survey and Installation of Fish Catch Monitoring System In Srepok River

Training Agenda

28 - 31 January 2008

Trained by IFRaDI, Sponsored by WWF

Day	Time	Description
28 Jan 08	08:00-08:30	Welcome
	08:30-09:30	Background, purpose of training By Mr. Chan Sokheng
	09:30-09:50	Break
	09:50-11:30	Training on the use and importance of fish Photo catalogues By Mr. Chan Sokheng
	11:30-14:00	Lunch
	14:00-15:00	Study catch monitoring form Mr. Putrea Solyda
	15:00-15:30	Group discussions
	15:30-15:45	Break
	15:45-17:00	Comment and feedback form for all participants
Catch Monitoring (continues)		
29 Jan 08	08:00-11:00	Practice and test the catch monitoring form
	11:00-11:30	Conclusion of fish catch monitoring in Srepok River
Baseline Survey		
29 Jan 08	14:00-15:30	Study and discuss the baseline fish survey form (Part 1: Interviews with villages chief) Mr. Putrea Solyda
	15:30-15:45	Break
	15:45-17:00	Study and discuss the baseline fish survey form (Part 2: Focus groups discussions with experienced fishers) Mr. Putrea Solyda
Baseline Survey (continues)		
30 Jan 08	08:00-09:30	Study and discuss the baseline fish survey form (Part 2) Mr. Putrea Solyda
	09:30-10:30	Study and discuss the baseline fish survey form (Part 3: Individual Interviews with fisher's household) Mr. Chan Sokheng
	10:30-10:45	Break
	10:45-11:30	Group discussions
	11:30-14:00	Lunch
31 Jan 08	14:00-17:00	Practice and test the baseline survey questionnaire
	08:00-11:30	Practice and test the baseline survey questionnaire
	11:30-14:00	Lunch
	14:00-15:30	Outputs of practices and testing of the questionnaire (Group discussions)
	15:30-15:45	Break
	15:45-16:30	Discussion and update catch monitoring form (Group discussions)
	16:30-17:00	Conclusions Mr. Putrea Solyda
		Net steps:
		1. Planning for baseline survey and monitoring activity
		2. Selecting qualified trainees of out of the 20 participants (excluding WWF staff)
		3. Tasking
		4. Discussing the formulation of monitoring plan

Annex 2.2 List of participants involved the training

No.	Name	Organization
1	Mr. So Socheat	WWF
2	Mr. Tet Chan	WWF/Fisheries Officer
3	Mr. Se Nou	Sre Chrey village
4	Mr. Nou Soy	Sre Chrey village
5	Mr. Kroy Chon	Sre Chrey village
6	Mr. Chor Sonit	Chi Meat village
7	Ms. Nar Champi	Chi Meat village
8	Mr. Touch Run	Chi Meat village
9	Mr. Hong Burtha	Koh Myeul Krom village
10	Mr. Phat Et	Koh Myeul Krom village
11	Ms. Tiv Noeng	Koh Myeul Krom village
12	Mr. Keo Sopheap	Koh Myeul Krom village
13	Mr. Mean Samit	Koh Myeul Krom village
14	Ms. Ung Kim	Koh Myeul Krom village
15	Mr. Kahan Dama	Koh Myeul Krom village
16	Ms. Kham Michen	Koh Myeul Leu village
17	Mr. Dom Don	Koh Myeul Leu village
18	Mr. Tau Leuy	Koh Myeul Leu village
19	Mr. Yang Rath	

Annex 2.3 List of the selected trainers to be involved in fish data recording of the fish catch monitoring program

No.	Name	Village
1	Mr. Gnoeng Seang	Sre Chrey
2	Mr. Nou Soy	Sre Chrey
3	Mr. Yang Rat	Sre Chrey
4	Ms. Nar Champi	Chi Meat
5	Mr. Hong Burtha	Myeul Krom
6	Mr. Mean Samit	Myeul Krom
7	Mr. Nhou Caloeng	Myeul Krom
8	Mr. Keo Sopheap	Myeul Leu
9	Mr. Dom Don	Myeul Leu
10	Mr. Tau Leuy	Myeul Leu

Temporary people living in the village

- Describe people who are living temporarily in the village: where are they from? what are they doing? where do they stay?
- In the past year, how many people from outside have come to make a living in the village? What do they do?
- In the past year, how many families in the village have temporary of living on forest or on the river bank?
- How many families from outside village have temporary of living on the riverbank?
- In the 10 years ago, how changing for this living temporarily in the village?

Livelihood and Ownership

- How many families in the village have farming?
- How many families in the village have rice field?
- How many families in the village do they plant anything along the riverbank?
- How many families in village have cows, buffalos? Cows buffalos
- Total cows, buffalos in the village? Cows buffalos
- How many families feed pigs in the village?
- How many families feed chickens in the village? Ducks?

Rice fields:

- Have rice fields ever flooded? Has the crop been destroyed?
- What problems do people encounter with lowland rice farming these days?
- How much land does each family have?
- How many hectares of lowland rice fields per family do people have? (From how many, to how many)
- What is the yield per hectare for paddy in an ordinary year? (From how much, to how much)
- Since 10 year ago have villagers pumped or scooped water onto their paddy fields? If they have, so which years has there not been enough water to do this?

Farming:

- What crops do people in this village usually plant in farm?
- Where are farm ordinarily (far from streams? near streams?)
- Why are they where they are?
- How many hectares of farm per family are people currently farming? (From how many, to how many)
- Do they same plant for each year? What kinds of yields do people get?
- How many months can they feed themselves?
- Are farm ever flooded? Does it damage them?
- Do people sell anything grown in their farm? How much can they earn in a season?
- What problems do people encounter with their farm these days?

Planting gardens along the river banks:

- Where do people plant crops? What seasons?
- What problems have crops planted on islands in the river or along the riverbanks encountered?
- Have crops planted along islands in the river or along the riverbanks ever flooded?
- Have people sold the crops that they plant along islands in the river or along the riverbanks? How much do they earn from this?
- Do villagers plant crops along the riverbank? What crops?
- What months?

Have participants show areas on the map

Planting other crops (includes fruit, gardens around ponds, etc.)

- Are other crops are grown? (Besides lowland rice, farm, and gardens along riverbanks) What crops, and where are they planted?
- What do people do with the crops?

Natural resources management

- Do villagers face related to natural resources management? If have why?

Gender differentiation in work

- How many families have violence? If have why?
- Do/can women go out alone to fishing?
- What activities do men participate in? Men not participate in?

Fishing Activity

- How many families in the village do fishing?
- Of which how many families whose livelihoods dependent on only fishing?
- How many fishing grounds, fish landing sites, deep pools/rapids?
- How many families in the village have fixed gillnets? drifting gillnets? longline fishhooks (ronong) ? fixed fishhooks (bangkay)? castnets? traps (lop)? spring-door traps (chan)? Other fishing gears? (If there are fewer than ten families, list the names in a table as below):

Family	floating gillnets	castnets	bankay	ronong	Traps (lop)	Boat w/out motor	Boat w/ motor	Other

Fisheries status

- Current status of fisheries in the village? Eg. Fish catch and fish abundance, fish species, other
- What issues (management, institutions) and problems? If have what problem? How to decided the problem?
- What suggest for management and conservation of fish resources in Srepok River?

Annex 2.5 Questionnaire for fisheries' focus group discussions

Questionnaire for fisheries' focus group discussions (a group of 5 to 10 experienced fishers, and two groups per village will be interviewed)

Date Interviewers:

Village

Commune:

District:

Province:

Number of fishers involve:

Explain the purpose of the interview and introduce the interview team.

Have the group draw a map on the ground showing Rivers, streams, tributaries, ponds/reservoir, lake, deep-water pools, rapids, water falls, spirit areas, etc. Include all areas where villagers go fishing.

Physical setting

1. List each of the streams/tributary (refer to the map) and indicate how much water it has at different seasons of the year. (Divide into three types, code number: 1:water flowing year round, 2:water in pools in the dry season, 3:dry in the dry season).

No.	Stream/tributary	Type (Code number)
1		
2		
3		

2. Has the condition of the pools changed since the past few years/recently?
3. List the deep-water pools and rapids and the depth and length of each pool. Indicate which have associated spirits?
4. Has the condition of the pools changed from year 2000?

No.	Stream/tributary/River	Deep pool/rapids	Depth	Size	Spirits
1					
2					
6					

5. Has the condition of the pools changed for the past few years/recently?
6. List the name of lake/reservoir/pond you have seen in your village and the neighboring villages of the Srepok River.
7. Has the condition changed for the past few years?

No.	Lakes, Reservoirs and ponds	Depth	Size

Fish species diversity, and distribution, occurrence and migrations

- 8. Go through the booklet of fish photos and identify those they have seen in the Srepok basin in the last two years
- 9. List each fish have seen and have not seen fishing in the village

Code No	Have seen	Have not seen	Notes

- 10. What type of fish not in the picture and you have seen?
- 11. Are there any dolphins anywhere? In what season?
- 12. Are there other aquatic mammalian species?
- 13. Are there crocodiles and other aquatic reptile species? Where?

Fishing activities and methods

- 14. Use of natural poisons
 - Have villagers used natural poisons? What kind? Where they use? How many people participated? How much fish did they catch?
- 15. How many kinds of gears do villagers use these days?
- 16. Which of these are used, where, when, and by whom?
 - Chemical poisons:
 - Manh (push nets), chayra (giant cast nets):
 - Explosives
 - Electro fishing
 - Large barrages
 - Bag nets
 - Others (mosquitoes net, ect.)
- 17. Describe the situation with respect to outsiders coming and fishing in the local area
 - Date/Fishing participated
 - Number of people
 - Use of gear
- 18. Is there any collective fishing? (Such as poisoning fish together? Catching fish in one pond together?).
- 19. What kind of fishing or collection of water life is prohibited? By whom? Why?
- 20. Where do villagers sell the fish them catch? What price do they get in different places?
- 21. How much fish does a family consume per day? How many days per week does a family consume fish and other animal meats? How many weeds per month and how many month per year?
- 22. What fees do you have to pay, to whom, in order to fish, transport fish, or sell fish? Who is give?
- 23. Catch assessment by each fishing gear (below table).

Referring question # 16 & 17	1	2	3	4	5	6	7	8	9	10	11	12	How many did each family use this year? How many meters? How many fish-hooks?	What size do people use? (mesh size? Hook size?)	How much fish do people catch per day in different seasons? And common species?
Water level in Srepok															
Catch by gillnet (mong dak)															
Catch by floating gillnet(mong bandet)															
Catch by cast net (samnanh)															
Catch by fishhooks (bangkay)															
Catch by fishhooks (bangkong)															
Catch by fishhooks (ronong)															
Catch by traps (lop)															
Catch by barrage (thnuos)															
Catch by															
Catch by															
Catch by															

24. Does anyone raise fish or other water life or plant anything in the water?

25. What other water life (including insects) is there that villagers collect to eat or sell? How do those animals depend on the flooding regime?

26. Are there any animals that lay eggs on islands in the river? (Birds, turtles,) What importance do those animals have for villagers?

27. Describe community fisheries activities if there are any.

28. This year, in this village, how many families only fish, and don't farm?

29. This year, in this village, how many families haven't fished at all? Why?

30. In the dry season, how many days a week do people in this village eat fish ordinarily? In the rainy season?

31. In the dry season, how many days a week do people eat frogs, snails, clams, shrimp, etc.? In the rainy season?

32. What do people use boats for transporting along the Srepok and streams? (Go to school, hospital, and transport product of forest...)

36. Since year 2000 has there been a major flood? For how many days? How high was the water?

37. Since year 2000 have villagers' farm ever flooded? What is the impact of flooding? How are the farms after the floods recede?
38. Since year 2000 have villagers' rice field ever flooded? What is the impact of flooding? How are the rice fields after the floods recede?
39. During the last five years have people ever observed fish having lesions or other illness? Where? What kind of fish? What kind of illness? In what season?
40. How do people use water of the Srepok?
41. From year 2000 how has water quality changed over time?
42. Where do people get the water they drink in the dry season? In the rainy season?
43. Since year 2000 has the river ever had unusual amounts of algae?
44. How has water quality and color's water river changed from one month to month?
45. In which years has the water been smelly or caused itching?
46. Since year 2000 has the river water ever been uddy/cloudy in the dry season? Ten years ago, how has water quality changed over time?

Link: Stream, deep, runoff water, abstain from speaking on the map

Gender differentiation in work

- o In the household, what do men do?
- o What do women do?
- o Boys?
- o Girls?

Coping and food

- o When times are tough, how does the household cope?
- o Can others help them out?
- o In household how they find daily food?
- o How they get meat (fish and other animal)?
- o How the family get vegetable?

Education

- o Household head educational attainments (No education, not complete primary school, primary school, secondary school, high school...)
- o How many children in school? Where? What levels? How do they get to school?

Nutrition

- o In the week, how much do they eat fish?
- o How important are wild grown vegetables, insects, and other wildlife to the daily diet?
- o Picking up wild grown vegetables along river or stream, which one is important?

Income sources: Description all sources of family income in the village, then rank the ten most important income sources.

Income source	Score
.... (Income sources)	

Annex 2.8 The training manual on fish catch monitoring

INSTRUCTION

TAKING MEASUREMENTS OF FISH CATCH

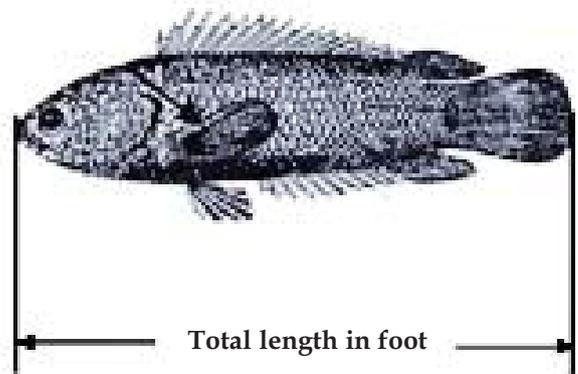
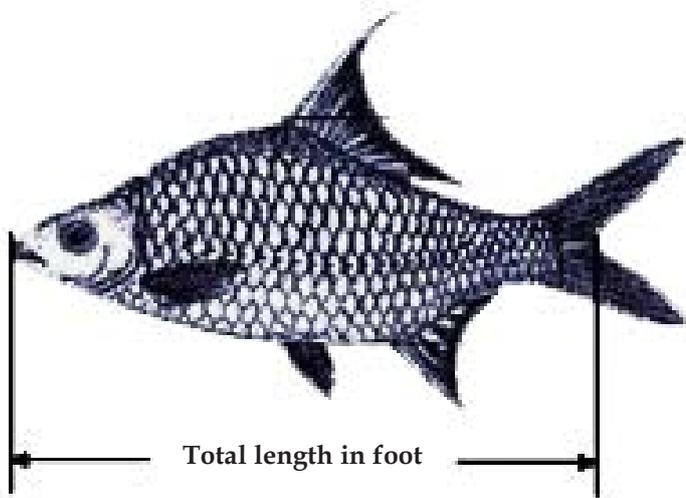
Name of fisherman:	Name of person who make recording;
Name of village:	The village where the fisherman lives;
Name of district:	The district where the fisherman lives;
Date:	Note day, month and year you go fishing using the solar system calendar. For example: 10 May 2003 or 10.05.03 You don't have to make any note on the date you don't go fishing.
Fishing area:	Enter the name of place you fish. For example: Mekong river, Se San, lake, rice field, stream, pond, etc.
Total catch:	Weigh all the catch you get within the day and record the weight;
Sample:	If the total catch exceeds 20 kg, screen out the fish weighing a bove 2 kg and then weigh and count them as normal;
Water quality:	Only tick in a circle containing either the word up or down;
Weather:	Only tick below a picture corresponding to the weather of the day you go fishing;
Fishing gear:	Note down the type of fishing gear used in the day;
Length:	For example: today gill net is used in fishing thus enter total length of the net;
Depth:	Enter the depth of the net, for example: 3 m;
Mesh size or hook:	If the gear is net, the mesh size has to be entered, but if hook is used enter the number indicating the size of the hook;
Number:	For hooks, enter total number in use;
Engine horse power:	The power of the boat engine, in horse power;
Starting/closing date:	Enter the date you arrive at the fishing area (date you go fishing) and date you return from fishing (after harvesting has been concluded);
Fishing time (starting/finishing):	For example: You arrive at the fishing ground at 6 pm and leave at 5 am, thus enter 6pm/5am;
Time spent on fishing trip:	Enter the number of hours you are on the fishing trip;
Fish species:	Name of fish species you caught during the day;
Code:	Refer to the fish catalogue. For example: No. 63 - Trey Riel;
Local name:	Name of the fish known locally. For example: Trey Riel, Trey Krom;
Weight:	Total weight of catch of individual fish species, in Kg;

Gross length: Max length of each fish species caught (in cm);
Number: Number of individual fish species caught (head);

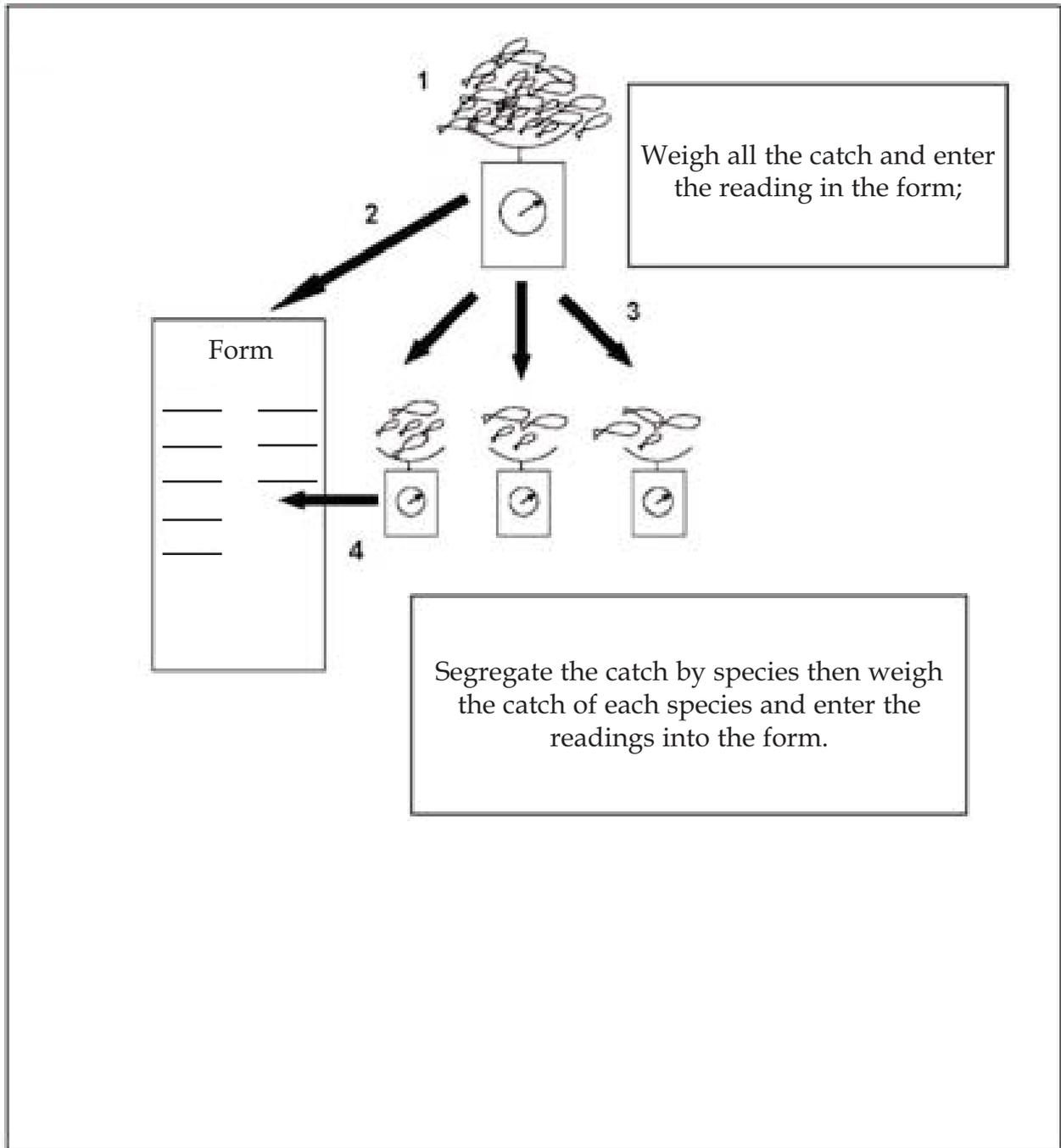
Fish sampling:

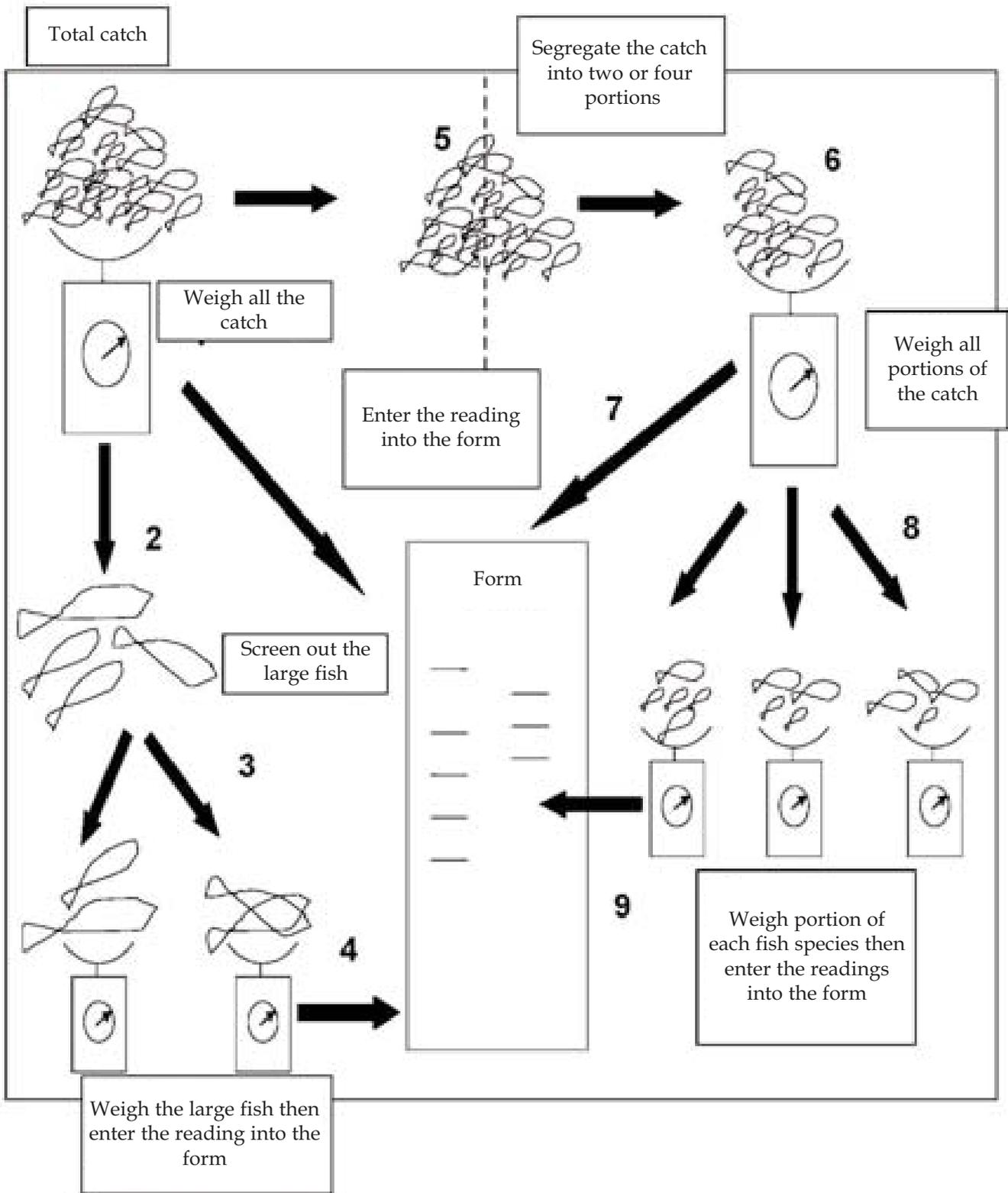
Selected: Tick \checkmark the fish selected as a sample;
Not selected: Tick \checkmark the large fish not selected as a sample;

Note: How to take fish measurements: Put fish head at the beginning of a meter (at one end of a meter) then take the reading on the meter taking in to account the whole body length to the tail as shown in the picture below.



When the total catch is below 20 kg





Annex 3.1 List of fish species found in Srepok River (February, 2008)

Scientific name	Khmer Name	English name	Family name
<i>Acanthopsis sp.1</i>			Cobitidae
<i>Acanthopsis sp.5</i>			Cobitidae
<i>Acanthopsoides delphax</i>			Cobitidae
<i>Acanthopsoides gracilentus</i>			Cobitidae
<i>Achiroides leucorhynchus</i>	Andat Chhke		Soleidae
<i>Achiroides melanorhynchus</i>	Andat Chhke		Soleidae
<i>Albulichthys albuloides</i>	Chhkok Tituy		Cyprinidae
<i>Amblyrhynchichthys truncatus</i>	Kambot Chramos		Cyprinidae
<i>Anabas testudineus</i>	Kranh Srai	Climbing perch	Anabantidae
<i>Anguilla marmorata</i>		Giant mottled eel	Anguillidae
<i>Bagarius bagarius</i>	Krawbey	Goonch	Sisoridae
<i>Bagarius suchus</i>	Krawbey	Crocodile catfish	Sisoridae
<i>Bagarius yarrelli</i>	Krawbey		Sisoridae
<i>Bagrithys macracanthus</i>	Chek Tum	Black lancer catfish	Bagriichthidae
<i>Bagrithys obscurus</i>	Chek Tum	False black lancer	Bagriichthidae
<i>Bangana behri</i>	Pava Mook Pee		Cyprinidae
<i>Barbichthys nitidus</i>	Phka Kor		Cyprinidae
<i>Barbonymus altus</i>	Kahe Kror horm	Red tailed tinfoil	Cyprinidae
<i>Barbonymus gonionotus</i>	Chhpin Brak	Java barb	Cyprinidae
<i>Barbonymus schwanenfeldi</i>	Kahe Loeung	Goldfoil barb	Cyprinidae
<i>Belodontichthys truncatus</i>	Klang Hay		Siluridae
<i>Botia beauforti</i>	Kanchrouk	Chameleon loach	Cobitidae
<i>Botia caudipunctata</i>	Kanchrouk		Cobitidae
<i>Botia eos</i>	Kanchrouk Krawhorm	Sun loach	Cobitidae
<i>Botia helodes</i>	Kanchrouk Chhnoht	Tiger botia	Cobitidae
<i>Botia lecontei</i>	Kanchrouk Loeung	Silver loach	Cobitidae
<i>Botia longidorsalis</i>			Cobitidae
<i>Botia modesta</i>	Kanchrouk Krawhorm	Orangefin loach	Cobitidae
<i>Botia morleti</i>	Kanchrouk	Skunk loach	Cobitidae
<i>Botia nigrolineata</i>			Cobitidae
<i>Brachirus harmandi</i>	Andat Chhke		Soleidae
<i>Brachirus orientalis</i>	Andat chhke Veng	Oriental sole	Soleidae
<i>Carinotetraodon lorteti</i>	Kampot	Redeye puffer	Tetraodontidae
<i>Channa gachua</i>	Ksan	Walking snakehead	Channidae
<i>Channa lucius</i>	Kanh Chorn Chey		Channidae
<i>Channa marulioides</i>			Channidae
<i>Channa micropeltes</i>	Chhdaur / Diep	Giant snakehead	Channidae
<i>Channa striata</i>	Phtuok / Raws	Striped snakehead	Channidae
<i>Chitala blanci</i>	Krai	Indochina featherback	Notopteridae
<i>Chitala lopsis</i>	Krai / Slat	Indonesian featherback	Notopteridae
<i>Chitala ornata</i>	Krai	Clown featherback	Notopteridae
<i>Cirrhinus jullieni</i>	Phkar Cha		Cyprinidae
<i>Cirrhinus microlepis</i>	Kralang / Pruol		Cyprinidae
<i>Cirrhinus molitorella</i>	Phkar Kor	Mud carp	Cyprinidae
<i>Clarias batrachus</i>	Angdaing Roueng	Philippine catfish	Clariidae

<i>Clarias gariepinus</i>	Andaing afrik	North African catfish	Clariidae
<i>Clarias macrocephalus</i>	Angdaing Toun		Clariidae
<i>Clarias meladerma</i>	Angdaing Toun	Blackskin catfish	Clariidae
<i>Clupisoma sinensis</i>	Chhwiet Prak		Schilbeidae
<i>Coilia lindmani</i>		Lindman's grenadier anchovy	Engraulidae
<i>Coilia macrognathos</i>		Longjaw grenadier anchovy	Engraulidae
<i>Corica laciniata</i>	Bawndol Ampeou	Bangkok river sprat	Clupeidae
<i>Corica soborna</i>		Ganges river sprat	Clupeidae
<i>Cosmochilus harmandi</i>	Kampoul Bay		Cyprinidae
<i>Crossocheilus atrilimes</i>		Barb	Cyprinidae
<i>Crossocheilus reticulatus</i>			Cyprinidae
<i>Cyclocheilichthys apogon</i>	Srawka Kdam / Kros	Beardless barb	Cyprinidae
<i>Cyclocheilichthys enoplos</i>	Chhkok		Cyprinidae
<i>Cyclocheilichthys furcatus</i>	Chhkok Ploeung		Cyprinidae
<i>Cyclocheilichthys heteronema</i>	Chhkok Pookmawt Bai		Cyprinidae
<i>Cyclocheilichthys lagleri</i>	Srawka Kdam		Cyprinidae
<i>Cyclocheilichthys repasson</i>	Srawka Kdam		Cyprinidae
<i>Cyclocheilichthys tapiensis</i>			Cyprinidae
<i>Cynoglossus feldmanni</i>	Andat Chhke	River tonguesole	Cynoglossidae
<i>Cynoglossus microlepis</i>	Andat Chhke	Smallscale tonguesole	Cynoglossidae
<i>Dasyatis laosensis</i>	Bawbel	Mekong stingray	Dasyatidae
<i>Datnioides quadrifasciatus</i>	Khlar	Four-barred tigerfish	Datnioididae
<i>Datnioides undecimradiatus</i>			Datnioididae
<i>Garra cambodgiensis</i>		Stonelapping minnow	Cyprinidae
<i>Garra fasciacauda</i>			Cyprinidae
<i>Gyrinocheilus aymonieri</i>	Bandaoul Sok / Smok	Siamese algae-eater	Gyrinocheilidae
<i>Gyrinocheilus pennocki</i>	Smok	Spotted algae eater	Gyrinocheilidae
<i>Hampala dispar</i>	Khmann		Cyprinidae
<i>Hampala macrolepidota</i>	Khmann	Hampala barb	Cyprinidae
<i>Helicophagus waandersi</i>	Pra Kandor		Pangasiidae
<i>Hemibagrus filamentus</i>	Tanel		Bagridae
<i>Hemibagrus spilopterus</i>	Chhlang	Asian redbtail catfish	Bagridae
<i>Hemibagrus wycki</i>	Chhlang Thmor		Bagridae
<i>Hemibagrus wyckioides</i>	Khya		Bagridae
<i>Hemisilurus mekongensis</i>	Krormorm		Siluridae
<i>Henicorhynchus lobatus</i>	Riel		Cyprinidae
<i>Henicorhynchus ornatipinnis</i>			Cyprinidae
<i>Henicorhynchus siamensis</i>	Riel / Riel Tob	Siamese mud carp	Cyprinidae
<i>Heterobagrus bocourti</i>	Kanhos Kdaung		Bagridae
<i>Himantura chaophraya</i>	Bawbel	Freshwater whipray	Dasyatidae
<i>Himantura imbricata</i>	Bawbel	Scaly whipray	Dasyatidae
<i>Himantura krempfi</i>	Bawbel	Marbled freshwater whip ray	Dasyatidae
<i>Hypophthalmichthys molitrix</i>	Carp sor	Silver carp	Cyprinidae
<i>Hypophthalmichthys nobilis</i>	Carp kbal thom	Bighead carp	Cyprinidae
<i>Hyporhamphus limbatus</i>	Phtoung / Phting	Congaturi halfbeak	Hemiramphidae
<i>Hypsibarbus lagleri</i>	Chhpin		Cyprinidae
<i>Hypsibarbus malcolmi</i>	Chhpin	Goldfin tinfoil barb	Cyprinidae
<i>Hypsibarbus pierrei</i>	Chhpin		Cyprinidae
<i>Hypsibarbus suvattii</i>			Cyprinidae

<i>Hypsibarbus wetmorei</i>	Chhpin Krahorm		Cyprinidae
<i>Kryptopterus cryptopterus</i>	Kamplieu Khlanh		Siluridae
<i>Labeo chrysophekadion</i>	Kaek	Black sharkminnow	Cyprinidae
<i>Labeo dyocheilus</i>	Kuol Chek / Pawa mook moi / Pruol Thmor		Cyprinidae
<i>Labeo rohita</i>	Reahou	Roho labeo	Cyprinidae
<i>Labiobarbus siamensis</i>	Ach kok		Cyprinidae
<i>Laides longibarbis</i>	Chhwiet Prak		Schilbeidae
<i>Leptobarbus hoeveni</i>	Chrawlang / Knuoch / Prorlung	Hoven's carp	Cyprinidae
<i>Lobocheilos melanotaenia</i>	Changwa Ronoung		Cyprinidae
<i>Luciosoma bleekeri</i>	Dawng Dao / Bang Kouy		Cyprinidae
<i>Lycothrissa crocodilus</i>	Chhmar Kror Poeu	Sabretoothed thryssa	Engraulidae
<i>Macrobrachium rosenbergii</i>			Palaeomonidae
<i>Macrochirichthys macrochirus</i>	Dangteng		Cyprinidae
<i>Macrognathus circumcinctus</i>			Mastacembelidae
<i>Macrognathus maculatus</i>	Kchoeung	Frecklefin eel	Mastacembelidae
<i>Macrognathus semiocellatus</i>	Kchoeung		Mastacembelidae
<i>Macrognathus siamensis</i>	Chhlonh Chhnoht	Peacock eel	Mastacembelidae
<i>Macrognathus taeniagaster</i>	Kchoeung		Mastacembelidae
<i>Mastacembelus armatus</i>	Kchoeung	Tiretrack eel	Mastacembelidae
<i>Mastacembelus erythrotaenia</i>	Kchoeung Phka	Fire eel	Mastacembelidae
<i>Mekongina erythrospila</i>	Pase ee		Cyprinidae
<i>Micronema apogon</i>	Kes Prak		Siluridae
<i>Micronema bleekeri</i>	Kes Krahawm		Siluridae
<i>Micronema cheveyi</i>	Kamplien Snoeung		Siluridae
<i>Monopterus albus</i>	Antong	Swamp eel	Synbranchidae
<i>Monotrete baileyi</i>			Tetraodontidae
<i>Monotrete barbatus</i>			Tetraodontidae
<i>Mystus albolineatus</i>	Kanhchos Bay		Bagridae
<i>Mystus atrifasciatus</i>	Kanchos Chhnoht		Bagridae
<i>Mystus gulio</i>	Kanchos	Long whiskers catfish	Bagridae
<i>Mystus multiradiatus</i>	Kanchos Chhnoht		Bagridae
<i>Mystus mysticetus</i>	Kanchos Chhnoht		Bagridae
<i>Mystus singaringan</i>	Kanchos		Bagridae
<i>Mystus wolffii</i>	Kanchos		Bagridae
<i>Neolissochilus blanci</i>			Cyprinidae
<i>Notopterus notopterus</i>	Slat	Bronze featherback	Notopteridae
<i>Ompok bimaculatus</i>	Krormom	Butter catfish	Siluridae
<i>Ophisternon bengalense</i>	Antong	Onegilled eel	Synbranchidae
<i>Osphronemus exodon</i>	Romeas	Elephant ear gourami	Osphronemidae
<i>Osphronemus goramy</i>	Trochiek Damrey	Giant gourami	Osphronemidae
<i>Osteochilus hasselti</i>	Kros	Nilem carp	Cyprinidae
<i>Osteochilus melanopleura</i>	Krum		Cyprinidae
<i>Osteochilus microcephalus</i>	Kros		Cyprinidae
<i>Osteochilus waandersii</i>	Kros		Cyprinidae
<i>Oxeyeotris marmorata</i>	Damrey	Marble goby	Eleotridae
<i>Pangasianodon gigas</i>	Reach	Giant catfish	Pangasiidae
<i>Pangasianodon hypophthalmus</i>	Pra	Sutchi catfish	Pangasiidae

<i>Pangasius bocourti</i>	Pra Kchau		Pangasiidae
<i>Pangasius conchophilus</i>	Ke / Bra Ke		Pangasiidae
<i>Pangasius djambal</i>	Po Pruy	Giant pangasius	Pangasiidae
<i>Pangasius krempfi</i>	Pra / Bong Lao		Pangasiidae
<i>Pangasius kunyit</i>			Pangasiidae
<i>Pangasius larnaudiei</i>	Po	Spot pangasius	Pangasiidae
<i>Pangasius macronema</i>	Chhwiet		Pangasiidae
<i>Pangasius mekongensis</i>			Pangasiidae
<i>Pangasius micronemus</i>			Pangasiidae
<i>Pangasius pleurotaenia</i>	Chhwiet		Pangasiidae
<i>Pangasius polyuranodon</i>	Chhwiet		Pangasiidae
<i>Pangasius siamensis</i>	Chhwiet veng		Pangasiidae
<i>Paralauca barroni</i>	Slak Russey		Cyprinidae
<i>Paralauca harmandi</i>	Slak Russey		Cyprinidae
<i>Paralauca riveroi</i>	Slak Russey		Cyprinidae
<i>Paralauca typus</i>	Slak Russey		Cyprinidae
<i>Parambassis apogonoides</i>	Kanhchanh Chras	Iridescent glassy perchlet	Chandidae
<i>Parambassis siamensis</i>	Kanchanh Chras Touch		Chandidae
<i>Parambassis wolffi</i>	Kantrang Preng	Duskyfin glassy perchlet	Chandidae
<i>Polynemus longipectoralis</i>		Eastern paradise fish	Polynemidae
<i>Pristolepis fasciata</i>	Kantrawb	Malayan leaffish	Nandidae
<i>Probarbus jullieni</i>	Trawsak	Isok barb	Cyprinidae
<i>Probarbus labeamajor</i>	Trawsak Sor	Thicklip barb	Cyprinidae
<i>Probarbus labeaminor</i>		Thinlip barb	Cyprinidae
<i>Pseudomystus siamensis</i>	Kanchos Thmor	Asian bumblebee catfish	Bagridae
<i>Puntioplites bulu</i>	Kuch Chhrea / Kanchrea		Cyprinidae
<i>Puntioplites falcifer</i>	Chrakaing		Cyprinidae
<i>Puntioplites proctozysron</i>	Chrakaing		Cyprinidae
<i>Puntius binotatus</i>		Spotted barb	Cyprinidae
<i>Puntius orphoides</i>	Ampil Tum	Javaen barb	Cyprinidae
<i>Raiamas guttatus</i>	Sawka Keo	Burmese trout	Cyprinidae
<i>Rasbora amplistriga</i>			Cyprinidae
<i>Rasbora atridorsalis</i>			Cyprinidae
<i>Rasbora aurotaenia</i>	Changwa Mool	Pale rasbora	Cyprinidae
<i>Rasbora hobelmani</i>	Changwa	Kottelat rasbora	Cyprinidae
<i>Rasbora myersi</i>	Changwa	Myer's silver rasbora	Cyprinidae
<i>Rasbora paviei</i>	Changwa Chhnoht	Sidestripe rasbora	Cyprinidae
<i>Rasbora tornieri</i>	Changwa Mool	SE Asia yellowtail rasbora	Cyprinidae
<i>Scaphognathops bandanensis</i>	Papak		Cyprinidae
<i>Scaphognathops stejnegeri</i>	Chrakaing		Cyprinidae
<i>Tenualosa toli</i>	Balung	Toli shad	Clupeidae
<i>Thynnichthys thynnoides</i>	Linh		Cyprinidae
<i>Tor laterivittatus</i>			Cyprinidae
<i>Tor sinensis</i>	Khaor		Cyprinidae
<i>Tor tambroides</i>	Khaor	Thai mahseer	Cyprinidae
<i>Trichogaster microlepis</i>	Kawmpheanh Phluk	Moonlight gourami	Osphronemidae
<i>Trichogaster pectoralis</i>	Kawnthor	Snakeskin gourami	Osphronemidae
<i>Trichogaster trichopterus</i>	Kawmpheanh Samrai	Three spot gourami	Osphronemidae
<i>Tuberoschistura cambodgiensis</i>			Balitoridae
<i>Wallago attu</i>	Sanday	Great white sheatfish	Siluridae
<i>Wallago leerii</i>	Stuak		Siluridae
<i>Xenentodon cancila</i>	Phtoung	Freshwater garfish	Belonidae