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Fish Migrations and Spawning Habits in the Mekong Mainstream - A Survey using Local Knowledge

(Basin-wide)

by
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Assessment of Mekong Fisheries: Fish Migrations and Spawning and the Impact of Water Management Project (AMFC)

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INTRODUCTION

Background

The Mekong River is the largest river in Southeast Asia. From its origin in China to the point where it enters into the South China Sea in Southern Vietnam, it covers a distance of more than 7000 km. Along its course, the Mekong flows through six countries before reaching the sea. Here, it discharges approximately 475,000 million m^3 of water. The river enters its lower basin at the border-point between Lao P.D.R., Myammar and Thailand, some 2,380 km from the sea. This also marks the entry point into the jurisdiction of the Mekong River Commission.

The Mekong is enriched with a remarkable fish diversity. The current estimate is that the river basin inhabits more than 1200 species, many of which are still awaiting taxonomic identification. On a per unit area basis, this is probably not rivalled by any other river basin.

Not only in terms of diversity is the Mekong unique. The river basin supports probably the largest inland fisheries in the world. It is for example several times larger than the Amazon or the Nile River fisheries [Programme review report, 1999]. Preliminary estimates of the annual catch for the lower Mekong (covering Lao P.D.R., Thailand, Cambodia and Vietnam) is about one million tonnes. More than 60 million people depend on these fisheries resources for income and food.

For any of the Mekong fishes, very little information exists on their biology and ecology. Most of the available information originates from studies at Khone Falls in Southern Lao PDR at the border with Cambodia (Singanouvong et. al. 1998; Baird 1998, Roberts 1993, Roberts and Warren 1994, Roberts and Baird 1995). This area is clearly a key site within the Mekong River and the results of these studies are extremely valuable. However, by their nature they are local studies and, as will be discussed in the following, ecological events in rivers often occur at the basin-wide level. Therefore, in order to describe ecological events in rivers, it is necessary to include the basin as a whole in the studies.

In order to improve the information base on Mekong fisheries, the Project *Assessment of Mekong Fisheries- Fish Migrations and Spawning Habits and Impacts of Water Management* (hereafter abbreviated to AMFP) was initiated in 1997. One of the important components of the project is to 'describe fish migrations and spawning habits, and identify key habitats, for a selected number of important Mekong fishes'. Initially, 45 species were tentatively proposed for detailed studies in the Project Document. This list has since been modified by the project (see Box 2).

This report presents the first research findings on fish migrations and spawning habits in the Mekong Mainstream. The findings are based on the first basin-wide survey carried out by the project during 1999.

However, before presenting and discussing these results, fish migrations including their implications for fisheries are discussed. Furthermore, the initial considerations

within the project are discussed, including their implications in relation to the applied research methodology.

Fish Migrations and their implications.

Fish migrations are an important feature of river ecology in most major tropical rivers. Often fishes migrate several hundred km in order to reach spawning sites or fertile feeding grounds (e.g. Bayley, 1973). In spectacular cases such migrations can cover distances of several thousand kilometers (Barthem and Goulding, 1997). Essentially, these migrations are adaptations to life in running water. Within each river system, fishes have adapted to the particular hydrological regime associated with that river. In a tropical floodplain river like the Mekong, the life cycle of many fish species are adapted to ensure that newly hatched fish larvae are brought out onto the highly productive floodplain areas at the onset of the flood season.

The long-distance migrations within main river channels and their main tributaries are normally referred to as **longitudinal** migrations. When fish migrate from the main river and tributaries onto floodplain areas during the flood season and back again during the dry season, it is referred to as **lateral** migration. One aspect of fish migration, which is often over-looked is the downstream passive movement by fish larvae, the **larval drift.** Larvae of some species may drift several hundred kilometers from upstream spawning areas to downstream nursery areas on the floodplain during the flood season. All the different movements are an integrated part of the life cycle strategies for riverine fishes. Many species, at different times and life stages, undertake all types of movement. For example, for many species, lateral migrations from floodplains and back to the river is often followed by a longitudinal migration within the main river channel.

The life cycles of migrating fishes ecologically connect different areas and habitats of rivers. Although rivers and their associated floodplains encompass a long range of different habitat types, these are all ecologically connected into a complex "fish migration network". Therefore, from the point of view of certain migrating fish species, the river basin constitutes one ecological unit.

In the Mekong, fish migrations have great implications for fisheries because a substantial part of the fisheries are based on the catching of migrating fish. Good examples of this are the dai fisheries in Cambodia, which in terms of production is the most important fishery in Cambodia (Lieng et. al., 1995), and the Khone Falls fishery, one of the most important fisheries in Laos (Baird, 1998; Singanouvong et. al. 1996a; Singanouvong et. al. 1996b). Even the larval drift is exploited. In the Mekong Delta in Vietnam, millions of *Pangasianodon hypophthalmus* larvae are caught every year and stocked into ponds and cages (Nguyen Thanh Tung, personal communication).

Fish migrations also have great implications for regional development planning and management. Many important fish stocks are shared between riparian countries and, therefore, call for regional management strategies. The fact that a river basin can be regarded as one single ecological unit implies that holistic (i.e. basin-wide) resource management strategies should be developed and implemented.

It is thus important to increase the knowledge about fish migrations in the Mekong Basin in order to be able to include such information in future development plans for the basin.

Previous studies of fish migrations in rivers have focused on one or a few species in smaller areas, using "conventional biological" methods such as tagging and sampling (Bayley, 1973; Quiros and Vidal, 1998). However, with few exceptions, these methods have provided only fragmentary information on life cycles of the studied target species (Welcomme, 1985, Barthem and Goulding, 1997). Barthem and Goulding (1997) concluded that "the value of tagging experiments in an area as large and unknown as the Amazon is doubtful". Instead, they based their hypotheses about the migration of two important catfish species in the Amazon on more than 15 years of studies comparing fish lengths and species composition in various rivers of the Amazon Basin during different seasons of the year.

Given the basin-wide, multi-species approach of AMFP, conventional research methods are not appropriate. In effect, no standard method, ready to be picked from the shelf, exists for basin-wide, multi-species studies in major river systems. The AMFP, which thus is novel and ambitious in its design and objectives, calls for new approaches in river fisheries science.

Based on these considerations, the project decided that the best approach would be to tap into a vast and already-existing source of information: that of the peoples and communities who, in every sense, are closest to the resource, the expert fishers of the Mekong Basin.

Local Knowledge as tool in Ecological Research

In recent years, local knowledge has been recognised as a valid and important source of ecological information (Huntington and Mymrin (1996); Johannes (1993)). This development has coincided with an increased call for local participation in natural resources management, triggered by a general realisation of the limitations of conventional, centralised management strategies (Pomeroy 1999, Hoggarth et. at., 1999).

As a consequence, local knowledge (often referred to as ***Traditional Ecological Knowledge*** with the acronym ***TEK)*** is now increasingly being promoted and used as a tool in natural resources management. This relates both to its use in terms of acquiring detailed, ecological knowledge related to natural resources, and in terms of involving local people in the process of developing and implementing management strategies (Price, 1995, Pomeroy, 1999).

TEK can be defined in many ways, but a simple and straight forward definition has been provided by Huntington (1998): *"TEK is the system of experimental knowledge gained by continual observation and transmitted among members of a community. It is set in a framework that encompasses both ecology and the interactions of humans and their environment on physical an spiritual planes ".*

Box 1: Examples of recognition of local knowledge in International conventions and agreements under the UN system.

Rio Declaration on Environment and Development

Principle 22

Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognise and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

Agenda 21

Chapter 26: *Recognising and Strengthening The Role Of Indigenous People And Their Communities.*

Article 26.1 (Basis for action):

Indigenous communities have developed over many generations a holistic traditional scientific knowledge of their lands, natural resources and environment.

Article 26.3 (Objectives):

Recognition of their values, traditional knowledge and resource management practices with a view to promoting environmentally sound and sustainable development

Article 26.5 (Activities):

Achieving a better understanding of indigenous people's knowledge and management experience related to the environment, and applying this to contemporary development challenges.

Convention on Biological Diversity (CBD)

Article 8j:

Each contracting party shall respect, preserve and maintain knowledge of indigenous and local communities, promote their wider application with the approval and involvement of the holders of such knowledge and encourage the equitable sharing of benefits arising from the utilisation of such knowledge

Article 17:

The contracting parties shall facilitate the exchange of information, including information on indigenous and traditional knowledge.

FAO Code of Conduct for Responsible Fishing

Article 12, paragraph 12:

States should investigate and document traditional fisheries knowledge and technologies, in particular those applied to small-scale fisheries...

The recognition of traditional ecological knowledge is a global trend, which is reflected in a number of important international Conventions and Agreements (see Box 1).

One of the advantages of local knowledge is that it already exists! It therefore "just" needs to be compiled. Although this is not as simple as it sounds, it is substantially faster, and cheaper, than establishing "conventional" biological sampling programmes. As mentioned above, given the environmental complexity of riverine ecosystems, it is an almost impossible task to obtain substantial information within the lifetime of a project by conventional scientific methods. The urgency with which information is needed for future development planning further supports the use of local knowledge.

However, time considerations are not the only advantage of using local knowledge. Local ecological knowledge is based on everyday observations that often reach beyond the lifetime of the individual. Such intimate knowledge about the local environment, and resources contained within it, is virtually impossible to acquire through conventional research surveys, which very rarely cover even one whole annual cycle. In line with this, Freeman (1999) argues that local knowledge in many cases is superior to traditional scientific methods. He, furthermore, provides four examples, where knowledge possessed by Inuit hunters in Canada proved superior to conventional scientific research findings.

Johannes (1993) elaborated on the potential for integrating TEK into environmental impact assessments (EIA). He suggested that for traditional ecological knowledge to be useful for EIA's, research should include four perspectives: a taxonomic perspective, a spatial perspective, a temporal perspective, and a social perspective.

Validation

A concern often raised about the use of local knowledge is linked to the problem of validation. Johannes (1993) stated that "a flagrant deficiency in much of the literature describing traditional ecological knowledge is the absence of any effort to determine its validity". Furthermore, he provides some suggestions for validation procedures which can be incorporated into the interview process (Johannes, 1993).

It is very important to include validation procedures into the methodology in order to verify the quality of information provided by local experts. During section ?? in this report, the validation procedures applied during this survey are described.

The use of TEK in the study of river fisheries

In spite of this recognition, very few studies have focussed any attention on local knowledge in the context of river fisheries. In an interesting study, Poizat and Baran (1997) compared fishermen's knowledge with gill-net sampling in Fatala River Estuary, Guinea, West Africa. They found that there was a "good coherence between fishermen's answers and gill-net sampling results" and supported the idea of using fisher's knowledge as a source of ecological information.

According to Dr. Michael Goulding, one of the leading experts on the ecology of the Amazon River, "indigenous and local natural history represents the true 'el dorado' of the Amazon" (ECT, 1998).

In the Mekong, local knowledge on fish ecology has been included in studies at the Khone Falls in Southern Laos. Roberts (1993) supplemented his fish sampling at the Khone Falls during June-July 1993 with interviews of some of the experienced fishermen from that area. He recommended that "the interviews should be extended to other times of the year and other places". Roberts and Warren (1994) based an important part of their account on the migration and spawning of *Probarbus jullieni* in and around the Khone Falls on interviews with local fishermen.

Survey Method

The AMFP has developed a methodology for the use of local knowledge[1] in the study of fish migrations and spawning habits in the Mekong basin. The methodology was tested through a trial survey during June - September 1998 in a small part of the basin in each of the four riparian countries (Jorgensen, *et. al,* 1999). The main objectives of the trial were to test the methodology and to build up experience in carrying out such type of survey.

Based on the trial survey, the methodology was refined (Jorgensen, *et. al.,* 1998), and the survey of the Mekong Mainstream, on which this report is based, was carried out during February to July 1999. The methodology is described in detail in the Survey Manual (Poulsen, *et. al.* 1999) and only the main points will be mentioned here.

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

1) ***Taxonomic.***
   All information relates to a specific taxonomic species. A local name should be connected to the species.

2) ***Spatial.***
   All information, which the fisher provides for a particular species relates to a specific fishing ground (and therefore a specific habitat).

3) ***Temporal.***
   Timing of ecological events related to a particular species and place. Information about a particular species at a particular place is correlated with timing (seasonal as well as diurnal).

[1] Although the term TEK is now a recognised acronym, AMFP prefers to use the broader term "Local Knowledge" because the objective is to obtain information related to local ecological events. This may, or may not, be based on traditional (i.e. inherited) knowledge.

Local knowledge is area specific and a Mekong fisher living in the upper reaches cannot be expected to know about occurrence and timing of species in the lower reaches. Since fish migrations often occur at the basin-wide level, we will not learn every aspect of the lifecycle of any species by talking with one or a few fishers only. We have to get information from many fishers from all over the basin before we can start to map out lifecycle patterns of migrating fish. Although this fact complicates things, it is at the same time a major strength: it gives the data a more solid foundation when they are based on the knowledge of many people rather than a few.

Therefore, one fisher provides information from his/her local area only. When information from fishers from different places along the Mekong is correlated, a substantial amount of information on life cycles for the concerned species will emerge.

The main tool during the survey was a photo flipchart of about 150 selected species. Out of these, 49 species were selected as target species for more detailed information gathering on occurrence, size range, migration and spawning. The selection was based on importance in fisheries as well as in a biodiversity context (according to anecdotal indications as well as observations by the project). See box 2 for details.

Apart from being the focal point during interviews, the photo flipchart also served the purpose of "breaking the ice". Often villagers gathered around the interview spot. The photos were the centre of attention and triggered discussions between villagers and interviewers, thereby establishing a relationship that would otherwise have taken much longer time to achieve.

Prior to the start of each interview, the fishers were informed about the purpose of the visit and of the intended use of the information provided by them.

In each country, a team consisting of two persons carried out the survey. One person carried out the conversation with the fishers while the other extracted data from the conversation onto pre-designed survey formats. The importance of continuity with regards to "interviewers" was strongly emphasised and experience from the **trial** survey showed that with experience, the quality of the survey increased.

Several workshops and training sessions were held with the interview teams, before, during and after fieldwork. During these workshops, methods were elaborately discussed and modified, progress and problems in relations to on-going fieldwork discussed and collected data were analysed and discussed.

Box 1. List of priority species (nomenclature follows Rainboth (1996).

Cyprinidae:

Aaptosyax grypus
Bangana behri
Barbodes gonionotus
Catlocarpio siamensis
Cirrhinus microlepis
Cyclocheilichtys enoplos
Hampala dispar
Hampala macrolepidota
Henicorhynchus siamensis
Hypsibarbus malcolmi
Mekongina erythrospila
Morulius chrysophekadion
Osteochilus hasselti
Paralaubuca typus
Probarbus jullienni
Probarbus labeamajor
Puntioplites falcifer

Notopteridae

Chitala blanci
Chitala ornata
Notopterus notopterus

Clupeidae

Tenualosa thibeaudeaui

Engraulidae

Lycothrissa crocodylus

Cobitidae

Botia modesta

Mastacembelidae

Mastacembelus armatus

Belontiidae

Trichogaster trichopterus

Osphronemidae

Osphronemus exodon

Nandidae

Pristolepis fasciata

Pangasiidae:

Helicophagus waandersi
Pangasianodon gigas
Pangasianodon hypophthalmus
Pangasius bocourti
Pangasius conchophilus
Pangasius krempfi
Pangasius larnaudiei
Pangasius macronema
Pangasius pleurotaenia
Pangasius polyuranodon
Pangasius sanitwongsei
Pangasius siamensis

Schilbeidae:

Laides hexanema
Laides sinensis

Siluridae

Micronema bleekeri
Wallago attu
Wallago leeri

Bagridae

Mystus nemurus

Clariidae

Clarias batrachus

Sisoridae

Bagarius yarelli

Scianidae

Boesemania microlepis

Anabantidae

Anabas testudineus

Channidae

Channa striata

Validation

This survey operates with several "layers" of validation.

Firstly, substantial effort is put into selecting the right fishers. This is very important because not only do the more knowledgeable and experienced fisher provide more information, he is also better motivated to participate and therefore less likely to exaggerate and/or provide false information. In addition, in many villages, certain persons have the reputation as "expert fishermen" and quite often it has shown to be a matter of pride for villagers to get these experts to provide information to the survey team.

Secondly, on-the-spot validation occurs during interviews. The survey teams quickly develop experience in assessing the quality of information provided by fishers. Especially during the initial group interviews (see Poulsen & Jorgensen, 1999, for methodological details), the quality and reliability is checked by the interview team. For example, at each location, certain fish species in the photo flipchart are known not to occur. If a fisherman from the upper reaches of Mekong in Northern Laos claims to recognise an estuarine species such as the tarpon *(Megalops cyprinoides),* it is a sign that one should be cautious with the information provided by him. In such cases, the interview team would not select this fisherman for further individual interview.

Sometimes there are reasons for fishers to make misidentifications. For example, during the trial survey, the giant Mekong barb, *Catlocarpio siamensis,* a typical mainstream long distance migrant, was identified by fishermen from Nong Houm Reservoir near Vientiane. One of the most common species in this reservoir is the introduced Bighead carp (*Hypophthalmichthys nobilis),* which was not included in the Photo Flipchart. Although the resemblance between the two species is not obvious, they are both big-size fish with a large head. The bighead carp obviously is a prominent feature in the Nong Houm reservoir fishery and the Giant Barb, which does not occur there, was the species bearing closest resemblance to the bighead carp in the photo flipchart.

Another common misidentification occurred between the two notopterid species *Notopterus notopterus* and *Chitala lopis.* The latter is a large species growing to 150 cm whereas *Notopterus notopterus* only reaches 40 cm. However, in the photo flipchart they appear to be of equal size.

It is important that interviewers are aware of such potential misidentifications and, where needed, can provide the fishers with additional information about the fishes on the photos.

According to experience from this survey, most fishers who were interviewed provided reliable data. Again, this is often a matter of pride for both the individual person as well as the village as a whole.

Thirdly, validation occurs during data analysis when data from all fishers are correlated. Any "faulty" data will normally fall out of context with other data. However, any dismissal of seemingly "wrong" data should be done with care. Data, which appear to contradict overall trends, may not necessarily be wrong. For example, it could reflect the occurrence of different stocks with different ecological habits.

Finally, additional validation will take place in subsequent field studies when key sites will be visited to verify obtained data.

RESULTS

Introduction

In the following, the main findings of the survey of the Mekong mainstream will be discussed. All the primary data on which this report is based are stored into a Microsoft ACCESS Database developed by AMFP (Visser 1999)[2].

The report is intended to serve at least three purposes:

1) to provide lifecycle information for important Mekong fish species
2) to provide basin-wide information on key fish habitats
3) to provide directions towards future research needs and priorities

The findings are discussed, species by species. First, species of the most numerous family, Cyprinidae, are described. This is followed by the families Cobitidae, Clupeidae, Bagridae, Clariidae, Pangasiidae, Schilbeidae, Siluridae, Channidae, Anabantidae, Belontiidae, Mastacembelidae, Nandidae. Within each family, species are covered in alphabetic order.

In the final section, some general aspects and trends of the findings are discussed.

Migration patterns for important Mekong fish species

Family: Cyprinidae

Aaptosyax grypus

Aaptosyax grypus has previously been reported to be a rare Mekong endemic species with a distribution limited to large rivers in the middle Mekong (Rainboth 1996).

This survey indicates a distribution range within the Mekong mainstream from Sambor, Cambodia, to Loei, Thailand. However, one of the reports from Loei states that the species does not occur there anymore indicating that the present day distribution may be significantly reduced.

Detailed migration information was obtained from four stations from O Krieng, Sambor District of Cambodia to Klongkeam, Ubolratchatani province in Thailand.

It is reported to be a pelagic species that migrate at the same time as *Probarbus sp.*, i.e. in the period December to February. This also coincides with the timing of the reported upstream migration of small cyprinids in the same stretch of the Mekong.

[2] The database is available upon request.

Since *Aaptosyax grypus* is a predatory species, it could be hypothesised that it migrates upstream following its prey of smaller migratory fishes. Roberts (1993) suggests that the upstream migration starting from late December may be a spawning migration.

Migrating *Aaptosyax* are all big fish and no information was obtained on smaller specimens. The only existing report on juveniles is two specimens weighing 100 g caught by gillnets in June 1996 at Ban Hang Khone, southern Lao PDR, just south of the Khone Falls (Baird 1998).

Also, no information was obtained on spawning during this survey.

The survey confirms that it is an extremely rare species. All fishers agree on this and one of the fishers reported that it is three years ago since he last saw the species.

Bangana behri.

This species occur from Sambor in the south to Chiang Khong in the north. According to Rainboth (1996) this species occur in rocky stretches of the mainstream during the dry season and moves into tributary streams during high waters. Several fishers reported that it lives in association with rocks in the Mekong. In the Mekong, rocky stretches do not occur downstream of Sambor. The distribution pattern therefore seems to be determined by the presence of rocky habitats.

Records from two stations in the Mekong Delta in Vietnam suggest that the species occur there. These reports are contradictory to the above. From these two station, the fish is reported to be non-migratory, which is also contradictory to the above and to previous studies. These reports may be mis-identifications and need re-checking.

The migration pattern below the Khone falls seems somewhat contradictory. At two stations in Stung Treng province, fishers report that the species migrate upstream at the onset of the rainy season (May-June) and downstream in the dry season from November to February. At other stations in Sambor and Kratie as well as two stations just south of Khone Falls, the species migrate downstream at the onset of the rainy season and upstream in the dry season. The reason for this seems to be the presence of the important tributary system, Sekong-Sesan-Srepok rivers. Fishers at stations near the tributary system reported that fishes are migrating from this system into the Mekong during receding water and migrate upstream the tributaries during the rainy season, possibly to spawn.

Upstream the Khone Falls this species begin migrating upstream in the dry season (February to May) and continue into the beginning of the rainy season. This may in fact be two separate migrations, a dry season non-reproductive migration of smaller fish and an early rainy season migration of larger fish in spawning condition.

Non-reproductive, dry-season migrations of *Bangana behri* has previously been reported from the just above the Khone Falls during December to February, when it is one of most important fishes in the fisheries (Warren *et. al.* 1998). These were mainly small specimens with a mean body weight of 275 g. The species has also been

reported in the dry season fisheries at Ban Hang Khone, immediately downstream of the Falls. These were also juveniles with mean sizes around 100 to 150 g (Baird, 1998).

There were no reports on upstream migrations of this species during the early rainy season from either of the two studies above and below Khone Falls.

Several accounts from this survey indicate that the upstream migrations occurring from Khone Falls all the way to Chiang Khong in northern Thailand are triggered by increasing water levels and change in water-colour (from clear to red-brown). The species is reported to migrate upstream in schools together with other cyprinids such as *Labeo cf. pierry Cirrhinus microlepis, Morulius chrysophekadion* and *Cyclocheilichthys enoplos* as well as the loach, *Botia modesta* (see later).

These rainy season migrations seems to constitute larger fish compared to the dry season migrations, and at Paksan and Xayaboury, Lao PDR, fishes were reported to have mature eggs during these migrations during June-July.

Barbodes gonionotus

This species occur throughout the whole stretch on the Mekong, from the delta around the saline intrusion zone to the northernmost station, Chiang Khong in Thailand.

It is not considered to be a long-distance migrant. Most fishers report that is is a "local migrant" which means that it migrates from the Mekong up into small streams and canals and onto flooded areas during the rainy season, and back again during receding water. This is confirmed from most stations during this survey.

Some reports indicate that the fish is triggered to migrate upstream by the first rains and rising water levels. When it finds a tributary, canal or small stream it migrate upstream and eventually onto flooded areas. Receding water triggers the movement back into canals and streams and into the Mekong again.

Most report developed eggs during the period March to June, although some report that eggs can be found all year round.

The above indicates that *Barbodes gonionotus* is an opportunistic spawner and that the species constitutes numerous local populations with some degree of overlap.

Catlocarpio siamensis

Catlocarpio siamensis is the largest of the Mekong cyprinids. It is said to grow to a length of up to three meters (Smith 1945, Rainboth 1996). In this survey the largesst reported size was a weight 150-kg.

Catlocarpio siamensis is now a rare fish species. The species seem to be encountered regularly at several stations from Nongkhai (Thailand) and further north up to Chiang

Saen, both on the Thai and the Lao side of the river. The species is also recorded at stations in Nakhon Phanom and Ubol Ratchathani. The species is more common in Cambodia and Vietnam, where it is encountered all the year at many stations.

Juveniles (two to six centimetres) are reported from three places in Thailand: Chiang Saen (Chiang Rai Province), Tad Phanom (Nakhon Phanom Province) and Khemaratch, (Ubol Ratchathani Province). In Cambodia same size of juveniles are seen in Sray Son Thor (Kompong Cham Province) and Muk Kompul (Kandal Province). In Vietnam there are juveniles in Can Tho (Can Tho Province) and Cao Lanh (Dong Thap, Province) in the Mekong, and also in some canals.

Juveniles of size 10-14 cm were also reported during the month of November in Songkhram River, Thailand, during the Phase I (Trial) of this survey. This indicates that *Catlocarpio siamensis* spawns in the Songkhram River basin.

While the adults have a preference for big pools in the Mekong at least part of the year, juveniles are mostly seen in swamps and small tributaries, from where they are sometimes collected and stocked in ponds. This is consistent with information given by Smith (1945), that states that "this is a fish of the large streams" but that "it breeds in Bung Borapet and other bungs [swamps] into which the floodwater of the river flows".

Eggs are seen from January to August, but most fishers report eggs from May to July. This is consistent with the presence of two to four centimetres long juveniles from July to November.

Hypothesis:
Above the Khone Falls, there are at least three populations of *Catlocarpio siamensis.* All of them migrate into tributaries to spawn, either in the tributary itself or within the associated floodplain.

One population occurs in upper part of the survey area and migrates from the Mekong mainstream to tributaries, e.g. in Chiang Rai province.

Further downstream, a population occurs around Nakhon Phanom Province from where it migrates into tributaries, e.g. the Songkhram River and spawns there.

Finally, There appear to be a population in and around Ubol Ratchathani Province, also migrating into tributaries to spawn.

Below the Khone Falls, there appear to be only one population. Spawning occurs mainly in the upper part of the stretch in the Mekong (i.e. upstream from Phnom Penh) and possibly also in the Sesan Tributary system.

When water begins to recede at the end of the flood season, the young-of-the-year and sub-adults migrate from flooded areas and back to the main river channels and tributaries.

Cirrhinus microlepis

This species occurs throughout the survey area from the Delta to Chiang Saen, near the border between Lao PDR, Thailand and Myanmar.

Its migration pattern is markedly different above and below Khone Falls. An upstream migration from Phnom Penh to the Khone Falls occurs between November and February, consisting mainly of sub-adult fishes of sizes 10 to 50 cm.

From April to July, fishes migrate the opposite direction, from Khone Falls and downstream. This migration also mainly constitutes sub-adults up to about 50 cm. It seems to be less conspicuous than the upstream migration as some stations within this stretch did not report any downstream migration.

In the Mekong Delta in Vietnam, only downstream migrations are reported constituting mainly juveniles of sizes between 2 to 20 cm. The smallest are mainly reported from June-July, whereas sizes between 10 and 20 cm are mainly reported from September to November.

The migration pattern above the Khone Falls is less clear. From Klong Kaem District, Ubolratchatani, fish migrate upstream in February, at Khemmaratch further upstream in Ubolratchatani, it migrates upstream in March-April. At Mukdahan, it migrates upstream in May. However, during June-July, it migrates downstream at Klong Kaem. At this time, fish in reproductive condition are reported.

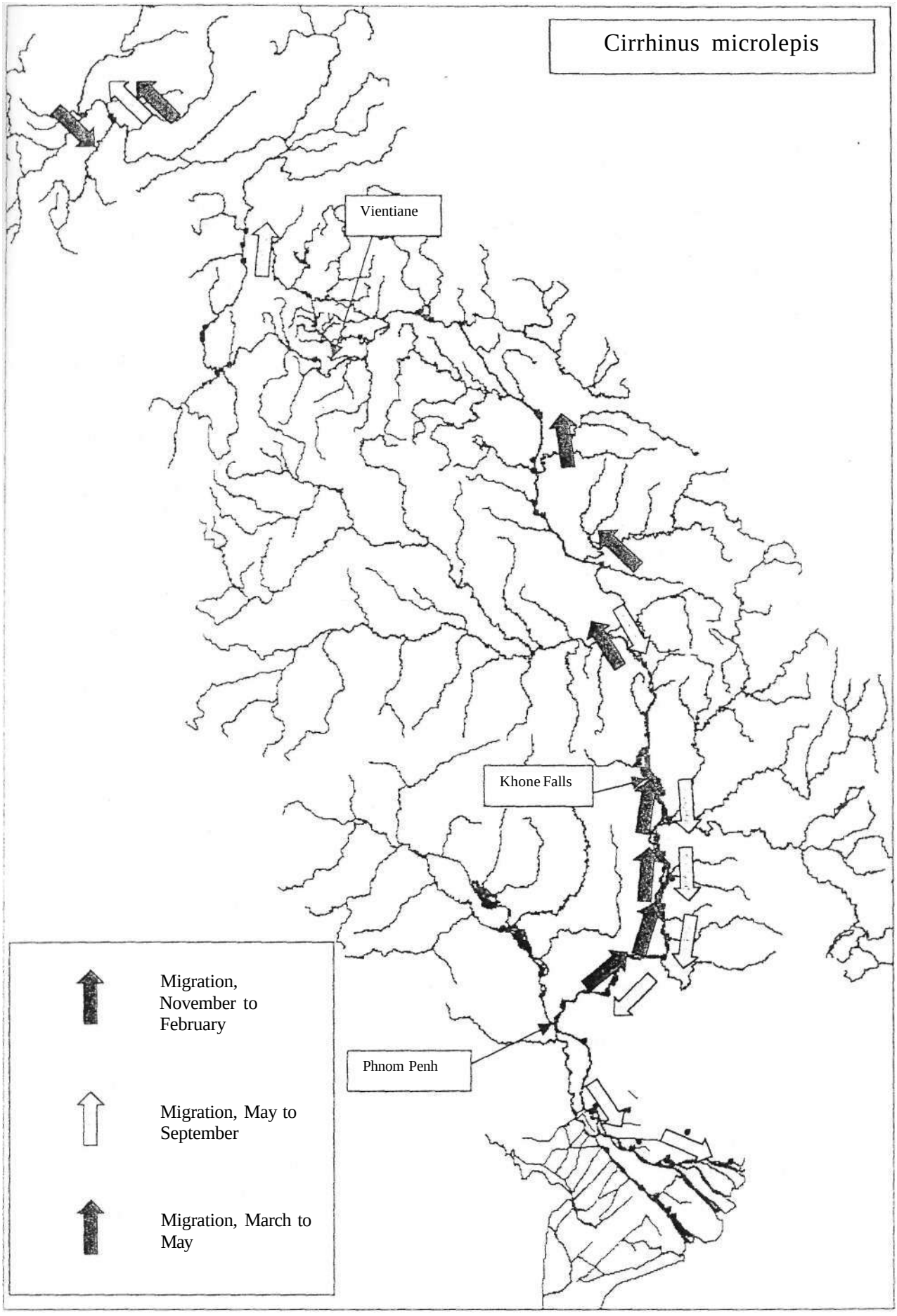
Along the stretch from Savannakhet to Xayabouri, no migration are reported. At Loei, the species occur all year round. From Xayabouri to Chiang Saen, upstream migrations occur from March to August. This seems to be two distinct migrations, one of sub-adults (size range 15 to 50 cm) during March-April and another during June-July constituting large fishes within the range of 40 to 90 cm. This appears to be a spawning migration as mature fishes bearing eggs was reported during this period (July-August).

Previous studies at Khone Falls indicate that *Cirrhinus microlepis* is one of the most important fishes during the dry season from January to March, when it migrates upstream (Warren et. al, 1998; Baird, 1998). During December to February it is also an important species in the dai fisheries in the Tonle Sap River when it migrates downstream the Tonle Sap and into the Mekong (Lieng et. al., 1995).

Cirrhinus microlepis has been artificially induced to spawn in Pakse in Champassak Province, Lao PDR (Bouakhamvongsa et. al., 1994). Broodstock were caught in June at a site 52 km south of Pakse town. This site is believed to be a spawning site by local fishers. They reported the spawning migration to be a downstream migration and indicated that the origin of this migration may be as far upstream as Khammouan.

Hypothesis:

There are at least two populations of *Cirrhinus microlepis.*


Cirrhinus microlepis
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

One population from Loei to Chiang Saen undertaking upstream spawning migrations from May to August to spawning grounds within the main river channel, where spawning occurs in June-July.

Another population occurring from Boulikhamxay in the North to the Mekong Delta. This may in fact be two populations with some degree of overlap, since spawning are reported to occur in the Mekong mainstream both above and below the Khone Falls (July-August). The eggs and larvae drift downstream and out onto flooded areas. Juveniles and adults also move downstream and out onto floodplains during the flood season, in particular to floodplain areas in southern Cambodia and Vietnam and up through the Tonle Sap system. When the water begins to recede at the end of the flood season, the fishes move back into rivers where they start a non-reproductive upstream dispersal migration.

Cyclocheilichthys enoplos.

The only stations where this species was not reported to occur was at Chiang Khong and Chiang Saen in Chiang Rai Province, northern Thailand. Based on this, the distribution range of this species is from the Mekong Delta to around Xayabouri.

The migration pattern is very similar to *Cirrhinus microlepis.* An upstream migration from Phnom Penh to Khone Falls from November to February, and a downstream migration from May to August. This migration continues down into the Mekong Delta area in Vietnam, where it continues until peak flooding in October-November. These two migrations mainly constitute juveniles and sub-adults, although adult of 90 cm are reported from the three stations closest to Khone Falls.

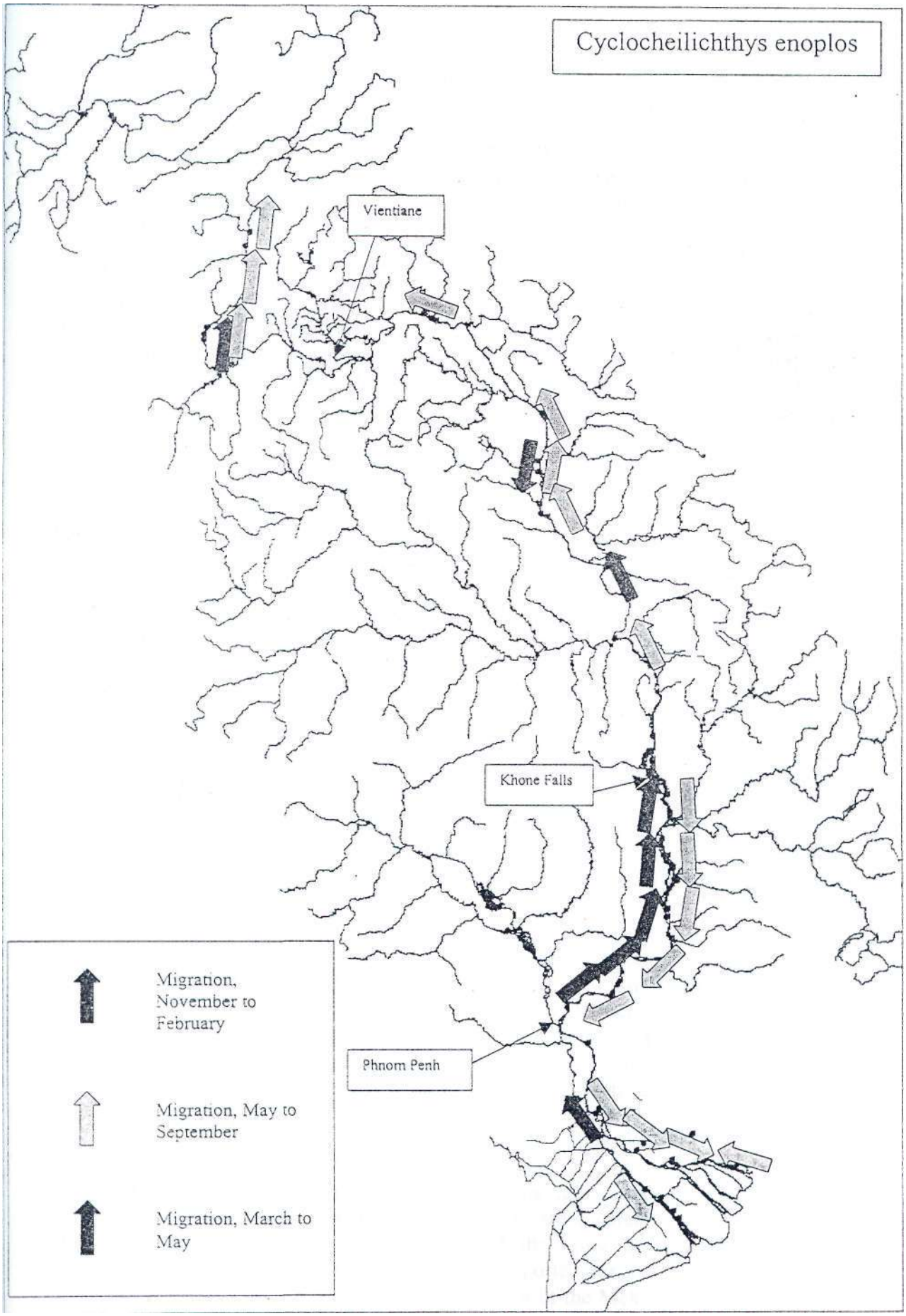
Above the Khone Falls, fishes migrate upstream from April to September. The fishes in these migrations are dominated by adult fishes, and it is probably a spawning migration as mature fishes bearing eggs was reported during this period at three stations in Xayabouri Province (April to September).

Juveniles and sub-adults can also be caught in this section of the river.

Several reports from Cambodia state that the juveniles and sub-adults[3] migrate out of flooded areas back into the river at receding water and start migrating upstream in the Mekong. At two stations, reports indicated that *Cyclocheilichthys enoplos* come down the Tonle Sap River into the Mekong. This corresponds with previous studies from the Tonle Sap River, where the species constitutes an important part of the catch during December to February (Lieng, *et. al.* 1995).

Above the Khone Falls, the first rainfall at the end of the dry season as well as rising water levels and higher turbidity are all reported to contribute to triggering the onset of the upstream migrations.

[3] Sub-adults here means immature fishes older than "young-of-the-year" fish.


Cyclocheilichthys enoplos
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

The bigger fish are reported to live in big pools at certain places within the Mekong (e.g. Boulikhamxay and Xayabouri provinces), whereas smaller fish occur near the river bank, in particular in connection flooded/sub-merged shrubs.

No information was reported on spawning habits of this species, apart from egg-bearing upstream migrating fish reported from Xayaboury. Previous work under Department of Fisheries in Thailand concluded that the spawning season is July-August, that *Cyclocheilichthys enoplos* is a total spawner and that both eggs and larvae are pelagic.

Hypothesis:
Cyclocheilichthys enoplos spawns at the early flood season in the main river channel and eggs and larvae drift downstream and out onto flooded areas or stagnant, shallow segments of the mainstream. Juveniles and adults also move out onto floodplains during the flood season. When the water begins to recede at the end of the flood season, the fishes move back into rivers where they start a non-reproductive upstream dispersal migration.

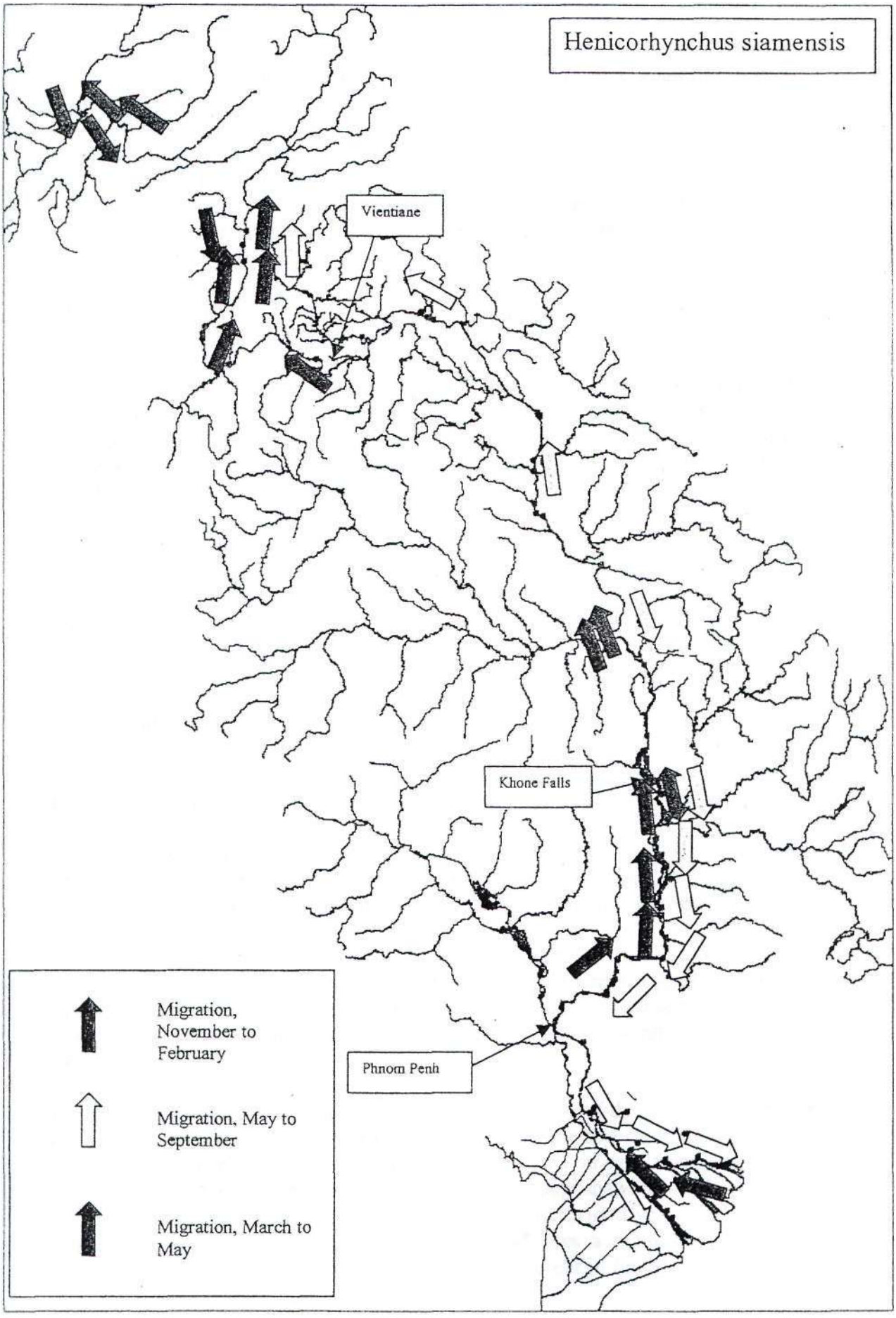
Henicorhynchus siamensis.

According to this survey, the distribution range for *Henicorhynchus siamensis* is from the Mekong Delta all the way along the Mekong to Chiang Khong, near the border between, Thailand, Laos and Myanmar.

This species is well-known for undertaking lateral migrations out onto floodplains in the flood season and returning to rivers again when water begins to recede (Rainboth 1996). The genus *Henicorhynchus* is the most important group of fishes in the Dai fishery in Tonle Sap River, constituting more than 60% of the catch during the period November to February (Lieng et. al. 1995). During this period, these fishes move out into the Tonle Sap River from flooded areas along the river and Great Lake. When in the Tonle Sap, they migrate down to the Mekong and continue their journey upstream the Mekong, probably at least until they reach the Khone Falls (Lieng et. al. 1995, Baird 1998).

This survey supports the above finding. All the stations from just upstream Phnom Penh to the Khone Falls report that *Henicorhynchus siamensis* migrate upstream during the period October to February. At Muk Kompul District in Kandal Province, the species is reported to migrate upstream just before full moon. Further upstream at two stations near Kratie, it is reported to migrate during full moon and at Sambor, a little further upstream, it migrates immediately after full moon. Some fishermen are exploiting this migration are migrating together with the fish all the way to Stung Treng.

Near the Khone Falls, the migration pattern seems less conspicuous. Upstream movements continue through March but in April fish are apparently moving in both directions. From May to July, at the onset of the rainy season, fish migrate downstream from the Khone Falls, a movement reported for all the stations right down to the Mekong Delta. Here, the fish migrate out of the Mekong into canals and


Henicorhynchus siamensis
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

flooded areas during August-September (e.g. reported from Cay Lai, Tien Giang Province in Vietnam). This migration includes movement of very small fishes, (young of the year) as well as mature fishes of about 20 cm. During receding water (November-December), the fish migrate to the Mekong again.

Upstream the Khone Falls, the movements are also less conspicuous. Near Ubolratchatani, *Henicorhynchus siamensis* migrate upstream from February to June. In February-March, this movement consists mainly of juveniles, whereas from April to June, it consists of adults (15-20 cm).

Further upstream, from Xayabouri to Chiang Khong, upstream migrations occur from March to July, first by juveniles, later by adults.

Spawning (i.e. observations of mature eggs) is reported to occur from April to July with a strong peak during May-June. Nearly all stations downstream from Savannakhet-Mukdahan report May-June as the spawning period. At Sambor, a fisherman reported observing mature females "releasing eggs which then flowed downstream" during the month of May.

At Chiang Khong, fish are reported to migrate up in tributaries to spawn from May to July. At Loei, spawning was reported to occur in July-August in a tributary (Loei River) in a small pool with slow current. In general, spawning seems to occur over a longer period and extend into August-September from Loei and upstream.

The limited information obtained from the stretch from Savannakhet-Mukdahan to Loei may indicate the occurrence of two different populations, or even species, upstream and downstream this stretch.

Morulius chrysophekadion

M. chrysophekadion is one of the large cyprinids. This survey affirms that it is distributed throughout the basin, from the northernmost stations in Lao PDR and Thailand to the southernmost stations in Bassac and Mekong in Vietnam.

There is some variation in the maximum size attained in the four countries. In Vietnam *Morulius chrysophekadion* grows to 40 cm in Cambodia, in Lao PDR it grows to 70 cm and in Thailand it attains a size of up to 90 cm (about 7 kg). The last figure is considerably higher than the maximum size of 60 cm published by Rainboth (1996).

Spawning behavior has not been directly observed by any of the interviewed fishers. However, eggs have been observed in the abdomen of the species in the period from February to October. There are significantly more reports on eggs from April to July. It thus appears that the species have a relatively long spawning season. This is supported by the fact that small juveniles (2-4 cm) are reported year round, although with more reports in October-November. This indicates a main spawning period around August. Bardach (1959) reported spawning to occur in June-July in Cambodia.

Juvenile *Morulius chrysophekadion* have also been recorded in small numbers, in the juvenile study carried out by AMFP in An Giang province, Vietnam in June-July 1999.

A fisher in Vietnam suggests that *Morulius chrysophekadion* spawns in flooded ricefields and grasslands. This suggestion is consistent with Smith (1945), who indicated that the species has an important spawning ground in Bung Borapet swamp in the Chao Phrya catchment in Thailand.

Fishers in Lao PDR and Thailand agree that *Morulius chrysophekadion* migrates upstream from March to August. Downstream migration in October is only reported by one fisherman in northern Thailand.

In Cambodia upstream migration is reported from October to March, while the species is reported as migrating downstream from March to August. In Vietnam there is very little and contradictory information on migrations in the mainstream of Mekong and Bassac rivers.
There are several reports on the species migrating into tributaries, small streams and canals. In Lao PDR and Thailand the species apparently starts migrating, when the water changes color from clear to reddish-brown (when the rainy season starts) or when the water starts rising.

Hypothesis:
There are multiple populations of *Morulius chrysophekadion* along the Mekong River. In Lao and Thailand the species will start its upstream migration at the onset of the rainy season, and continue into tributaries and floodplain areas to spawn. In northern Cambodia the species migrates downstream at the same time and moves into the floodplains to spawn further downstream - some specimens may even travel all the way to the Great Lake. Further downstream in Vietnam floodplains (ricefields) are abundant everywhere and the fish has no reason to migrate.

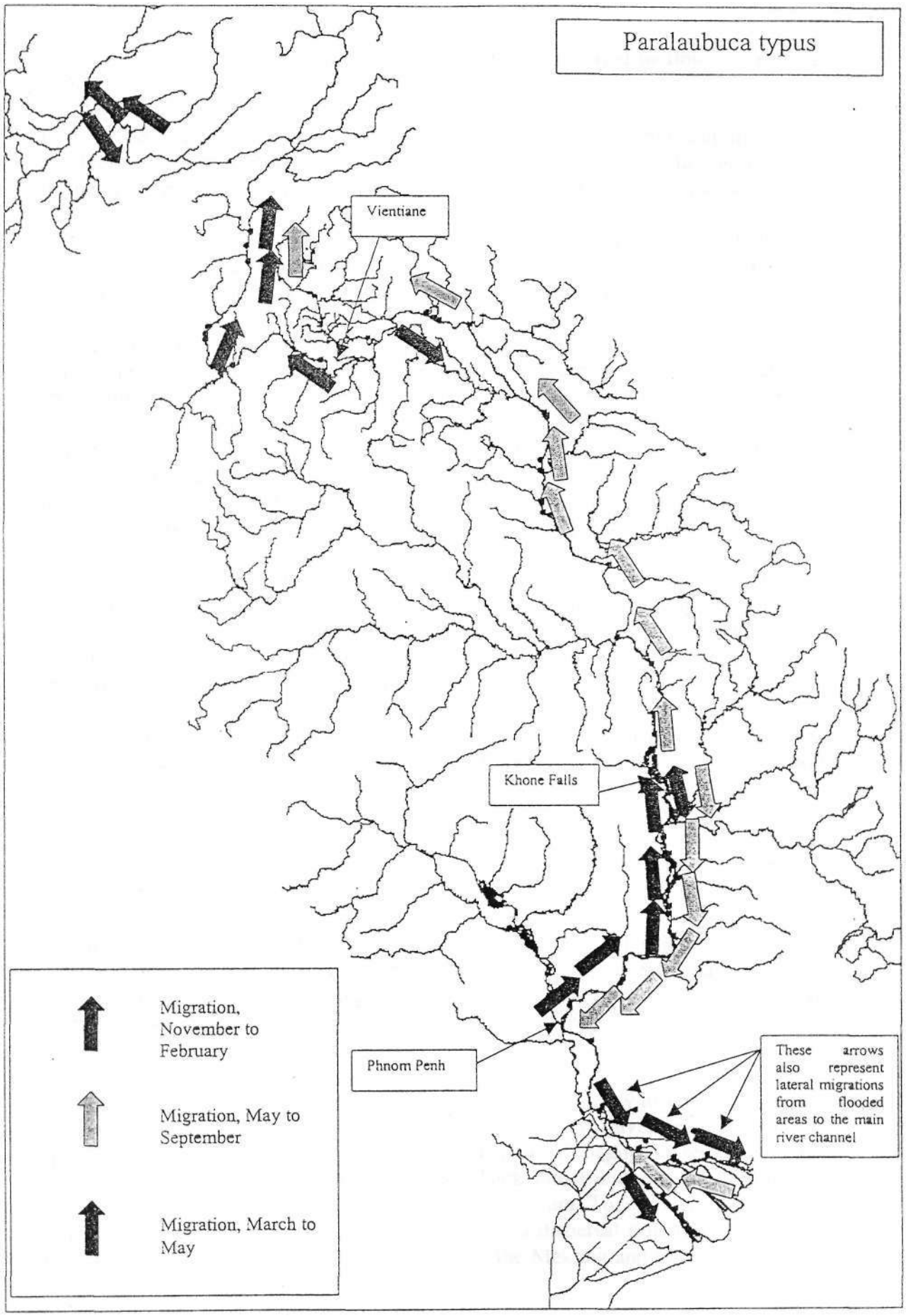
Paralaubuca typus

Paralaubuca typus occur throughout the survey area, from the Mekong Delta to Chiang Saen near the border between Lao PDR, Thailand and Myanmar. It was reported from all the surveyed stations.

Below the Khone Falls, two distinct and conspicuous migrations occur. During the period November to February, a non-reproductive upstream migration is undertaken all the way from Kandal, near Phnom Penh, to the Khone Falls (reported from all 13 stations throughout Cambodia).

A fisherman from Kompong Cham reported that the fish come from Tonle Sap as well as from small canals into the mainstream. Two fishermen, from Kandal and Kompong Cham, reported the migration to occur around the full moon.

From May to July, the fish is migrating downstream (also reported for all stations). At this time, the fish are reported to be in reproductive condition. 22 reports confirm that


Paralaubuca typus
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May
These arrows also represent lateral migrations from flooded areas to the main river channel

mature eggs can be seen from May to July. Two fishermen from Sambor reported observing fish releasing eggs in May. The eggs were reported to flow downstream with the current.

From the Mekong Delta, rising water appear to trigger the fish to move up into canals and then onto flooded areas. When the water recede, the fish return through canals to the mainstream (this movement is reported from all three "floodplain" stations).

At two stations in Dong Thap Province (Hong Ngu and Tarn Nong), spawning had been observed by fishers. At Hong Ngu, spawning was observed in the mainstream Mekong in May, whereas, at Tarn Nong, it was observed in a floodplain area in June.

Above the Khone Falls, an upstream migration occur somewhat delayed compared to below the Falls, from March to July (reported from 14 stations). This migration is apparently triggered by a combination of "the first strong rain", rising water, change in water colour/turbidity and the appearance of insects (reported from 6 stations). Several fishermen throughout this stretch report observing the fish in shallow water near the river bank feeding on insects. From six station the species is reported to migrate together with several other species, in particular *Henicorhynchus sp.* (pa (pla) soi), but also *Botia modesta,* small *Pangasius sp.* (pla yon) and *Micronema sp.*

Eggs have been observed in the abdomen during the period from April to July (observed from 10 stations) with a strong peak in May-June, indicating that spawning occur during this period. One fisher (from Loei) report developed ova during August-November. This report is not line with all other reports and should be further investigated.

At both Loei and Chiang Khong, *Paralaubuca typus* is reported to occur all year round, migrating up into tributaries (e.g. Loei River) and into flooded areas at both places.

Paralaubuca typus in one of the most important fishes in the specialised "tone" trap fishery at Ban Hang Khone from January to March (Baird, 1998). This fishery mainly targets small highly migratory cyprinids.

The species was also recorded from market surveys in Stung Treng during February 1994 and at Kratie during January-February, where it was considered part a group of "small non-reproductive fish migrating upstream from downriver" (Roberts and Warren, 1994). This is in line with the finding of our survey.

Hypothesis:
Paralaubuca typus spawns at the onset of the flood season (May to July) and the eggs and larvae are swept downstream and out onto flooded areas. Juveniles and adults also spend the flood season on the floodplain. When water begins to recede, the fish (young-of-the-year as well as adults migrate back into tributaries (e.g. Tonle Sap River) and eventually back into the Mekong Mainstream. Together with other small migratory fishes, *Paralaubuca typus* takes part in a dispersal migration all the way from the Great Lake/Tonle Sap River system to the Mekong and upstream to Khone Falls during November to February.

Upstream the Khone Falls, there are at least two populations, one from the Falls to somewhere above Vientiane/Nongkhai, and one further upstream from Loei to Chiang Saen near the border between Lao PDR, Thailand and Myanmar.

Downstream the Falls, *Paralaubuca typus* constitutes one single population with multiple spawning sites. Alternatively, there may be more than one population, with substantial overlapping.

Probarbus jullieni* (and *Probarbus labeamajor)

This species occur throughout the survey area, from the Mekong Delta to the border between Lao PDR, Thailand and Myanmar.

Three species have been described within the genus (Roberts 1992). *Probarbus jullieni* and *Probarbus labeamajor* seems to have very similar migrations habits and, although fishers at many places can distinguish between the two species (e.g. they have different local names), they are reported to migrate together. A third species (*Probarbus labeaminor?)* was reported at Sungkom district, Nong Khai Province in Thailand, also with similar migratory habits to *Probarbus jullieni* and *Probarbus labeamajor.*

As for most of the other migrating species covered in this survey, the migrations of *Probarbus jullieni* can be divided into spawning migrations and trophic migrations.

Upstream spawning migrations occur from October to February from Kompong Cham in Cambodia to the northernmost station of Chiang Khong. Above the Khone Falls, the main spawning period is reported to be January to February, sometimes extending into March-April. At Chiang Khong, fishermen reported that *Probarbus* migrate up the tributary Nam Ta in Lao PDR to spawn during March-April. A spawning site was described.

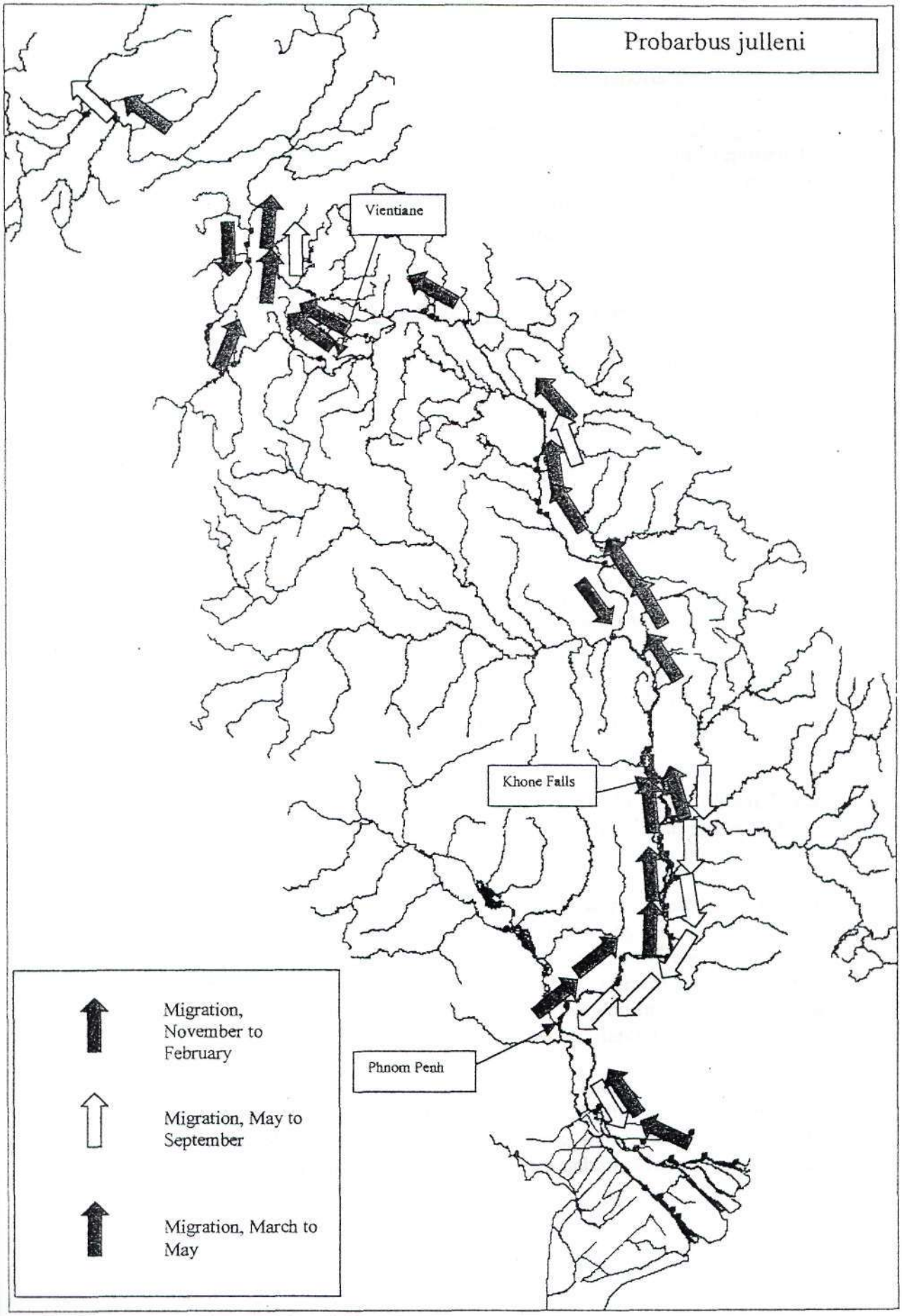
At Loei, Thailand, a site named "Bung Ghang" was reported to be a spawning ground.

At Mukdahan, spawning was reported to occur at two Mekong sites (named "Don Son Korn" and "Don Nang Nean" (the fisher reported observing "hundred fish gathering there"). Another fisher at Mukdahan reported mature male fishes with milt and seeing fish swimming near the surface during October-November.

In Sungkom district, Nong Khai Province, three *Probarbus* species were reported to migrate together, but spawn separately, during January-February. Early stage eggs could be seen in October-November.

At Paksan in Lao PDR, ripe females were reported in March-April.

A report at Pak Lay, Xayabouri Province in Lao PDR, does not adhere to the other spawning reports. Here eggs were observed in August. Stage of development of the observed eggs was not reported. Further investigation is needed to verify this.


Probarbus julleni
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

Below the Khone Falls there were no reports on actual spawning sites. Furthermore, reports on the occurrence of eggs are less clear compared to reports from above the Falls. Four reports, from Thalabovirrat near the Falls to Sambor, report eggs from November to March. However, at four stations from Sambor to Kandal, eggs were reported to occur from May to August, at a time when the fishes are reported to migrate downstream. Since development stages were not mentioned, this could be eggs in a the very early stage of development. It could also indicate a different population (or even species) from further upstream. Further investigations are needed to verify this.

From the Mekong Delta, there were no reports on spawning or occurrence of eggs. In the Delta, *Probarbus sp.* occur mainly as juveniles fishes up to 40 cm. Only at one station, Hong Ngu in Dong Thap Province, fishes up to 90 cm were reported.

Spawning of *Probarbus* is quite well documented in previous studies. Roberts and Warren (1994) described the upstream spawning migration at the Khone Falls from October to January. They also reported that *P. jullieni* and *P. labeamajor* migrate together. A spawning site near Don Hee was identified.

Baird (1998) documented the *Probarbus* fishery from October to January at Ban Hang Khone, just below the Khone Falls. Virtually all *Probarbus spp.* caught were in reproductive condition. The main species was *Probarbus jullieni* accounting for more than 65 % of the catch during this period, with *Probarbus labeamajor* accounting for just over 12 %.

Viravong (1996) documented a spawning ground in Ou River in Northern Lao PDR and described in detail the spawning behavior *of Probarbus jullieni*, during February 1995.

Finally, a *Probarbus* spawning ground in the Nam Lik in the Nam Ngum River catchment was documented during the phase I of this survey (Trial Survey) in 1998.

Trophic migrations are reported throughout the occurrence range. These occur mainly at the onset of the flood season and are mainly undertaken by juveniles and sub-adults. At a station at Nakhon Phanom in Thailand, juveniles of about 6 cm are reported to live "near the beach, and when the beach begins to be covered with water, they migrate upstream". They apparently spend the flood season in flooded areas. At the same station, juveniles of about 2 cm can be seen during March to May.

Also at Loei, fish are reported to move up the Loei River and into flooded areas. At this time, juveniles "can not be seen in the Mekong". Also in Cambodia, there are several reports on lateral migrations from the Mekong into smaller streams and flooded areas, mainly smaller fishes of 20 to 60 cm. At Sambor, juveniles are reported from Lake Sandan, a floodplain lake.

Puntioplites falcifer

According to the data gathered during the survey, *Puntioplites falcifer* is a common species in the mainstream Mekong all the way from Chiang Rai Province in Northern Thailand to the southernmost station in VietNam. Although relatively easy to identify because of the very long dorsal fin, it is possible that the identity of the species have been confused with other *Puntioplites* spp., especially *P. proctozysron,* which is another common species.

Max size reported is around 40 cm, which is slightly larger than the maximum size of 35 cm reported by Rainboth (1996).

Several fishers have mentioned that *P. falcifer* has a preference for deep pools in the river. But it has also been mentioned that it migrates to streams, canals and lakes during the flood season. The last statement is not in agreement with Rainboth (1996), who specifically states that *P. falcifer* has a preference for large rivers and avoid standing water. *P. proctozysron,* on the other hand, has a preference for lentic environments.

P. falcifer is a social species which migrate in large schools. It is also reported to migrate together with a number of other species, in particular *Cosmochilus harmandi, Cirrhinus* spp., *Morulius chrysophekadion,* and *Bangana* sp.

It is dificult to summarize the migration patterns of this species because the migrations are spread out over a long period. But the basin can be divided into four parts.

1: Northern Lao PDR and Thailand (from Loei-Chiang Rai Province): Upstream migrations here occur from Feb-May and July-Aug, but the main period of upstream migration is from March-April. Downstream migration occurs from September-November.

2: From Champassack to Nakhon Phanom Province: Upstream migrations in this region are concentrated in May-June. Downstream migrations are reported in November-December.

3: Northern Cambodia (Stung treng - Kratie): P. falcifer migrates upstream in this river stretch from November - December, and downstream in April-June.

4: The Mekong in VietNam: Only one report on upstream migration in Tien Giang Province in July. The fish migrates downstream in October-December.

From Nongkhai to Thakhek and from Kompong Cham to Tra Vinh in Vietnam there are no indications on direction of migrations. There is also no information on the direction of migrations in the Bassac River.

A number of natural events have been connected with the migrations of this species some of them to a certain extent contradictory. Fishers a five stations in Lao PDR for instance mentioned that *P. falcifer* occurs in large numbers when the water is reddish in colour, while fishers at two other Laotian stations mentioned clear water to be indicative for high occurrence of this species. Changes in waterlevel apparently are very important, the migration activity of this species intensifies both when the water level rises and falls.
Some fishers reported periods of upstream migration and good fishery to be associated with a change in water temperature and strong winds. In Cambodia both upstream and downstream migrations are associated with full moon.

A Thai fisher, in Mukdahan, mentioned that *P. falcifer* attains sexually maturity, when it weighs about 0.3-0.4 kg. In all of the four countries eggs are reported in the period from March-December with most reports from May-June, there are far more reports on eggs in Cambodia than in the other countries, however. This could be because the species has a low occurrence in the Mekong mainstream, in Lao PDR and in Thailand during the spawning season. 2 cm long juveniles are reported all the year although in highest occurrence from May to November.

Vietnamese fishers maintain that *P. falcifer* spawns in small streams and in ricefields. One Vietnamese fisher further suggested that this fish spawns in the Great Lake in Cambodia.

Hypothesis:
During the first heavy rains of the rainy season *Puntioplites falcifer* migrates to the nearest large tributary, and spawn in tributaries and canals and associated floodplain areas. The juveniles are spread out along the riverbank, and some of them enter the Mekong. When the river level falls, adults and juvenile *P. falcifer* move back to the Mekong, where they stay in deep pools until the next flood season.

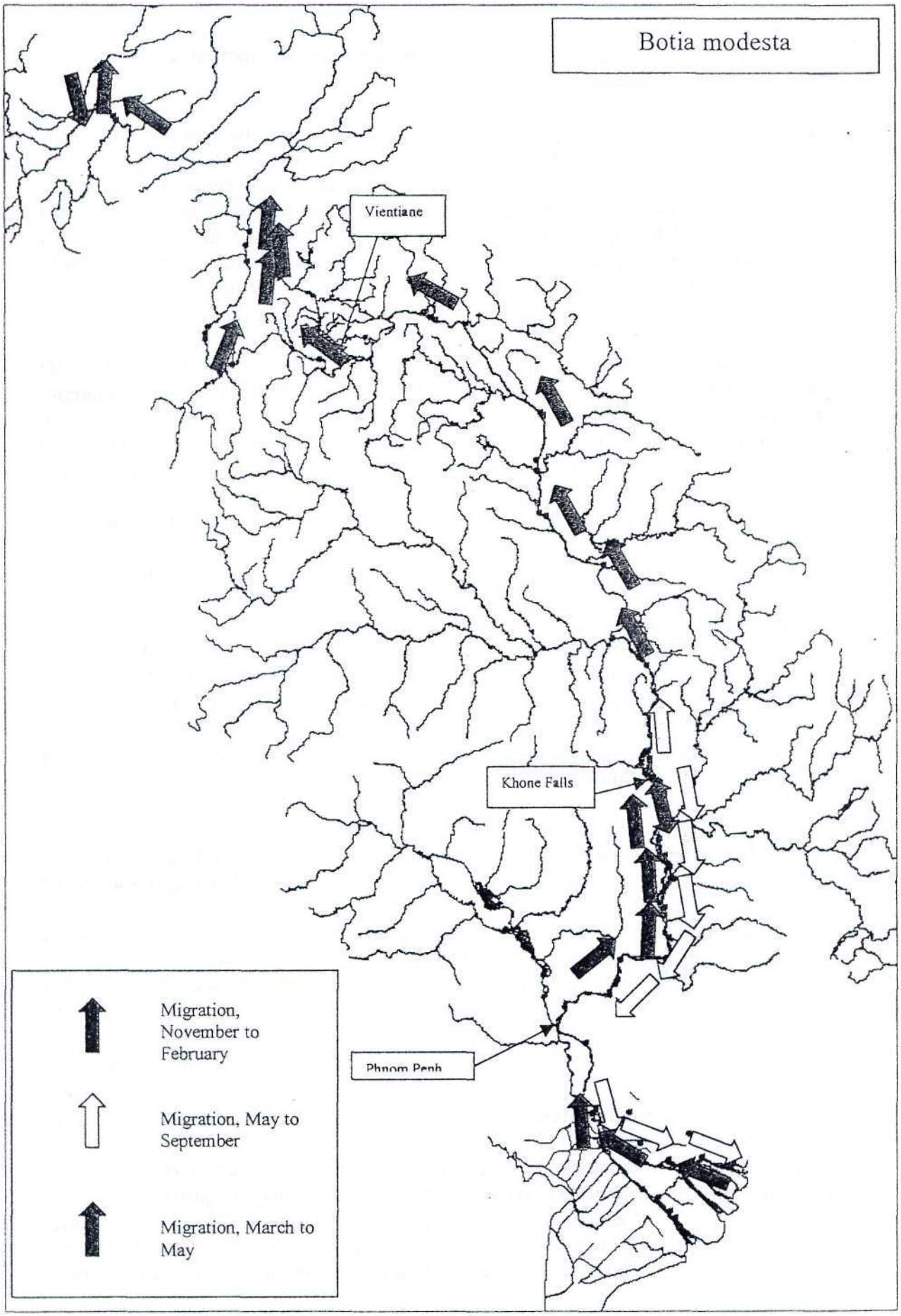
Family: Cobitidae

Botia modesta.

Botia modesta occurs throughout the survey area, from the Mekong Delta to Chiang Saen near the border between Lao PDR, Thailand and Myanmar. It was reported from all the surveyed stations.

An upstream *Botia modesta* migration was reported from the Mekong Delta, around the saline intrusion zone to just below the Khone Falls from November to March (reported from 16 out of 18 Mekong stations). This migration is reported to be triggered by receding water levels (reported from 8 stations). At four stations from Kandal to Kompong Cham, it is reported to migrate during full moon (or just before full moon at Kandal).

From May to July, the species migrates the opposite way, downstream from the Khone Falls, apparently to flooded areas in Southern Cambodia and the Mekong


Botia modesta
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

Delta (i.e. this migration was reported for all three "floodplain" stations in the Mekong Delta).

Above the Khone Falls, *Botia modesta* migrate upstream during February to May (reported for 12 stations out of 14). At five stations, it is reported to migrate together with *Henicorhynchus sp.* ("Pa (pla) soi"). However, at the northern station at Chiang Khong, it is reported that *Botia modesta* does not migrate together with other species. It is reported to migrate into small streams, e.g. at Huai Noi and Huai Kum, near Mukdahan-Savannakhet. At Chiang Khong, it is reported to go into the tributary, Nam Ing, and the young-of-the-year return from Nam Ing to Mekong during September-November (indicating that spawning occur in Nam Ing).

One station just above the Khone Falls (Khong Island) reports the main upstream migrating period to be June-July. This is the only station above the Falls which report migration during this period. However, the timing coincides with the downstream migration reported below the Falls. At the same station, it is reported that *Botia modesta* does not migrate into tributaries and smaller streams.

Eggs are reported to occur from February to July throughout the distribution range (17 stations). There is a strong peak around May-June (11 stations), indicating that spawning takes place during this period.

Juveniles of a size around 2 cm are reported from several places throughout the range. At Chiang Khong and Chiang Saen in the north, they appear from March to May and again from September to November. At Xayaboury, they also appear from March to May and at Mukdahan in November (reported independently from two stations).

From Stung Treng to Sambor, 2 cm juveniles are reported to occur during November-February, whereas from Kratie to Kandal, they occur from July to October (3 stations).

In the Mekong Delta, 2 cm juveniles are reported to occur within the period June to November (reported from 8 stations).

Botia modesta has previously been reported as one of the most important species in the specialised "tone" trap fishery at Ban Hang Khone, immediately downstream the Khone Falls, between January to March (Baird, 1998).

Hypothesis:

There are several (multiple?) populations of *Botia modesta* in the Mekong.

Above the Khone Falls, *Botia modesta* migrates into tributaries and streams, where they spawn during the early flood season. Eggs and larvae are swept onto flooded areas, where they spend the flood season. When water begins to recede, they move back to the main tributaries and to the Mekong mainstream. There may be limited overlap between different populations in this stretch of the river.

Below the Khone Falls, *Botia modesta* also spawns at the onset of the flood season, and eggs and larvae are brought onto flooded areas in southern Cambodia and the Mekong Delta in Vietnam. Spawning may be limited to the northern part of Cambodia, between Kratie and the Khone Falls. As a consequence, the population occurring in southern Cambodia and the Mekong Delta (and possibly in the Tonle Sap/Great Lake system) originates from the area between from Kratie and upstream towards the Khone Falls. Separate populations may exist in large tributaries, e.g. the Sesan system.

The extended period in which 2 cm juveniles can be found throughout the range suggests an extended spawning period or, alternatively, different spawning periods for different populations. Different species of the genus may also be involved.

Family: Clupeidae

Tenualosa thibeaudeaui.

Tenualosa thibeaudeaui occur from the Mekong Delta in the south to Chiang Khong in Chiang Rai Province, Thailand, in the north. However, throughout its range it appears to be rare. For example, ten reports from Cambodia state that there are very few of this species at the respective stations. Also, limited information provided by fishers suggests that it is rare. A fisherman in Paksan in Boulikhamxay Province, Lao PDR, stated that he recognise the fish but doesn't know much about it. He then referred to some elder members of his family since "the species was much more common in the past". This corresponds with the findings of Roberts (1993) who reported that this species was previously one of the most important species in the Khone Falls fisheries but has undergone a drastic decline in recent years.

Eight stations from Cambodia report an upstream migration from Kandal Province (near Phnom Penh) to the Khone Falls from October to February (peak during November-December). From April to July the fish is migrating downstream from Khone Falls, at least to Kompong Cham Province. At Sray Son Thor in Kompong Cham Province, it was reported that the species migrates from the Tonle Sap River. At one station near Stung Treng (Siem Bok), the fish is reported to undertake local migrations into, and out of, small streams and flooded areas (lateral migration) during rising and receding water levels, respectively.

From the Mekong Delta, *Tenualosa thibeaudeaui* was reported from 4 stations. Three stations near the saline intrusion zone, in Tien Giang and Tra Vinh Provinces, and one at Hong Ngu near the border with Cambodia. At Go Cong Tay, the species is reported to occur all year round. It appears that the species is not considered particularly migratory in this part of the river, i.e. no information on migration were reported from the Mekong Delta.

Above the Khone Falls, *Tenualosa thibeaudeaui* migrates upstream from March to June (reported from 11 stations). The main factors triggering this migration was reported to be a combination of: 1) the first rain, 2) increased water levels and 3) increased turbidity.

There are six reports on occurrence of eggs in the abdomen of the fish. Five stations report that developed eggs appear in May-June. Three of those are in Cambodia, from Stung Treng to Kandal, whereas the remaining two reports are from Xayabouri Province in Lao PDR. At Khemarat, Ubolratchatani Province in Thailand, eggs are reported during March-April.

Hypothesis:
There are at least two populations of *Tenualosa thibeaudeaui* in the Mekong. One from around Xayaboury and upstream, and one in the lower Mekong from the Mekong Delta to Paksan in Lao PDR. The latter population may represent more than one, e.g. one above and one below the Khone Falls.

Tenualosa thibeaudeaui spawns at the onset of the flood season (mainly during May-June). The eggs and larvae are brought into flooded areas by the rising waters. Adults also move into flooded areas. When water recedes at the end of the flood season, the fish (adults and young-of-the-year) return to the main rivers and tributaries and begin a dispersal migration.

Below the Khone Falls, the fish migrates from flooded areas in southern Cambodia and the Mekong Delta, as well as from the Tonle Sap system, to the Mekong mainstream, where they then migrate upstream to the Khone Falls.

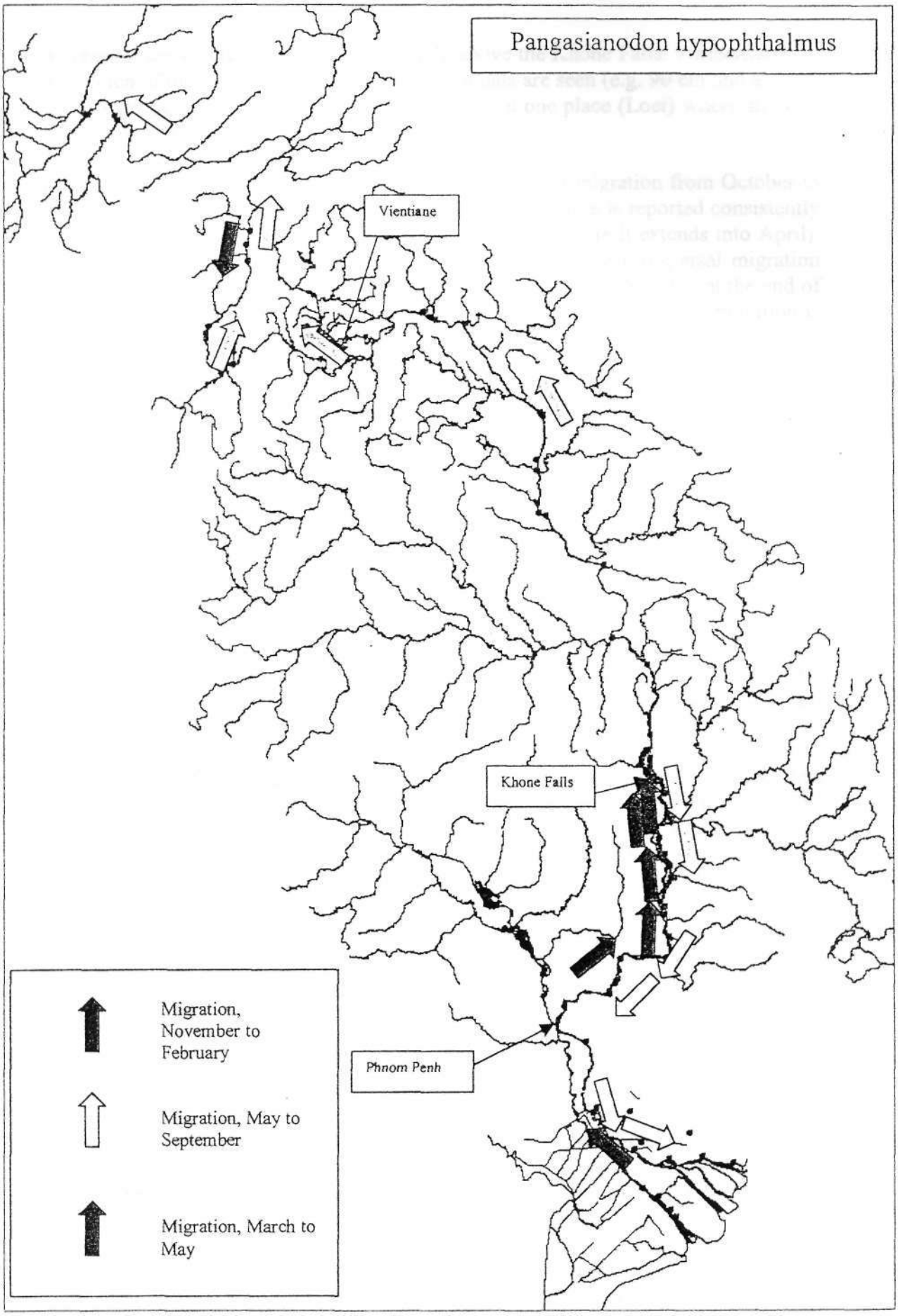
Above the Khone Falls, a combination of the first rain, rising waters and increased turbidity triggers the fish to migrate upstreams to spawning sites associated with flooded areas in tributaries of the Mekong, where they spawn during May-June. When water begins to recede, the fish move back to the mainstream, where they spend the dry season.

Family: Pangasidae

Pangasianodon hypophthalmus.

According to this survey, the distribution range for *Pangasianodon hypophthalmus* is from the Mekong Delta all the way along the Mekong to Chiang Khon. However, it was not recognised at Chiang Saen, near the border between, Thailand, Lao PDR and Myanmar.

Four stations in the middle Mekong, from Mukdahan in the south to That Phanom in the north do not report on this species. At Khammouan and Boulikhamxay provinces in Lao PDR, information is also very limited. However, from Sungkom District (Nong Khai Province) to Chiang Khong, an upstream migration is reported from May to July. Two of those stations (Loei and Xayabouri) report eggs and milt during this migration. At Loei, the fish are reported to "swim upstream at the surface early in the morning".


Pangasianodon hypophthalmus
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

In general, this species appear to be very rare above the Khone Falls. Furthermore, in this stretch of the river, mainly large size individuals are seen (e.g. 90 cm and above). Juveniles were not reported in this stretch, except at one place (Loei) where sizes 15 to 30 cm were reported.

South of the Khone Falls, there is a pronounced upstream migration from October to February (with peak in November-December). This migration is reported consistently from all stations from Kandal Province to Stung Treng (where it extends into April). It is apparently triggered by receding water and appear to be a dispersal migration following the lateral migration from flooded areas back into the Mekong at the end of the flood season. From two stations (at Kratie and Kompong Cham) this migration is reported to occur during full moon.

From May to August, there is a migration the opposite way, downstream from Stung Treng to Kandal and further into the Mekong Delta in Vietnam, at least to Cai Be. This movement is reported from 13 stations, including a "floodplain" station in Tien Giang Province, Vietnam.

From Stung Treng to Kandal, eggs are reported during March to August with a strong peak in June-July. Thus, the downstream migration is both a spawning migration and a trophic migration eventually bringing the fish onto floodplain areas in Cambodia and Vietnam during the flood season.

In An Giang and Dong Thap Provinces, larvae of *Pangasianodon hypophthalmus* are caught every year in June-July during their downstream drift from spawning site(s) somewhere upstream in Cambodia. They are caught in specialised larvae dai nets just south of the Cambodian-Vietnamese border and are used as stocking material in the cage culture industry in Vietnam. According to one "larvae" fisherman from the Chao Doc area, at least four species of pangasids were caught in the larval stages at Chao Doc in June-July until 1998, when the fishery was banned at this site. The most important one was *Pangasianodon hypophthalmus* and, to a lesser extent, *Pangasius bocourti* (see later). The two other species were not identified. During the two month period of operation, several peaks of *Pangasianodon* larvae occur (usually three).

The occurrence of larvae (or "young-of-the-year") is also reported in this survey. At three stations in Kompong Cham Province as well as one station in Kandal Province in Cambodia, fish larvae of 2 cm are reported from May to July. The same is reported from two stations in Vietnam.

In general, fish from the Mekong Delta in Vietnam are below 50 cm, dominated by fish below 30.

Pangasianodon hypophthalmus is one of five pangasid species considered important in the Khone Falls "lee" (wing) trap fishery during May to July each year (Baird, 1998). The wing trap is designed to catch fishes when they migrate over the waterfalls. However, in 1994, the species was absent from "lee" catches.

In the same study, a gillnet fishery was described, operating at Ban Hang Khone just south of the Falls during the same period, from May to July, targeting *Pangasius krempfi* (see later). 28 species was recorded in this fishery over a 4 year period (1993-

1997). However, *Pangasianodon hypophthalmus* was not recorded from this fishery (Baird, 1998).

Hypothesis:
Pangasianodon hypophthalmus spawns in deep pools in the Mekong mainstream somewhere between Kratie to Khone Falls at the beginning of the flood season. When the eggs hatch, the larvae drift downstream until they are swept out onto floodplain areas in southern Cambodia and Vietnam. At this time, the current in the Tonle Sap River has reversed resulting in a proportion of the larvae drifting up the Tonle Sap and out into flooded areas along the Tonle Sap River and the Great Lake.
Therefore, *Pangasianodon hypophthalmus* consists of one population downstream from the Khone Falls at the Lao/Cambodian border.
A distinct population spawns at yet unidentified spawning ground(s) further upstream, at least as far as Xayabouri. There may be some degree of overlap between the two populations, although the lack of reports from a stretch in the middle Mekong from Mukdahan to Nakhon Phanom suggests limited overlap.

When water begins to recede at the end of the rainy season, the fish return to the main river and begin a dispersal migration upstream from Vietnam through Cambodia to near the Khone Falls.

Pangasius conchophilus

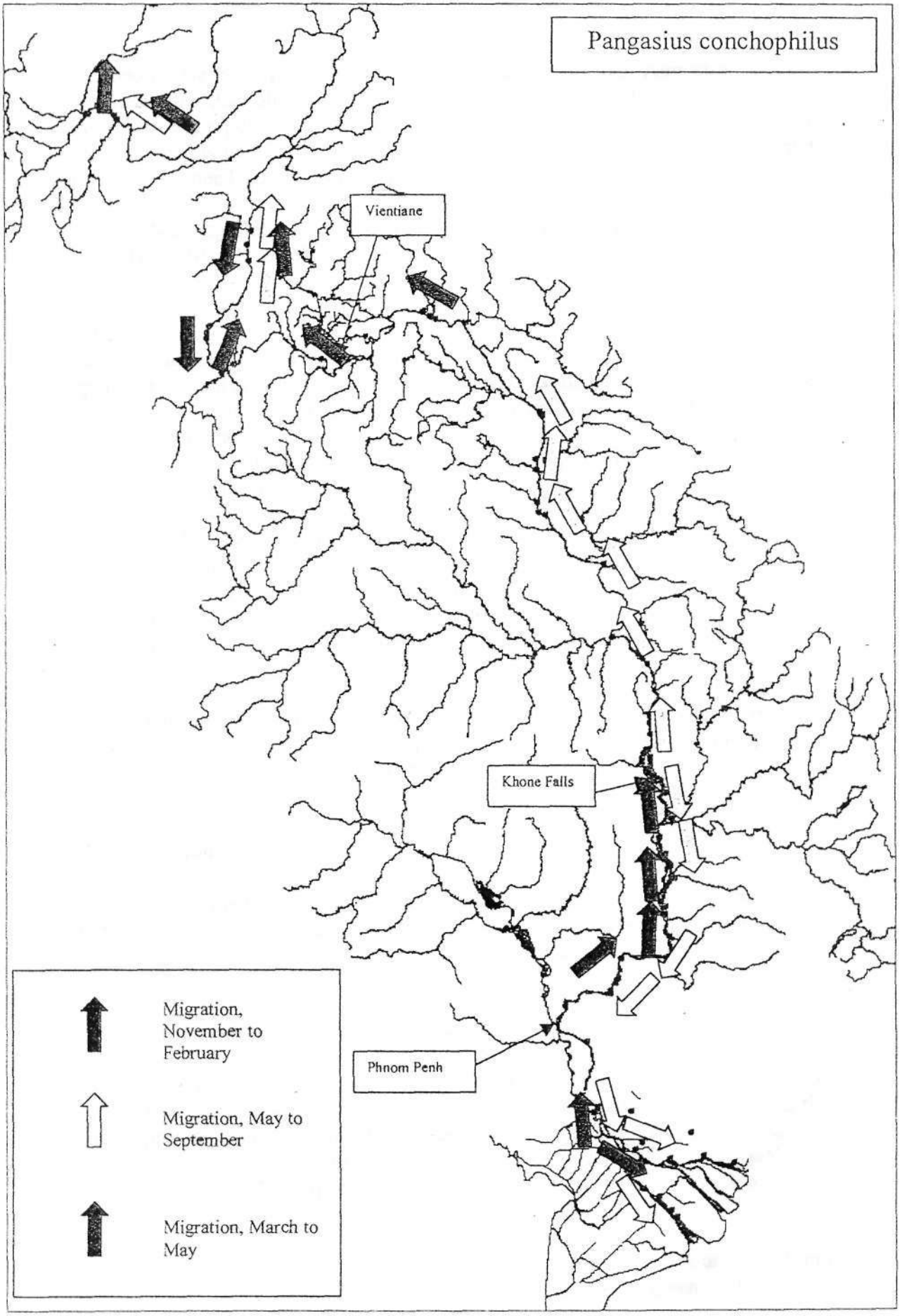
According to this survey, the distribution range for *Pangasius conchophilus* is from the Mekong Delta all the way along the Mekong to Chiang Saen, near the border between, Thailand, Lao PDR and Myanmar.

Pangasius conchophilus migrate upstream from March to August from the Khong Island, just upstream Khone Falls to northernmost station at Chiang Saen. This movement is reported from all surveyed stations along this stretch. It appear to constitute two separate migrations, a non-spawning (trophic?) migration from March to May constituting sub-adults within the size range of 10 to 40 cm, and a spawning migration from May to August constituting individuals of sizes 40 to 90 cm.

Along this stretch, eggs are reported from May to August with a strong peak in June-July. Juveniles of 4 cm were reported from two stations, at Klong Kaem District, Ubolratchatani Province, and That Phanom District, Nakhon Phanom Province, Thailand.

From the Khone Falls to Kandal near Phnom Penh, eggs have been observed from March to August (12 reports), with a peak around May-June (9 reports). At this time, the fish is migrating downstream (reported from all 13 stations in Cambodia).

Juveniles (young-of-the-year) are reported from several places along this stretch. For example, at Kratie, fish of 2 cm appear during June-August. At Kandal, they appear during July-August. At both places, they appear in peaks of 3 to 5 days. This corresponds with a spawning time around May to June and would indicate that spawning occurred somewhere upstream between Kratie and Khone Falls, or in the Sesan tributary system.


Pangasius conchophilus
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

In the Mekong Delta in Vietnam, mainly juveniles are reported. Almost all stations report fish smaller than 30 cm. Only at one station (Hong Ngu, Dong Thap Province) fish of 90 cm are reported. Since they are reported to reach a weight of 35 kg, this may indicate a mis-identification *(Pangasius conchophilus* is not believed to reach such sizes). This needs to be further verified.

Also in the Mekong Delta, 2 cm juveniles appear in June (e.g. Thot Not, Can Tho Province; Hong Ngu, Dong Thap Province). At the end of the year they have grown to about 20 cm.

Hypothesis:
Pangasius conchophilus spawns in the Mekong mainstream somewhere between Kompong Cham and Khone Falls at the beginning of the flood season. When the eggs hatch, the larvae drift downstream until they are swept out onto floodplain areas in southern Cambodia and Vietnam. At this time, the current in the Tonle Sap River has reversed resulting in a proportion of the larvae drifting up the Tonle Sap and out into flooded areas along the Tonle Sap River and the Great Lake.
Therefore, *Pangasius conchophilus* consists of one population downstream from the Khone Falls at the Lao/Cambodian border.
One, or more, distinct population(s) live in the Mekong mainstream above the Khone Falls. They spawn during the same period (i.e. at the onset of the flood season, from May to July) at yet unidentified spawning grounds, at least as far as Chiang Saen near the border between Lao PDR, Thailand and Myanmar. If there are more than one population they may overlap to some extent.

When water begins to recede at the end of the rainy season, the young-of-the-year return to the main river and begin a dispersal migration upstream from Vietnam through Cambodia to near the Khone Falls.

Pangasius djambal

Pangasius djambal is very difficult to separate from *Pangasius bocourti* without close examination of gill rakers (Rainboth (1996); Vidthayanon, personal communication). Therefore, some reports from this survey may be based on mis-identifications with *Pangasius bocourti.*

The northern distribution boundary for *Pangasius djambal* is Chiang Khong in Thailand. The species was not identified from Nongkhai and the three upper stations at Paksan in Lao PDR. At the downstream station in Paksan and in Thakhek it was present, but only in small numbers. Except for one of the stations at Mukdahan, the species is present from Nakhon Phanom and all the way to Muk Kompul, Kandal Province in Cambodia. It was also identified at one of the canal stations in ViefNam.
While the presence of the species in Lao PDR and Thailand is limited to a few months, it is present all the year at most stations in Cambodia.

According to the results of the survey maximum size of the species is around 90 cm and 16 kg, which is larger than the maximum size 50 and 60 cm given by Roberts & Vidthayanon (1991) and Rainboth (1996) respectively.

In Lao and Thailand *P. djambal* starts the upstream migration in May, when the waterlevel increases, and it continues until August. A fisher from Mukdahan mentioned that the species migrates upstream several times every year. The duration of each migration period is one or two days.

Downstream migration has been reported for October-November at stations in Loei and in Savannakhet.

In Cambodia *P. djambal* migrates downstream over an eight months period, the main migration period however is June-July. Upstream migration mainly takes place in December to February.

There are no observations of spawning activity in this species. There are also no indications of the spawning habitat. A fisher from Thailand reported that the species attains sexual maturity, when it weighs about one kilogram. Eggs in the abdomen of the species have been observed from March to August, but most fishers report that eggs are present from April to July.

Small juveniles (2-4 cm) have been observed at Nakhon Phanom and Savannakhet, and from Kratie to Kompong Cham from May to November.

Hypothesis:
There seem to be one population of *Pangasius djambal*, distributed within the area between Loei and Chiang Khong. This population most likely spawns in the Ing River.

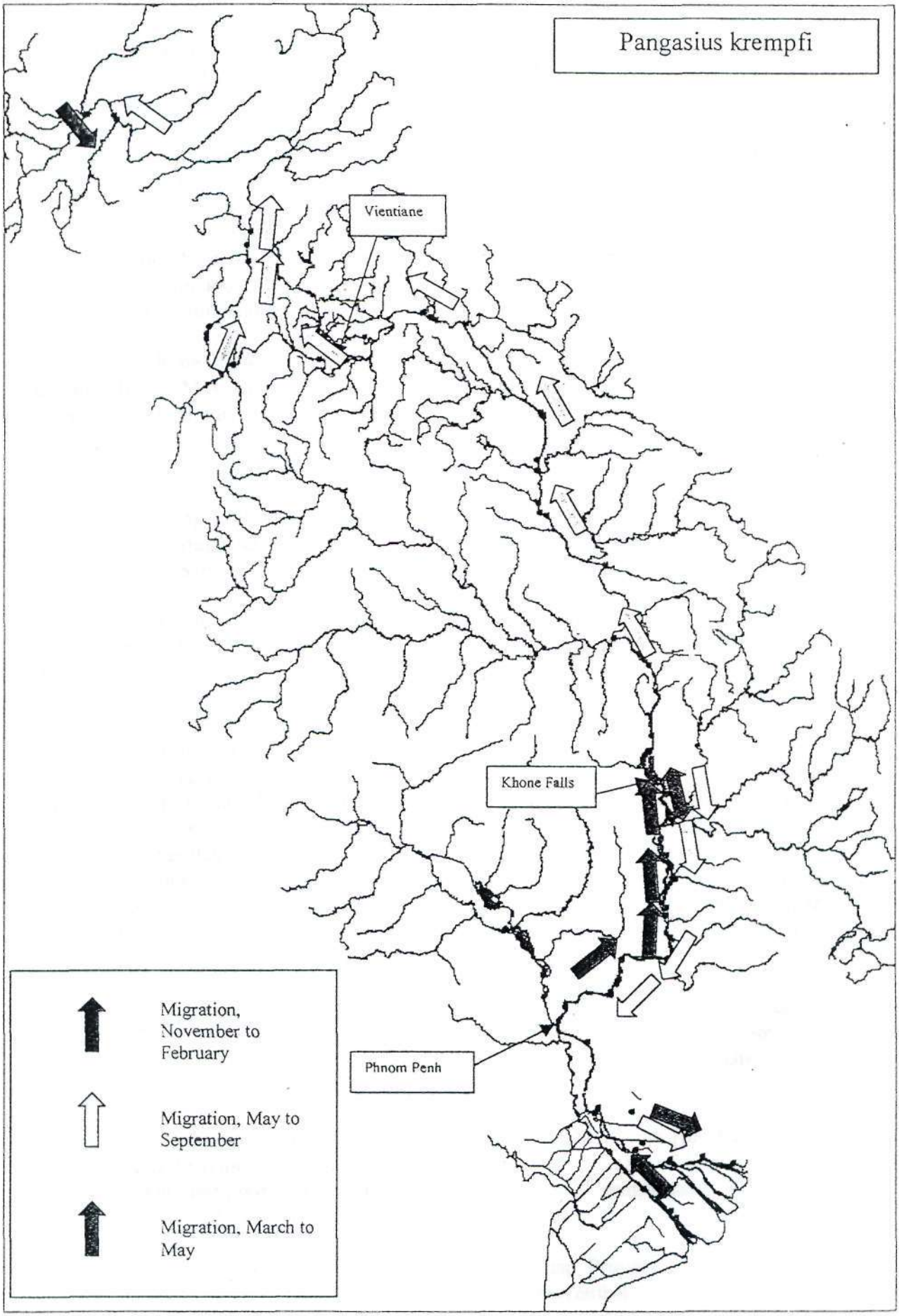
It is not possible to conclude whether the *P. djambal* in the rest of Lao PDR, Thailand and in Cambodia belong to the same population. These individuals, most probably, spawn in the Songkhram and Mun Rivers as well as in some tributaries in Lao PDR. If this is as distinct sub-population, there may be substantial overlap with the sub-population further upstream.

There may be a distinct population south of the Khone Falls, which spawns in the Se San Tributary system. Adults and juveniles (including larvae) migrate downstream to areas with more extensive floodplains downstream Kratie.

Pangasius krempfi.

According to this survey, the distribution range for *Pangasius krempfi* is from the Mekong Delta all the way along the Mekong to Chiang Saen, near the border between, Thailand, Lao PDR and Myanmar.

Upstream the Khone Falls, *Pangasius krempfi* is mainly seen during its upstream migration during May to September (12 out of 15 stations report this, the remaining three stations do not reports on this species). This migration is dominated by fish in spawning condition. Seven stations above Khone Falls report eggs occurring during this migration in June-September with a peak in July. At one station (Sungkom


Pangasius krempfi
Vientiane
Khone Falls
Phnom Penh
Migration, November to February
Migration, May to September
Migration, March to May

District, Nongkhai, Thailand) it was reported that fish releasing eggs were caught in July-August near Pa Sak Neua Village. At the same village, the species was also caught in October-November. At that time, it does not have eggs.

The upstream migrations occur in peaks of 3-5 days, several times during the migration period.

Downstream movement is only reported in two cases above the Khone Falls, both during the months of October. According to the fishers, downstream movements are much less conspicuous because, unlike upstream migrations, they are not undertaken in big schools within short peak periods.

Below the Khone Falls, eggs are reported to occur in the abdomen of *Pangasius krempfi* during May-August, with a peak in June-July (six reports). However, the migration pattern during this period is less clear. At Thalabovirrat near the Falls, the fish migrates upstream in May-June, in line with the reported migration further upstream.

From Stung Treng to Kompong Cham Province, the fish migrate downstream during this period, although less conspicuously (several stations do not report downstream migrations). At Sambor, a fisher reported catching fish releasing eggs in June-July.

In Kandal Province, near Phnom Penh, *Pangasius krempfi* is reported to migrate upstream from March to May from Vietnam. This migration occur in peaks of up to five days and involve sizes between 40 to 90 cm. Nothing was reported on spawning condition.

Almost all stations above the Khone Falls report most fish to be within the range 40 to 90 cm, dominated by fish above 70 cm. At Chiang Khong in the north, fish weighing 7 to 10 kg were reported during the wet season migration. Most of the stations report that they never see juveniles of this species. However, at one station (Mukdahan, Thailand), juveniles of as small as 4 cm were reported to occur during May-June. Juveniles of such a size would appear to be at least two months old, which would then imply a spawning time during March-April. This does not concur with the other reports on spawning for this species. This report on juveniles could indicate a mis-identification and should be verified.

South of the Khone Falls in Cambodia and Vietnam, there are several reports on juveniles. At Thalabovirrat, near the Falls fish of 6 cm are reported and at Sambor, sizes of 10 cm are reported. In Kompong Cham Province (Sray Son Thor District), 2 cm juveniles are reported from August to October.

In Vietnam, most reports are of fishes of sizes 10 to 70 cm. In Vinh Huu Sub-district in Tien Giang Province (near the saline intrusion zone), juveniles of 6 to 50 cm are reported in February, with sizes increasing as the dry season progresses (e.g. in April the size range is 20 to 50 cm).

Only one station in Vietnam (Cao Lanh in Dong Thap Province) report that the species undertakes migrations (upstream from November to February and downstream from April to July, both movements involve mainly big fishes of 70 to 90

cm). There are no reports on spawning, or occurrence of eggs, from the Mekong Delta.

Previous studies at Khone Falls support the findings that *Pangasius krempfi* spawn during the early flood season from May to July (Roberts and Baird, 1995). At Ban Hang Khone, the species is one of the most important in the rainy season wing trap fishery from May to July (Baird, 1998). All the fish migrating during this period were in reproductive condition, the smallest weighing about 1.2 kg. The study concluded that only reproductive individuals are believed to make the annual migration. Our survey supports this finding.

According to the study from Ban Hang Khone, fishers there believe that these migrations are triggered by rising water levels in the Mekong (Baird, 1998). This is supported by findings in this survey, from below the Falls in Cambodia as well as from above in Lao PDR and Thailand.

Pangasius krempfi is believed to spend part of its life in the sea (Roberts, 1993; Roberts and Baird, 1995). The latter authors state that *Pangasius krempfi* is an "anadromous fish with a life story resembling that of Salmon". This survey is obviously not able to verify this (i.e. we did not interview marine fishers). The widespread occurrence over the whole year throughout the Delta region as well as several reports on juvenile occurrence in the same area indicate that at least part of the population remain within fresh- and brackish-water for most, if not all, parts of their lifecycle.

There are some doubts about the status of the taxonomy of the species. Rainboth (1996) indicates that there may be two different species involved, one in the middle Mekong (based on specimens caught at Nong Khai) and one in the lower Mekong (Cambodia-Vietnam).

Hypothesis:
There are at least two populations of *Pangasius krempfi* in the Mekong. One population migrates during May to September from just south of Khone Falls upstream to spawning grounds along the mainstream Mekong all the way to Chiang Khong near the Lao-Thai-Myanmar border. The larvae drift downstream with the current to unidentified nursing areas. Another population migrates downstream from around Stung Treng to unidentified spawning grounds somewhere between Stung treng and Kompong Cham during the spawning season from May to August. The larvae drift downstream to nursing grounds on floodplains in the Mekong Delta. When water begins to recede in October, the fish migrate back to the main river at initiate an upstream dispersal migration, reaching the stretch just below the Khone Falls. *Pangasius krempfi* spend the dry season in deep pools within the mainstream.

Pangasius macronema

According to the results of the survey the maximum size *of Pangasius macronema* is about 28 cm, this is somewhat larger than 18 and 20 cm reported by (Rainboth 1996 and Roberts & Vidthayanon 1991 respectively). In spite of being the smallest Pangasiid species, it is very important in the fisheries, a fact that is reflected in the

Singanouvong, D., C. Soulignavong, K. Vonghachak, B. Saadsy and T.J. Warren (1996b) The main wt-season migration through Hoo Som Yai, a steep-gradient channel at the great fault line on the Mekong River, Champassack Province, Southern Lao PDR. IDRC Fisheries Ecology Technical Report No. 4. 115 p.

Smith, H. M. (1945) The fresh-water fishes of Siam, or Thailand. Bull. U.S. Natn. Mus., 188:1-xi +1-622.

Viravong, S. (1996) Spawning Ground of Jullien's Golden-Price Carp (Probarbus julleini Sauvage) at Ou River in the Northern Part of Lao People Democratic Republic. MsC Thesis, Graduate Programme in Fisheries Science, Kasetsart University, Thailand. 156 p.

Visser, T (1999) AMFP Migration and Spawning Database Manual

Welcomme, R. L. (1985) River Fisheries. FAO Fisheries Technical Paper No. 262, Food and Agricultural Organisation of the United Nations, Rome, Italy. 329 p.

number of fishers that have been able to provide information about the habits of this species. *Pangasius macronema* however is very similar to several other schilbeid and pangasiid species, and misidentification may be a problem.

The principal habitat for this species seem to be the Mekong mainstream, only one fisher in Khammouan Province, Lao PDR reports that it migrates up in small streams. The distribution range covers most of the Mekong except for a short stretch covering Nakhon Phanom and Mukdahan Provinces, in Thailand.

In Cambodia and Vietnam the species is generally present all the year although in varying abundance. During the period when it is migrating it is more abundant.

From Bolikhamsay Province and northwards the species is migrating upstream over a period from around April to August. The data indicate however that May and June is the main period of upstream migration in this region. Fishers in Loei, Province, Thailand and in Xayabury Province, Lao PDR, concurrently reported downstream migration in October-November (another fisher in Xayabury, however, reported upstream migration in the same period).

In Cambodia there is an upstream migration starting in November until January/February. A single fisher in Stung Treng Province also reported that *Pangasius macronema* migrates upstream in May-June, while fishers at four stations reported the fish to go downstream in the same period.

There is only little information on the direction of the migrations in Vietnam, but at the two lowermost stations in the Mekong, *Pangasius macronema* is reported to migrate downstream from July to November.

Pangasius macronema has previously been reported to pass Khone Falls in Southern Lao PDR in April-May (Roberts & Baird 1995).

There is only limited information about the breeding habits of this species. Only one fisher from Tien Giang Province in Vietnam reported that the species is spawning in the main river in August to September. This is later than reported by Bardach (1959), who reported that *Pangasius macronema* spawns in Cambodia in June.

Eggs have been observed in the abdomen of this fish all year round except for February. But eggs are most often reported from April to June. One fisher in Cambodia reported that *Pangasius macronema* have eggs two times a year, the first time in May-June, second time in November-December. Since he is the only person reporting that, it is possible that it is due to the confusion of two species. This should be further verified. A fisher in Loei Province, Thailand reported that the fish migrating downstream during October-November are spent.

Juveniles from 2-4 cm have been observed all year round in all the countries except Lao PDR, where juveniles smaller than 6 cm are never seen. The average of all minimum sizes reported for all countries, month for month, indicate that spawning mainly takes place around August-October.

Many fishers have provided information about natural events coinciding with the migrations of *Pangasius macronema.* Changes in waterlevel seem to have an influence on the movements of this species. It is not clear however, whether it is an increase or a decrease in the water level (or both) that concurs with the migration. Seven Laotian fishers have mentioned changes in water colour as important indicators of peak occurrence, but there is not consensus on whether it is an increase or a decrease in the turbidity that coincides with the event. Eight fishers from Laos and two from Thailand affirm that the timing of the peak occurrence of this species coincides with the emergence of insects. Most of the fishers indicated dragonflies, but one mentioned termites and stoneflies.

Hypothesis:
There are three populations of *Pangasius macronema.*

The distribution range of the first population is from Thakhek, Khammouan Province, in Lao PDR to Chieng Saen, Chiang Rai Province in Thailand. This population migrates upstream in May-June at the onset of the flood to spawn in the upper reaches of the Mekong. After spawning, adults and juveniles are spread out in the area.

The second population is distributed From Khemmaratch, Ubolratchathani, Thailand in the north down to Kratie in Cambodia. This population breeds above Khone Falls. After spawning, juveniles and adult fish disperse in the area. When the water level starts decreasing in November, *Pangasius macronema* migrates to some of the deep pools (eg near Kratie) where it stays until the next flood.

The third population partly overlaps with the second. It is distributed from Stung Treng in Cambodia down to Can Tho Province in Bassac river, and to the mouth of the Mekong in Vietnam. This population spawns in the area around Quatre Bras at the confluence of Tonle Sap and Mekong rivers. These individuals migrate to, and remain in, the same area as the second population during the dry season.

Family: Siluridae

Wallago attu

The distribution of *Wallago attu* is from the mouth of the Mekong all the way up to Northern Laos and Thailand. It is one of the large Mekong species, which is reported to grow larger than 90 cm. Rainboth (1996) states that it can reach a size of 200 cm.

There is some confusion as to what degree the species migrates in the main river. There seem to be consensus between fishers in the four countries however that the species migrate to smaller streams, canals and to the floodplain at some stage during the flood season. During the dry season it lives in deep pools. The migration seems to have a dual purpose: 1) the pursuit of food, especially at the time where smaller fishes are migrating, and 2) spawning.

Eggs are reported to be present in the abdomen of *Wallago attu* from March to October, with most fishers reporting May-July. Juveniles smaller than 4.cm are found

from June to December, with an apparent peak in October-November. A fisher in Chiang Khong in Northern Thailand reported the following: "In June-July groups of fishes larger than 2 kg spawn in shallow water on flooded grassland. The eggs attach to the substrate and hatch within 3 days." Another Thai fisher, in Loei Province, reported personal observation of spawning in Huai Kid reservoir near the mouth of the Huai Kid stream. Small juveniles have also been observed in a swamp in Chiang Rai Province in Thailand. A Vietnamese fisher reported that it breeds in the rice fields.

The timing of the spawning coincides with the spawning time reported by Bardach (1959), who stated that *Wallago attu* spawns from May to October with peak activity from July to September.

Hypothesis:
Wallago attu only undertakes short longitudinal migrations to the nearest stream, as well as some localised movements to pursue schools of smaller fish on which it preys. During the flood season it stays in swamps, canals and streams on the floodplain, where it also spawns. When the water level in the Mekong drops and the flood recedes *Wallago attu* migrates to the Mekong or larger tributaries, where it lives in deep pools until the next inundation period.

Wallago leeri

Although *Wallago leeri* seems to be less common than the con-generic *Wallago attu* it has almost the same distribution range from about 50 km from the river mouth in Vietnam to the northernmost stations in Thailand.

Like its relative, *Wallago leeri* attains a size larger than 90 cm. A fisher in Chiang Khong, in Northern Thailand mentioned that it attains maximum weight of 80 kg. The maximum size recorded by Rainboth (1996) was 145 cm.

This survey produced limited data on the migrations of this species. The data on downstream migrations nevertheless follow a general pattern. In Cambodia downstream migrations start in May and end in July. Fishers at one station in Lao PDR and one in Thailand concurrently reported that *Wallago leeri* migrates downstream in October-November. The data for the timing of upstream movements are too scattered to allow any interpretation.

Fishers in Lao PDR and Thailand agree that *Wallago leeri* migrates into smaller streams to spawn. One Laotian fisher reported that these fish migrate in groups. A Thai fisher explained that the species normally can be found in small Mekong tributaries, when the water level starts rising, especially after strong rain. Detailed information on the movements of this species in Cambodia and Vietnam is not available.

Eggs in the abdomen of the fish have been observed from April to October, with the majority of observations between May and July.

One fisher, in Chiang Khong, in Northern Thailand, had personally observed the spawning of *Wallago leeri.* He reported that *Wallago leeri* spawns in flooded grassland in July. He further maintained that the species spawns at night, and that it breeds in deeper water than *Wallago attu.* During the spawning performance the fish swim in pairs, and the eggs are spawned near the surface.

Family: Mastacembelidae

Mastacembelus armatus

Mastacembelus armatus is one of the largest species of spiny eels and as such relatively easy to identify for most fishermen. The maximum size is somewhat more than 90 cm, which is larger than reported by Rainboth (1996) who gives the maximum size to 80 cm.

The species was identified at all stations in the survey. At many of the stations the species occurs all the year. The level of abundance, however, is very variable, even between closely situated stations. In Cambodia south of Kratie fishers indicate that it is a rare species.

Some fishers indicate that *Mastacembelus armatus* lives in crevices and under rocks in the main river in the dry season, but enter canals, lakes and other floodplain areas during the flood season. The species is reported to have developed eggs all the year, although most fishers report eggs in April-June. A Thai fisher had observed spawning in a whirlpool in April - May. The eggs stuck to filamentous algae in the whirlpool. A fisher in VietNam reported that *Mastacembelus armatus* spawns in ricefields

Hypothesis:
Mastacembelus armatus is a relatively stationary species, which performs only short local migrations, and which have very strict habitat requirements (at least to its dry season habitat). In the dry season it is only found in areas with a rocky bottom. Spawning also seems to take place in this habitat. During the flood season part of the population move to floodplain habitats in the vicinity of the dry season refuges mainly to feed, some individuals may also spawn there however.

Although this report has focussed on describing migration patterns at the level of individual species, some more general ecological remarks can be made. When migration patterns and reproductive strategies for all the described species are put together, important ecological indications emerge:

1) Khone Falls

The Khone Falls in southern Lao PDR clearly emerge as a key area in the Mekong. Although for most of the described species, the Falls do not appear to be a physical barrier (e.g. most species live both below and above the Falls), the migration patterns for most of the species are significantly different below and above the Falls. For many species (%?), there is an upstream dry-season migration from the south up to the Khone Falls and a migration the opposite way, from the Khone Falls and downstream during the onset of the flood season. On the other hand, above the Falls, many of the same species (%?) migrate upstream during the onset of the flood season. In other words, the same species migrate in opposite directions below and above the Falls at the same time. The timing of this migration coincides with the main spawning period for most species (%?), both below and above the Falls.

2) Stretch from Kompong Cham to Khone Falls.

This stretch of the Mekong appears to be very important as a dry season habitat for most species (%?). Along this stretch, and in particular from Kratie and upstream, there are numerous deep pools within the Mekong (Hill and Hill, 1994). This survey confirms that many of the important migratory fishes spend the dry season within this stretch, presumably in deep pools (i.e. most species can be found in this stretch all year round).

3) Importance of floodplains

With very few exceptions (e.g. *Aaptosyax grypus),* the described species depend on flooded areas at some stage during their lifecycle, in particular during larvae/juvenile stages. Many of the longitudinal migrations appear to be adaptations to ensure that offspring are eventually brought onto the productive flooded areas, where they can capitalise on the fertile environments associated with floodplains. This is particularly apparent in southern Cambodia and in the Mekong Delta in Vietnam, where the movement into, and out of, the flooded areas at rising water and receding water, respectively, is a common feature for most species (%?). However, it was also reported regularly further upstream, e.g. in flooded areas along Loei River and even at the northern station of Chiang Khong.

The difference between floodplain areas in the lower Mekong (i.e. below the Khone Falls) and middle Mekong is that in the lower Mekong (southern Cambodia, including the Tonle Sap catchment, and the Mekong Delta), floodplains are directly connected

to the mainstream, whereas in the middle Mekong, floodplains are mainly associated with tributaries.

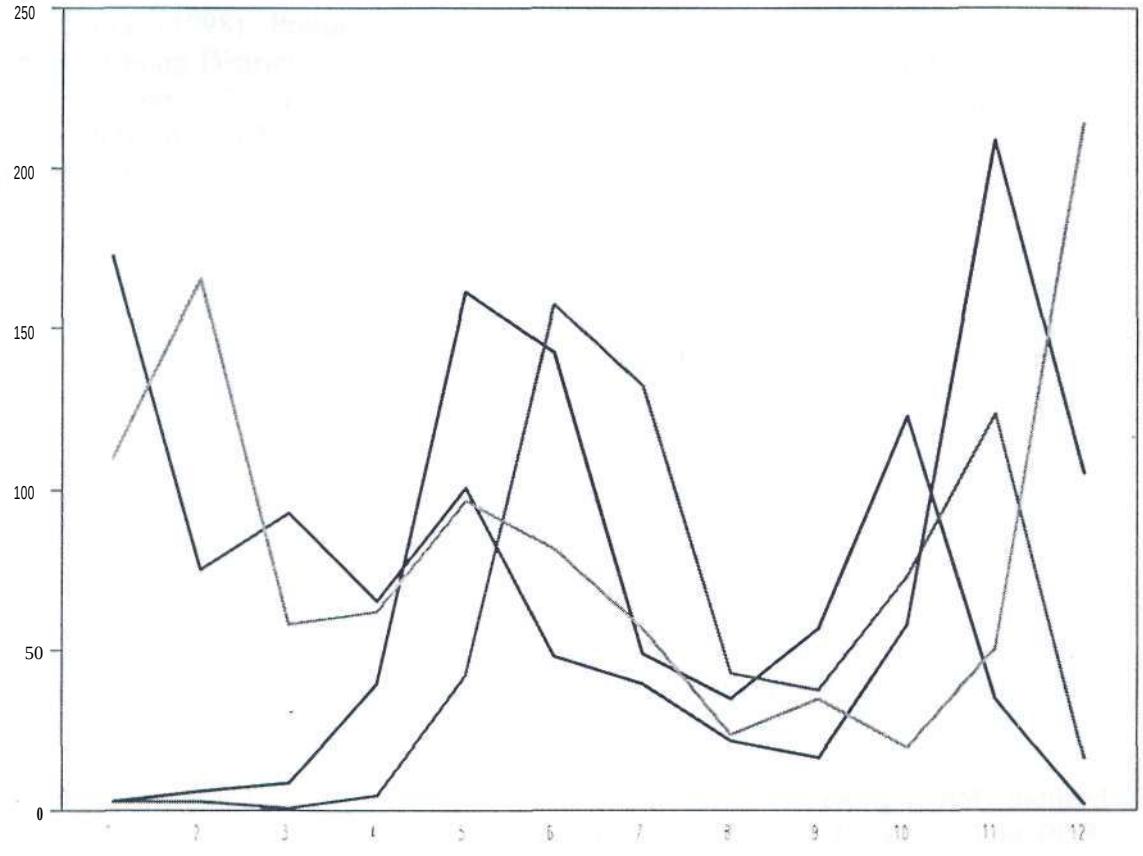
Therefore, in the middle Mekong fish can only get access to floodplains through tributaries and smaller streams. The upstream migrations reported for many species from the middle Mekong just before, and during, the onset of the flood season appear to be an adaptation to "find" a tributary where the fish will be able to reach flooded areas (or get its offspring onto flooded areas).

On the other hand, below the Khone Falls, in particular downstream from Kratie, floodplains are accessible directly from the mainstream. Therefore, they can be reached more easily, simply by moving downstream (actively or passively) until the extensive floodplains in southern Cambodia and the Mekong Delta, as well as the Tonle Sap system, are reached. The migration patterns for most species in this survey appear to be an adaptation to these environmental circumstances.

4) Effects of hydrological factors.

According to most reports from fishers throughout the whole river stretch, the main trigger of fish migrations is changes in water levels (or related factors such as rain, turbidity and water colour). As a consequence, the main periods for migratory activities are when the water level begins to rise at the onset of the flood season, and again when the water level begins to recede at the onset of the dry season, respectively (see fig ??). This confirms, that riverine fishes in floodplain rivers are adapted to the hydrological regime of the river.

Figure ??. Total reports on upstream and downstream migrations for all surveyed species (— = start of downstream migration, — = end of downstream migrations, — = start of upstream migration, — = end of upstream migration).



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This report is based on ecological information provided by the following expert fishers of the Mekong. Without their willing and enthusiastic cooperation, this study would not have been possible. The authors hereby express their gratitude to all these local experts of the Mekong

Fisher Name	CountryID	Province	District
La Van Thanh	VNM	Tra Vinh	Cau Ke
Le Van Liem	VNM	Tra Vinh	Cau Ke
Phan Hieu	VNM	Tra Vinh	Cau Ke
Phan Hung	VNM	Tra Vinh	Cau Ke
Tu Be	VNM	Vinh Long	Long ho
Yu Thin	CAM	Kra Tie	Sam Bor
Ke Kuch	CAM	Kra Tie	Sam Bor
Bao Pounn	CAM	Kra Tie	Sam Bor
Um Ket	CAM	Kra Tie	Sam Bor
Tea Tob	CAM	Kra Tie	Sam Bor
Muoi	VNM	Tien giang	Go cong tay
Minn	VNM	Tien giang	Go cong tay
Ket chrel	CAM	Kra Tie	Sam Bor
Ki Hing	CAM	Kra Tie	Sam Bor
Lim Soonon	CAM	Kra Tie	Sam Bor
Chan Thi	CAM	Kra Tie	Sam Bor
Than Hoeung	CAM	Kratie	Samoor
Chan Kim	CAM	Kratie	Samoor
Moung Pourek	CAM	Kratie	Samoor
Set Tun	CAM	Kratie	Samoor
Pou Thoeun	CAM	Kratie	Samboor
Phen Try	CAM	Kratie	Samoor
Mr. Theuang	LAO	BORIKHAMXAY	Paksann
Mr. Ounn	LAO	BORIKHAMXAY	Paksann
Mr. Pia	LAO	BORIKHAMXAY	Paksann
Mr. Kao	LAO	BORIKHAMXAY	Paksann
Pham Van Tu	VNM	Can Tho	Thot not
Le Van Duc	VNM	Can Tho	Thot not
Mr. Kham phy	LAO	KHAMMOUANH	Thakhek
Mr. Xay	LAO	KHAMMOUANH	Thakhek
Mr. Soun sa hatt	LAO	KHAMMOUANH	Thakhek
Mr. Soun On	LAO	KHAMMOUANH	Thakhek
Nguyen Huu Phuoc	VNM	Dong Thap	Tam nong
Phung Van Hung	VNM	Dong Thap	Tam nong
Phung Van Thao	VNM	Dong Thap	Tam nong
Ann Minh	VNM	Tien giang	Cai be
Kev Rum	CAM	Stung Treng	Siem Bok
Prum Yoeung	CAM	Stung Treng	Siem Bok
Chau Sary	CAM	Stung Treng	Siem Bok
Sao Un	CAM	Stung Treng	Siem Bok
Khnoun Samorn	CAM	Stung Treng	Siem Bok
To Van Bay	VNM	Tra Vinn	Cau Ke
To Van Chieu	VNM	Tra Vinh	Cau Ke
Nguyen Van Hung	VNM	Tra Vinn	Cau Ke
To Van Vui	VNM	Tra Vinn	Cau Ke
Le Phat Tan	VNM	Can Tho	Can Tho
Le Long Ho	VNM	Can Tho	Can Tho
Dang Thanh Phuong	VNM	Can Tho	Can Tho
Nguyen Van Muoi	VNM	Can Tho	Can Tho
Nguyen Van Tu	VNM	Can Tho	Can Tho
Nguyen Van Tong	VNM	Can Tho	Can Tho
Lu Van Sau	VNM	Can Tho	Can Tho
Mr Mi	LAO	Xayaoury	Pak Lay
Mr Lien	LAO	Xayaoury	Pak Lay
Mr.Bounma	LAO	Xayaoury	Pak Lay
Mr Thai	LAO	Xayaoury	Pak Lay
Man Sol	CAM	Kra tie	Chloung
Sus Sray	CAM	Kra tie	Chloung
Sus Phay	CAM	Kra tie	Chloung
Li Phut Teat	CAM	Kra tie	Chloung
Pat Srey Man	CAM	Kra tie	Chloung
Minn	VNM	Tien giang	Go cong tay
Cuong	VNM	Tien gang	Chau thanh
Ngo Van Hoang	VNM	Dong Thap	Tam Nong
Nguyen ut Nho	VNM	Dong Thap	Tam Nong
Bui Quoc Thann	VNM	Dong Thap	Tam Nong
Nguyen Van Bao	VNM	Dong Thap	Tam Nong
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Mr. Sy	LAO	BORIKHAMXAY	Paksann
Mr. Xay sa na	LAO	BORIKHAMXAY	Paksann
Tu Out	VNM	Dong Thap	Cao lanh
Sang Kean	CAM	Stung Treng	Thalaborrwat
Yin Van	CAM	Stung Treng	Thalaborrwat
Khen Ech	CAM	Stung Treng	Thalaborrwat
Bun Rin	CAM	Stung Treng	Thalaborrwat
Van Than	CAM	Stung Treng	Thalaborrwat
Van Seurn	CAM	Stung Treng	Thalaborrwat
Sun Chon	CAM	Stung Treng	Thalaborrwat
La Van Nha	VNM	Tra Vinn	Tieu Can
Pham Hoaang Son	VNM	Tra Vinn	Tieu Can
Le Van Ut	VNM	Tra Vinn	Tieu Can
Pham Hoang Tan	VNM	Tra Vinn	Tieu Can

Fisher Name	CountryID	Province	District
Nguyen Jang Hai	CAM	Kra tie	Chloung
Nguyen Jang Vang	CAM	Kra tie	Chloung
Chov Jang Dai	CAM	Kra tie	Chloung
Le Jum Jon	CAM	Kratie	Prek Pra Soup
Nguyen Vien Kao	CAM	Kratie	Prek Pra Soup
Ng Jang Jeng	CAM	Kratie	Prek Pra Soup
Lim Vang Nguoi	CAM	Kratie	Prek Pra Soup
Doan Van Soc	VNM	Can Tho	Can Tho
Nguyen Van Truc	VNM	Can Tho	Can Tho
Nguyen Khac Oinn	VNM	Can Tho	Can Tho
Pramot Nualsuk (Mr.)	THA	Nongkhay	Sungkom
Manit Lukleam ZMr.)	THA	Nongkhay	Sungkom
Prasit Tunkao (Mr.)	THA	Nongkhay	Sungkom
Non-existent	THA	Nongkhay	Sungkom
Thao Kham Chai,Thao On	LAO	Champassak	Khong
Thao boune	LAO	Champassak	Khong
Thao Thong Dam	LAO	Champassak	Khong
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Son (Mr.)	THA	Mukdaharn	Muang-Mukdaharn
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Pham Ngoc Hai	VNM	Tra Vinh	Tieu Can
Le Thann Tai	VNM	Tra Vinh	Tieu Can
Nguyen Van Chau	VNM	Tra Vinh	Tieu Can
Pham Ngoc Chiem	VNM	Tra Vinh	Tieu Can
Mr. Kham bao	LAO	KHAMMOUAN	Thakhek
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Mr. Loung sing	LAO	KHAMMOUAN	Thakhek
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Nguyen Van Son	VNM	Dong Thap	Tam nong
Ly Quoc Tuan	VNM	Dong Thap	Tam nong
Le Van Truong	VNM	Dong Thap	Tam nong
Nu Pa-yom	THA	Nakornpanom	Tad-panom
Sompeed Son-buthara	THA	Nakornpanom	Tad-panom
Sa Ya	CAM	Kompong Cham	Sray Son Thor
Mat Sa Les	CAM	Kompong Cham	Sray Son Thor
Phum Ly	CAM	Kompong Cham	Sray Son Thor
Koo Sun	CAM	Kompong Cham	Sray Son Thor
Le Jun Pra	CAM	Kratie	Prek Pra Soup
Vien Jang Hang	CAM	Kratie	Prek Pra Soup
Nguyen Pguong	CAM	Kratie	Prek Pra Soup
Din Jan Chan	CAM	Kratie	Prek Pra Soup
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Mr. Lome	LAO	BORIKHAMXAY	Paksann
Mr. Phan sa na	LAO	BORIKHAMXAY	Paksann
Horm Hon	CAM	Suing Treng	Thalaborrwat
Ny Sim	CAM	Stung Treng	Thalaborrwat
Thach Va	CAM	Stung Treng	Thalaborrwat
Bin Pin	CAM	Stung Treng	Thalaborrwat
Sok Chhun	CAM	Stung Treng	Thalaborrwat
Yan Yongghen	THA	Chieng-rai	Chieng-kong
Chaiya Jinaratcha	THA	Chieng-rai	Chieng-kong
Somnuk Suwanprapa	THA	Chieng-rai	Chieng-kong
Pun Kudtiya	THA	Chieng-rai	Chieng-kong
Jun Yongghen	THA	Chieng-rai	Chieng-kong
Sor Jinaratcha	THA	Chieng-rai	Chieng-kong
Leub Sim	CAM	Kan Dal	Muk Kompul
Mean Yet	CAM	Kan Dal	Muk Kompul
San Dam	CAM	Stung Treng	Thalaborrwat
Kim Chhun	CAM	Stung Treng	Thalaborrwat
Nat Sai	CAM	Stung Treng	Thalaborrwat
Sok Savut	CAM	Stung Treng	Thalaborrwat
San Luon	CAM	Stung Treng	Thalaborrwat
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Mr.Chanta	LAO	Xayabury	Pak Lay
Mr.Xiengsomboun	LAO	Xayabury	Pak Lay
Mr.La	LAO	Xayabury	Pak Lay
Kung Vuthy	CAM	Stung Treng	Thalaborrwat
Yung Yoeung	CAM	Stung Treng	Thalaborrwat
Prom Sary	CAM	Stung Treng	Thalaborrwat
Than Sorn	CAM	Stung Treng	Thalaborrwat
Hai xe	VNM	Tien giang	Cai be
Somghot Panmen	THA	Uboiratchathani	Klong-keam
Somsamai Jula	THA	Uboiratchathani	Klong-keam
Loi Punkpa	THA	Uboiratchathani	Klong-keam
Unspecified	THA	Uboiratchathani	Klong-keam
Mr.Somphone	LAO	Xayaboury	Pak Lay
Mr.Khamla	LAO	Xayaboury	Pak Lay
Mr.Uane	LAO	Xayaboury	Pak Lay
Mr.Sivai	LAO	Xayaboury	Pak Lay
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Ouk Meit	CAM	Stung Treng	Stung Treng
Ket Chhem	CAM	Stung Treng	Stung Treng
Sroun Buntheng	CAM	Stung Treng	Stung Treng
Trinh van Em	VNM	Dong thap	Cao lanh
Do Van Moc	VNM	Dong thap	Cao lanh
Yui Loeuk	CAM	Kan Dal	Muk Kompul
Seng Lay	CAM	Kan Dal	Muk Kompul
Dang Yangwa	CAM	Kan Dal	Muk Kompul
Chea At	CAM	Kan Dal	Muk Kompul
Teaw Lawrean	THA	Ubolratchathani	Kemmaratch
Bua Sudta	THA	Ubolratchathani	Kemmaratch
Hai Mot	VNM	Tien giang	Chau thann
Ba Sai	VNM	Tien giang	Chau thann
Trinh Dac Minh	VNM	Dong Thap	Tam Nong
Bui Thi No	VNM	Dong Thao	Tam Nong
Pham Van Cau	VNM	Dong Thao	Tam Nong
Meas Rorn	CAM	Kra Tie	Sam Bor
An Yu	CAM	Kra Tie	Sam Bor
An Seng	CAM	Kra Tie	Sam Bor
Chin	CAM	Kra Tie	Sam Bor
Um Chek	CAM	Kra Tie	Sam Bor
Bo Sokna	CAM	Kra Tie	Sam Bor
Bin Koy	CAM	Stung Treng	Stung Treng
Tom La	CAM	Stung Treng	Stung Treng
Phu Maoo	CAM	Stung Treng	Stung Treng
Sem Sakhon	CAM	Stung Treng	Stung Treng
Nam Nhieu	VNM	Dong Thap	Cao lanh
Koy Thann	CAM	Kra Tie	Sam Bor
Chan Thi	CAM	Kra Tie	Sam Bor
Te Kibun	CAM	Kra Tie	Sam Bor
Nguyen Dankay	CAM	Kra Tie	Sam Bor
Ly Tong	CAM	Kra Tie	Sam Bor
Anh Giup	VNM	Tien Giang	Cai lay
Ann Tu	VNM	Tien Giang	Cai lay
Ann Ba	VNM	Tra Vinn	Cau Ke
Chu Tam	VNM	Tra Vinn	Cau Ke
Chu Tu	VNM	Tra Vinn	Cau Ke
Ann Tu	VNM	Tra Vinn	Cau Ke
Mr.Thong	LAO	Xayaoury	Xayaoury
Mr.Leck	LAO	Xayaoury	Xayaoury
Mr.Mei	LAO	Xayaoury	Xayaoury
Mr.Lod	LAO	Xayaoury	Xayaoury
Ho Thann Hong	VNM	Tien Giang	Cai lay
Ho Thann Hung	VNM	Tien Giang	Cai lay
Nguyen Van Dung	VNM	Tra Vinn	Cau Ke
Sau Do	VNM	Tra Vinn	Cau Ke
Quy	VNM	Dong thao	Hong ngu
Lo	VNM	Dong thao	Hong ngu
Hong	VNM	Dong thao	Hong ngu
Hoa	VNM	Dong thao	Hong ngu
Hok Khun Neng	CAM	Kratie	Samoor
Lorn Ma Ra	CAM	Kratie	Samoor
Chheang Chham	CAM	Kratie	Samoor
Sek Tek	CAM	Kratie	Samoor
Phan Van Be	VNM	Can Tho	Thot not
Phan Van Long	VNM	Can Tho	Thot not
Cuong	VNM	Dong thao	Cao Lann
Mr.Thidonann	LAO	Xayaoury	Xayaoury
Mr.Bounnorng	LAO	Xayaoury	Xayaoury
Mr.Xiengleck	LAO	Xayaoury	Xayaoury
Mr.Xiengmann	LAO	Xayaoury	Xayaoury
Lam van bau	VNM	Dong thao	Tam nong
Kumoang Pangkong	THA	Loei	Chieng-khan
Veerachai Juntamon	THA	Loei	Chieng-khan
Boonsonk Son-singh	THA	Loei	Chieng-khan
Tongbo Tongpao (Mr.)	THA	Mukdanarn	Wan-yai
Prasom Somsaiao (Mr.)	THA	Mukdanarn	Wan-yai
Hud Wanwong (Mr.)	THA	Mukdanarn	Wan-yai
Wan Wanwong (Mr.)	THA	Mukdanarn	Wan-yai
Prasom Somsaiao (Mr.)	THA	Mukdanarn	Wan-yai
Pravead Wanwong (Mr.)	THA	Mukdanarn	Wan-yai
Sen Ly	CAM	Kompong Cham	Kos So Tin
Sman No Ry	CAM	Kompong Cham	Kos So Tin
Nes Ly	CAM	Kompong Cham	Kos So Tin
Mat Kry Ya	CAM	Kompong Cham	Kos So Tin
El Bur Sa	CAM	Kompong Cham	Kos So Tin
Nguyen Van Can	VNM	Can Tho	Thot not
Pham Van Hao	VNM	Can Tho	Thot not
Nguyen Van Hoang	VNM	Can Tho	Thot not
Nguyen Jang Leong	CAM	Kra tie	Chioung

Author Ethnic Name	CountryID	Province	Dist/District
Mr. Leuane	LAO	SAVANNAKHET	Khanthaboury
Sman Eh Yes	CAM	kom pong cham	kruch chhma
Ly Hak	CAM	kom pong cham	kruch chhma
Mat Yes	CAM	kom pong cham	kruch chhma
Mat sary	CAM	kom pong cham	kruch chhma
Lam Van Ban	VNM	Dong Thap	Tam Nong
Lam Van Phe	VNM	Dong Thap	Tam Nong
Sau quan	VNM	Tien giang	My tho Town
Nguyen van bao	VNM	Dong thap	Tam nong
Widdayakorn Willaipol	THA	Chieng-rai	Chieng-san
Somnuk Tongsawat	THA	Chieng-rai	Chieng-san
Virat Yotawod	THA	Chieng-rai	Chieng-san
Dang Cheajedton	THA	Chieng-rai	Chieng-san
Bac Tu Hau	VNM	Tien giang	Go cong tay
Chu Ba	VNM	Tien giang	Go cong tay
Hur Juk	CAM	kom pong cham	kruch chhma
Nguyen vanha	CAM	kom pong cham	kruch chhma
Meng jang phian	CAM	kom pong cham	kruch chhma
Jen sok tuon	CAM	kom pong cham	kruch chhma
Mr. Sa Nga	LAO	KHAMMOUAN	Thakhek
Mr. Bounh chann	LAO	KHAMMOUAN	Thakhek
Mr. Pho sy	LAO	KHAMMOUAN	Thakhek
Mr. Bounn lieng	LAO	KHAMMOUAN	Thakhek
Ek Sokport	CAM	Stung Treng	Thalaborriwat
Kao Chhem	CAM	Stung Treng	Thalaborriwat
Ek Ly	CAM	Stung Treng	Thalaborriwat
Nhech Koy	CAM	Stung Treng	Thalaborriwat
Mao Khim	CAM	Stung Treng	Thalaborriwat
Khuon Hen	CAM	Stung Treng	Thalaborriwat
Le Van Chu	VNM	Tra Vinh	Tieu Can
Nguyen Van Tu	VNM	Tra Vinh	Tieu Can
Nguyen Van Thoai	VNM	Tra Vinh	Tieu Can
Le Van Chan	VNM	Tra Vinh	Tieu Can
Wang Simma	THA	Nakornpanom	Tad-panom
Renu Ghot-ti-punya	THA	Nakornpanom	Tad-panom
Niyom Juntanid	THA	Nakornpanom	Tad-panom
Nguyen Van Ro	VNM	Dong Thap	Tam nong
Nguyen Van Nhat	VNM	Dong Thap	Tam nong
Chieu Van Mai	VNM	Tra vinh	Tieu can
Chieu Van Liem	VNM	Tra vinh	Tieu can
Tran Van Quang	VNM	Tra vinh	Tieu can
Nguyen Van Tam	VNM	Tra vinh	Tieu can
Nguyen Hung Em	VNM	Can tho	Thot not
Nguyen Thann Hung	VNM	Can tho	Thot not
Mat Sa les	CAM	Kompong Cham	Kos So Tin
Moi Mo Sa	CAM	Kompong Cham	Kos So Tin
Sang Hum	CAM	Kompong Cham	Kos So Tin
Sman Phlue	CAM	Kompong Cham	Kos So Tin
Sompong Chaiwanna	THA	Chieng-rai	Chieng-kong
Sompieng Puntong	THA	Chieng-rai	Chieng-kong
Somsak Pratoomma	THA	Chieng-rai	Chieng-kong
Somsak Pratoomma	THA	Chieng-rai	Chieng-kong
Nhoeuk Sam Ol	CAM	Stung Treng	Siem Bok
Mung Hut	CAM	Stung Treng	Siem Bok
Mo Sary	CAM	Stung Treng	Siem Bok
Suoi Sorn	CAM	Stung Treng	Siem Bok
Hing Chhorn	CAM	Stung Treng	Siem Bok
Mr. Thong khay	LAO	BORIKHAMXAY	Paksann
Mr. Thoong	LAO	BORIKHAMXAY	Paksann
Mr. Kham peuang	LAO	BORIKHAMXAY	Paksann
Mr. Boun aou	LAO	BORIKHAMXAY	Paksann
Somghot kod-chamung (Mr.)	THA	Mukdanarn	Muang-Mukdanarn
Chaichana Kod-chamung (Mr.)	THA	Mukdanarn	Muang-Mukdanarn
Lummol Kod-chamung (Mr.)	THA	Mukdanarn	Muang-Mukdanarn
Choo Son-sieng	THA	Loei	Chieng-khan
Thao Bounthiene	LAO	Xayaboury	Xayaboury
Thao Gnot	LAO	Xayaboury	Xayaboury
Thao Mi	LAO	Xayaboury	Xayaboury
Thao Xieng La	LAO	Xayaboury	Xayaboury
Nhien	VNM	Dong thap	Hong ngu
Tay	VNM	Dong thap	Hong ngu
Nhi	VNM	Dong thap	Hong ngu
Hen	VNM	Dong thao	Hong ngu
Phan Yan	CAM	Stung Treng	Siem Bok
Kat Sovat	CAM	Stung Treng	Siem Bok
Phan Vuthy	CAM	Stung Treng	Siem Bok
Tha Bunvy	CAM	Stung Treng	Siem Bok
Sean Hean	CAM	Stung Treng	Siem Bok
Le Yung Va	CAM	Komoong Cham	Sray Son Thor
Gh Yung Meng	CAM	Kompong Cham	Sray Son Thor
Lum Kim Vang	CAM	Kompong Cham	Sray Son Thor
Se San	CAM	Kompong Cham	Sray Son Thor