

Local Knowledge in the Study of River Fish Biology: Experiences from the Mekong



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Mekong River Commission

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FOREWORD

The Lower Mekong Basin, covering major areas of Cambodia, Laos, Thailand and Vietnam, is a region of dynamic change and growth.

Reports in the *Mekong Development Series* closely examine aspects of change and development in the river basin for an audience of researchers, planners, community development workers and the interested public.

Sustainable management of water and related resources is at the heart of the Mekong River Commission's work. This report, therefore, is a fitting start to the *Mekong Development Series*, as it presents research undertaken within the Mekong River Commission's Fisheries Programme, which has the objective of "coordinated and sustainable management, use and development of the economic and nutritional potential of the inland living aquatic resources in the Mekong River Basin".

The Fisheries Programme has greatly increased our knowledge of fish resources - the huge number of species, their impressive seasonal migrations, the importance of habitats for breeding, feeding and dry season shelter and their inter-dependence with the vast Mekong floodplains as well as developing fisheries management systems to ensure the availability of this resource for future generations.

Ultimately it is this knowledge and appreciation of the natural wealth of the Mekong River Basin that will drive all efforts to sustain the health of the basin for the good of all people. The *Mekong Development Series* aims to disseminate that knowledge and appreciation as widely as possible.

Joern Kristensen, CEO
Mekong River Commission

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SUMMARY

Since 1997 the Fisheries Programme of the Mekong River Commission has been accessing local knowledge in the Lower Mekong Basin. The objective of the study is to provide life-cycle information about important Mekong fish species, particularly in relation to migration and spawning. This has been achieved by interviewing local fishers and knowledgeable 'experts' as well as fish sellers in markets.

Migration is an essential stage of the life cycle of most fish species and many will travel great distances in a quest to reach feeding and spawning sites. It is a process that ensures their survival and ecologically connects different parts of the river, which in this respect functions as a whole.

In a tropical river such as the Mekong, the ebb and flow of the seasonal flood largely governs migratory behaviour. Through a series of inter-related events and adaptations young fish are able to reach the fertile environment of the flood plain.

The study highlighted the critical nature of habitat and flood patterns to the propensity of fish species to migrate, spawn and find dry-season refuges. Changes in flood patterns or water quality, blockage of important migration channels and destruction of dry season refuges could all adversely affect fish stocks that are crucial to the health, nutrition and livelihoods of some of the poorest people in the Lower Basin countries.

Fish migrations therefore have many implications for regional development, planning and management. Important fish stocks are shared between countries and joint management strategies are needed to ensure appropriate development.

This migration and spawning study is the first of its kind to be carried out on a basin-wide scale. By comparing results generated from 51 stations along the Mekong mainstream it was possible to construct migration maps for important fish species in greater detail than ever before. An example of just one of these maps is presented in the following report. Essential habitats and spawning sites have also been identified and their use and inter-relationship with seasonal flow of water established and discussed. For some species the relationship between migration and physical events such as moon phase and water levels has also emerged along with previously unknown facts about endangered species such as the Mekong giant catfish (*Pangasianodon gigas*).

The study has demonstrated that by accessing local knowledge it is possible to obtain vital information that could not have been revealed using conventional biological techniques. Although indigenous knowledge on its own is not expected to provide all the answers, the study has affirmed its value as being able to provide a coherent basis for basin-wide planning and development strategies. The study has also created a whole collaborative network between fishers, government officials and technical staff on a scale unprecedented in the Mekong region.

Further steps to be taken should include the following:

- New knowledge of species-specific migration runs generated through the study should be used to design specific interventions to ameliorate the impacts of changes in land and water use in the Basin.

- The network of fishers, and the close collaboration between fishermen and fisheries officials in the four countries, should be built on with a view towards establishing effective transboundary co-management schemes.
- The monitoring role undertaken by fishers in this study should be maintained as an ongoing capacity to assess changes in fish movements and quantity.

Chapter 1

INTRODUCTION

The Mekong River and its Fish

The Mekong is the largest river in South-East Asia and the twelfth largest in the world. From its source in the Tibetan Himalayas it flows through six countries China, Myanmar, Thailand, the Lao People's Democratic Republic (Lao PDR) and Cambodia and covers a distance of more than 4,400 kilometres before reaching the South China Sea.¹ The river basin covers an area of nearly 800,000 square kilometres and enters its lower reaches at the border-point between China, Lao PDR and Myanmar, some 2,380 kilometres from the sea. This point also marks the entry of the river into the boundary of the Mekong River Commission (MRC), an organisation set up in 1995 to promote and co-ordinate the sustainable management and equitable development of water and related resources for the mutual benefit of all countries and peoples involved.

An estimated 1,700 species of fish are believed to inhabit the waters of the Mekong,² including the endangered Mekong giant catfish (*Pangasianodon gigas*). Another endangered Mekong species, though not a fish, is the freshwater Irrawaddy dolphin (*Orcaella brevirostris*).³

Apart from its sheer diversity, the Mekong supports one of the largest inland fisheries in the world. The total annual catch of the lower areas (Cambodia, Lao PDR, Thailand and Vietnam) alone is conservatively estimated at 1.6 to 1.8 million metric tons.⁴ This translates into a retail value of approximately 1.4 billion US dollars, though the true value of the basin to the local population is much more difficult to measure.

Most of the current knowledge of tropical flood plain river fish biology is based on research carried out in South America and Africa.⁵ Ecological details of the Mekong and even of its most significant fish species remain fragmentary. Studies of fish migrations in rivers have traditionally focused on a limited number of species in selected areas using conventional biological methods such as tagging and sampling.⁶ These methods are prohibitively expensive, time-consuming and logistically difficult to perform. They involve a complicated process of capturing and tagging live fish, then releasing them back into the water to be recaptured at a later time and place. Fishers are expected to return the tags by post or through the local fisheries office and to provide an accurate description of place and time of capture. In a huge and ecologically diverse river such as the Mekong, this is an enormously difficult task to perform. With few exceptions these techniques have provided only limited information on the life cycles of the studied target species and no standard method exists for basin-wide, multi-species studies in major river systems.⁷

However, an immense store of knowledge and experience already exists and has been passed on through the generations of people who have inhabited the Mekong basin for centuries. The value of this

¹ Pantalu, 1986.

² Rainboth, 2001. Pers. comm.

³ Both are included on the IUCN Red List of Endangered Species.

⁴ Jensen, 2001.

⁵ see Welcomme, 1979; 1985; & Lowe McConnell, 1987 for example.

⁶ Bayley, 1973; Quiros & Vidal, 1998.

⁷ Welcomme, 1985; Barthem & Goulding, 1997.

human archive as a resource in scientific research has long been recognised. Local knowledge is now increasingly being recognised and used in compiling detailed ecological information and developing and implementing management strategies.⁸ This change is partly due to increased recognition of indigenous people's rights, and a general realisation of the limits of conventional centralised management strategies and data collection techniques.

Traditional Milk of the Mekong Basin

Most people of the Mekong Basin depend directly or indirectly on fishing for food and as a supplement to the family income. Every accessible river, lake, pond, dike, flooded forest, ditch and paddy field is exploited to the full. Aquatic plants and vegetables and creatures such as shellfish, frogs and snakes are also harvested as these are important in the diet as well as for traditional medical purposes.

Fish is a major source of the daily protein intake in the diet - over 80 per cent in Cambodia.¹ Smaller fish, which may be of little commercial value, provide dietary calcium as their soft bones are chewed and eaten.

Evidence of fishing as a key livelihood activity through the centuries is preserved in ancient bas-reliefs in the temples of the region.

¹*Ojendal & Torrell, 1997*

Fish Migrations and Their Implications

Fish migrations are an important feature of river ecology in most major tropical rivers. Often, fish migrate several hundred kilometres in order to reach spawning sites or feeding grounds.⁹ In extreme cases such migrations can cover distances of several thousand kilometers.¹⁰

Long-distance migrations within main river channels and tributaries are normally referred to as 'longitudinal' whilst those from the main river and tributaries into flood plain areas during the flood season and back again during the dry season are referred to as 'lateral'. Another important type of fish movement in rivers is the downstream passive movement by fish larvae known as 'larval drift'. During the flood season, larvae of some species may drift several hundred kilometres from upstream spawning to downstream nursery areas in the flood plain. All the different movements are integrated components of the life cycle strategies for riverine fish. Many species at different times and life stages undertake all the above movements. Lateral migrations from flood plains back to the river are often followed by longitudinal migrations within the main river channel.

Essentially these migrations are adaptations to life in running water. Within each river system fish have adapted to the associated hydrological conditions. For example, in a tropical flood plain river like the Mekong, the life cycles of many fish species are adapted to ensure that newly hatched fish larvae and juveniles are brought into the highly productive flood plain areas at the onset of the season.

⁸ Price, 1995; Hoggarth *et al*, 1999.

⁹ Bayley, 1973.

¹⁰ Barthem & Golding, 1997.

The life cycles of migrating fish ecologically connect different areas and habitats of rivers. Although rivers and their associated flood plains encompass a wide range of different habitat types, they are all ecologically linked in a complex fish migration network. From the point of view of migratory fish species, the river basin functions as a unit.

Fish migrations have great implications for regional development planning and management. Many important fish stocks are shared between the riparian countries and therefore call for regional management strategies.

In the Mekong, many fisheries are largely based on the capture of migrating fish. Good examples are the bagnet (*dai*) fisheries of Cambodia¹¹ and the Khone Falls fishery, one of the most important in Lao PDR.¹² Even the larval drift is exploited as millions of iridescent shark-catfish (*Pangasianodon hypophthalmus*) larvae are caught each year and stocked in ponds and cages in the Mekong delta in Vietnam.

River of Bounty

A remarkable natural phenomena that occurs on an annual basis makes the Tonle Sap Lake in Cambodia one of the richest sources of freshwater fish in the world. The Tonle Sap River connects the Tonle Sap or Great Lake to the Mekong. During the rainy season the force of floodwater in the Mekong causes the flow of the Tonle Sap River to reverse for about three months of the year, pushing water upstream into the lake. Young fish are swept in with the water and thrive in the flooded plains. When the water level drops in the Mekong during the dry season (October - May), the flow reverses once more and the fish migrate back to their refuges upstream as the water of the lake also recedes.

Local people make the most of this mass migration and are ready with their nets. Huge quantities of fish are caught in bagnet or dai fisheries along the Tonle Sap River to be consumed mainly locally. When migration is at its peak (the few days prior to the full moon in the period December to February) the bags are emptied every 15 to 20 minutes. Each bag may hold up to 500 kilograms of fish, though on days when few fish are migrating the frequency of lifting is much less.

Much of the catch consists of the small species known in Cambodia as trey riel (from which the Cambodian unit of currency gets its name). Trey riel is used to produce fish paste (prahoc), fermented fish (phaok) sweet fish (mam), smoked fish and fish sauce.

Nothing is wasted as surplus fish are dried for pig feed or fertiliser. The reversal of the river's flow is regarded as one of the most important events of the year and is celebrated enthusiastically during the 'Water Festival' with boat races featuring as the main event.

¹¹ Liang *et al*, 1995.

¹² Singanoubong *et al.*, 1996a;1996b; Baird, 1998.

Chapter 2

METHODOLOGY

Fish Migrations and Spawning - How the Survey Accessed Local Knowledge

Since 1997, the Mekong River Commission has been accessing local knowledge of fish migration and spawning in the lower Mekong basin. The aim of this ongoing study is to build a profile and establish a baseline set of data on the life cycles, habitats and behaviour particularly in relation to migration and spawning of important fish species throughout the basin. This is the first study of its kind to be carried out on such a large scale. The information it generates will form the foundations for further research and promote understanding of this complex ecosystem.

The fish migration and spawning survey was carried out amongst local fishers of the Mekong river basin between February and July 1999 using a methodology developed, field-tested and refined by the Mekong River Commission.¹³ The results demonstrate the quality, scope, value and application of local knowledge as a research and management tool.

Fifty-one sites were selected to include a range of habitats and ecological features based on maps, pre-survey excursions into the region, a review of the scientific literature, and the advice of experienced local department of fisheries staff.

The fishers interviewed were all males between 15 and 80 years of age (majority 31 to 45 years) with two to 50 years fishing experience (majority 11 to 30 years). The most widely used fishing equipment included stationary and drifting gillnets, castnets, longlines and traps. In all, 20 different types of equipment were identified.

A team of two experienced fisheries scientists¹⁴ was selected in each country to carry out the interviews. These teams attended workshops and training sessions before, during and after the interviews to analyse preliminary data, discuss problems and progress and modify the methods accordingly.

Fishing Ingenuity

Enormous ingenuity has been demonstrated in the design and construction of fishing equipment in the Mekong River Basin. Local fishers apply their knowledge and experience of fish behaviour and characteristics to the invention of new gear designed specifically to target certain species.

The Department of Fisheries in Cambodia has catalogued 180 different types of fishing gear. This number reflects the sheer diversity of fish species and the variety of behavioural patterns. The fishery is so closely adapted to the local situation that it is extremely unlikely that a species inhabiting the area or passing by on a regular basis can avoid being caught by somebody.

¹³ Valbo-Jorgensen *et al*, 1998. This method is described in detail in the Survey Manual, Poulsen & Valbo-Jorgensen, 1999.

¹⁴ Interviews were carried out by staff from the following counterpart institutions: Research Institute for Aquaculture No. 2, Ho Chi Minh City, Vietnam, Department of Fisheries, Thailand; Department of Livestock and Fisheries, Vientiane, Lao PDR; and the Department of Fisheries, Phnom Penh.

Whilst one interviewer concentrated on taking a written account of discussions, the other focused on generating a response using a pre-designed survey format. Data sheets were used to facilitate data entry but rigid questionnaires were deliberately avoided as previous research has shown that interviews are more productive if a less formal and more conversational and interactive approach is used.¹⁵ This demanded substantial skill on the part of the interviewer as well as enthusiasm and a sound knowledge of the subject under investigation. Emphasis was placed on maintaining the same survey team throughout the survey as interview techniques improved noticeably with time and practice.

One hundred and twenty groups of fishers were interviewed in total. The purpose of these group interviews was to obtain as much detailed information as possible about fisheries and fish habitats in the study area. Fishers were asked to draw a map of their habitual fishing ground. They were also asked to supply information on equipment used and on river width, depth, riverbed conditions, vegetation and seasonal changes. A list of the fish species occurring at the fishing ground was then compiled by asking the fisher groups to look through a flip chart of photographs of 174 species, confirm their presence or absence and identify them by their local names. Life-sized cut-outs were also used to obtain information about fish size. These group interviews acted as an indicator of the level of knowledge amongst the group and made it possible for the interview team to select the most knowledgeable or 'expert' fishers¹⁶ for further interview.

A total of 355 'experts' were selected from the groups and interviewed individually. During these interviews, detailed species-specific ecological information was obtained for 50 of the 174 species included in the flip chart. Representative species were selected on the basis of their relative ecological, economical and cultural importance and their biodiversity. Consideration was also given to endangered species. Each species was discussed individually to avoid confusion. Fishers were asked, among other things, the time of year the fish is normally present, whether there tends to be a peak in abundance and, if so, the length of the peak. They were also asked whether any spawning activity had been observed and, if so, to draw a map of the spawning ground. Many fishers were able to provide information about the period when the fish were carrying eggs.

Validation Process

A number of procedures were built into the survey to ensure the quality of the information supplied. Fishers were asked to provide specimens where possible and local fish markets were always visited to confirm the presence and abundance of species. Fish sellers often proved most capable of identifying species and were also able to provide exact local names of fish and say when certain fish have eggs in the abdomen. However, they are naturally keen to get as high a price as possible for their fish and therefore information relating to this source is potentially less reliable.

Data Analysis

Qualitative and quantitative data was stored in a tailor-made Microsoft Access '97 database.¹⁷ This allowed a query-based analysis of the data. Species by species analysis was carried out for the entire basin or for an entire ecological reach and a broad picture began to emerge. Much of the 'additional

¹⁵ Johannes *et al*, 2000.

¹⁶ For the purpose of this study an 'expert' fisher is considered to be anyone who is knowledgeable about one or more species of fish in a particular area though not necessarily a person who fishes on a full-time, professional basis.

¹⁷ Visser, 1999.

information' gathered on the data sheets turned out to be the most interesting when the data was analysed. For example, during the design stage, nobody thought to include specific questions about deep pools as a potential refuge for fish. However, these emerged as an extremely important dry season habitat for many different species including the endangered seven line barb (*Probarbus jullieni*).¹⁸

Additional points of note

Local knowledge

As previously stated, many species of fish are known to travel great distances during their lifetimes. However, local fishers can only be expected to know about the fish that inhabit or pass through the areas where they habitually fish. It was important to take this into account when designing the survey.

Interviewees

People were generally more than willing to supply information. However, it is important to be selective. Substantial effort was made to identify the most knowledgeable fishers to ensure the quality of the data. The researchers believed that those who were prepared to provide information free of charge were genuinely interested in the survey and therefore highly motivated and more likely to give an accurate response. It was felt that promises of individual reward would attract less knowledgeable people and might lead fishers to exaggerate their responses. In fact the identified experts were often treated with pride by villagers and also took personal pride in giving correct information. No individual reward was offered, but fishers were treated to a collective meal once all interviews had been completed in the area.

Interviewers

Department of Fisheries officers were selected to carry out the interviews. However, because these are the people most commonly responsible for collecting fees and taxes and enforcing fishing law in the Mekong countries there is a certain degree of mistrust on both sides. It was therefore necessary to reassure interviewees that the information they supplied would not be used against them. Questions relating to sensitive issues such as income were not included.

Language

Ideally, interviews should be carried out in the fishers' native language with no translation. However, the Mekong region is home to such a diversity of ethnic groups and languages that this was not always possible.

Local names of fish species were found to be highly variable even amongst those interviewees who spoke the same language. In an extreme example, fishers from three Laotian villages located just a few kilometres apart used three different names for the same species of fish. In addition, local names were often given to species groups rather than individual species, though if asked, a supplementary name was frequently offered. In some cases several names were used for the same fish at different stages of its life cycle and fishers insisted that two different species were in fact the male and female of the same. This could understandably complicate biological studies that require taxonomic accuracy and it was for this reason that a set of photographs was used.

¹⁸ IUCN Red List of Endangered Animals.

Gender issues

Although it is common for women to be involved in the fisheries throughout the basin, the nature of their involvement varies between countries. In Lao PDR and Thailand, women tend to fish in rice fields, swamps and small streams close to the family home whilst men tend to fish further afield in larger rivers and along the mainstream. Similarly, women in Cambodia do not go to the commercial fishing lots. In contrast, women in Vietnam appear to fish in the same locations as men. The fish migration and spawning survey focused on the Mekong mainstream, a place where it is most common to find only male fishers at work. In addition, much of the survey work was carried out after dark at a time when women tended to be busy with household tasks. However, interviewees in markets were usually female, particularly in Cambodia. It would be prudent to actively include women in studies of areas where they commonly fish.¹⁹

Fish and luck

*Religion and superstition play an integral part of everyday life in the riparian countries and certain species of fish are considered sacred. In the Mekong, the giant catfish (*Pangasianodon gigas*) is considered holy, and is surrounded by myths and traditions. In Cambodia, it is thought to be bad luck to catch one. In Lao PDR, some people believe that the giant mottled eel (*Anguilla marmorata*) eats people, and they do not like to talk about it. It is also common that women and children disappear from the meeting as soon as the eel is mentioned.*

¹⁹ Valbo-Jorgensen, Pers. Comm., 2001.

Chapter 3

RESULTS & DISCUSSION

The survey of the Mekong mainstream generated a huge quantity of valuable data. By correlating the information obtained at each station it was possible to compose migration maps in greater detail than had previously been possible. For some species the relationship between migration and physical events such as moon phase and water levels have also emerged, along with information about reproduction and endangered or extinct species.

These results exist as evidence of the depth of local knowledge and of the effectiveness of semi-structured interviews. An example of just one of the migration maps is presented below followed by more general conclusions that can be drawn from the results of the study.

Migration of the Trey Riel

*The survey showed that trey riel (*Henicorhynchus siamensis*), the small cyprinid exploited by the dai fisheries on the Tonle Sap, is distributed along the entire stretch of river from the Mekong Delta all the way up to Chiang Khong near the border between Thailand, Lao PDR and Myanmar. The migration pattern of this species is shown in the figure below.*

All stations between Phnom Penh and the Khone Falls reported that this species migrates upstream during October and February. At Muk Kompul district, Kandal province it was reported to migrate just before full moon. A little further up at two stations near Kratie it was reported to migrate during full moon. Further still at Sambor it was reported to migrate immediately after full moon.

Some fishers who exploit this pattern by following the fish all the way up to Stung Treng reported that the species migrates at a rate of approximately seventeen kilometres per day.

Near the Khone Falls the pattern becomes less pronounced. Although upstream movement continues throughout March, these fish appear to start moving both up and downstream in April. From May to July at the onset of the rains, fish migrate downstream from the Khone Falls and this movement is reported at all stations down to the Mekong Delta.

On reaching the Mekong Delta, the species migrates out of the main channel into canals and flooded areas during August and September. This movement includes small young (young-of-the-year), as well as more mature fish measuring approximately 20 centimetres in length.

As the water begins to recede in November and December migration occurs once more back into the mainstream.

Migratory movement is also less well defined above the Khone Falls. From February to June the species continues to travel upstream near Ubolratchatani. Between February and March the shoals are seen to consist mainly of juveniles, but from April to June mainly of adults. Further upstream from Xayaboury to Chiang Khong juveniles appear and are closely followed by adults migrating from March to July.

Mature eggs were observed between April and July with a strong peak from May to June, coinciding with upstream migration. Most stations downstream from Savannakhet-Mukdahan also reported that spawning takes place in May/June.

At Sambor mature females were observed releasing eggs which then flowed downstream during May. At Chiang Khong fish were reported to migrate up into tributaries to spawn from May to July. At Loei spawning was reported to occur in July/August in a small pool in the slower current of the Loei River tributary.

Above and beyond Loei, spawning generally appears to occur over a longer period extending into August/September. Information obtained from fishers at stations between Savannakhet-Mukdahan and Loei points to the possible presence of two different populations or even two different species both above and below this stretch.

What was Learned about Fish Migration

Most Lower Mekong Basin fish species are adapted to high natural mortalities. They reach sexual maturity early, and lay a high number of eggs which develop rapidly. Nearly all species are much more sensitive to environmental changes than to over-fishing. This implies that for the fisheries to be sustained, it is more important to manage the environment than to manage the fisheries *per se*.

The study highlighted the critical links between flood patterns and habitat availability to the propensity of fishes to migrate, spawn and find dry-season refuges.

Dry season refuges

The Khone Falls in southern Lao PDR clearly emerge as an important dry season habitat within the Mekong river. Although not appearing to present a physical barrier for most of the described species, the migratory patterns of most differ significantly below and above the falls. Many species migrate upstream from the south up to the Khone falls in the dry season as well as downstream from the Khone falls during the onset of the floods. Conversely, above the Khone falls, many of the same species migrate at the same time in opposite directions. The timing of the migrations coincides with the main spawning periods for most species both below and above the falls.

Deep pools within the Mekong mainstream are known to be an important dry season refuge for fish. This study confirmed their importance and a list of 53 species reported to be using deep pools along with the number of reports per species is provided in the original survey report.

The area between Kratie and the Khone Falls appears to be an essential dry-season habitat for almost all the surveyed species. Numerous deep pools are known to be present within that particular stretch. Furthermore, the area contains rapids and flooded vegetation which may be exploited by fish. The survey confirmed that many of the important migratory species spend the dry season in deep pools within this stretch of the river.

Deep pools also play an important role as a dry season habitat further upstream. Most of the large migratory species within that stretch migrate from the Mekong up into its tributaries during the flood

season and return to deep pools in the mainstream at the beginning of the dry season. Many fishermen know exactly where these pools are and even, in some cases, their depth.

Flood plains

With few exceptions, the species covered in the survey depend on flooded areas at some stage of their life cycles and especially during the larval/juvenile stages. Many longitudinal migrations appear to be adaptations to ensure that offspring are eventually brought into the productive flooded areas where they can capitalise on the associated fertile environments. This is particularly apparent in southern Cambodia and the Mekong delta where the most fish species migrate during times of both rising and receding water levels. Such movement was also reported regularly further upstream.

Hydrological factors

Changes in water levels (or related factors such as rainfall, turbidity and water colour) act as a trigger to fish migration. For all species, the most important factor associated with both longitudinal and lateral migration was found to be a change in water level. Consequently, the main migratory period occurs when the water level begins to rise at the onset of the wet season and fall at the onset of the dry season. Furthermore, the peak spawning period for most species coincides with the start of rising water levels at the beginning of the wet season, with the exception of a few species that spawn in the dry season.

Spawning grounds

Many fishers were able to provide information about the periods when fish are carrying eggs and thus an indication of the spawning period. However, exact spawning grounds turned out to be much more difficult to identify than expected probably because the Mekong is very turbid particularly during the flood season when most species usually spawn. This could also explain why the spawning grounds that were reported were mainly for species spawning in shallow water on the flood plain.

What was Learned about Using Local Knowledge Effectively

Survey design

Local knowledge is by definition area-specific and fishers are not likely to have detailed knowledge about the species outside the area where they normally fish. This survey was designed so that each site acted as one piece in the puzzle and when all pieces were put together, migration patterns for the species emerged. Although a certain rigidity to the survey was important in order to compare results from station to station, it was equally important to allow room to include additional information. Often this section of the survey was the most interesting, as it contained information about all the things the researchers did not think of asking when the data sheets were designed. The information about deep pools was not considered specifically when designing the survey. However, the development of co-management systems for deep pool habitats may be a priority for future fisheries management in the Mekong Basin, and the survey provided an unexpected opportunity to map out important deep-pool areas and to indicate which species are using deep pool habitats.

Endangered species

One of the areas where local knowledge proved to be superior to any other methodology was in mapping the distribution of endangered species. Rare species are not likely to show up in any sampling study of limited duration. But fishers, who set their gear in the same place day after day, will almost certainly know whether a particular species is there or not, and can also provide historical information about species that have disappeared within their lifetime.

Representative species

The great diversity of fish species in the Mekong, their migratory nature, and the variations in local names used for them, makes it impossible to continuously monitor the status of all fish stocks. The only option for developing management strategies is to group the fishes according to their ecology, and develop specific strategies for each group. For management purposes, one or several indicator species should be identified in each group. The indicator species should be easy to monitor and a good representative of its group, thereby being able to provide information about the situation for the entire group. Information from local fishers will be critical to monitoring the status of such representative species.

Chapter 4

CONCLUSION & RECOMMENDATIONS

This study has demonstrated the value of local knowledge and the possibility of piecing it together in a coherent fashion even over such a wide area as the Lower Mekong Basin. It has yielded results that could not have been attained with more conventional biological techniques and provided detailed information on migration patterns, habitat use, flood plain and river spawning sites and their inter-relationship with seasonal flow. Such information is essential in the assessment of the ecological impact of development proposals and to the future management of the Mekong River Basin.

Although the use of local knowledge alone does not provide all the answers, it can reveal areas that need to be studied further, thus allowing scarce resources to be allocated judiciously.

The study has also developed a basis for bringing the fishers of the Basin into an ongoing management process. Further steps to be taken should include the following:

- New knowledge of species-specific migration runs generated through the study should be used to design specific interventions to ameliorate the impacts of changes in land and water use in the Basin.
- The network of fishers, and the close collaboration between fishermen and fisheries officials in the four countries, should be built on with a view of establishing effective transboundary co-management schemes.
- The monitoring role undertaken by fishers in this study should be maintained as an ongoing capacity to assess changes in fish movements and quantity.

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