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Biodiversity Assessment of the Mekong River in Northern Lao PDR: A Follow Up Study

October, 2004

WANI/REPORT - MWBP.L.W.2.10.05

Follow-Up Survey for Biodiversity Assessment of the Mekong River in Northern Lao PDR

Edited by Pierre Dubeau

October 2004

The World Conservation Union (IUCN), Water and Nature Initiative and Mekong Wetlands Biodiversity Conservation Programme

Report Citation: Author: ed. Dubeau, P. (October 2004) Follow-up Survey for Biodiversity Assessment of the Mekong River in Northern Lao PDR, IUCN Water and Nature Initiative and Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme, Bangkok.

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ACKNOWLEDGEMENTS

This report is based on collaboration between IUCN Water and Nature Initiative (WANI), the Mekong Wetland Biodiversity Conservation and Sustainable Use Programme[1] (MWBP) and a number of Lao government partners; the Environmental Research Institutes (ERI) from the Science, Technology and Environment Agency (STEA), the Living Aquatic Resources Research Centre (LARReC) and the Lao National Mekong Committee (LNMC).

The success of this scoping study is due to the commitment of a number of individuals. In particular Ms Monamany Noybouakhong, Director of Environmental Research Institute (ERI) who led in the formulation of this scoping study.

In addition, Mr Douangkham Singhanouvong from the Living Aquatic Resources Research Centre (LARReC) and Mr Singha Ounniyom Director of Water Resources Development Division, Lao National Mekong Committee Secretariat (LNMC) provided valuable logistical and technical support.

Special thanks to Mr Bounmy Souksavath from Waterways Administration, Ministry of Communication, Transportation, Post and Construction (MCTPC).

Ms Latsamay Sylavong Programme Manager IUCN Lao PDR and Kelsey Jack Programme Assistant IUCN Lao PDR also provided extensive support during the preparation and implementation of the scoping survey, and in the preparation of the final report.

Thanks are also due to the Captain of the boat, and to his family who worked as crew members for their assistance during the trip from Huay Xai to Luang Prabang.

[1] The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC).

EXECUTIVE SUMMARY

The Follow-up Scoping Survey presented in this report builds on the first rapid biodiversity scoping study of the upper stretches of the Mekong conducted in February 2003. It is intended that these surveys will form the basis for regular monitoring and assessment of the biodiversity of the riverine ecosystems, habitats and species in the stretch of the Upper Mekong in Lao PDR. Combined, these surveys provide an overview of the upper Lao Mekong to be made available for further planning of monitoring and assessment activities.

The survey was carried out by a team of 15 people, including three international specialists (biodiversity, fisheries and livelihoods experts), and 12 Lao PDR Government staff representing the Environmental Research Institute of the Science Technology Environmental Agency, the Living Aquatic Resources Research Centre (LARReC), the Lao National Mekong Committee (LNMC), the Ministry of Communications, Transportation, Ports and Construction (MCTPC) and representatives from provincial governments of Luang Namtha and Bokeo.

The mission was carried out in two stages: the first part focused on the same survey area between Xieng Kok and Huay Xai that was covered in the first scoping study. The second part, between Huay Xai and Luang Prabang adopted the same approach and methodology for biodiversity assessment, which were used during the first scoping mission, but focusing on a stretch of the river that had not previously been addressed.

The upper Lao Mekong River with its succession of narrows, mid-stream rock outcroppings and islands presents a wide variety of habitats, which contributes to its rich and distinctive biodiversity. This stretch of the Mekong falls into at least three different ecological zones - fast mountain river with extensive rock outcrops and rapid systems, wider, slower flowing meandering river, and further downstream a braided river with succession of large islands and extensive mudflat/sandbars all of which are important to maintain the nature and functions of the upper Mekong various ecosystems. These complex ecosystems are also important for local livelihoods.

The survey team observed a number of development pressures in the area, as well as increased human activity including construction of roads with increased access to fragile areas, and changes in land use along riverbanks and watersheds.

This area of the river will be directly affected by modifications planned under future phases of Navigation Channel Improvement Project. The first scoping study addressed concerns that there had not been adequate assessment of the environmental impacts of the resulting changes to the river itself and subsequent increased river traffic. These remain areas of concern that future monitoring and assessment should also address.

All of these development pressures need to be considered in the context of wider changes within the whole of the Mekong River Basin such as large-scale infrastructure development upstream and climate variation. The combined and cumulative impacts of these changes are difficult to assess in a limited survey but are anticipated to have significant implications. Given the importance of this stretch of the river and the pace of change in the area the survey team consider that regular, systematic monitoring and assessment are essential in order to ensure the ecological integrity of the river as a whole, and to ensure the sustainability of development initiatives.

There are a number of key features to be included in future monitoring and assessment. An ecosystem-specific methodology for a programme of regional biodiversity monitoring and assessment should be implemented in the Lao Upper Mekong. Opportunities for coordination with neighbouring countries should be explored.

A fisheries monitoring programme should investigate changes in the local fishing strategies at the sites where the most dramatic changes to the river morphology have occurred.

Building upon existing databases in the Lao PDR, a database and bio-repository specific to the Upper Mekong should be developed. Again, where there are opportunities for coordination and exchange with neighbouring countries these should be explored.

These initiatives need to be supported with a programme of capacity development and training specifically focusing on biodiversity and socio-economic assessment and monitoring.

Further consideration should be given to the ways in which regular monitoring and assessment can contribute to developing guiding principals based on environmental flow requirements.

1.0 INTRODUCTION

The upper reaches of the Mekong River are internationally recognised as important for biodiversity, especially for migratory species of fish including the Giant Catfish. This biodiversity is important for the immediate vicinity of the Upper Mekong and the Mekong River as a whole. The continued viability of this biodiversity is also important for the sustainability of rural livelihoods in the Mekong Basin. However, currently very little detailed information on biodiversity is available.

During 2003 and 2004 IUCN helped facilitate two biodiversity scoping surveys in the Upper Mekong. The first of these surveys was carried out in February 2003 in collaboration with the Lao National Mekong Committee. A final report of this survey was made available in August 2003. As a follow-up to this survey, IUCN in collaboration with Environmental Research, as well as other Lao national and provincial government agencies conducted a further scoping study on the Upper Mekong in June 2004. The findings of this second scoping study are presented in this report.

Both of these surveys were carried out under the auspices of the GEF funded, Mekong Wetland Biodiversity Conservation and Sustainable Use Programme (MWBP[2]) with these surveys funded by the IUCN Water and Nature Initiative (WANI). The MWBP includes a number of outputs that deal with developing guiding principals for wetlands management, preparing biodiversity overlays and supporting training for Red Listing activities. The Giant Catfish, an endangered species on the IUCN Red List, has also been identified as an MWBP flagship species.

The information presented in this report is based on a rapid reconnaissance survey carried out to obtain an insight into the riverine biodiversity, river morphology and livelihoods of riparian communities along the stretch of Mekong River extending from Xieng Kok to Luang Prabang in the Lao PDR.

This report on the follow up survey is intended to facilitate the planning of more detailed biodiversity and livelihoods assessments and monitoring activities along the above stretch of the Mekong River. Information included in this document should not be interpreted as an IEE or EIA pertaining to the northern part of the Mekong River but rather as a framework for further more comprehensive monitoring and assessment activities.

[2] The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC).

2.0 OBJECTIVES AND APPROACH

2.1 Objectives

The main objectives of the second scoping survey were:

- To develop further understanding and insights into the biodiversity of the riverine ecosystems, habitats and species in the stretch of the Mekong between the China/Lao PDR border and Ban Huay Xai, and into the riparian communities that depend upon the natural resources for their livelihoods (using recently available studies and reports, coupled with follow-up inspection and monitoring of changes in the river ecosystem).

- To identify parameters and prepare proposals for a regular programme of monitoring and survey work, with clear identification of areas of high biodiversity interest that may be future targets for conservation.

- To document changes (if any) pertaining to the biodiversity (riverine ecosystems, habitats and species), river morphology and livelihoods of riparian communities subsequent to the first scoping survey in February 2003, in the stretch of the Mekong between the China/Lao PDR border (Xieng Kok) and Ban Huay Xai.

- To identify training and capacity development needs for biodiversity and socio-economic assessment and monitoring activities in the Mekong River.

2.2 Team Members and Itinerary

The follow-up survey team consisted of the following persons:

- Dr Channa Bambaradeniya – Team Leader of 2nd Mekong Biodiversity Scoping Survey and Programme Coordinator, IUCN Sri Lanka;
- Ms Kate Lazarus – Watershed/Integrated Water Resource Management, Oxfam America, Living Mekong Initiative;
- Mr Pierre Dubeau – Aquatic Ecosystem Specialist/Consultant for IUCN

Lao PDR Government Officials:

- Mr Thavone Vongphosy, Department of the Environment, STEA accompanied by 3 representatives from Environment Research Institute (ERI);
- Mr Douangkham Singhanouvong and Mr Khompeng Bouakhamvongsa – Living Aquatic Resources Research Centre (LARReC);
- Mr Singha Ounniyom – Director of Water Resources Development Division, Lao National Mekong Committee Secretariat (LNMC);
- Mr Bounmy Souksavath – Representative from Waterways Administration, Ministry of Communication, Transportation, Post and Construction (MCTPC);
- Representative of Water Resources Coordination Committee (WRCC);
- In addition, 2 provincial representatives from Luang Namtha and Bokeo participated in the mission from Xieng Kok to Huay Xai.

Itinerary:

May 31, 2004
- Depart Vientiane for Luang Namtha
- Drive to Ban Xieng Kok

June 1, 2004
- Travel by boat from B. Xieng Kok to Muang Mom

June 2, 2004
- Travel by boat to Ban Khok Kha (1.5 hours upstream from Huay Xai)

June 3, 2004
- Drop representatives from Luang Namtha and Bokeo Province at Huay Xai
- Travel by boat to Luang Prabang

June 4, 2004
- Debriefing in Luang Prabang
- Return by air to Vientiane
- Final debriefing in Vientiane

2.3 Approach and Methodology

2.3.1 Navigation

On first day, the group travelled from Xieng Kok to Muang Mom in four small speed boats, travelling down river at an average speed of 60 km per hour.

From Muang Mom to Luang Prabang, the group travelled for two days by medium-sized Lao passenger boat, at a speed more suited to biodiversity assessment surveying (25-40 km per hour).

2.3.2 Identification and Categorisation of Riverine Ecosystems and Habitats

The methodology adopted to document the ecosystems and habitats from Huay Xai to Luang Prabang was similar to those adopted during the first scoping survey conducted in February 2003. During the second survey, GPS coordinates were obtained at regular (5 km) intervals along the upper stretch of the river, using a Garmin GPS meter. Vegetation types in the riparian area were categorised according to physiognomy of flora (structure and composition) and human disturbance. In addition, specific wetland habitats within the river system, such as pools, mud/sand/pebble flats (islands), and rock-outcroppings were also noted. Vegetation types in the riparian area and the wetland habitats along the river were recorded by percent of total vegetation at 5 km intervals. Coordinates of important natural and relatively pristine riverine ecosystems were obtained separately.

2.3.3 Qualitative Documentation of Stream Morphology, Flow and Topography

Each 5 km section of the river was categorised according to occurrence of mid-stream rock-outcrops, narrow passages, and islands, by looking at the main cross-section of the river channel (bankfull width). Streamflow characterisation included average speed, stream width, and occurrence of rapids, riffles and pools (pools and deep channels with a depth greater than 10 meters). Topographical variations on the mainland along the river were also noted.

The different biological, hydrological and topographical features recorded qualitatively are listed in Table 1. The entire dataset for each GPS waypoint was compiled into a spreadsheet format (see accompanying Excel file «IUCN_FollowupSurvey_RawData.xls», Appendix). Each column of entries represents the general impression of the stretch of river between the two GPS Stations. The data have been presented on simple area/bar charts to indicate the change in the prevalence of different features along the river. The features have been grouped by a) river character, b) bank and river bed substrate, c) adjacent countryside topography, d) adjacent riverine vegetation.

GPS Reference Waypoints
River features:
Estimated average width (m)
Estimated flow rate (slow/medium/fast – index 0 to 2)
Rapids, riffles, pools, narrows (index of occurrence: 0 to 2)
Islands, narrows, mid-stream rocks (index of occurrence: 0 to 2)
Riverbank characteristics:
Rocks and boulders, small rocks
Sandy bank, sand bars
Mud/sediment flats, pebble flats
Natural embankment, artificial embankment
Exposed
Mid-stream rocks
Island
Adjacent countryside topography :
Floodplain: wide/narrow
Terrain: mountains, hills, flat
Adjacent riverine vegetation:
Primary forest (riverine evergreen forest)
Degraded secondary forest
Bamboo forest
Scrubland
Banana
Plantation forest
Reeds

Agricultural land
Human activity:
Villages
Riverside cultivation
Harvesting NTFPs
Urban/Industry
Fishers
Trading
Gold mining
River modification activities

Table 1: List of Hydrological, Topographical and Biological Features Recorded and Quantified During the Survey Mission, June 2004

These preliminary observations will provide important background information to assist in the design of a comprehensive survey programme for mapping habitats. To make recording of observations easier, the use of a slow boat should be considered.

2.3.4 Documentation of Freshwater Fish and Wild Animals

Freshwater fish, birds and mammals were documented as the opportunity arose along the different ecosystems/habitats of Mekong River from Xieng Kok to Luang Prabang. The specimens of fauna were identified by the scientific experts who participated in the survey. Their identification was further confirmed using field guides on relevant faunal groups of Southeast Asia. The specific rapid survey methods adopted to document the different groups of fauna, and the guides used to confirm their identifications and taxonomy are summarised in Table 2.

Group	Method	Taxonomic Reference/Guides
Freshwater fish	Observation of commercial/subsistence catch; community-based identification using fish guide/ photographs	Kottelat, M (2001)
Reptiles	Observation of live specimens	Cox *et al.* (1998)
Birds	Direct observation of live birds using binoculars and indirect methods (calls/songs; observation of feathers/wings of hunted birds available with villagers; verification of hunted specimens by showing illustrations of birds to villagers)	Robson, C (2000)
Mammals	Direct observation of live/dead specimens; indirect methods (faecal matter, tracks); interviews with villagers using photographic guide	Francis, C. M. (2001)
Butterflies	Observation of live/dead specimens	Monastyrskii, A & Devyatkin, A (2002)

Table 2: Summary of Rapid Sampling Methods for Fauna, and Guides Used for Their Identification and Taxonomy

2.3.5 Documentation of Agricultural and Livestock Biodiversity

Observations were made on agricultural crops grown along the riparian area of the Mekong and its tributaries. Species of woody plants grown in home gardens were noted, and information on farm animals in riparian villages was obtained from a number of villages.

2.3.6 Documentation of Non-Timber Forest Products

Information on non-timber forest products used for subsistence and/or commercial purposes was gathered from villagers.

2.3.7 Documentation of Threats to Biodiversity

Issues related to degradation/deterioration of ecosystems and habitats, over-exploitation of species and spread of invasive alien species were noted along the survey stretch and discussed with villagers.

2.3.8 Discussions and Semi-Structured Interviews

Group discussions about livelihoods, local knowledge and impacts of water fluctuation on riparian communities were conducted at selected sites during the course of the mission with villagers, fishers and key informants. Several villages were visited, including Ban Pung Chom Seng, Ban Pha Khao, Ban Mom, Ban Khok ka, and Ban Pak Ou. In-depth interviews with key informants provided information on local knowledge and on villagers' perspectives on the impacts of the navigation project and river traffic. Perceptions and concerns were gathered from local people and fishers about the impacts of river development, such as riverbank collapse, and vulnerability of livelihoods.

More specifically, the survey assessed fisheries by using a method that has been developed by the Mekong River Commission - Assessment of Mekong Fishery (AMFP) Programme. This method, which has been applied to number of fisheries and areas in the Lower Mekong River Basin over the past seven years, combines the use of biological science, local knowledge and socio-economic data.

Generally, an interview with the village heads was conducted to gather general information about the circumstances in the village and to identify the most experienced fishers for more in-depth interviews. The interviews with fishers gathered detailed information on a large number of fish species (in the hundreds, varying by location and level of fishing activity), fish migration, fishing habitats, spawning season and spawning grounds. Questions on fish prices, catch sizes (numbers and weights) and changing fish conditions and fisheries were also included.

A key method for documenting the fish species inhabiting the river was by showing interviewees a standardised photo flipchart identifying each species.

The method for assessing fisheries developed by the Assessment of Mekong Fisheries Programme was tested in various circumstances during the survey. A list of local fish species was gathered from local fishers and issues such as seasonality, spawning behaviour and frequency of catch were discussed.

2.3.9 Preparation of a Photo-Catalogue

Digital photographs were taken as part of the survey, and include ecosystems, habitats, fauna, livelihood issues and village life.

2.4 Survey Constraints

Due to time constraints, sampling of fish and other fauna could not be done in a systematic manner. For the same reason, streams and swamps connected to the Mekong River were not surveyed.

In addition, the timing of the survey was not optimal as many of the key features of the river were already submerged by rising water levels.

The success of the follow-up scoping survey was made possible by the combined effort and commitment of the team who provided a wide diversity of skills and expertise.

Within a short time, the survey team was able to gather a wealth of information using combined qualitative and quantitative methodologies as well as drawing essential knowledge from local people.

3.0 SURVEY OBSERVATIONS AND FINDINGS

3.1 River Morphology and Hydrology

3.1.1 River Features

A detailed survey of the Mekong River was conducted between Huay Xai and Luang Prabang, a 300 km long stretch flowing through rugged terrain and mountainous areas. This stretch of the Mekong River can be roughly divided into three sections based on the dominant landscape physiognomy. The first segment, from km 0 to km 80, is generally wider than the downstream reaches, with sections extending up to 600 m across. At the start, around Huay Xai, urban development is present, occupying stretches of the riverbank characterised by wide meanders. Low-lying islands with alternating erosion and depositional site arrangements contribute to the formation of large sand/pebble banks and steep eroded banks.

The middle segment of the survey covered the greatest distance of the three, with morphological characteristics that dominate the landscape. For over half of the stretch, the river is confined and flows in a relatively straight course, keeping an easterly bearing through narrow valleys flanked by high mountains (200 to 400 m above the river). Numerous deep channels, frequent narrows and associated deep pools contribute to the rapid and turbulent flow.

The MRC Hydrological Atlas (1:20,000) bathymetry data established that the deepest point of the Mekong is located between km 250 and km 255. A three hundred meter narrow, with average depths of 30 meters and a maximum depth of 90 meters, flows between two steep mountains. These depth values correspond to base flow conditions. Depth sounding data were collected during the dry season more than ten years ago.

Near the end of the survey stretch, beyond km 280, the Mekong is met by the Nam Ou River in an area of dramatic Karst mountain landscape. At this point, the Mekong River changes considerably, opening onto a wide valley with extensive shallow sections, shoals and sandbars, partially covered by herbaceous vegetation and shrublands.

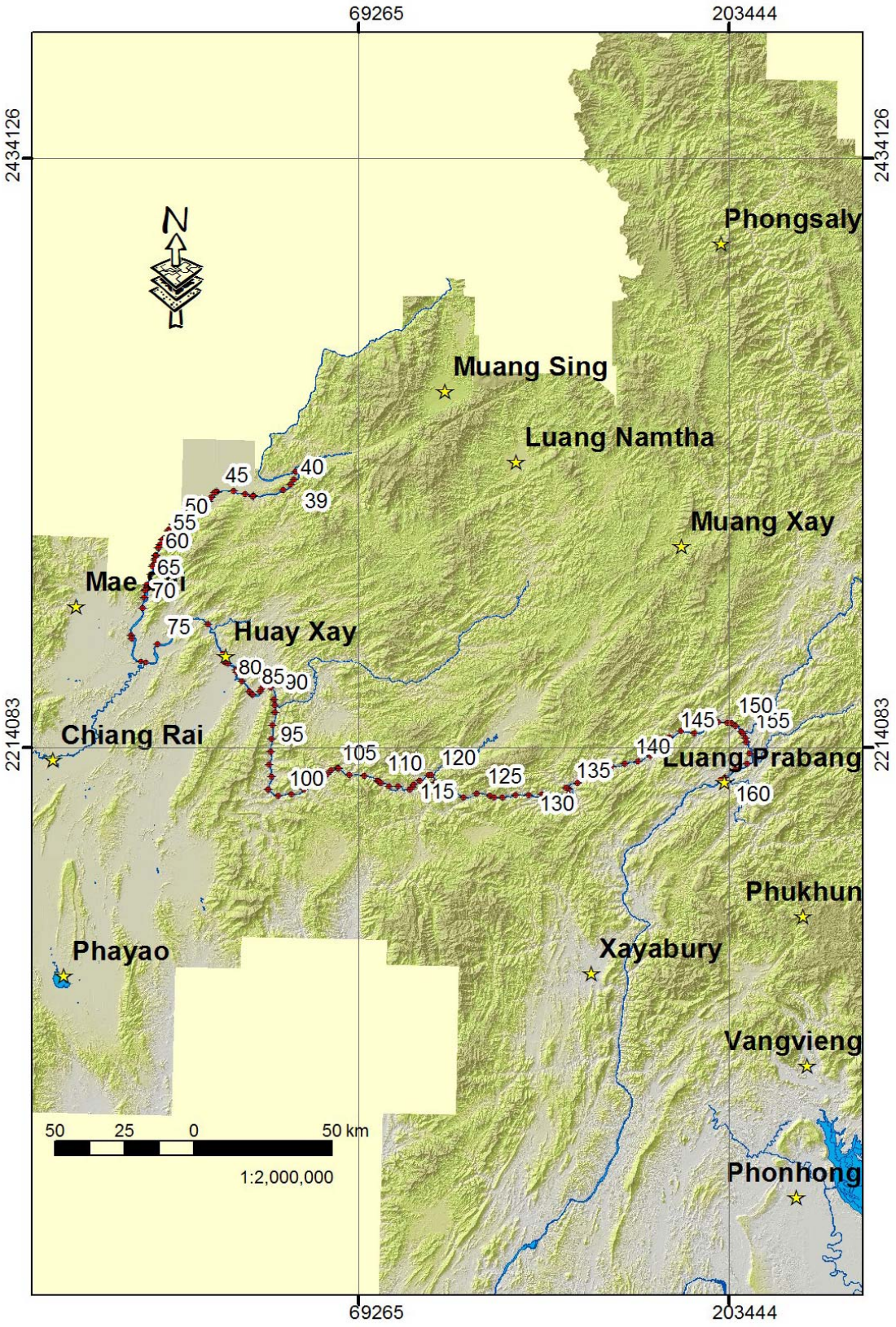

Figure 1: Map of the Mekong River Showing the Area Surveyed and GPS Waypoints Recorded Between Xieng Kok and Luang Prabang

To gain an overall impression of the Mekong River between Huay Xai and Luang Prabang, channel width was estimated for each five km segment as part of the detailed characterisation of the river's main morphological characteristics. This information was then cross-checked with the MRC hydrological atlas for validation and accuracy. Figure 2 presents a general outline of the river width along the 300 km survey. The river's three distinct sections are clearly illustrated by examining stream width. The first section, up to km 80 is generally wider, progressing through an open landscape. Beyond km 80, the river is narrower while passing through mountain ranges dominating the central part of northern Lao PDR. Nearing the end of the mid section, the Mekong enters the large valley where Luang Prabang is located.

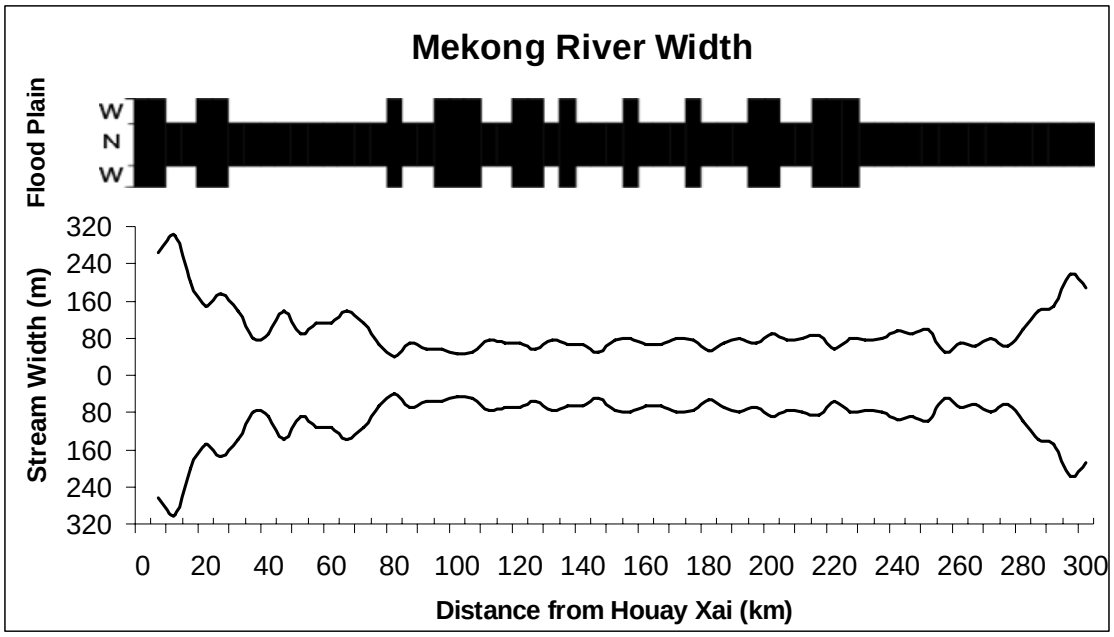

Figure 2: Width of the Mekong River Between Huay Xai And Luang Prabang to km 300

Main Channel Estimated Bankfull Width (Bottom) and Floodplain Width, Narrow/Wide (Top)

River morphological characteristics, such as narrows, mid-stream rocks and islands, constitute important habitats and contribute to the biological diversity of the Mekong. As these features are removed, the river becomes more and more like a uniform canal, fulfilling its function as a navigation route at the expense of other socio-economic and ecological functions. Figure 3 shows the changes in occurrence of mid-stream rocks, narrows, and island from Huay Xai to Luang Prabang.

Mid-stream rocks, large outcroppings of bedrock and narrows are common occurrences throughout the length of the surveyed area. In effect, this is the last stretch where the Mekong River flows through a landscape dominated by high mountains and narrow valleys. As the river passes through high mountains, it meets frequent narrow constrictions. Alternating narrow stretches and open valleys contribute to a rich diversity of habitats.

Low-lying islands with associated sand/pebble bars are present along the wider, meandering stretches of the river. These depositional formations are key habitats for the flora and fauna found in this region. Between km 130 and km 270, larger vegetated rock outcrops are occasionally encountered.

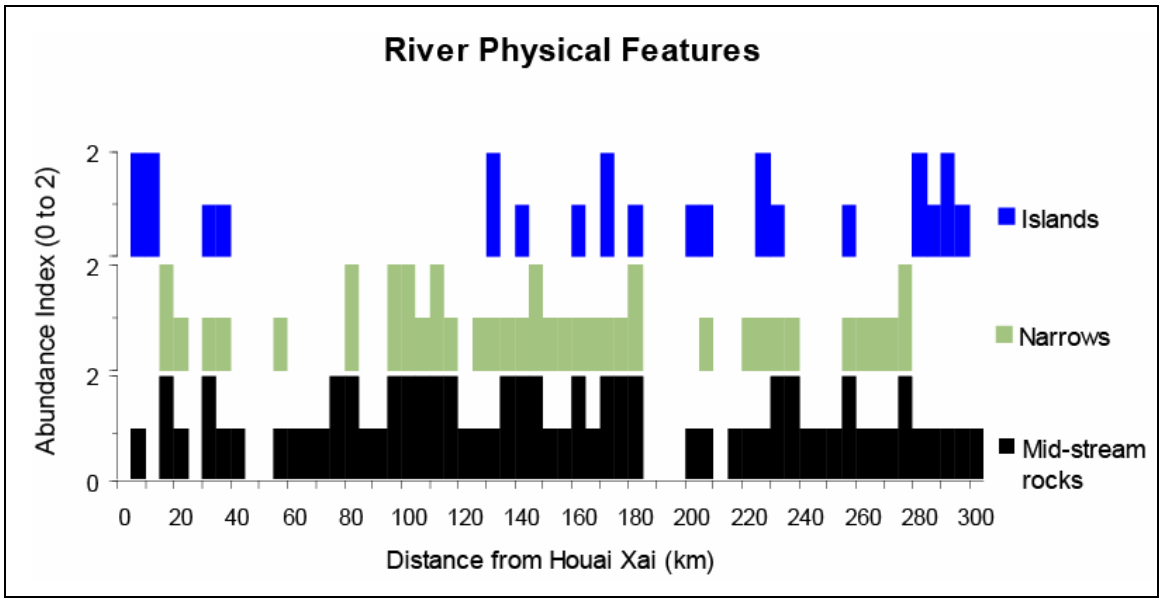

Figure 3: Occurrence of Islands Narrows and Mid-Stream Rocks in the Mekong River Between Huay Xai and Luang Prabang
(Index of Abundance, Absence = 0, Presence = 1, Abundant = 2)

Various stream flow types (riffles, rapids, and run), and the abundance of each, observed and noted during the trip. Presence of pools and deep (> 10 m) channels were estimated from visual observations. The MRC hydrological atlas was used to establish the location and extent of deep sections in the river. Figure 4 presents a general outline of the flow conditions found along the surveyed stretch.

In keeping with the physical features of the river, as shown in Figure 3, the associated flows, as illustrated in Figure 4, help identified the location of the main narrow passages. The fast flowing stretches in the mountains are often visually spectacular, yet their overall representation is relatively small, making up less than 10% of the total surveyed stretch.

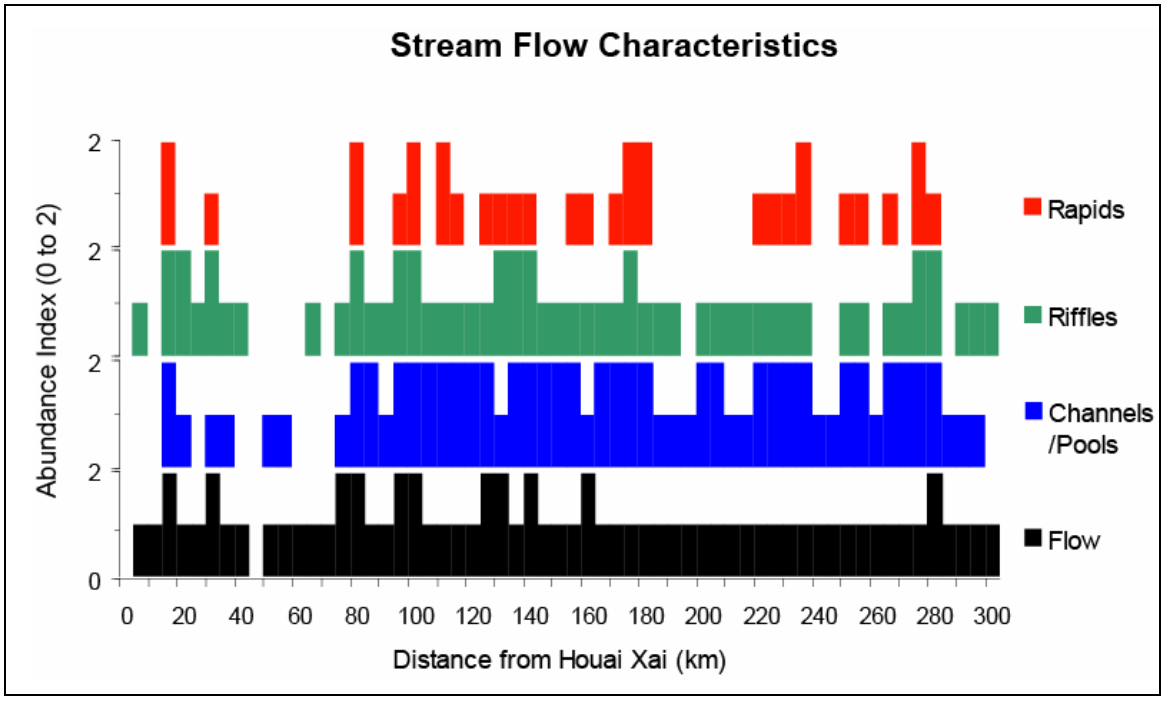

Figure 4: Occurrence of Rapids, Riffles and Deep Channels/Pools
(Depth > 10 m approximately)

3.1.2 Detailed Physical Descriptions of the River

Section 1, km 0 to 13: Starting point of 'Rapid Survey' from Huay Xai onwards. From the onset, the Mekong River is wide and relatively shallow. It is punctuated by several large, low-lying islands, and sandbars. Water flows calmly through an uninterrupted run with no apparent obstacles to navigation. Mid-stream rocks are absent. This section follows a southeasterly course. A ferry crossing is in operation at Huay Xai.

Section 2, km 13 to 18: The river makes a sharp 90 degree turn and flows east for approximately 1.5 km, then resumes its southeasterly course. A short stretch flows over a rocky area, approximately 1 km long, widens out briefly, then narrows again before reaching an area with large sandbar expanses along the east shore. Several deeper channels, up to 30 meters deep, were encountered. (Note: this site should be explored as potential fish refuges).

Section 3, km 18 to 30: Here, the river is 300 m to 400 m wide, flanked with extensive sandbars (depositional areas) on alternating sides. Halfway through this stretch, the river makes a wide smooth turn in a northeasterly direction before turning south again. This section ends with a slight constriction, where an abrupt narrowing of the valley occurs.

Section 4, km 28 to 70: For the next 33 km, the river flows in a southern direction, through a narrow valley with long and deep channels interspersed with mid-stream rocks. Beyond Ban Pak Tha (at the confluence of the Namtha River), the channel keeps a straight course and widens slightly while remaining encased by steep mountains on both sides. Up to km 60, the river remains generally narrow. Deeper channels are frequent nearing km 49, followed by an even narrower stretch of approximately 1.5 km in length. Starting at around km 53, the valley opens up on the east side near Ban Sa (at Houay Sa River). For several kilometres the landscape on the east shore remains relatively flat and open. Smaller rock outcroppings are present. The first noticeable bend since the start of this section is found at km 60. The last stretch is slightly wider and ends in a long bend that takes the river in a northeasterly course.

Section 5, km 70 to 83: The next reach is characterised by a relatively wider floodplain and a significant change in the surrounding landscape. From this point on, the river maintains a southeasterly course. No deep channels are encountered, and no obstructions that could obstruct navigation are observed, in spite of the presence of large mid-stream rocks and islands. Further along the bend, the river becomes increasingly narrow and deep. Rocky shoreline areas and steep stream banks are frequent on the inside of the bend while the floodplain remains wide on the outside. From km 78 onward, the river is evenly narrow with significant expanses of floodplain up to the end of the section at km 83.

Section 6, km 83 to 95: From this section onward all the way to km 276, the general morphology of the Mekong remains relatively uniform. Here, the Mekong River flows through a succession of steep, narrow gorges, interspersed with short, wide valleys often associated with changes in the surrounding landscape morphology. Following a general pattern, rocky outcroppings and deeper channels are found in the narrow sections. Along these sections, the river flows swiftly. Relatively narrow floodplains are encountered where the valleys open.

Overall, this is a straight confined section running through a narrow valley with extensive rocky shoreline.

Section 7, km 95 to 105: The River passes through a mountain valley, making a long curve past Ban Khok Ka, where deep, narrow channels are present. Wide adjacent terraces extend along the shores, alternating sides as the river winds through the mountains.

Section 8, km 105 to 121: While the main river channel widens out, the surrounding valley remains narrow and steep, with the river running a straight course to the east. A number of deep pools are found in this section.

Section 9, km 121 to 130: For the next 10 km, the river flows through a broad valley.

Section 10, km 130 to 148: The river keeps its general course all the way to Ban Pakbeng (km 140), where it makes a swift turn to the southeast, and continues its progress.

Section 11, km 148 to 196: The section is characterised by a narrowing and deepening of the main channel. A long and uninterrupted deep channel is encountered near km 150 where the deepest pool (> 30 m) since Huay Xai is found. Next, the stream width becomes irregular (60 to 200 meter wide). Beyond km 160, the Mekong flows in an easterly direction, where it meets with the Nam Ngum tributary, and widens out slightly for about 2 km before returning to its previous width. Moving east, the occurrence of deep channels increases steadily (with some channels over one half km in length) interspersed with strings of deep pools (> 30 m).

At the confluence of H. Xouang (Ban Thaxouang) the river widens briefly to resume its normal course through the mountains. The main channel continues to deepen. The next deep pool (> 35 m) is found at about km 180, and is followed by a succession of alternating broad and narrow stretches.

Section 12, km 194 to 202: For a short distance, the path of the river changes drastically, circumventing a cluster of mountains. This mountain formation appears to be located in a transition area between adjacent mountain ranges.

Section 13, km 202 to 216: Here, the river channel widens out once again, flowing through a broad valley expanding on its north shore. The river is generally shallower, with some sections deeper than 10 m.

Section 14, km 216 to 228: The river enters a canyon of about two kilometres in length. At its narrowest point, the channel reaches depths greater than 40 meters. After leaving the canyon, the river channel shows irregular patterns with highly variable width, and a string of deep pools (>35 m) interspersed with abundant large mid-stream rocks.

Section 15, km 228 to 250: Entering a broad valley, the river follows an erratic path for a few kilometres, then flows on a straight course to km 250. Occasional deep pools and channels associated with narrows are encountered. A wide rocky ledge extends on the south shore between km 230 and 235.

Section 16, km 250 to 257: This short segment is characterised by a succession of long and narrow channels. Here, the stream bottom reaches its deepest point (> 85 m) while flowing through a narrow passage flanked with tall mountains on both sides

Section 17, km 257 to 276: This is the last mountainous stretch of the survey, with 20 km of varied river morphology. The river remains generally deep with a succession of narrows flanked by a rocky shoreline. Steep banks are present on the north shore and irregular rocky ledges on the south. Wider sections alternate, from 80 m to 250 m. Abundant rocky outcrops are found throughout.

The last stretch opens onto a large deep basin (> 30m) with a very steep bank on the north shore, then enters a narrow passage with a long deep trough (1.5 km long with an average depth greater than 30 m). This channel ends at the confluence with the Nam Ou River, just before the Luang Prabang caves.

Section 18, km 276 to 289: Beyond the intersection of the Nam Ou River, the Mekong and floodplains broaden out significantly (> 200 m). Mid-stream rocks and large islands are scattered across the width. Stream flows appear faster as a result of the reduced depth. At km 284, the river shifts straight south before splitting into two main branches.

Section 19, km 289 to 300: Nearing the end of the survey section, the river and adjacent floodplains are wide (about 450 m) and shallow with some rocky outcroppings.

3.1.3 Riverbank Characteristics

The average percent of different riverbank features from Huay Xai to Luang Prabang is presented in Figure 5. Approximately 45% of the riverbank on either side of the river consisted of natural embankment, while artificial embankment was negligible. About 10% of the riverbank was exposed, either due to clearing of vegetation or to erosion.

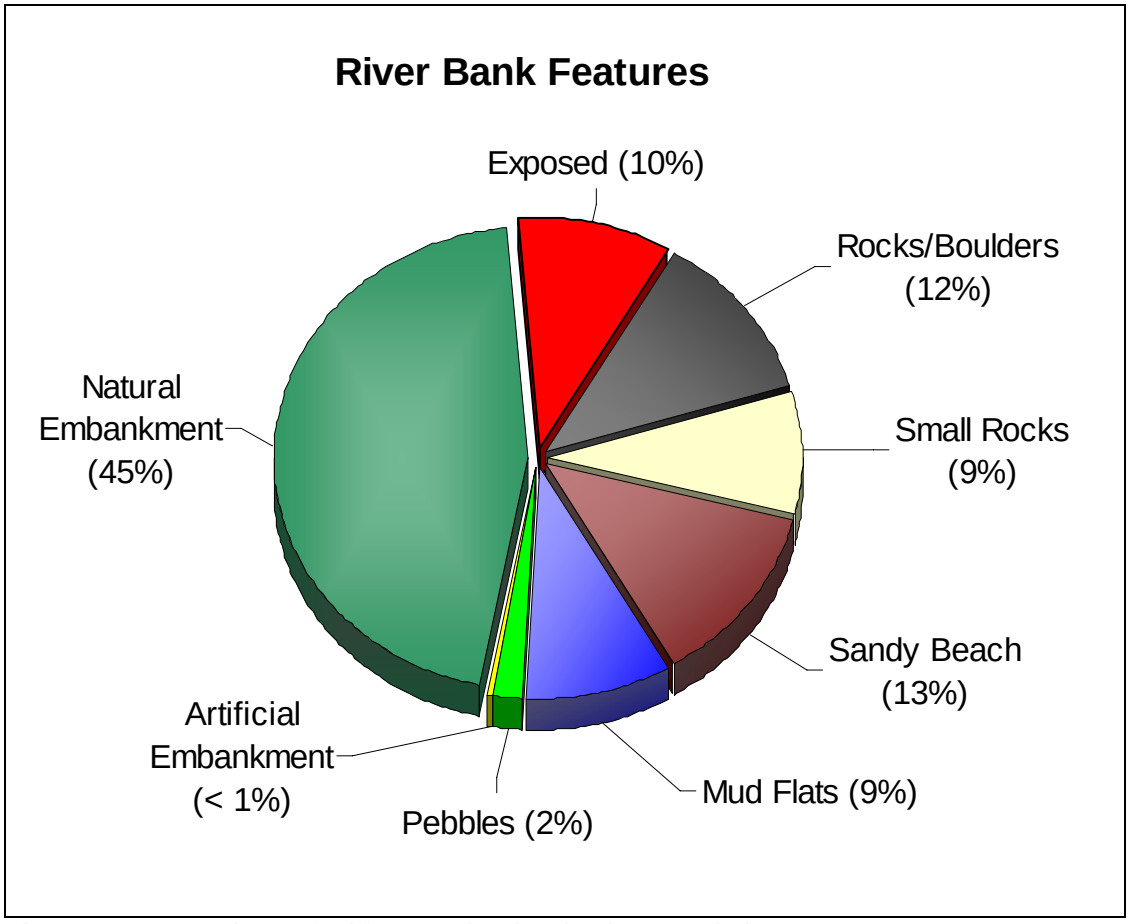

Figure 5: Proportions of Different Riverbank Characteristics

The riverbank characteristics, as noted at 5-km intervals, are presented in Figure 6. At the start, the river has both wide and narrow segments with mud flats on both sides of the river. A 30 km stretch extending from km 60 to 120 (waypoint 96-102) largely consists of exposed riverbank, with large rocks and boulders more prominent from km 85 to 265 (waypoint 102-149), along a stretch of 180 km. The riverbank is well protected by a natural embankment of rocky substratum along a 90 km stretch from km 145 to 235 (waypoint 122-142).

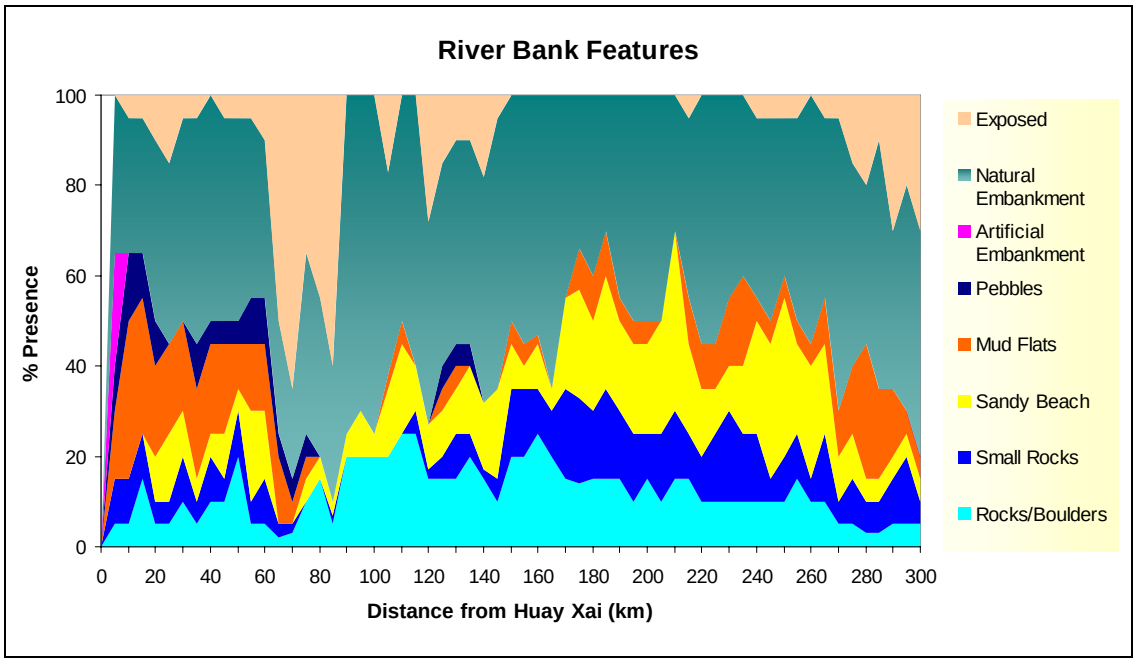

Figure 6: Riverbank Characteristics Observed at 5-Km Intervals Along the Stretch of the Mekong from Huay Xai to Luang Prabang

In many locations, the riverbanks are steep and exposed. Bank erosion appeared more important on the Lao PDR side than on the Thai side. Several low-lying islands are regularly visited by different types of river birds (see Section 3.2.2). These islands are covered with small bushes that become submerged at the height of the rainy season.

Bank erosion was encountered at Ban Chom Seng, Ban Tang and Ban Yang Kham. Stretches of eroded bank measured between 1,200 and 1,500 m, 1,500 and 2,000 m, and 2,000 and 2,500 m, respectively. In Ban Namphoun and Ban Bok areas in Bokeo province, less severely eroded stretches measured between 5 and 6 m, and 3 and 4 m respectively. Between the border of Lao PDR and Myanmar in Ton Phueng district, Bokeo province, soil slides were encountered. According to Mr Hom Pheagn, an estimated rate of bank erosion over the last four years was 150 m per year. There is no evidence that bank erosion is a direct consequence of removing the rapids.

3.1.4 Surrounding Landscape Features

The area along the Mekong River is dominated by mountainous landscapes of exceptional beauty. The impressive scenery, rich biodiversity and local culture offer a vast potential for ecotourism development. The area is sparsely populated with small hamlets/villages, which practice various agricultural activities. Bamboo forests cover an estimated 40% of the surrounding landscape. The livelihoods of riparian people are unique and almost strictly based on agriculture (85% of all food consumed). The riparian areas, which are seasonally flooded, provide rich soils for gardening. Many fruit trees grow on the banks of the river. The rich and diverse ecosystems along the Mekong provide habitats for many bird species.

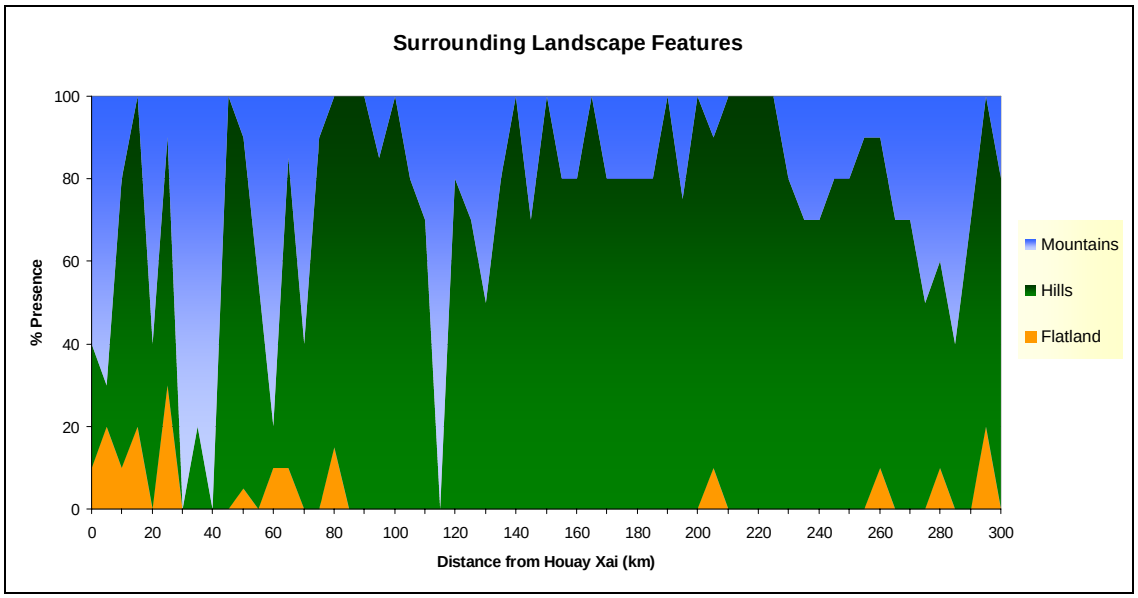

Figure 7: Surrounding Landscape Features

3.1.5 Status of Rapids

The team requested to travel upstream of Xieng Kok to visit rapids sites, including the Khrai Rapids, but were warned that armed men could interfere and endanger the safety of the team members.

Blasting of all rapids from Xieng Kok to Huay Xai has been completed. Each former rapid site was briefly surveyed while travelling downstream and remaining debris on the riverbanks was noted.

Above and below the Wang Wit Rapid, unusual rock debris was scattered along the bank on the Lao side of the river. The rock piles dumped on the riverbanks appeared to have originated from rapids blasting activities. Flood waters may carry the debris downstream and fill deep pools if the rocks are left near the shore. Mr Bounmy Souksavath from the Ministry of Communication, Transport, Post and Construction indicated that the government was supposed to use the debris to make an artificial embankment, but had not yet done so.

Extensive road construction was observed upstream of Wang Wit Rapids, which has resulted in significant landslides in five different locations. These landslides (some documented in photos) appear to be a direct result of forest clearing and debris eroding the banks of the Mekong River.

Along the stretch upstream of Wang Wit Rapids, there were a few scattered houses, widespread deforestation/cultivation in the uplands, and various plantations (predominantly banana and teak). Garbage floating in the river, mainly plastic and Styrofoam debris were noted.

During this mission, a few Chinese cargo boats were observed, and a number were moored downstream at the Chiang Saen port. Villagers claimed that Chinese cargo vessels were travelling primarily along the Lao side of the river, resulting in an increase in water fluctuation, which in turn is responsible for extensive bank erosion.

These recent changes in river conditions have significant impacts on local communities. Local fisheries are likely to be adversely affected by the large vessels now found in the river.

Since the removal of the rapids, some villagers using small boats have had difficulty adapting to the changes in stream flows.

3.2 Biological – Ecosystems, Habitats and Species

3.2.1 Habitats/Vegetation Types Overview

The terrestrial vegetation types observed in the riparian area included primary forest, degraded secondary forest, bamboo forest, wild banana, plantation forests, reed beds, scrubland, and agricultural land. The average cover of different riparian vegetation types is presented in Figure 8. The primary forest cover was approximately 6%, while the degraded forest and bamboo forest accounted for nearly half of the vegetation cover in riparian areas. The agricultural lands consisted mainly of shifting (slash and burn) cultivation. Vast areas of riparian forests from Huay Xai to Luang Prabang were subjected to shifting cultivation, which was observed to be under expansion. The plantation forests were mainly Teak. The scrubland consisted of abandoned shifting cultivation plots and other fallow land.

Along with the terrestrial vegetation/habitat types, several wetland habitat types were observed along the Mekong River, as indicated in
Figure **8:** Riparian Vegetation Cover along Mekong River from Huay Xai to Luang Prabang

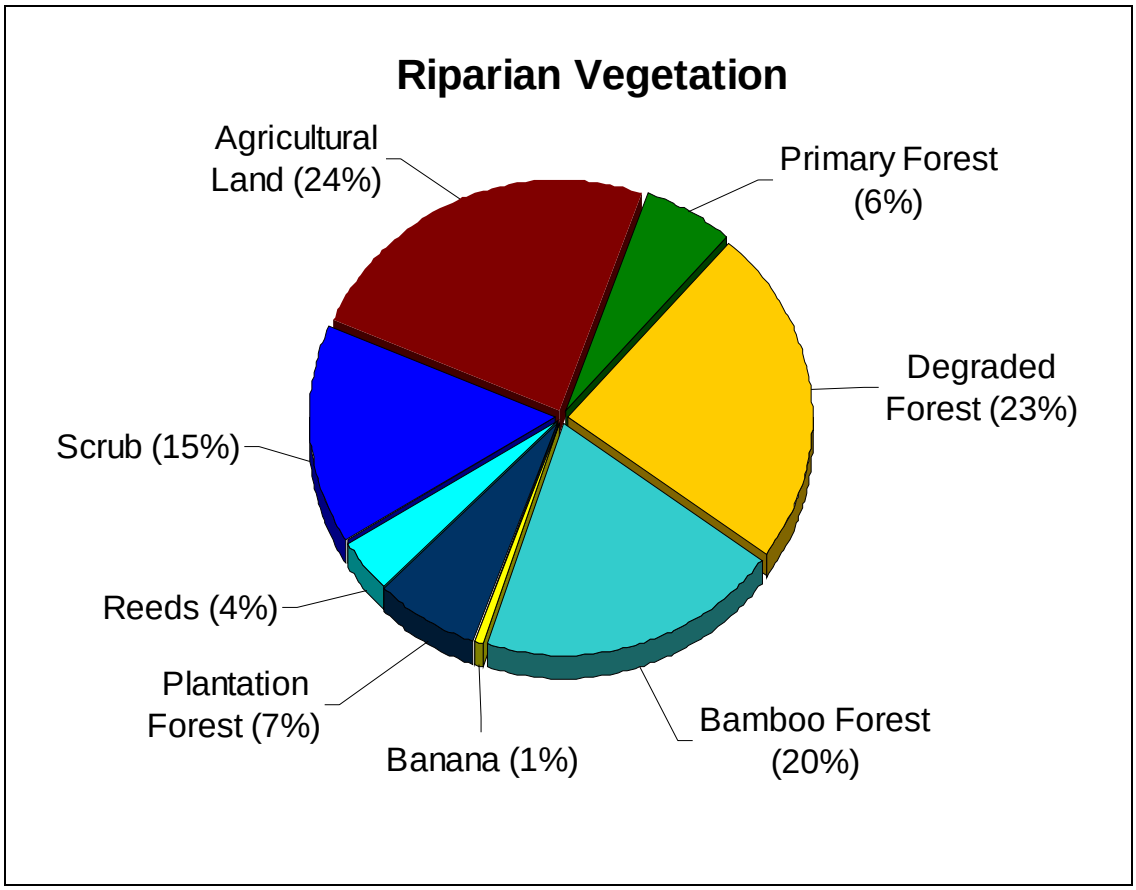

Figure 8: Riparian Vegetation Cover along Mekong River from Huay Xai to Luang Prabang

Wetland habitat type	Description	Way Point Number [a]
Rivers	Mekong and its tributaries	
Streams	Several streams running through evergreen forest and joining the Mekong	
Seasonal mudflats, pebble flats and sand bars	Seasonally inundated habitats	78, 81, 85,88, 141, 155
Seasonally inundated shrubland	Seasonally inundated herbaceous shrubland vegetation on either side of the Mekong river as well as in islands of the Mekong river	141, 155
Seasonally inundated swamp forests	Areas with woody plants, including trees that are inundated during the rainy season, located in lowland areas beside the river	
Rock outcrops within river	Wet rocks, boulders and cliffs emerging out of water.	
Riverine rapids and deep pools	Deep water pools in the river, especially in areas of riverine rapids	
Pools in riverbank	Small water pools beside the river, with rocky/sandy/muddy substratum	

Table 3: Wetland Habitat Types Observed from Huay Xai to Luang Prabang

[a] See Appendix for more information on each waypoint number

The occurrence and abundance of riparian vegetation types at 5-km intervals from Huay Xai to Luang Prabang is presented in Figure 9. The reed beds were more prominent in the Huay Xai area for the first 75 km (waypoint 77-100) while the Teak plantation forests were more common further downstream, at km 225 onwards (waypoint 140). A vast tract of forest cover, consisting of primary forest, secondary forest and bamboo forest, was observed, predominantly on the Lao side, along a 60 km stretch of the river, from km 145 to km 210 (waypoint 123-137).

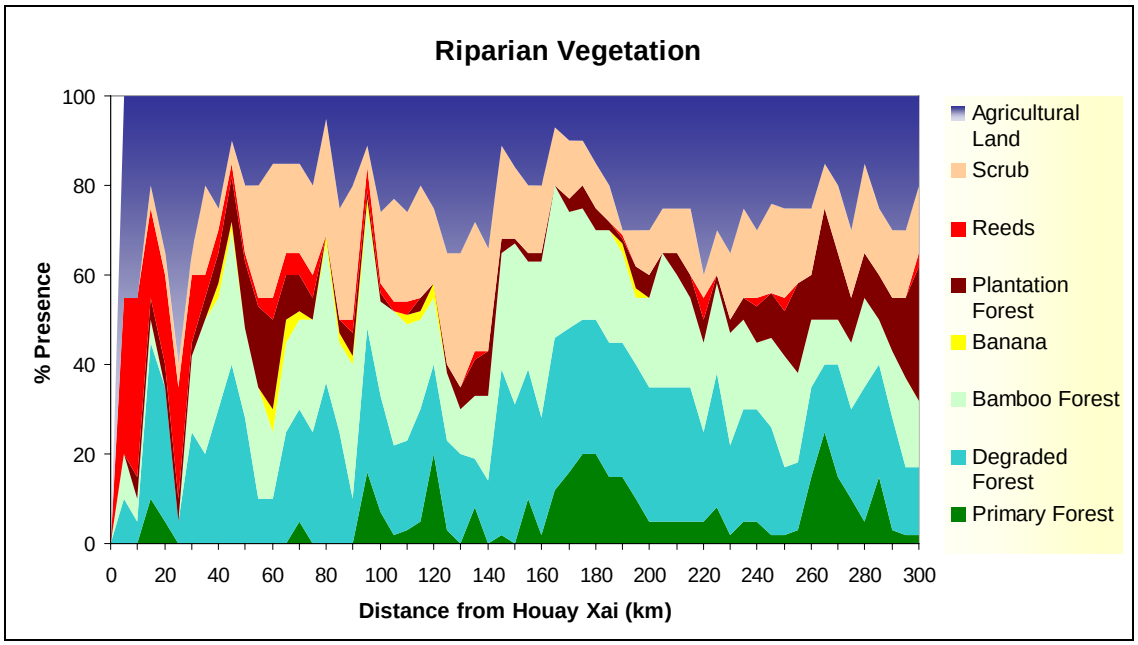

Figure 9: Abundance of Riparian Vegetation Types along the Mekong River, from Huay Xai to Luang Prabang

3.2.2 Species of Fauna Recorded

One additional reptile species (Flat-tailed gecko) was added to the observations taken during the first survey (Annex). Although only four species of reptiles were documented during both surveys, the area would certainly reveal more species if a detailed survey on herpetofauna were conducted.

The total bird species recorded from Xieng Kok to Luang Prabang during both surveys totalled 87 species (
Appendix , Table A8), including 11 species observed during the second scoping survey. The most common bird species observed was the small pratincole (*Glareola lacteal*).

Similarly, a total of 10 mammal species were documented during both surveys, with four new species recorded during the second survey (
Appendix , Table A9).

A clear increase in the species richness and abundance of butterflies was evident during the second survey. This could be attributed to the lush riverine vegetation resulting from rainfall, providing feeding and egg-laying habitats for butterflies. A total of 28 butterfly species were recorded during the two surveys (
Appendix , Table A10), 16 of which were only documented during the second survey. In addition, several species of unidentified lycaenid butterflies were observed.

Seventy-five new species of fish were added, based on the interviews with experienced fishers (
Appendix , Table A11). The list of fish species totals 157 species (including Lao names). Table 4 presents the number of fish species reported for each major taxonomic group during both survey missions. One group, the cypriniformes, accounted for more than half the species reported.

Order	Family	Sub-Family	Tribe	Total
Rajiformes	Dasyatidae			1
Osteoglossiformes	Notopteridae			4
Anguilliformes	Anguillidae			1
Clupeiformes	Engraulidae			1
Cypriniformes	Cyprinidae	Acheilognathinae		2
		Alburninae		3
		Danioinae	Oxygastrini	3
			Neobolini	1
			Chedrini	1
			Danioini	5
		Leuciscinae		1
		Gobioninae		2
		Cyprininae	Cyprinini	2
				4
			Systomini	13
				10
				3
			Catlini	2
			Labeonini	12
				5
	Balitoridae	Balitorinae	Gastromyzontini	1
		Nemacheilinae		2
	Cobitidae	Botiinae		6
		Cobitinae		9
Sub-Total	**Cypriniformes**			**87**
Siluriformes	Bagriichthidae			1
	Bagridae			7
	Siluridae			11
	Schilbeidae			1
	Sisoridae			1
	Clariidae			1
	Loricariidae			1
Osmeriformes	Salangidae			1
Beloniformes	Belonidae			1
	Hemiramphidae			1
Synbranchiformes	Synbranchidae			1
	Mastacembelidae			4
Perciformes	Chandidae			2
	Toxotidae			1
	Nandidae			1
	Cichlidae			1
	Eleotridae			1
	Gobiidae	Gobiinae		1
		Gobionellinae		1
	Anabantidae			1

Order	Family	Sub-Family	Tribe	Total
	Belontiidae			2
	Osphronemidae			4
	Channidae			2
Pleuronectiformes	Soleidae			3
	Cynoglossidae			1
Tetraodontiformes	Tetraodontidae			2
Siluriformes	Pangasiidae			9
Total				**157**

Table 4: Number of Fish Species Caught by Main Taxonomic Groups

3.2.3 Important Ecosystems/Habitats To Be Conserved as Biodiversity Refuges

Areas along the Mekong River that have been identified as key sites for the conservation of biodiversity are highlighted in Table 5. The forest cover extending from waypoint (WPT) number 123-137 (km 150 to 210), covering a distance of approximately 60 km on the Lao side, is an area of very high importance for terrestrial biodiversity. The Karst ecosystems encountered between WPT numbers 110-112 (km 115), and 148-154 (km 260 to 276) harbours unique species of flora, which have adapted to exist in the rocky landscape with calcium carbonate deposits. The mid-river mudflats are important habitats for wading birds and waterfowl.

Waypoints	Description of Area
78	Sand bar and reed bed – important bird habitat (pratincoles, prinias, warblers)
81,85,88	Mud flat islands: important habitat for wading birds and waterfowl
82-83	LHS: evergreen riverine forest (primary and disturbed)
103-105	Mixture of terrestrial and wetland habitats, resulting in an ecotone consisting of primary forest, degraded secondary forest, bamboo forest, streams, rocky shores, reed bed and scrubland
110-112	Primary forest and Karst rock outcrop forest on RHS
114	Mud flat and sand/pebble bar – wader habitat
116-117	RHS: primary and secondary forest with rocky riverbank
120-122	Secondary forest, bamboo forest and scrubland
123-137	LHS: mixture of primary forest, secondary forest, bamboo forest and scrubland
139-140	LHS: mixture of primary forest, secondary forest, bamboo forest and scrubland
141-143	LHS: mixture of primary forest, secondary forest, bamboo forest and scrubland
141	Mud flats with herbaceous vegetation – wader habitat
147-148	RHS: mixture of primary forest, secondary forest, bamboo forest and scrubland
148-149	LHS: primary forest (rock outcrop forest)

Waypoints	Description of Area
150-151	Hilly Karst rock outcrop forest on RHS and LHS
151-152	RHS: hilly Karst rock outcrop forest
154	Hilly Karst rock outcrop forest on RHS and LHS
155	Mud flat with herbaceous vegetation – wader and waterfowl habitat
156-157	RHS: mixture of primary and secondary forest, and river island with mud flat and degraded forest – wader and waterfowl habitat

Table 5: Biodiversity Refuges along the Mekong River, from Huay Xai to Luang Prabang

(RHS – Right hand side/Myanmar or Thailand side; LHS – Left hand side/Lao side)

3.3 Social Dimensions – Meetings with People, Summary of Discussions

3.3.1 Livestock 'Biodiversity'

The following section presents some general observations about the Mekong River, fishing and livelihoods. The team responsible for documenting livestock biodiversity reported that the general health of Mekong River was still good, and endowed with rich biodiversity.

Three fishers, Mr Tha, Mr Ko, Mr Xon and Mr Sithat, reported that there was no noticeable change in the status of the Mekong River since the blasting of the rapids. In short, they feel that fishing remains good both in terms of species and abundance. In Ban Jam Seang, living conditions have recently improved with the establishment of a programme encouraging local people to hand over their weapons. As a result, pressure on wildlife has subsided. Villagers are increasingly engaged in farming activities as hunting declines. Mr Maillot reported a drop in fish catch from the Mekong River mainstream following the period of blasting. To compensate for the loss, Mr Maillot had to resort to fishing in small streams and ponds on the Mekong floodplain.

With regard to livestock biodiversity, the team identified cows, buffaloes, ducks and chicken as the primary domestic animals. Pigs and dogs were less commonly reported.

3.3.2 Agricultural 'Biodiversity'

Large areas of land on both sides of the river are being used for agriculture. Maize, banana, sugarcane, and teak plantations contribute to the agricultural biodiversity found along the Mekong. In Ban Chom Seng, paddy cultivation is the main occupation. Paddy fields cover an estimated 60-70% of the land, which yield on average 3.5 tons per hectare. Orchards observed along the Mekong include coconut, orange, mango, papaya, and tamarind trees. It should be noted that villagers reported not using any chemical fertilisers. The rich soils found along the river alluvial floodplain offer optimal conditions for supporting organic farming activities.

Common vegetables such as *pak kat*, onion, chili, garlic, eggplants, sesames, and peanuts are grown, and some products are sold to markets in Vientiane.

Teak plantations are commonly found in the valleys along the Upper Mekong River. In Ban Pha Khao teak production is important, and a forest conservation area was established to protect remaining stands of valuable hard wood trees.

Past Ban Pha Khao, hill rice cultivation (shifting cultivation) is more prevalent than along the upstream stretch, as the river cuts a path through deep narrow valleys. In Ban Mom, hill rice cultivation is the main source of rice production. Fruit production is also significant in this region. In addition to the fruit trees that are generally planted in the region, rambutan, litchi and longan are grown. In this village, chemical fertilisers have only been used for the past two years. The proximity to the border between Lao PDR and Burma gives villagers from Ban Mom access to important markets. In addition, the proximity to a main harbour terminal provides significant trading potentials for the area.

Wild cotton production was reported in Ban Donsvanh. Thailand is the main market for wild cotton produced in Lao PDR.

The team responsible for documenting agricultural biodiversity noted that overall forest cover was in decline and that secondary forests dominated the landscape. Both the degraded forests and tree plantations might limit the development of agriculture and livestock activities.

3.3.3 Gathering of 'Biodiversity' Beyond the Village Areas – NTFPs and Hunting

Villagers interviewed during the mission reported that non timber forest products (NTFPs) are both very important for subsistence and as a source of income. The species commonly harvested are rattans, *Tao* palm leaves, *Posa*, bamboo shoot (all species), rattan shoot, mushroom, and algae. *Posa* is an important source of income, sold to Chinese traders in Ban Phao Kao.

Hunting wildlife using local equipment provides supplemental sources of protein. Villagers reported a decline in wildlife hunting since handing over guns. However, local hunting is still commonly practiced. Snares are used to catch small animals, such as squirrels, rabbits, mouse deer and some birds, as well as some larger mammals such as wild pigs and barking deer.

In Ban Pak Ou, villagers reported that a number of wild animals were found in the area, including leopards, cobra and wild chicken.

Logging activities were observed sporadically along the bank of the Mekong. In Thasouang (Xayaboury province.), logs are transported by boat to Oudomxay province.

Some villagers suggested that the removal of the rapids created significant positive impacts on their lives, making travel safer and improving trading potential.

3.3.4 Human Activities/ (Traffic on the Mekong Waterways)

A number of different human activities were observed along the stretch from Huay Xai to Luang Prabang (Figure 10). These included: urban and industrial development, petrol stations, saw mills, charcoal factories, boat making businesses, gold panning, riverbank agriculture, trading (small riverbank shops, cargo boats full of various materials, loading and unloading of goods at villages), homesteads and villages, animal husbandry (water buffalo, cows, goats), logging, teak plantations, fishing (local fishers, fishing gear set-up in river), upland shifting cultivation, and road development.

The predominant livelihood activity observed was upland shifting cultivation, which has resulted in serious environmental degradation. Some slash and burn agriculture was observed, but, for the most part, land which had been cultivated for maize or rice was left fallow. The agricultural land was carved out of mountain or hills for over 80% of the area observed. Local people also rely on fishing for their river-based livelihoods.

Several different types of fishing practices were observed, including use of a seine net, other types of fishing gear (information from fish-team observations), and bank/rock fishing. Other activities such as charcoal factories, sawmill/logging operations, and petrol stations, were minimal. However, in many cases, these activities produced severe impacts on the environment and biodiversity, including air and water pollution and degradation of the land. Roads were also observed periodically, but were of limited reach.

While roads will improve access to these poor communities, they also bring concerns such as increase in diseases and human/wildlife trade. In Pak Ou village, the skin of a clouded leopard was observed hanging from a local villager's house. The villager indicated that the leopard skin had been given to him by a friend from Oudomxai province.

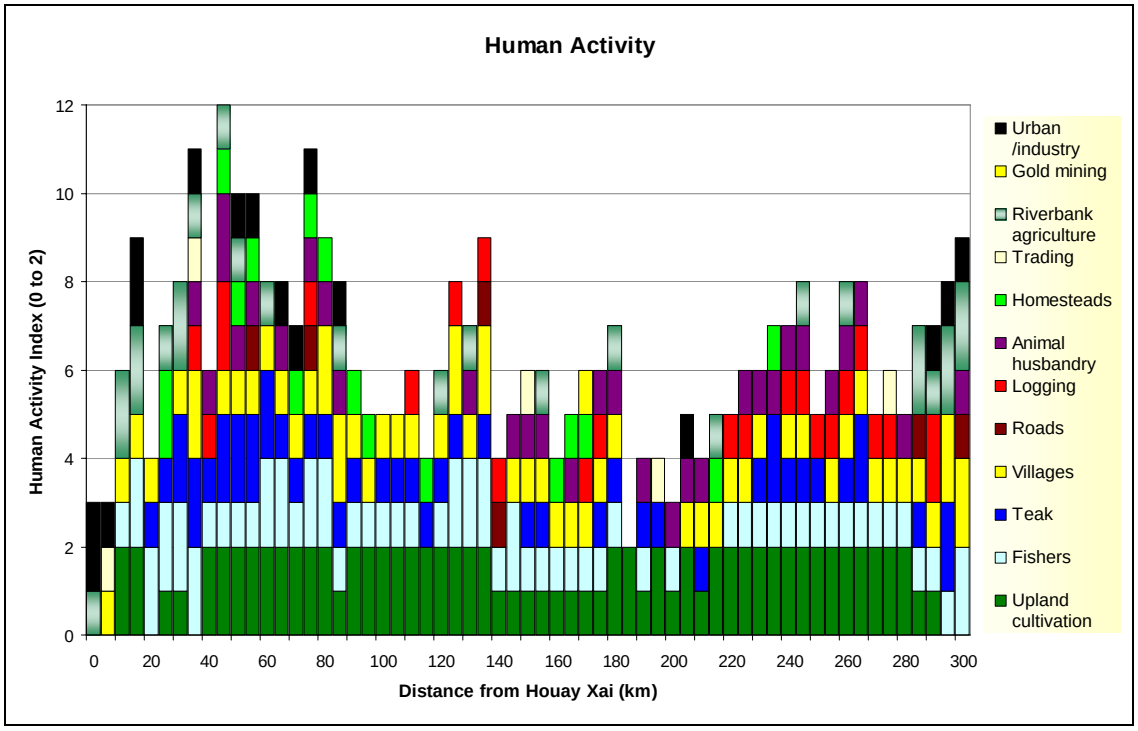

Figure 10: Degree of Human Activity Occurring along the Mekong River from Huay Xai to Luang Prabang

(Degree of occurrence, Absence = 0, Presence = 1, Abundant = 2)

Numerous villages are located along the survey area. In many cases, one or two houses were observed from the river, with communities spanning farther into the forest. In all cases, the livelihoods were both land and river-based, with a predominant focus on cultivation and fishing. In many cases, fishing was supplemented with cultivation or other activities (trading, boat making and passenger/cargo boats). Trading among the villages was not documented since the team did not encounter any markets. Nevertheless, it can still be concluded that the livelihoods of people in these areas were below the poverty line, with few social services or livelihood options.

3.3.5 Human Activities in the Watershed Vicinity – Road Construction and Other Issues

Observations from Ban Mom to Khong Pi Luang rapids

Plans for building a bridge from Ban Mom to the Burmese side of the river were noted, though no information was available regarding the schedule of the project or potential impacts on the area. This issue should be addressed in future monitoring activities.

Some industrial activities, including large oil canisters with nets on top, were observed. The section of the river around Chiang Saen is highly developed on the Thai side, with several types of construction along the river (artificial embankments, digging of the banks, soil gathering for transfer to other areas, etc). A harbor/port hosted a group of around 6-10 Chinese cargo ships, and a few small Lao and Thai boats. In addition to the Chinese boats, which carried a variety of cargo (fruits/vegetables, cars, etc), other smaller boats were observed carrying loads of cargo, though the types of items could not be observed. In this area, the Lao side supports primarily cultivated land, with a few villages and some fishing activity. Serious bank erosion was observed on both the Thai and Lao sides of the river, though more on the Lao side, particularly where the river bends (as expected). Some of the erosion appeared to be natural (changes in river flow) and some from human activity such as forest clearing (resulting in landslides), village development (degradation to the environment) and over use (trampling by animals, riverbank agriculture, etc).

3.3.6 Fish and Fisheries

From Xieng Kok to Luang Prabang, five villages and two fishing sites (Don Veng and Don Ban Dan) were visited by the survey team. Table 6 presents the information for each site surveyed including the number of households and fishers, and the number of boats used in each village.

No	District	Village	No. HH [a]	Population	No. Fishers		No. Boats	
					Full Time	Part Time	With Engine	Without Engine
1	Viengphoukha	Chom Seng	41	170	5	36	1	4
2	Viengphoukha	Phak Khao	41	150	4	37	1	3
3	Mom	Mom	145	450	9	0	0	0
4	Hongsa	Tha Souang	40	300	5	10	15	0
5	Pak Ou	Pak Ou	63	374	20	30	50	0

Table 6: List of Villages Visited by Fishery Team

[a] HH: Household Size

Fishers reported that during the blasting period fish catches changed only slightly. Since the end of the blasting period, fish catch and fish species composition have returned to normal. In some areas, such as Pak Ou village, fish catch increased over the previous two years, mainly during the wet season. The most likely explanation for these changes is higher water levels higher than in previous years. Local fishers are familiar with fluctuations in fish catch from year to year.

In general, fishery activities from Xieng Kok to Huay Xai is less prevalent than from Huay Xai to Luang Prabang, the main reason being the scarcity of villages from Xieng Kok to Mom village. Also, strong water currents occurring in the upper part of Mekong deter fishing. More specifically, in Mom village, only a few people fish in the Mekong River, while the majority fish in smaller tributaries, backswamps and ponds where fish are easier to catch. Villagers in this area fish for subsistence and to sell in markets.

In Ban Pha Kao, near Song Khet Rapids, road construction has caused a decreased in fish catch. A local fisher interviewed claimed that he could no longer catch fish in streams connected to the Mekong since the road has blocked the path for the fish to migrate to the floodplain.

The main reason why the Mekong is not widely fished is that villagers cannot afford the upfront investment to acquire the necessary gear for fishing in the main river. Intensification in boat traffic may also be limiting fishing on the Mekong, as speedboats and large cargo vessels interfere with fishing activities.

A number of fishing villages were encountered between Mom village and Luang Prabang, including Ban Tin That on the Lao side and Nong Veng on the Thai side. Fishers from both villages come to Don Veng to fish for the Giant Catfish and other species. Fishing for the Giant Catfish has been traditionally practiced near Dan Beang, where Lao and Thai fishers have long shared this important fishery. According to fishers interviewed, seven Giant Catfish were caught this year, weighing between 150 and 200 kg (see Appendix), representing a catch unprecedented in recent years.

Below Dan village, short gillnets (3-5 m long) near rocky shores are used extensively, particularly between Ban Khok Ka and Ban Pak Ou, targeting larger fish that come to feed on rocky substrates. From Khon Pi Luang to Ban Pakbeng, the number of nets and engine boats were also noted. From Pak Ou to Luang Prabang, fishers reported using used longer gillnets and long line.

4.0 ISSUES NOTED

4.1 Issues of Development

The impacts of the Chinese led development of the Mekong River between the Lao-Chinese border and Luang Prabang are not well understood.

Construction of a road close to the riverbank on the Lao side has resulted in several landslides, and it appears that mitigation of impacts has not been incorporated into planning (observed from Xieng Kok to Wong Wit Rapids).

Quarrying of rocks near the riverbank in the Tang Pan Rapids has led to bank erosion.

The destruction of many local fisheries as a direct result of river development activities, such as blasting of the Mekong rapids, are difficult to substantiate and raise several important issues. Most likely, changes in river morphology will cause fishers to adapt their strategies to the changed river. The widespread practice of fishing near rapids with fast flowing water, using special gear adapted to the rough conditions (hanging nets deployed from rock outcroppings across short stretches of water), will have to be abandoned or modified to accommodate to wider and deeper channels.

Segments of the Mekong River have undergone significant changes to allow large vessels to navigate. The changes have come at the expense of other uses of the river, including fishing. With the absence of baseline data, the overall loss of local fisheries will not be easy to quantify. The establishment of new fisheries in the area will have to be considered in an overall assessment of the impacts of the project.

A monitoring programme should investigate changes in the local fishing strategies at the sites where the most dramatic changes to the river morphology have occurred. Details of the suggested monitoring approaches are presented in Section 5.0.

The basin wide impacts on migratory fish species are an important issue, and should consider both the changes in river flow affecting fish movement and the impact on spawning strategies. Again, no reliable studies or baseline data are available for the project location. To date, most of the rapids targeted by the project have been significantly altered, and stream flows have been reduced where rocks outcroppings have been removed and the river has been widened. Although, the upper Lao Mekong River stretch is, or was, difficult to navigate, there are no physical barriers preventing fish passage in the region – Khone Falls, several hundred kilometres downstream is the only known natural physical barrier significantly affecting movement of aquatic animals.

Changes in migration patterns through the altered stretch of the river are likely. Abundance and distribution of fish species in and upstream of the project area may be affected. In particular, species adapted to fast flowing and turbulent waters may decrease in number and be replaced by other species. The fish fauna found beyond the impacted area may also change.

Information is limited on specific fish use of habitat, including spawning behaviour. Detailed investigation of local fisheries might provide insight into the changes in fish fauna in the vicinity of the rapids. Comparison of fish fauna composition in similar downstream rapids that are still in their pristine state, could provide the basis for a sound assessment of the project impact.

These are key questions that form the basis for development of a long-term monitoring programme.

4.2 Issues for Conservation

River basin level conservation management issues presented here include both direct/local and indirect impacts from project development activities.

A conservation management plan should be outlined, to help maintain ecosystem functions in a network of key biodiversity sites. Guiding principals that use environmental flow requirements should be integrated into the plan. Populations of 'representative' species currently found in the river system must be maintained.

Illegal poaching of wildlife is a severe threat to wild fauna that occurs in riparian habitats of the river. A Clouded Leopard (*Neofelis nebulosa*) skin was observed in a house in Pak Ou village. A fisher was observed trading live green pigeon (10 Thick-billed green pigeons and 2 Wedge-tailed green pigeons), caught from the forest.

The invasive alien Giant Mimosa (*Mimosa pigra*) has spread widely along the riverbank from Xieng Kok to Luang Prabang. A clear increase in the spread of this species was noted between the first and second survey. Some of the mud flat islands had up to 90% cover by Giant Mimosa, which suppresses the growth of other native species, including reeds.

Clearing of primary forest for slash and burn agriculture is a major concern for biodiversity conservation, given the fact that remaining primary forest cover along the river is about 6%. It was also observed that some of the refuge areas identified during the first survey have been partially cleared for agricultural activities (i.e. areas near Huai Tant island).

Harmful fishing practices were reported by some fishers, including electrocution (using 12v batteries) and blast fishing, which results in mass mortality of aquatic organisms.

Large scale logging operations were observed in some locations (i.e. waypoint 121 at km 142), with expansion likely as navigation develops.

The Mekong River rapids impacted by the project constitute a distinctive ecosystem and potentially support unique fish fauna, and other undiscovered aquatic species. A detailed investigation of all the taxa found in the vicinity of the rapids and an assessment of the level of endemism found in the upper Lao Mekong region is of key concern.

Changes in the area adjacent to the project, through increased human activity, forestry, agriculture, tourism, etc. are likely to have significant impacts on the rich biodiversity found in the region.

4.3 Issues Related to Biodiversity Sampling

The following list of sampling related issues were discussed in the previous report:

- Technical
- Personnel
- Logistic
- Permissions
- Questions and gaps in information

Following the second visit to the area, additional considerations include:

- Lack of equipment to facilitate the sampling of different groups of biota
- Lack of baseline information
- Lack of maps/remote sensed images/aerial photographs
- Lack of trained personnel (para-taxonomists, ecologists)
- Issues related to safety and security (i.e. The Tang Salum Rapids could not be reached because of security concerns; the participants did not have adequate safety gear such as good life jackets and helmets)

Fish Considerations: The sampling of rapids for assessing fish biodiversity is both technically and scientifically challenging. The development of adequate sampling methods is problematic. As such, establishment of baseline information on the rapids has not yet taken place. Once adequate samples have been collected, trained personnel must be found to identify the collected specimens.

5.0 RECOMMENDATION FOR PLANNING A REGIONAL BIODIVERSITY SURVEY AND MONITORING PROGRAMME ON THE UPPER MEKONG RIVER

An ecosystem-specific methodology for a programme of regional biodiversity monitoring and assessment should be implemented in the Lao Upper Mekong. Opportunities for coordination with neighbouring countries should be explored.

Building upon existing databases in the Lao PDR, a database and bio-repository specific for the Upper Mekong should be developed. Where there are opportunities for coordination and exchange with neighbouring countries these should also be explored.

Identify implementing agencies in each Upper Mekong country, and develop the infrastructure and capacity of the relevant agencies to implement the biodiversity survey and monitoring programme.

Recommendations:

1. Develop capacity and technical expertise of Lao government staff
    a. Team of at least 20 people from Lao to do next study
    b. Carry out two surveys each year – one in the dry season and one during the peak floods
    c. IUCN should organise a week of training before next monitoring trip
    d. Bio-repository - herbarium – plan identification, animals preserved and curated
2. Centralised database of outputs (CD-ROM, photo gallery)
3. Ensure there is a pre-meeting before monitoring trip
4. Develop basic manual on how to make assessments; translated into Lao and available before next monitoring trip
5. Incorporate livelihood issues into next monitoring trip with specific recommendations

5.1 Recommendation for Further Fisheries Survey Activities

The following recommendations for further fisheries investigations and long-term monitoring are in keeping with ongoing assessment activities that are part of the Assessment Project, AMFC/MRC, at LARReC.

Based on the information provided by the villagers and from the team's own observations, the most suitable sites for conducting detailed assessment activities are Chom Seng, Pha Khao and Tin Pha villages.

Fisheries monitoring on the upper Mekong River would be conducted in the first two villages, while the last village would be selected for a focus investigation on Giant Catfish life history. Fishers in each village would be selected to participate in the monitoring program. For the selected fishers, a self-reporting system, using logbooks to record individuals' daily catch, would be implemented. LARReC has extensive experience using this approach.

5.2 Extensive Biodiversity Survey

Details are provided in the report from the first survey: ‘Scoping Survey for Biodiversity Assessment of the Mekong River Northern Laos and Thailand’, (Section 7.1).

The main headings of the section include:

- Objectives and Products
- Personnel and Expertise Required
- Institutional Arrangements
- Process
- Possible Methods To Be Used
- Sampling of Terrestrial and Seasonally Inundated Ecosystems/Habitats Located 500 m on Either Side of the Mekong River Mainstream
- Sampling of Freshwater Wetlands
- Key Sampling Sites and Habitats
- Selection of Sampling Site for the Extensive Survey
- Equipment
- Timing
- Logistics

Also included is a section entitled: “Baseline Survey and Monitoring for Khon Pi Luang Rapids, Thailand and Lao PDR,” which can be broken down as follows:

- Objectives and Products
- Survey Concept and Design
- Identification of Key Habitats and Survey Sampling Sites
- Expertise Required
- Sampling Methods and Equipment Required
    - Drift net sampling
    - Opportunistic use of technical more approaches

6.0 RECOMMENDATIONS

Regular systematic monitoring of the Upper Mekong for biodiversity and socio-economics assessment is necessary to ensure appropriate development of this important area of the Mekong River. A number of pressures have already been identified, including development of river navigation, development of roads, increased access to fragile areas, and changes in land use along riverbanks and watersheds. In addition, the implications of large-scale infrastructure development upstream and climate variation need to be considered. The combined and cumulative effects of these pressures remain unknown, but are anticipated to have significant implications. Without regular systematic monitoring, it will be difficult to ensure sustainable development and conservation.

To assess seasonal variation, regular monitoring should be conducted twice a year. The team should use a slow boat and take at least 15 days per mission. Additional time would be required for analysis of data, preparation of reports, and further dissemination activities. This level of commitment has implications for participation in the missions. It is recommended that a team of junior to mid-level technical staff be established with training support.

Specific training in assessment and monitoring methodologies for established monitoring team is required. Developing linkages with academic and research institutions will provide opportunities for technical support, and for including monitoring activities in the preparation of biodiversity curricula.

A wealth of information will be generated by monitoring activities and will need to be appropriately managed. Establishing a central database should be considered to organise and maintain biodiversity and socio-economic data on the Mekong River.

Collection and storage of specimens should also be considered. A national biodiversity repository (a herbarium and a faunal repository) would facilitate future biodiversity monitoring activities in the Mekong River.

Numerous areas along the river were identified during the first and second surveys as potential protected areas (i.e. national park, sanctuary etc.) or environmentally sensitive areas. Assessing such opportunities should be included in future monitoring activities. Initiatives to address livelihood constraints of local people could also alleviate poverty and reduce pressure on natural resources.

It is recognised that all of these recommendations have significant cost implications. Identifying financial resources is therefore an essential part in developing a regular monitoring programme.

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APPENDIX 1: TERMS OF REFERENCE

INTRODUCTION

In late February 2003, IUCN and the Lao National Mekong Committee carried out a rapid biodiversity scoping study of the upper stretches of the Mekong between Lao PDR and Myanmar, and between Lao PDR and Thailand. The objective was to prepare for a more detailed survey of the area that has been scheduled for river modification activities under the Navigation Channel Improvement Project. The area studied was from the Tang Salum Rapid to Huay Xai/Chiang Khong.

The area was considered to be rich in biodiversity, falling into at least three different ecological zones – fast mountain river with extensive rock outcrops and rapid systems, wider, slower moving meandering river, and then back to faster river with braided channels and deep pools. All of these areas are considered to be important for fish life cycles and fisheries, although in the upper reaches, fishery activities appeared to be limited at this time of year. Various stretches of the river and its surrounding landscape were identified as biodiversity refuges, for which steps should be taken for their protection.

The impacts of the navigation channel improvement measures are difficult to predict, but may be relatively limited owing to the extensive nature of the rock formations and shoals over much of the length of the river surveyed. However, the absence of a comprehensive and effective EIA and/or baseline survey has meant that not only are the impacts difficult to predict, but also it will be very difficult to say how the modification measures have actually affected the river and its biodiversity.

There was great concern about the long-term impacts of increased and larger cargo boats using this part of the river. Already there is evidence of impacts upon the environment and the local livelihoods of riparian communities. The potential for increased negative impacts with the implementation of Phases 2 and 3 is considered to be high, and no further implementation should be done without an adequate impact assessment based upon baseline information gathered during additional surveys.

Three such surveys are recommended:

1. An extensive biodiversity survey of the entire stretch of the river between the Chinese/Lao border to Luang Prabang, sampling at least 10 sites, during November/December 2003. (This was not carried out)

2. An intensive baseline survey to be carried out at Khon Pi Luang Rapids (Thailand and Lao PDR) in both June and November 2003, to be coupled with a study of livelihoods of local communities. This rapid is significant both from a biological point of view, but also because it is scheduled for modification in December 2003. Hence a baseline survey can be carried out in time, at both rising water and falling water regimes. (to some extent this has been studied through community natural resource identification, and through the EIA carried out on behalf of the Thai Government)

3. Preliminary survey of the habitat and spawning of Giant Mekong Catfish around Chiang Khong. The Giant Mekong Catfish is a Critically Endangered endemic species of the Mekong, which can be used as a flagship species and indicator for the health of the Mekong. (This was carried out in May 2003)

IUCN, in collaboration with the Environmental Research Institute (STEA) will carry out a follow-up survey to monitor the changes that have happened in the interim period using reports and documents that have been prepared.

It will also extend the area of survey between Ban Huay Xai and Luang Prabang, a stretch of the river where further river modification works are envisaged under the Upper Mekong Navigation Agreement.

This follow-up survey will be carried out under the auspices of the Mekong Wetland Biodiversity Conservation Programme. Funding for this survey comes from the Water and Nature Initiative Funds managed by the IUCN Asia Regional Office. Logistic arrangements are being carried out by the Environment Research Institute (STEA) and IUCN –Lao PDR. As far as possible, continuity with the earlier survey should be ensured by having at least half the people involved in the earlier survey taking part in the follow up.

OBJECTIVES

1. To develop further understanding and insight into the biodiversity of the riverine ecosystems, habitats and species in the stretch of the Mekong between the China/Lao PDR border and Ban Huay Xai, and of the riparian communities that depend upon the natural resources in this stretch of the river for their livelihoods (using recently available studies and reports, coupled with follow-up inspection and monitoring of changes in the river ecosystem)

2. To prepare proposals and identify parameters for further regular programme of monitoring and survey work with clearer identification of areas of particular biodiversity interest that may be developed into areas for conservation.

3. To provide the tools and support for capacity building on survey methodologies with Lao government partners.

REFERENCE MATERIAL

The following papers and studies have been prepared since February 2003 and should be available for the survey team:

- Status report on the Mekong Giant Catfish – by Zeb Hogan
- Report on SEARIN's work at Khon Pi Luang as well as Thai Baan research to identify natural resources used by local communities
- Progress report on the EIA carried out on the proposed river modification works at Khon Pi Luang on behalf of the Thai government

Additional information should also be obtained if possible

- Information on water levels from the river monitoring station at Chiang Saen, Thailand – from MRC
- Information on boat traffic/movements and upgrading of the port at Chiang Saen, and information on boat traffic in Lao PDR

ACTIVITIES/METHODS

1. Visit the area by boat according to the attached draft programme;
2. Inspect key sites down the river, taking biological samples and photographs where possible;
3. Visit riparian communities, discuss the features, habitats and species that they use from the river, including seasonal variations;
4. Inspect any fish catches and other natural resources, identify species, inspect gut contents to establish feed species;

5. Prepare report of the rapid biodiversity assessment according to format and authors to be agreed;
6. Develop plan for more detailed biodiversity monitoring and survey;
7. Team members to prepare summary reports; and
8. Team Leader to finalise and present the report to LNMCS

PARTICIPANTS

The Core Team will be led by Mr Thavone Vongphosy Department of the Environment, (STEA). Ms Monamany Nhoybouakong, Director of Environment Research Institute (STEA) and Dr Channa Bambaradeniya (IUCN) will act as Joint Team Leaders. The Core Team will be responsible for the monitoring and survey work. *Each member will be required to prepare a summary report* to be compiled as a Final Report.

The rapid survey Core Team will consist of the following persons:

- Dr Channa Bambaradeniya – Programme Coordinator - IUCN Sri Lanka
- Mr Pierre Dubeau – Aquatic Ecosystems Ecologist
- Lao PDR Government officials:
- Mr Thavone Vongphosy, Department of the Environment, STEA accompanied by 2 representatives from Environment Research Institute (ERI);
- Mr Singha Ounniyom – Director of Water Resources Development Division, Lao National Mekong Committee Secretariat (LNMC);
- Mr Douangkham Singhanouvong, LARREC
- Mr Bounmy Souksavath, representative from Waterways Administration, MCTPC in Lao PDR,
- Representative of Water Resources Coordination Committee WRCC

From Cambodia

- Ms Kate Lazarus, Watershed/Integrated Water Resource Management, Oxfam

In addition, 2 provincial representatives from Luang Namtha and Bokeo will join the mission to Huay Xai.

DRAFT PROGRAMME

NB. Boat travel will be by large boat.

May 31, 2004
- Depart from Vientiane for Luang Namtha;
- Drive from Ban Xieng Kok

June 1, 2004
- Travel by boat to Muang Mom

June 2, 2004
- Travel by boat to Ban Kok Kha (1.5 hours upstream from Huay Xai)

June 3, 2004
- Drop representatives from Luang Namtha and Bokeo Province at Huay Xai;
- Travel by boat to Luang Prabang

June 4, 2004
- Debriefing in Luang Prabang;
- Return by air to Vientiane and final debriefing in Vientiane

NB. Provincial representatives from Luang Namtha and Bokeo will join the mission as far as Huay Xai.

EQUIPMENT REQUIRED AND PERSON RESPONSIBLE

- GPS recorders
- Fish larvae sampling traps – LARReC
- Plastic sample bags/bottles – obtain in Vientiane
- Dissection kits and preservative
- Other sampling gear etc
- Maps of river – LNMC
- MRC Mekong Fisheries Database on computer
- EIA reports by Chinese on Navigation channel improvements
- Additional photocopies of maps and diagrams of rapids from EIA
- Laptop computer with photographic material from First Scoping Study
- Digital cameras

APPENDIX 2: DETAILED SURVEY - RAW DATA

Detailed information collected at each GPS waypoint between Huay Xai and Luang Prabang is included in a spreadsheet accompanying this report, see file name: «IUCN_FollowupSurvey_RawData.xls».

Photos documenting the mission are also available on CD-ROM upon request.

APPENDIX 3: SPECIES LISTS

Reptiles

Family	Common and Scientific Name	Habitat
Gekkonidae	Spiny-tailed House Gecko – *Hemidactylus frenatus*	Home gardens
	Four-clawed Gecko – *Gehyra mutilata*	Home gardens
	Flat-tailed Gecko – *Cosymbotus platyrus*	Home gardens
Agamidae	Common Garden Lizard – *Calotes versicolor*	Home gardens

Table A7: List of Reptiles Recorded

Birds

A Total of 87 bird species were recorded: 11 new species recorded during second scoping survey (indicated in bold letters)

Family	Common and Scientific Name	Habitat [1]	Relative Abund. [2]
Anatidae	Ruddy Shelduck – *Tadorna ferruginea*	SB, MF	R
	Spot-billed Duck – *Anas poecilorhyncha*	SB, MF	R
	Lesser Whistling Duck – *Dendrocygna javanica*	MF	UC
	Fulvous whistling Duck – *Dendrocygna bicolor*	MF	R
Scolopacidae	Common Sandpiper – *Actitis hypoleucos*	SB, MF	C
Burhinidae	Great Thick-knee – *Esacus recurvirostris*	SB, MF	R
Charadriidae	Little-ringed Plover – *Charadrius dubius*	SB, MF, RB	C
	Long-billed Plover – *Charadrius placidus*	SB, MF	R
	Kentish Plover – *Charadrius alexandrianus*	SB, MF	UC
	River Lapwing – *Vanellus duvaucelii*	SB, MF, RB	UC
	Grey-headed Lapwing – *Vanellus cinereus*	SB, MF, RB	UC
	Red-wattled Lapwing – *Vanellus indicus*	SB, MF, RB	UC
	Temminck's Stint – *Calidris temminckii*	SB, MF	UC
Glareolidae	Small Pratincole – *Glareola lacteal*	SB, MF, RB,RO	C
Ardeidae	Little Egret – *Egretta garzetta*	SB, MF, RB	C
	Intermediate Egret – *Mesophoyx intermedia*	SB, MF, RB	UC
	Great Egret – *Casmerodius albus*	SB, MF	R
	Chinese Pond Heron – *Ardeola bacchus*	SB, MF, RB	C
	Grey Heron – *Ardea cinerea*	SB, MF	UC
	Little Heron – *Butorides striatus*	RO, RB	R
Alcedinidae	Common Kingfisher – *Alcedo atthis*	RB, RO	UC
	Blyth's Kingfisher – *Alcedo hercules*	RB, RO	R
Halcyonidae	White-throated Kingfisher – *Halcyon smyrnensis*	RB, RO	C
	Stork-billed Kingfisher – *Halcyon capensis*	RB	R
	Collard Kingfisher – *Todiramphus chloris*	RB	R
Motacillidae	White Wagtail – *Motacilla alba*	RB, RO, MF,SB	C
	Grey Wagtail – *Motacilla cinerea*	RB, MF	R
	Paddyfield Pipit – *Anthus rufulus*	MF, HG, C	UC
Turdidae	**Slaty-backed Forktail – *Enicurus schistaceus***	RB, RO	R
Hirundinidae	Barn Swallow – *Hirundo rustica*	SB, RO, HG	C
	Red-rumped Swallow – *Hirundo daurica*	HG, SB, DSF	C

Family	Common and Scientific Name	Habitat [1]	Relative Abund. [2]
	Wire-tailed Swallow – *Hirundo smithii*	DSF, RB	R
	Plain Martin – *Riparia paludicola*	RB, SB, S, C	UC
Apodidae	House Swift – *Apus affinis*	S, C,	C
	Asian Palm Swift – *Cypsiurus balasiensis*	HG, RB	C
Hemiprocnidae	Crested Treeswift – *Hemiprocne coronata*	S, DSF	R
Tytonidae	Barn Owl – *Tyto alba*	HG, DSF	R
Strigidae	Asian Barred Owlet – *Glaucidium cuculoides*	REF, DSF	R
	Collared Scops-Owl – Otus Lempiji	REF, DSF	R
Eurostopodidae	Great-eared Nightjar – *Eurostopodus macrotis*	REF, DSF	UC
Pycnonotidae	Red-whiskered Bulbul – *Pycnonotus jocosus*	REF,BF,DSF,HG	C
	Black-crested Bulbul – *Pycnonotus melanicterus*	REF,BF,DSF,HG	UC
	Black Bulbul – *Hypsipetes leucocephalus*	REF, DSF	R
	Grey-eyed Bulbul – *Hypsipetes propinquus*	REF, DSF	UC
	Sooty-headed Bulbul – *Pycnonotus aurigaster*	REF, DSF, HG	C
	Crested Finchbul - *Spizixos canifrons*	REF, DSF	UC
Oriolidae	Black-hooded Oriole – *Oriolus xanthornus*	DSF	R
	Grey-chinned Minivet – *Pericrocotus solaris*	REF, DSF	R
Dicruridae	Black Drongo – *Dicrurus macrocercus*	DSF	R
Muscicapidae	Asian Brown Flycatcher – *Muscicapa dauurica*	DSF, HG	R
	Red-throated Flycatcher – *Ficedula parva*	RB, DSF	UC
Megalaimidae	Blue-throated Barbet – *Megalaima asiatica*	REF, DSF	C
	Coppersmith Barbet –*Megalaima haemacephala*	REF, DSF	UC
	Green-eared Barbet – *Megalaima faiostricta*	REF, DSF	UC
Picidae	Greater Yellownape – *Picus flavinucha*	REF, DSF	R
Sylviidae	Lanceolated Warbler – *Locustella lanceolata*	TGB, S, DSF	R
	Arctic Warbler – *Phylloscopus borealis*	DSF, S, HG, TGB	R
	Great Reed – Warbler – *Acrocephalus arundinaceus*	TGB	UC
	Common Tailorbird – *Orthotomus sutorius*	DSF,HG,BF,TGB	C
	Dark-necked Tailorbird – *Orthotomus atrogularis*	DSF	R
Cisticolidae	Grey-breasted Prinia – *Prinia hodgsonii*	DSF, HG, TGB, S	C
Sylviidae	Striped Tit Babbler – *Macronus gularis*	DSF, BF	UC
	Rufous-fronted Babbler – *Stachyris rufifrons*	DSF, S	C
	White-browed Scimitar Babbler – *Pomatorhinus schisticeps*	DSF, REF	R
	Puff-throated Babbler – *Pellorneum ruficeps*	DSF, REF	UC
Zosteropidae	Oriental White-eye – *Zosterops palpebrosus*	DSF, REF, BF	UC
	Japanese White-eye – *Zosterops japonicus*	DSF, REF, BF	UC
Columbidae	**Thick-billed Green Pigeon (*Treron curvirostra*)**	REF	R
	Wedge-tailed Green Pigeon (*Treron sphenura*)	REF	R
	Blue Rock Pigeon (*Columba livia*)	HG	
	Green Imperial Pigeon – *Ducula aenea*	REF, DSF	R
Centropodidae	Greater Coucal – *Centropus sinensis*	DSF, REF	C
Cuculidae	Asian Koel – *Eudynamys scolopacea*	DSF, HG	UC
Meropidae	Blue-tailed Bee Eater – *Merops philippinus*	RB	C
	Green Bee Eater – *Merops orientalis*	RB, DSF	UC
Dicaeidae	Scarlet-backed Flowerpecker – *Dicaeum cruentatum*	DSF, S, HG	UC
Nectariniidae	Purple Sunbird – *Nectarinia asiatica*	DSF, HG, REF	C

Family	Common and Scientific Name	Habitat [1]	Relative Abund. [2]
Passeridae	House Sparrow – *Passer domesticus*	HG, S, C	C
	Eurasian Tree Sparrow – *Passer montanus*	DSF	UC
Phasianidae	Red Junglefowl – *Gallus gallus*	DSF, REF	R
	Silver Pheasant – *Lophura nycthemera*	DSF, REF	R
Coraciidae	Indian Roller – *Coracias benghalensis*	DSF,C,S	C
Corvidae	Black-billed Magpie – *Pica pica*	DSF, HG, C	C
Irenidae	Common Iora – *Aegithina tiphia*	DSF, HG, C	C
Ploceidae	**Baya weaver – *Ploceus philippinus***	DSF	UC
Estrildidae	White-rumped Munia – *Lonchura striata*	BF, DSF	C
	Scaly-breasted Munia – *Lonchura punctulata*	BF, DSF	C

Table A8: Checklist of Birds Recorded Along The Northern Mekong Riverine Ecosystems, Extending from Tang Salum To Luang Prabang

(Cumulative list from observation made during surveys 1 and 2)

[1] Habitats: RB – Riverbank; SB – Sand bars; MF – Mud flats; RO – Rock outcrops; REF – Riverine evergreen forests; BF – Bamboo forests; TGB – Tall Grass beds; S – Shrubland; HG – Home Gardens; DSF – Disturbed secondary forest, C – Cultivations

[2] Relative abundance - Based on frequency of observations along the riverine ecosystem stretch: C - Common (> 50% of observations); UC - Uncommon (20-50% of observations); R - Rare (< 20% of observations)

Mammals

Ten species, including 4 new species were reported (new species indicated in bold letters).

Family	Common and Scientific Name	Habitat
Lorisidae	Slow Loris – *Nycticebus coucang*	Riverine evergreen forests, disturbed secondary forests
Cercopithecidae	Pig-tailed Macaque – *Macaca nemestrina*	Riverine evergreen forests, disturbed secondary forests
Felidae	Fishing Cat – *Prionailurus viverrinus*	Riverbanks, Riverine evergreen forests, disturbed secondary forests
	Clouded Leopard – *Neofelis nebulosa*	Riverine evergreen forests
Sciuridae	Sundasciurus spp. and Callosciurus spp.	Riverine evergreen forests, disturbed secondary forests
Suidae	**Wild Pig – *Sus scrofa***	Disturbed secondary forests
Hystricidae	**Porcupine – *Hystrix spp.***	Disturbed secondary forests
Leporidae	**Siamese Hare – *Lepus peguensis***	Disturbed secondary forests
Bovidae	Domestic/feral buffalo – *Bubalus arnee*	Mudflats, degraded secondary forest

Table A9: List of Mammals Recorded
(Cumulative list of surveys 1 and 2)

Butterflies

Family	Common and Scientific Name	Habitat
	Lime Butterfly – *Papilio demoleus*	Home gardens, Mud flats
	Crimson Rose – *Pachliopta aristolochiae*	Home gardens, secondary forests, riverine evergreen forests
	Red Helen – *Papilio helenus*	Home gardens, secondary forests, riverine evergreen forests
	Papilio noblei	secondary forests, riverine evergreen forests
	Common mormon – *Papilio polytes*	Home gardens, shrublands
	Five-bar sword tail – *Graphium antiphates*	Shrubland, degraded forest
	Common Bird wing – *Troides darsius*	Home gardens, shrubland
	Common Mime – *Chilasa clytia*	Riverbank shrubland and home gardens
	Great Mormon – *Papilio memnon*	Riverbank shrubland and home gardens
	Common Jay – *Graphium doson*	Riverbank shrubland and home gardens
	Blue Bottle – *Graphium sarpedon*	Riverbank shrubland and home gardens
Danaidae	Plain Tiger – *Danaus chrysippus*	Home gardens, shrublands
	Common Tiger – *Danaus genutia*	Home gardens, shrublands
	Glassy Tiger – *Parantica aglea*	Home gardens, shrublands
	Blue Glassy Tiger – *Ideopsis similis*	Home gardens, shrublands
	Common Crow – *Euploea core*	Home gardens, shrublands, mudflats
	Striped Blue Crow – *Euploea mulciber*	Riverbank shrubland and home gardens
Acraeidae	**Red Coster – *Acraea violae***	Riverbank shrubland and home gardens
Pieridae	*Artogeia canidia*	Riverbank shrubland and home gardens
	Spotted saw tooth – *Prioneris thestylis*	Riverbank shrubland and home gardens
	Lemon Immigrant – *Catopsilia Pomona*	Riverbank shrubland and home gardens
	Chocolate Albatross – *Appias lyncida*	Riverbank shrubland and home gardens
	Common Albatross – *Appias albius*	Riverbank shrubland and home gardens
	Common Gull – *Lepora nerissa*	Riverbank shrubland and home gardens
	Common Grass Yellow – *Eurema hecabe*	Riverbank shrubland and home gardens
Nymphalidae	**Great Egg fly – *Hypolima bolina***	Riverbank shrubland
	Clipper – *Parthenos sylvia*	Riverbank shrubland
	Common sailor – *Neptis hylas*	Riverbank shrubland
Lycaenidae	Several species	Riverbank shrubland

Table A10: List of Butterflies Recorded

(Cumulative list of surveys 1 and 2)

Fish

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
1	20	*Dasyatis laosensis*	Pa fa lai					X				X		X
2	31	*Chitala blanci*	Pa tong											X
3	32	*Chitala lopis*	Pa tong								X		X	X
4	33	*Chitala ornata*	Pa tong Dao				X				X			X
5	34	*Notopterus notopterus*	Pa tong				X						X	
6	40	*Anguilla marmorata*	Pa tong meo											X
7	95	*Lycothrissa crocodilus*	Pa mak hao								X	X	X	X
8	118	*Acheilognathus barbatulus*	Pa satay	X	X									
9	119	*Acheilognathus deignani*	Pa pik leang		X									
10	126	*Paralaubuca barroni*	Pa tep								X	X	X	X
11	129	*Paralaubuca typus*	Pa tep			X	X				X	X	X	X
12	130	*Pseudohemiculter dispar*	Pa mak hao								X	X	X	X
13	133	*Macrochirichthys macrochirus*	Pa hang pha (Pa pep)	X	X		X				X	X	X	X
14	134	*Oxygaster anomalura*	Pa sie									X	X	X
15	141	*Parachela williaminae*	Pa siu pep	X										
16	143	*Raiamas guttatus*	Pa mak hao lay	X	X						X	X		X
17	149	*Opsarius pulchellus*	Pa kham	X						X				
18	158	*Chela laubuca*	Pa sie houa ngand	X									X	
19	159	*Devario annandalei*	Pa kharm ter								X		X	
20	160	*Devario chrysotaeniatus*	Pa siu		X									
21	166	*Devario fangfangae*	Pa siu tong		X									
22	197	*Thryssocypris tonlesapensis*	Pa sie								X	X	X	X
23	201	*Luciocyprinus striolatus*	Pa kim	X										
24	202	*Abbottina rivularis*	Pa man	X	X									
25	204	*Hemibarbus labeo*	Pa sikhai		X									
26	207	*Carassius auratus*	Pa nai (pa fadd)									X	X	
27	208	*Cyprinus carpio*	Pa nai	X	X						X	X	X	X

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
28	211	*Neolissochilus stracheyi*	Pa deng	X										
29	215	*Tor laterivittatus*	Pa deng, pa hien	X	X		X							
30	217	*Tor sinensis*	Pa ka								X			X
31	218	*Tor tambroides*	Pa kha	X			X							
32	225	*Albulichthys albuloides*	Pa chork		X	X	X		X		X	X	X	X
33	226	*Amblyrhynchichthys truncatus*	Pa sabak		X									
34	229	*Cosmochilus harmandi*	Pa chook (Pa satay)	X							X	X	X	X
35	230	*Cyclocheilichthys apogon*	Pa chork xay								X	X	X	X
36	231	*Cyclocheilichthys armatus*	Pa chork xay								X	X	X	X
37	233	*Cyclocheilichthys furcatus*	Pa chork laii								X			X
38	238	*Cyclocheilichthys repasson*	Pa satay	X	X									
39	241	*Discherodontus ashmeadi*	Pa nam											X
40	242	*Discherodontus schroederi*	Pa chat	X	X									
41	247	*Mystacoleucus greenwayi*	Pa lang kor (Pa nam ya)	X	X		X				X		X	X
42	249	*Mystacoleucus marginatus*	Pa lang nam								X			
43	254	*Puntioplites falcifer*	Pa ii keng (Pa wi)	X		X	X		X		X	X	X	X
44	260	*Sikukia stejnegeri*	?				X							
45	263	*Barbonymus altus*	Pa vien fai	X		X					X	X	X	X
46	264	*Barbonymus gonionotus*	Pa khao	X	X						X			
47	265	*Barbonymus schwanenfeldii*	Pa vien fai											X
48	266	*Hypsibarbus lagleri*	Pa pak										X	X
49	268	*Hypsibarbus pierrei*	Pa pak pik daeing (Pa deng)		X						X	X		X
50	274	*Onychostoma spp.*	Pa khing								X	X	X	X
51	296	*Scaphiodonichthys acanthopterus*	Pa be nam (Pa kep)		X									X
52	297	*Scaphognathops bandanensis*	Pa pak pik leuang								X		X	
53	297	*Scaphognathops sp.*	Pa pak											X
54	298	*Scaphognathops theunensis*	Pa pak piik leung	X										
55	300	*Hampala dispar*	Pa khoun		X									
56	301	*Hampala macrolepidota*	Pa sik	X	X									

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
57	303	*Puntius brevis*	Pa pok	X			X							
58	316	*Catlocarpio sianensis*	Pa ka hoo								X	X		X
59	317	*Thynnichthys thynnoides*	Pa koum								X	X	X	X
60	318	*Bangana sp.1*	Pa Va	X	X						X	X		
61	326	*Cirrhinus jullieni*	Pa pik daing								X	X	X	X
62	328	*Cirrhinus molitorella*	Pa kaing gnai (Pa kieng)	X	X	X	X				X			
63	330	*Cirrhinus prosemion*	Pa kaing noy											X
64	333	*Labiobarbus lineata*	Pa lang khoonh											X
65	334	*Labiobarbus sp.cf.lineata*	Pa khee larm											X
66	335	*Labiobarbus siamensis*	Pa …				X							
67	340	*Henicorhynchus sp.*	Pa soi			X	X		X					
68	343	*Labeo dyocheilus*	Pa sa ii								X	X		X
69	352	*Labeo chrysophekadion*	Pa wa khan	X		X	X							
70	356	*Osteochilus hasseltii*	Pa i thai								X			
71	359	*Osteochilus microcephalus*	Pa khang serk								X	X	X	X
72	365	*Crossocheilus oblongus*	Pa mane											X
73	367	*Crossocheilus atrilimes*	Pa mane mok								X	X	X	X
74	369	*Epalzeorhynchos munense*	Pa mane poum											X
75	370	*Garra cambodgiensis*	Pa Phao (Pa man)	X	X					X				X
76	372	*Garra fasciacauda*	Pa Mane	X	X		X				X			X
77	416	*Sewellia sp.*	Pa pong	X										
78	429	*Schistura sp*	Pa pan	X	X									
79	521	*Tuberoschistura cambodgiensis*	Pa manh											X
80	523	*Botia beauforti*	Pa chichang	X			X							
81	525	*Botia caudipunctata*	Pa mou											X
82	526	*Botia eos*	Pa mou								X	X	X	
83	527	*Botia helodes*	Pa chiang		X		X							
84	531	*Botia longidorsalis*	Pa mou								X			X
85	535	*Botia nigrolineata*	Pa khi lai	X										

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
86	541	*Acanthopsoides delphax*	Pa khim (pa hak kouai)	X										
87	541	*Acanthopsoides sp.*	Pa hak kouai								X	X	X	X
88	542	*Acanthopsoides gracilentus*	Pa hak kouai	X	X						X		X	X
89	555	*Lepidocephalichthys berdmorei*	Pa Khun lun	X										
90	558	*Lepidocephalichthys hasselti*	Pa khun lun	X										
91	560	*Misgurnus anguillicaudatus*	Pa lang ou, pa ngu kieu	X	X									
92	564	*Pangio fusca*	Pa phanh								X	X	X	X
93	566	*Pangio myersi*	Pa Hak kouai								X	X		X
94	567	*Pangio oblonga*	Pa phanh											X
95	576	*Bagrichthys macracanthus*	Pa gnang bone									X		X
96	577	*Hemibagrus filamentus*	Pa kot mun	X		X	X							
97	580	*Hemibagrus wyckii*	Pa kot dam	X	X	X	X				X		X	
98	581	*Hemibagrus wyckioides*	Pa kheung (Pa kadd, Pa kot deng?)	X	X	X					X			
99	582	*Mystus atrifasciatus*	Pa ka gneang								X			
100	587	*Mystus multiradiatus*	Pa ka gneang								X	X		X
101	588	*Mystus mysticetus*	Pa ka gneang								X		X	X
102	595	*Pseudomystus siamensis*	Pa Gnang bone								X	X	X	X
103	597	*Belodontichthys truncatus*	Pa khop	X	X						X	X		X
104	598	*Ceratoglanis pachynema*	Pa hu khong	X	X		X							
105	601	*Micronema cheveyi*	Pa vhane											X
106	602	*Kryptopterus cryptopterus*	Pa seuarm vhane											X
107	608	*Micronema apogon*	Pa sa ngoua (Pa dap)	X										X
108	609	*Micronema sp.*	Pa nang								X	X	X	X
109	611	*Ompok bimaculatus*	Pa seuarm								X			X
110	611	*Ompok sp.*	Pa vhaane								X			X
111	614	*Pterocryptis sp.*	Pa Douk moune								X			
112	620	*Wallago attu*	Pa khao	X							X	X	X	X
113	621	*Wallago leerii*	Pa khoune (Pa khao dam)	X							X	X	X	X
114	623	*Laides longibarbis*	Pa ngone			X	X							

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
115	625	*Helicophagus waandersii*	Pa na nou								X	X	X	X
116	626	*Pangasianodon gigas*	Pa leum ling (Pa beuk)								X	X		X
117	627	*Pangasianodon hypophthalmus*	Pa Leum								X	X	X	X
118	628	*Pangasius sp.*	Pa humud	X			X							
119	631	*Pangasius krempfi*	Pa souay leuang								X	X		X
120	632	*Pangasius larnaudii*	Pa peung								X	X		X
121	635	*Pangasius sanitwongsei*	Pa leum	X										
122	638	*Pangasius pleurotaenia*	Pa gnone											X
123	644	*Bagarius yarrelli*	Pa khae leung	X	X	X								
124	687	*Clarias fuscus*	Pa duk	X	X									
125	695	*Liposarcus sp.*	Pa …								X	X	X	X
126	729	*Sundasalanx mekongensis*	Pa Ngiok (new fish)							X	X	X	X	
127	781	*Xenentodon canciloides*	Pa sob nok		X									
128	794	*Dermogenys siamensis*	Pa ike	X										
129	853	*Monopterus albus*	Eel (Pa yen)	X	X						X	X	X	X
130	857	*Macrognathus sp.*	Pa lad hua		X									
131	859	*Macrognathus taeniagaster*	Pa lat								X	X	X	X
132	862	*Mastacembelus armatus*	Pa lot (pa lang ou)	X							X	X	X	X
133	863	*Mastacembelus erythrotaenia*	Pa lat								X			X
134	897	*Parambassis apogonoides*	Pa khap khong								X	X	X	X
135	899	*Parambassis wolffii*	Pa khap khong				X							X
136	970	*Toxotes chatareus*	Pa meo								X		X	
137	974	*Badis ruber*	Pa sidet	X										
138	982	*Oreochromis niloticus*	Pa sam deng	X										
139	1007	*Oxyeleotris marmorata*	Pa bou			X	X				X	X	X	X
140	1048	*Glossogobius aureus*	Pa tep	X										
141	1119	*Rhinogobius sp.*	Pa bou								X			
142	1179	*Anabas testudineus*	Pa sadet	X	X									
143	1182	*Betta sp.*	Pa kat								X		X	X

No	Code [a]	Scientific Name	Local Name	Visit February 2003							Visit June 2004			
				1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4
144	1189	*Trichogaster microlepis*	Pa ka deut khao (Pa tep)	X	X						X			
145	1193	*Trichopsis schalleri*	Pa mat								X			
146	1195	*Trichopsis vittata*	Pa mat								X			X
147	1196	*Osphronemus exodon*	Pa mend											X
148	1197	*Osphronemus goramy*	Pa mend											X
149	1199	*Channa gachua*	Pa khang	X										
150	1204	*Channa striata*	Pa khor								X	X	X	X
151	1205	*Achiroides leucorhynchos*	Pa pe								X	X		X
152	1209	*Brachirus orientalis*	Pa pe											X
153	1210	*Brachirus panoides*	Pa pe											X
154	1217	*Cynoglossus feldmanni*	Pa pe								X			
155	1233	*Monotreta abei*	Pa pao										X	
156	1241	*Monotrete turgidus*	Pa pong, pa phao	X	X									
157	1263	*Helicophagus leptorhynchus*	Pa chalang	X										

Table A11: List of Fish Species Reported by Villagers During Interviews

The first visit took place 25-26 February 2003 and the second visit 2-3 June 2004

[a] Species Code numbers from Mekong Fish Database (AMFC/MRC) During the two field visits, 11 surveys were conducted.

APPENDIX 4: DETAILED INTERVIEW ACCOUNTS

Interview 1: Participants: Mrs Boualien, Age 41
Location: Chomseng village Date: 1 June 2004

Interview conducted with the deputy chief, Mrs Boualien. According to Mrs Boualien, there were fewer fish caught last year, especially during the period when blasting took place. Intense noise from blasting appeared to be one of the main causes for this drop in fish catch. Another reason invoked was the use of illegal fishing practices (such as dynamite) by Burmese, Chinese and some Lao people.

Fish prices have remains constant over the past years, averaging 130-150 baht per kilo for catfish and 50-80 baht per kilo for scale fish. Common fishing gear includes long line and gill net with mesh size of 4 and 8 cm.

Interview 2: Participants: Mr Maihong, Age 41, Mr Nan Oun, Age 70, Mr Mai Toun, Age 46
Location: Pha Khao village Date: 1 June 2004

All three fishers reported that the number and species of fish caught, as well as fish prices, have not changed in the last few years. However, they were concerned about fish declining in the future with the arrival of fishers from outside the community (Burmese and Chinese) and the use of illegal fishing methods such as dynamites and electricity (12v batteries).

An unusual species was reported in large numbers this year, probably *Neosalanx* sp. (very tiny fish with a head like a sneak head). In addition to this species, a fisher found two species of Chinese carp near Phakhao village (Pa Ketlap and Pa Kinya), probably escaped from local ponds.

For the past few years, fish prices have remained relatively constant: Catfish 90 baht per kilo, scale-fish 50 baht per kilo.

Interview 3: Participants: Mr Mai In Keo, Age 50 and his wife
Location: Mom village Date: 1 June 2004

Mr Mainkeo, an experienced fisher in the village, claimed that no one fishes in the Mekong River. Most people fish in the ponds found in the floodplain, such as Nong Ya Xay. People have no money to buy the fishing gear and boats required for the Mekong mainstream, and people from this community prefer to run businesses and engage in trade rather than fishing.

The main species caught were *Noptopterus notopterus*, *Channa* spp, Common carp, Tilapia, *Rasbora* spp. and *Clarias* spp. For the past two years, the number of fish has decreased due to road construction, which is responsible for blocking access to the adjacent floodplains. Additional causes might include the used of seine nets by some fishers, targeting small fish (juveniles) during the dry season. Mr Mainkeo claims that in the past he caught about 100 kg/day, but now he catches only 2-3 kg/day, and some days he cannot catch enough to feed his family.

The price of fish varied from 60-80 baht/kg, Clarias will fetch about 80 baht/kg, while carp sells for 60 baht/kg.

Interview 4: Participants: Mr Houmpheng, Age 38 (Lao), Mr Say Ya, Age 37 (Thai)
Location: Don Veng (Tin That Village) Date: 2 June 2004 (Giant Catfish related)

This area is an important fishing ground for Giant Catfish, for both Lao and Thai fishers. This year, 40 fishers and 40 boats, 50% of which were Thai fished in this area. According to Mr

Houmpheng, the fishing season for Giant Catfish is from 24 April to the end of May. For the last four years no one has caught any Giant Catfish. However, this year, seven large fish were caught, four of which were more then 200 kg, while the other three specimens were between 150-200kg.

When asked about the impact of the navigation project on the Giant Catfish, the fishers did not establish any clear linkages. However, significant water level fluctuations have been observed over the past few years. A recent increase in water levels could explain the return of the Giant Catfish as well as increase fish catch in the area.

Interview 5: Participants: Two Fishers from Dan Village (Lao PDR)
Location: Don Ban Dan (Dan Village) Date: 2 June 2004

This is the second fishing ground of importance in the area. About 20 fishers visit the area on a regular basis. The fishing season lasts from June to November and the peak period occurs between April and May. Fish migration occurs from February to April for cyprinids and from May to July for Catfish. The average catch is 4-5 kg/day during the month of June. The main species caught in this area are Cyclocheilichthys ssp. and a number of Pangasid species.

Interview 6: Participants: Mr Houmpheng (a Boat traffic officer and fish trader), Age 38
Location: Thasouang Village Date: 3 June 2004

There were about 15 fishers in this village, 5 of which are full time fishers, and about 15 boats. Fishing starts around November to September and the peak season occurs from February to March and from May to July. Many scale fish species, including Cirrhinus molitorella, Henicorhychus ssp. and others, migrate between February and March. From May to July, the main species engaged in lateral migration are Morulius chrysophekadon, Hemibagrus ssp. (Pa kot) and Pangasius spp.

The price for cyprinids is about 15,000 kip per kg and about 18,000 kips for catfish, except for Wallago spp. (Pa Khoun), which sell for more 100 baht per kg.

Interview 7: Participants: Mr Oukhaning, Age 43
Location: Pak Ou village Date: 3 June 2004

Mr Oukhaning is a fish trader and owner of a restaurant in Pak Ou village. Fishing is an important activity in the village with over 80% of the households engaged in some fishing activities, while fulltime fishers are found in 40% of the households. Fishing occurs all year around. Peak fishing season takes place in September. Downstream migration occurs in November (scale fish) and December, while upstream migration occurs from April to June (for both scale fish and Catfish species).

The main types of gear are gill net with mesh size between 4 and 18 cm and cast net with mesh size of 1.5-8 cm. Long lines and single hooks are also commonly used. The main fishing grounds are found near Vang Khok Ang, Vang Khok khom, Vang Tham Ting, Vang Ban Khok ban Muang, Keng Leunk, Keng Tha Nou. According to Mr Oukhaning, fish catches have significantly increased this season over the last few years. Mr Oukhaning supplies about 20 kg of fish to the market everyday.

Mekong Wetlands Biodiversity and Sustainable Use Programme (MWBP)

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. MWBP is a five-year programme that aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely.
www.mekongwetlands.org

The World Conservation Union (IUCN)

IUCN - The World Conservation Union brings together States, government agencies, and a diverse range of non-governmental organizations in a unique partnership. As a Union of members, The World Conservation Union seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.
www.iucn.org

IUCN Water & Nature Initiative (WANI)

The Water & Nature Initiative is a 5-year action programme to demonstrate that ecosystem-based management and stakeholder participation will help to solve the water dilemma of today - bringing rivers back to life and maintaining the resource base for many. www.waterandnature.org