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Development of a Species Conservation Action Plan for the Mekong Giant Catfish



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Preparation of this document

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Executive summary

- (1) The Mekong giant catfish, one of the world's largest freshwater fish and a charismatic animal revered throughout the Mekong region, is considered critically endangered (IUCN Red List 2003).
- (2) A range of conservation initiatives for the giant catfish are being carried out by organisations including the fisheries departments of Cambodia, Laos and Thailand, the Mekong River Commission, the UNDP/IUCN/MRC Mekong Wetlands Biodiversity Project, the Network of Aquaculture Centers in Asia-Pacific, WWF Indochina, and Imperial College London.
- (3) A Species Conservation Action Plan joint workshop was held in Phnom Penh, Cambodia on December 12-13 2005. The purpose of the workshop was to review existing knowledge on Mekong giant catfish, identify future conservation and research priority activities, and to continue the joint planning process aimed at developing an overarching conservation strategy for the Mekong giant catfish.
- (4) Although knowledge of the ecology of wild Mekong giant catfish is lacking, data does exist on giant catfish breeding, growth, past and present abundance, and distribution. This knowledge is often in local language literature; some has been translated and published in English-language documents.
- (5) Knowledge about the Mekong giant catfish is increasing, as several giant catfish-related projects move forward, including projects aimed to assess and improve breeding techniques, better understand population genetics, examine migratory behaviour, and determine true distribution and population status.
- (6) A conservation vision has been developed emphasizing the importance of "maintenance of a viable wild population of Mekong giant catfish, a genetically representative captive population, and critical habitats and ecosystem processes". This vision will be the basis for the development of a draft Species Conservation Action Plan.
- (7) The Species Conservation Action Plan is part of an overarching, basin-wide conservation strategy for the Mekong giant catfish. This strategy aims to achieve the greatest possible effectiveness of the conservation activities of all stakeholders. This strategy is based on information exchange and coordination of activities conducted by different organisations; effective use of research to resolve key uncertainties, and effective conservation planning. At the core of this strategy is a series of joint workshops, interspersed with specific research, conservation, and outreach activities by contributing organisations.
- (8) Key workshops in the conservation strategy planning process are a joint inception workshop held in Bangkok in August 2005, a species conservation action plan (SCAP) workshop held in Phnom Penh, December 2005; a quantitative assessment workshop to be held in Vientiane in August 2006, and a conservation strategy workshop to be held in Bangkok, December 2006.

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Glossary

Cryopreservation	The storage of gametes or embryos by freezing at low temperatures.
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
IRBM	Integrated River Basin Management
IUCN	International Union for the Conservation of Nature and Natural Resources
MRC	Mekong River Commission
NACA	Network of Aquaculture Centers in Asia-Pacific
SCAP	Species Conservation Action Plan
UNDP	United Nations Development Programme
WWF	World Wide Fund for Nature

1 Introduction

The Mekong giant catfish (MGC) (*Pangasianodon gigas*) is listed as critically endangered in the IUCN Red List. Its precarious status is likely to be the result of excessive targeted and incidental harvesting over the past twenty years, and to a lesser extent habitat degradation. Given the critical state of the population, conservation and eventual recovery will require a combination of measures such as reduction in harvest, conservation/restoration of critical habitat, and captive breeding.



Although there are a number of conservation initiatives and programmes focusing on the Mekong giant catfish, there is currently no overall conservation and recovery strategy. The effectiveness of measures taken so far is largely unknown. A series of workshops has been organized to address these issues through coordinated and regular dialogue, partnership among stakeholders, and the development of an overarching conservation strategy.

The main purpose of the December 2005 meeting was to exchange information on the current status of the Mekong giant catfish and Mekong giant catfish related research and to lay the foundation for the development of a draft Species Conservation Action Plan.

The meeting had two primary components. The first day of the meeting was devoted to reviews of current knowledge on the Mekong Giant Catfish and updates of activities of working group members since the first meeting of the group in August 2005. On the second day of the meeting, we discussed these reviews, identified priority activities, and made decisions necessary for the development of a draft version Species Conservation Action Plan (SCAP). This draft SCAP will be further refined at the fourth meeting of the Mekong Giant Catfish Conservation Group.

2 Organisations represented and Mekong giant catfish-related activities

(abbreviated from Mekong Giant Catfish Conservation Group August 2005 Workshop Report)

2.1 Overview

An overview of the organisations represented and their MGC related activities is given in Table 1.

Table 1 Overview of Mekong giant catfish related activities by the organisations represented

Organisation	Conservation, management, policy	Research	Information exchange
Department of Fisheries , Cambodia	Involved in buy and release programme, national fisheries regulations	Migration study using tag-recapture	
Department of Fisheries , Thailand	Captive breeding programme, national fisheries regulations	Research on basic biology and culture of captive MGC	
Department of Livestock and Fisheries, Lao PDR	National fisheries regulations	Spawning of MGC	
FAO Fisheries Department	Broodstock management and genetic resource management; responsible aquaculture and fisheries development.		Technical and policy information and guidance on responsible fishing, captive breeding and restocking, aquaculture development etc.
Imperial College London Darwin Project	Conservation strategy development	Population biology, fisheries management, modelling	
Kasetsart University, Department of Aquaculture		Molecular genetics of MGC, breeding strategies	
Mekong River Commission, Fisheries Programme	Habitat conservation	Migration, capture and aquaculture studies	Mekong basin capture fisheries
Network of Aquaculture Centers in Asia-Pacific			Regional information and training and aquaculture and aquatic resource management
Research Institute for Aquaculture No.2, Vietnam			Incidental capture of MGC
UNDP/IUCN/MRC Mekong Wetlands Biodiversity Programme	Wetland biodiversity conservation, protected areas, conservation assessment of flagship species	Giant catfish migration study	Conservation action plans
WWF Living Mekong and Thailand Programmes	Large-scale habitat conservation initiatives		

2.2 Details of organisations

Department of Fisheries, Cambodia

Line department responsible for all aspects of fisheries management in Cambodia. Of particular interest to giant catfish conservation may be a large-scale tagging study being carried out by the Department in the Tonle Sap and Mekong rivers to study fish migrations. Fish are caught in large-scale gears, in particular the Dai fisheries of the Tonle Sap. Fish bought from fishermen, tagged and released near the site of capture. A reward of 5000 riel/ tag is offered for reporting of tag recaptures by fishermen. Fish of 13 species were tagged, including several MGC. Several thousand fish have been released, and about 15% of these have been recaptured, mostly along the Tonle Sap River and lake. None of the tagged MGC have yet been recaptured.

Department of Fisheries, Thailand

Line department responsible for all aspects of fisheries management in Thailand. The DoF has a mandate primarily to promote fisheries production, but is increasingly involved in conservation activities. The MGC has little relevance to production, but attracts a great deal of public interest. The DoF runs the main captive breeding programme for giant catfish. Spawning in captivity of wild MGC captured in Chiang Khong has been carried out since 1983. There are now some 20,000 offspring of wild parents in captivity, mostly in DoF stations. In addition many individuals have been stocked into reservoirs and public ponds. Since 2004 the first captive reared fish have spawned

successfully, thus producing second generation captive fish. The latter are reared mostly for aquaculture purposes, while first generation captive offspring from wild parents is raised principally for restocking of natural populations and broodstock. There is also a developing private aquaculture industry for MGC for food, ornament and recreational fishing. Some 4800 tagged, captive reared MGC ranging in size from 1 g to 5-6 kg have been released into the Mekong, but no recaptures have been reported.

Maintenance of the captive population is difficult and expensive given the large size of the fish and the need to maintain a reasonably large broodstock to maintain genetic diversity. Management of the captive stock is largely driven by practicalities rather than genetic considerations. Whilst it is recognized that this is not ideal, a lack of specific information, management plans and funds constrains the improvement of this situation. It is hoped that proposed research activities will provide a foundation for better broodstock management, and that GEF funding may be obtained to offset the additional costs involved in managing the captive stock for biodiversity conservation.

Department of Livestock and Fisheries, Lao PDR

Line department responsible for all aspects of fisheries management in Laos. There are no specific MGC related activities in the Department. The Chiang Khong fishery for mature MGC occurs at the border between Thailand and Laos, and some Thai fishers to use Lao boats. There is no management of this fishery from the Lao side.

FAO Fisheries Department

The FAO Fisheries Department is the UN lead agency for promoting sustainable use of living aquatic resources. Key FAO activities relevant to the conservation of the Mekong giant catfish are relate to two international policy and legal instruments: The Code of Conduct for Responsible Fisheries and the Convention on Biological Diversity.

In support of the Code of Conduct FAO undertakes technical studies and information exchange activities on a number of areas potentially relevant to MGC conservation including impacts of dams, habitat rehabilitation for fisheries, genetic resource management (stock identification, broodstock management and selective breeding), responsible stock enhancement, best farming practices, fish health, habitat protection, and CITES implementation and eventual de-listing.

Imperial College London (ICL) Darwin Project

Imperial College London is a leading international centre for research into pure and applied population biology. It implements the Darwin Initiative project 'Development of a conservation strategy for the critically endangered Mekong giant'. This will involve

- (1) quantitative assessment of population status based on existing information,
- (2) quantitative assessment of the likely effectiveness of different conservation measures such as supportive breeding, harvest restrictions and habitat conservation/restoration
- (3) review and improvement of captive breeding procedures;
- (4) promotion of appropriate adaptive policies for the further development of the strategy; and
- (5) definition of an overall conservation strategy in consultation with a broad range of partner institutions.

Kasetart University, Department of Aquaculture

The Department of Aquaculture at Kasetsart University, Bangkok, conducts research and offers courses covering all aspects of Aquaculture. The Fish Genetics Laboratory in the Department conducts molecular genetic analyses on wild and captive populations of Mekong catfishes including the MGC. The Fish Genetics Lab collaborates closely with the Thai DoF on a variety of catfish genetics projects.

Mekong River Commission (MRC)

MRC is a regional organisation established by the Governments of Cambodia, Thailand, Lao PDR and Viet Nam. It focuses on basin-wide issues of water and aquatic habitat management and development. Since the mid-1990s it has conducted a large fisheries programme in close cooperation with the government fisheries agencies in the Lower Mekong Basin, covering all aspects of river fisheries ecology, management and development. The programme is focused more on production aspects and management of fisheries rather than endangered species. Nonetheless migrations and aquaculture development of MGC have been investigated as part of wider studies. Phase 2 of the Fisheries Programme will place more emphasis on the evaluation and management of stocking programmes for enhancement and restoration.

Network of Aquaculture Centers in Asia-Pacific (NACA)

NACA is an Asian intergovernmental organisation promoting the sustainable development of aquaculture and aquatic resource management through networking and capacity building. NACA has increasingly become involved in fish conservation issues, primarily in connection with genetic impacts of fish stocking programmes and escapees from aquaculture. NACA will be holding a workshop on genetic markers in biodiversity research in December 2005, which will include a range of methods potentially relevant to MGC conservation. NACA has also collaborated on some catfish genetics projects with Kasetsart University.

Research Institute for Aquaculture No. 2, Vietnam

RIA 2 is a government institute for aquaculture research in southern Vietnam. It also engages in some fisheries research related to fry fisheries and culture-based fisheries. Vietnam has never had a fishery targeting the MGC explicitly, but incidental catches were common historically. Only one MGC capture has been reported recently, of an 80 kg fish in 2001. There are no specific MGC related activities in Vietnam.

UNDP/IUCN/MRC Mekong Wetlands Biodiversity Programme (MWBP)

The Mekong Wetlands Biodiversity Programme (MWBP) is a collaborative, regional initiative between the four governments of the Lower Mekong Basin - Cambodia, Lao PDR, Thailand and Vietnam, sponsored by the GEF and implemented jointly by UNDP, IUCN and MRC. It addresses the root causes of wetland degradation throughout the Mekong basin based upon the principle that conservation of wetland biodiversity can not be achieved without addressing issues of sustainable livelihoods and poverty. It is developing Species Conservation Action Plans for four endangered flagship species including the Mekong Giant Catfish.

The MWBP is a joint GEF programme of the four riparian governments of the LMB managed by UNDP, IUCN and MRC. It aims to address the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. The MWBP is strengthening the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely.

The giant catfish is one of four flagship species of MWBP. It is believed to be a suitable flagship because it is a charismatic species that can generate interest and attention, representative of wider taxa (other migratory catfishes), and trans-boundary in nature (thus fostering regional cooperation). MWBP interventions aim to: (1) Address conservation and management issues affecting the giant catfish through the development and implementation of a Species Conservation Action Plan (SCAP); (2) Implementing measures to decrease the catch of wild Mekong Giant Catfish; (3) Exploring - with project partners, a science-based captive breeding and reintroduction programme; and (4) Identifying and managing critical habitats.

The Giant Catfish SCAP Development Process involves establishment of a multi-sectoral regional working group to provide input to the SCAP development and implementation, and direct interventions to address the critical issues affecting the Giant catfish.

WWF Living Mekong and Thailand programmes

The WWF Living Mekong programme focuses on the conservation of aquatic biodiversity in the Mekong basin. Ensuring the presence of MGC in the wild in 2010 is an explicit target of the programme. The Living Mekong programme also collaborates with the Giant Fish programme of WWF US, in which the MGC is again a target species. Key activities in the Living Mekong Programme are aimed at mitigating dam impacts, the development of water management strategies, ensuring access to floodplains for fish, and making roads more passive to floods. The WWF Living Mekong programme works mostly through WWF country offices, often with government departments in the host countries.

The WWF International Thailand programme currently has no independent MGC related activities, but works closely with the Living Mekong Programme. The programme is currently involved in the management of dugongs under the Convention of Migratory Species, and it was suggested that this convention may also be relevant to the MGC. Key questions from the perspective of the WWF Thailand programme concern the status of the wild population (how critical is it?) and the optimisation of the captive breeding programme conducted by the Thai DoF.

2.3 Coordination of activities and information exchange

(To be completed)

3 Development of a Species Conservation Action Plan

The development of the Species Conservation Action Plan, pilot implementation of conservation activities, and review is expected to occur in phases as the Mekong Giant Catfish Conservation Group continues to meet and develop. Below is the proposed, phased approach. Please note that the process is well underway and many steps have already been achieved.

1. Identification of relevant experts both national and international (forming the Mekong Giant Catfish Conservation Group).
2. Establishment of the species network to facilitate information exchange – this would be useful in gaining access to success stories elsewhere.
3. International, regional and national experts compile information on the conservation status of the flagship species in preparation for the first meeting
4. Organise a first meeting upon invitation of experts - establishment of the species working group tasked with preparation of the SCAP
 - a. Red-listing process for the flagship species and other key associated taxa.
 - b. Identification of urgent actions that need to be taken for species conservation i.e. through identification of pilot projects that could be initiated quickly and secure budget allocation.
 - c. Develop proposal for development and implementation of the SCAP, develop a work plan
5. Initiate pilot projects, comprehensive threat analysis and socio-economic significance of flagship species.
6. Additional field assessment of the status, distribution, and key conservation issues affecting the survival of the species and proposed management actions. Identify important knowledge gaps to be filled.
7. Prepare a first draft of the SCAP for review by the Mekong Giant Catfish Conservation Group.
8. Prepare 2nd draft and convene second SCAP meeting.
9. Prepare final draft along and a summary document with recommendations.
10. Present summary recommendations and final draft to Mekong Giant Catfish Conservation Group.
11. Prepare proposals and raise funds for implementation of the SCAP.
12. Implement further projects and activities in line with recommendations of the SCAP
13. Review the SCAP.

This process has now been combined with the Darwin Initiative Project and will consist of a total of four initial workshops: a joint inception workshop at NACA; Bangkok, 23-24 August 2005; a Species Conservation Action Plan (SCAP) workshop in Phnom Penh, December 2005; a quantitative assessment workshop in Vientiane, August 2006; and a conservation strategy workshop in Bangkok, December 2006.

4 Giant catfish: reviews of existing knowledge

4.1 Overview

Lack of knowledge about Mekong giant catfish is a significant obstacle to the effective management and conservation of the species. To correct this problem, the Mekong Giant Catfish Conservation Group has implemented a program of knowledge assessment, research, and information exchange. To that end, one of the main objectives of the second meeting of the Mekong Giant Catfish Conservation Group in Phnom Penh was to review existing knowledge either 1) directly related or 2) relevant to Mekong giant catfish conservation.

4.2 Reviews of existing knowledge

4.2.1 Spatial population structure and migrations

Historically the Mekong giant catfish occurred in the Tonle Sap Lake, the Tonle Sap River, and main channel of the Mekong River in Vietnam, Cambodia, Lao PDR, Thailand, and possibly Myanmar and south-western China. The giant catfish also occurred in tributaries of the Mekong, including the Mun and Songkhram Rivers in Thailand and possibly the Sekong, Sesan, and Srepok in Cambodia. Preliminary surveys indicate that critical habitat of the fish includes the Tonle Sap Great Lake (nursing area), the Tonle Sap River (migratory corridor), and the Mekong River in the areas of northern Cambodia and northern Thailand and Laos (spawning sites). The species has also been introduced in Thai reservoirs and the Chao Phraya River in Thailand.



P. gigas now occurs in the main channels of the Mekong River and its tributaries in Cambodia. Small populations also exist in northern Thailand and Lao PDR. The species is no longer a regular catch in northeast Thailand, southern Laos, or Vietnam. Fishermen report giant catfish

occasionally (once every few years) in Neak Loeung, Kratie, Stung Treng, the Khone Falls, the Mun River, the Songkhram River, Luang Prabang, and Pak Beng. Further interviews with fishermen in these areas may provide additional insight into the true distribution, abundance, migration patterns, and conservation status of giant catfish.

Table 2. Seasonal distribution of Mekong giant catfish in Cambodia.

Tonle Sap Lake	Tonle Sap River	Kampong Cham	Kratie / Stung Treng
<i>P. gigas</i> is caught in the Tonle Sap Lake in December, January, and February. Fish probably inhabit the lake during other months as well but this has not been confirmed	<i>P. gigas</i> moves down the Tonle Sap River from late October until December (migration inferred from timing of catch).	Fishers captured one fish in Kampong Cham in November 2005. Fishers believe that this fish had moved out of the Tonle Sap Lake.	Fishers report <i>P. gigas</i> in February and March. The occurrence of fish in this area has not been confirmed but is highly likely (based on many years of anecdotal information).

The precise area of extent of occurrence of *P. gigas* is difficult to determine given the current knowledge about the distribution of the species. The key data requirements to resolve uncertainties include:

1. Information about spawning migrations and spawning sites
2. Better understanding of the life cycle of Mekong giant catfish
3. Data on stock structure, including captive stocks
4. Information about behavior of catfish released to supplement wild fish populations
5. Identification of migration corridors

Delineation of giant catfish stocks is necessary to safeguard populations from unsustainable harvest and habitat fragmentation. Information about migration and stock structure is also relevant to reserve design, the impacts of damming, international treaties, local control of fisheries, stock assessment, and population modelling.

4.2.2 Cambodian fisheries catch data, recent and historical

Mekong giant catfish have been reported in Cambodia as early as 1940 with sporadic recordings from 1940 until present day. To our knowledge, there has been no systematic information gathered on past catch of Mekong giant catfish in Cambodia. It may be possible to reconstruct historical catch data by examining French documents (a slew of natural history reports were published by the French in the 1930's and 1940's) or interviewing the oldest fishers about their recollections of past catches. Tyson and Vidthayanon (1991) may also contain some information about past catfish catches in Cambodia.

The Cambodian Department of Fisheries, in cooperation with the Mekong River Commission Fisheries Programme and the Mekong Wetlands Biodiversity Programme, have been recording catches of Mekong giant catfish since 1999. Since 1999, the DoF has recorded the capture of 51 Mekong giant catfish in Cambodia. The DoF and the World Wildlife Fund found and released an additional four Mekong giant catfish that were being held in mixed-stock pond culture outside of Phnom Penh. The Tonle Sap River has been the source of the majority of reported captured Mekong giant catfish between 1999 and 2005. Fishers have also consistently reported 1-2 fish (usually smaller fish) from the Tonle Sap Lake. It is important to note that there has not been any systematic collection of information on Mekong giant catfish catch in Cambodia, except in the Tonle Sap River dai fishery. Therefore, these catch statistics are almost certainly underestimates of the number of fish caught in Cambodia in recent times.

Mekong giant catfish occur and have been caught in all main river areas throughout Cambodia, including the Tonle Sap Lake, the Tonle Sap River, the Mekong River at Phnom Penh, the Mekong River downstream of Phnom Penh, and the Mekong River upstream of Phnom Penh at Kampong Cham and Kratie (Table 2). An analysis of size data implies that Mekong giant catfish may complete their life cycle within Cambodia. The presence of Mekong giant catfish in ponds outside of Phnom Penh indicates that very young Mekong giant catfish mixed with young *Panagsianodon hypophthalmus* during the spawning season of these species (June-July?). Fishers have caught juvenile (between 15-30kg) giant catfish in the Tonle Sap Lake and Tonle Sap River. Fishers report catches of adult Mekong giant catfish (between 100-270kg) in the Tonle Sap Lake, the Tonle Sap River, and the Mekong River both upstream and downstream of Phnom Penh.

In years past, the Mekong Fish Conservation Project, in conjunction with the Cambodian DoF and the Mekong River Commission (among others) has purchased, tagged, and released all endangered species caught in the bagnet fishery. Since 2000, approximately 35 Mekong giant catfish have been released as part of this program. In 2005, the DoF has designated bagnet row #2 as a special research and conservation fishery. The bagnet owners have signed a contract that they will release endangered species, free of charge, when they are captured in the bagnet. In order to ensure compliance, a monitoring team has been established to record fish catches at bagnet row #2.

In recent years, the Tonle Sap River fishery has also been a significant source of fish for tagging, DNA collection, and data gathering. While the usefulness of tagging is not clear (no tagged Mekong giant catfish has ever been recaptured alive), the data collected at the Tonle Sap River dai fishery has been useful to help determine the ecology and status of Mekong giant catfish in Cambodia.

Key Information Requirements

- The data on giant catfish catches in Cambodia is of unknown quality. While the catches that have been reported have in almost every case been verified (by a reliable source), many catches undoubtedly go unreported. In terms of catch, better information on both past and current catch nationwide would be useful, especially to determine catch trends and also identify catch “hotspots”. Catch hotspots, areas with high catch rates, are important to identify for potential further conservation action.
- The survival rate of fish that are caught, then released, is unknown. If catch and release is going to be considered a viable conservation option, the survival rate of these fish needs to be determined. This information may also be important if fisheries staff plan to use wild caught fish for research purposes.
- The catch rate of young fish is important to determine the abundance of young life history stages, to identify critical habitat, and to determine whether or not Mekong giant catfish continue to spawn in the wild.

Recommendations for future work in Cambodia

- Research on wild fish, including tag and release, migration studies, and spawning site identification.
- Opportunistic study of dead fish, including stomach content analysis, age determination, and tissue sampling for genetics research
- Surveys of the commercial fisheries of the Tonle Sap Lake, upper Tonle Sap River, and the small-scale fisheries from Kratie to the Cambodia/Lao PDR border
- Pond surveys for juvenile fish

- Designation of important habitats as fish conservation areas
- Further development of methods to collect reliable information about Mekong giant catfish catches in Cambodia. There are several options. One, information can be collected opportunistically or systematically by provincial Department of Fisheries officials. The benefits of this approach include the fact that provincial Department of Fisheries staff are stationed throughout Cambodia and have authority over issues relating to fish catch. The drawback is that fishers are often lack incentive to cooperate with the Department of Fisheries. Without the cooperation of fishers, it is virtually impossible to collect information on fish catch. Therefore, it is important to either 1) find a practical and effective way to encourage fishers to cooperate with and provide data to the DoF or 2) the DoF should consider partnering with another organization that can work more effectively with fishers in a non-enforcement (i.e. data gathering) capacity.

The catch of fifty-one Mekong giant catfish in Cambodia since 1999 indicates that Cambodia is home to a globally significant population of Mekong giant catfish. Cambodia is one of the only places where wild Mekong giant catfish still occur. Moreover, catch data indicates that all life history stages are present in Cambodia, showing that breeding may occur within the country. And even if giant catfish do not breed in Cambodia, the presence of all life history stages means that Cambodia is an important area for the rearing and growth of Mekong giant catfish. While Mekong giant catfish appear very rare, and reports of catches are fragmented, catches in the Tonle Sap River have declined only slightly in the past five years. This may indicate that the population of Mekong giant catfish in Cambodia is still healthy enough for restoration (i.e. it is not “too late” for giant catfish in Cambodia).

It is also important to note that, in a general sense, catch data has important implications for conservation on several levels. First, for fish, catch data are often our best indicator of abundance. Second, catch data can be used to infer fish distribution and (roughly) map migrations. Third, catch data can be used to help control fishing mortality by identifying areas with high fishing pressure and high catch.

Good catch data can also be used to help determine effective fishing regulations, outreach to the appropriate fishing communities, identify critical habitat, help delineate protected areas, calculate catch trends, and examine fishing patterns (including seasonality).

4.2.3 Country reports on catfish history and status

Lao PDR

Giant catfish (*Pangasianodon gigas*) is one of the largest fresh water fish in the lower Mekong basin. In past times in Lao PDR, giant catfish could be caught in several areas from the northern provinces to the southern sections of the country. However, in more recent times, the giant catfish is only caught in Vientiane capital and in Bokeo Province (opposite to Chiang Khong, Thailand), where 1-2 fish are caught per year. Some 10 years ago giant catfish could occasionally be caught in the deep pool ‘Vang Pa Beuk’, Sikotabong district, Vientiane capital, but in recent years there are no records of catch. Smith (1945) recorded giant catfish from the Mekong in Lao PDR China, Burma, Lao PDR, Thailand, Cambodia and Vietnam. Chevey (1930) reported the occurrence in Ban Hangkone village, Kong district, Champasak province, Southern Lao PDR. Taki (1971) recorded the presence of giant catfish in Ban Nalong village, PakNgeum district, Vientiane capital.



In Luang Prabang old fishermen report that in the past they could catch 2 fish per net and season, but when the catch gradually declined to 0.2 fish per net and season the fishing was abandoned. In 2005 LARReC carried out a hydroacoustic (HC) survey of deep pools in Luang Prabang and concluded that large fish were present. Although the survey could not identify the species; it was seen as an indication of possible presence of *P. gigas*. In the same season/year fishers of the Bokeo Province caught 2 *P. gigas*, one weighing 80 kg., indicating that young fish occur in the area.

The Living Aquatic Resources Research Center's (LARReC) highest priority of the research is to obtain food self-sufficiency to provide over all areas of the Mekong river basin and to improve domestication of indigenous fishes species including *P.gigas*.

In the context of Mekong giant catfish, the priorities of Lao PDR include:

- Establishment of local (provincial) projects to manage and conserve Mekong giant catfish.
- Identification of potential Fishery Conservation Zones (FCZs) in some areas for the conservation of Mekong giant catfish.
- Collaboration between Lao PDR, Thailand, Vietnam and Cambodia to encourage conservation and develop aquaculture.
- Implementation of basic research to study the ecology of Mekong giant catfish and determine the optimal habitat requirements for the species. This work must be coordinated to prevent duplication of effort.
- Establishment of a 4-country field station for research for the conservation and culture of Mekong giant catfish.

4.2.4 Principles of population modelling and assessment

Modelling population trends of Mekong giant catfish can help us understand the reasons for population decline and identify effective conservation and restoration options. Modelling is an important step in conservation planning decision making, useful not only to make predictions but also to clarify the problem, synthesise relevant information from different sources, evaluate alternative hypotheses about threats/causes of decline, and stimulate communication between managers, scientists, and the public.

Models are formulated using life history parameters and other variables, then tested with real data to see how they perform. The best models can then be used to evaluate different management scenarios. If alternate hypotheses exist, several different models can be tested to see which are most consistent with the data. When several models are equally consistent with the data, all of the models can be used to make projections to check whether or not they have different management implications.

In the case of Mekong giant catfish, useful data for input into a model include; 1) total catch: recent and historical; 2) spatial distribution of catch (recent and historical); 3) length and weight of giant catfish caught; 4) maturity stage of giant catfish caught; 5) tag recaptures; 6) information on migrations; 7) fishing gear use (recent and historical) and gear selectivity; and 8) population genetic data. Models must also account for uncertainty and observation error. For example, in the case of giant catfish, there is very little data on population number, but a substantial amount of information on giant catfish catch. To use catch as an index of abundance, it is necessary to understand the relationship between catch and abundance – this relationship is rarely easy to interpret and can be biased by river conditions, fishing gear type and effort, and reporting error/bias.

4.2.5 Principles of captive breeding and enhancement

Captive breeding, i.e. the production of fingerlings from the controlled breeding of broodstock either taken from the wild or raised in captivity, has been used to augment natural populations of fish, to provide fish for grow-out in aquaculture facilities, and to help rebuild or restore populations of endangered species. Captive breeding is one means to help implement the FAO Code of Conduct for Responsible Fisheries (CCRF). Specifically, Article 9.3 on responsible aquaculture recommends that, “*States should conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management.*” The CCRF further notes that States should, “*promote the use of appropriate procedures for the selection of broodstock and the production of eggs, larvae and fry*”, and, “*promote research and culture techniques for endangered species to protect, rehabilitate and enhance their stocks, taking into account the critical need to conserve genetic diversity of endangered species*”. The goals of the Darwin initiative are consistent with the CCRF in that it seeks to restore viable populations of Mekong giant catfish in the wild.

The main issues concerning captive breeding are:

- Maintenance of appropriate kind and level of genetic variation;
- Avoidance of inbreeding (the mating of close relatives that can depress fitness through expression of deleterious recessive genes) or outbreeding (the mating of genetically very different stocks that can depress fitness through the breakdown of co-adapted gene complexes);
- Avoidance of artificial or domestication selection in the hatchery that can render the hatchery-produced fingerling or juvenile unfit for life in the wild;
- Proper fish health management so that the hatchery fish do not promote or spread disease;
- Proper broodstock and larval feed and nutrition;
- Release strategy – how to optimize survival of hatchery produced fish by choosing correct size at release and the correct time and place for release;

- Efficacy of using wild fish from the Mekong as broodstock – does this work or does it remove viable fish from the wild spawning stock;
- Role of ex situ conservation, living and frozen gene banks;
- Ecological and genetic interactions with wild fish upon release;
- Monitoring and evaluation – how effective is captive breeding, what kind of tags can be used to identify hatchery fish and what are the criteria for success.

The captive breeding of Mekong giant catfish is well established (Thai DOF) and survival of hatchery fish in reservoirs appears satisfactory. However, there is no indication that hatchery fish are contributing to the wild river population. Similarly, there is no information on how hatchery practices may be selecting for characters that are maladaptive for life in the Mekong River.

There is abundant theoretical information on how to manage broodstock in order to optimize genetic diversity, avoid inbreeding and maintain effective population size. Single pair matings, using fish from a variety of ages, avoiding mating of fish from geographically isolated areas together, using large numbers of broodstock, mating fish from the entire length of the spawning season, and avoiding the mating close relatives can all help maintain genetic diversity. There are genetic analytical techniques such as micro-satellite DNA analysis that can be used to help design breeding programmes and provide genetic tags to monitor the hatchery fish. However, at present the genetic structure of the wild populations of Mekong giant catfish are not known and therefore breeding programmes do not know what level of genetic diversity to duplicate in the hatchery stocks.

To deal with these issues, information is needed about the genetic diversity present in wild and hatchery Mekong giant catfish populations, the optimum breeding strategy for the current conditions, survival of hatchery produced juveniles once released; interaction of hatchery and wild fish in nature, and larval feed and conditioning required to avoid domestication selection. It is also important to determine the trade-offs with using hatchery fish and other rehabilitation measures and the optimum time and location of release of hatchery-reared fish. The success of the breeding program can be judged against the goals of the program to decide whether to continue or stop.

A genetic description of captive broodstock and stocks of catfish in reservoirs and Thai DOF facilities is being undertaken by partners in the Darwin Initiative – Thai DOF, NACA and Kasetsart University. It appears unlikely that enough wild catfish can be captured and sampled to provide any useful information on the stock structure of natural populations. However, population genetic analysis of related fish with migratory behavior could provide insight on the stock structure of Mekong giant catfish. Following the genetic analysis work should commence on incorporating catfish stocks into an overall plan for genetic resource management, i.e. develop a breeding programme that optimizes genetic diversity in catfish populations. Genetic analysis of the different batches of hatchery-produced juveniles should be undertaken to assess genetic changes imparted by the breeding programme and to ensure large effective population size in the hatchery output. To address potential in life-history traits that may not be reflected in the genetic data, monitoring of quantitative traits such as fecundity, age-at-maturity, etc. could be undertaken.

The following activities are also important to a successful conservation aquaculture program:

1. Habitat surveys and analysis of catfish with similar life histories can be undertaken to determine release strategies. Field sampling, tagging of hatchery-released fish and monitoring of key points in the Mekong Basin should be implemented to determine the effectiveness of the captive breeding programme.
2. Modeling the population dynamics and genetics of the captive breeding programme should be undertaken to identify breeding strategies, and to evaluate effectiveness of the captive breeding and release in achieving the ultimate conservation goals.
3. Feeding and fish health studies should be instigated to ensure healthy hatchery stocks that can survive in the wild and do not increase the risk of disease in wild populations.

4. Basic studies on gamete quality of captive broodstock should be undertaken. Cryo-preservation of milt from representative catfish and optimization of freezing techniques can be instigated.

Captive breeding programmes can play a significant role in species recovery plans provided that attention is paid to proper genetic resource management, monitoring, fishery management and habitat protection/rehabilitation. However, simply because captive populations or captive broodstocks exist is no reason to become complacent or to stop trying to protect and rebuild natural populations through other means that do not depend on hatchery production. It is fortunate that such a large number of Mekong giant catfish exist in reservoirs and in Thai DOF facilities. Therefore, it is not necessary at this point to take any drastic action in regards to captive breeding and embark on a poorly thought out captive breeding programme that might endanger the few remaining wild Mekong giant catfish. There is time to study well the genetic resources of the captive population to ensure that viable juveniles with appropriate genetic diversity are released in a sound manner and monitored.

4.2.6 Principles and potential of cryopreservation

Cryopreservation is the storage of gametes or embryos by freezing at low temperatures. In the context of conservation of Mekong giant catfish, cryopreservation can be used to preserve fish gametes and embryos for captive breeding. The Thai Department of Fisheries is currently working on cryopreservation of spermatozoa of giant catfish for conservation and aquaculture. Spermatozoa is preserved with diluents containing 125 mM KHCO₃, 250 mM sucrose, 9.75 mM glutathione and 8% DMSO (dimethyl sulfoxide). After 96 hours of storage there is no significant difference in fertilizing ability of spermatozoa subjected to two freezing methods and is comparable to fresh milt. Using cryopreservation, spermatozoa of Mekong giant catfish males is successfully preserved in liquid nitrogen, retaining fertilising capacity for up to 3-4 months, with a fertilisation rate of around 65 % (controls: 73 %). After 18 months, the fertilisation rate was 67.7 ± 7.1, while controls were 79.0 ± 1.4 %. The Thai Department of Fisheries is continuing its work on cryopreservation in collaboration with the Asian Institute of Technology and SEAFDEC.

4.2.7 Compilation of genetic information, sample analysis, guidelines for future sampling

The Department of Aquaculture, Faculty of Fisheries and Kasetsart University (Bangkok) are conducting a study of the genetic diversity of Mekong catfishes. Four species are included in the current study, *Pangasianodon gigas*, *P. hypophthalmus*, *Pangasius sanitwongsei*, and *Pangasius larnaudei*. Using microsatellite loci and mitochondrial DNA as markers, and tissue samples from Thailand and Cambodia, researchers are examining the genetic population structure of wild Mekong catfish and looking at pairwise genetic relatedness between giant catfish individuals. Genetic variation at microsatellite loci of *P. gigas* is moderate but mt-DNA variation is low. Hatchery stocks of giant catfish showed substantial genetic variation at microsatellite loci but not at 16SrRNA gene. Private alleles were observed both in captive and wild stock hence suggesting possibility to collect more genetic variation from the wild stock. *P. sanitwongsei* possessed very low genetic variation, supporting the assertion that the species is now very rare in the wild.

Table 3. The number of samples and microsatellite loci for 5 study species of Mekong catfish

<i>Pangasianodon gigas</i> (wild samples)	15 fish	11 loci
<i>Pangasianodon gigas</i> (hatchery samples)	7 hatchery (4-38 fish/hatchery)	7 loci
<i>Pangasianodon hypophthalmus</i>	1 pop(19 fish)	8 loci
<i>Pangasius sanitwongsei</i>	2 pop(10-38 fish)	8 loci
<i>Pangasius larnaudii</i>	3 pop(10-26 fish)	5 loci

4.2.8 Compilation of information on the Thai captive breeding programme and aquaculture

The Thai Department of Fisheries has been breeding and raising Mekong giant catfish in captivity since 1983. The DoF has approximately 20,000 offspring in fisheries stations throughout Thailand. Using these offspring, the DoF has produced broodstock to produce second generation hatchery bred fish. Five DoF stations have produced F2 hatchery-bred Mekong giant catfish as of 2005 (annual production capacity in parentheses):

1. Chiangmai (70,000)
2. Phayao (50,000)
3. Pitsanulok (70,000)
4. Kalasin (50,000)
5. Ayuthaya (IARI) (100,000)

In addition to these facilities, there are two private producers (Chiang Rai and Suphunburi) and six DoF “potential producers” (facilities with broodstock that have not yet produced F2 offspring). The number and location of hatchery broodstock is given in table XXXXX.

Table 4. Thai DoF hatchery broodstock, December 2005

Locations	Number	Size (kg)
IARI	24	30-40
Khon Kaen IFRDC	7	30
Sakon Nakon IFRDC	20	30
Chiang Rai IFS	10	60
Phayao IFRDC	56	50
Chiang Mai IFRDC	30	90
Kalasin IFS	55	30
Nakornratchasima IFRDC	20	20-30
Sukhothai IFS	10	30
Nong Khai IFRDC	4	30
Lampang IFS	5	40
Total	241	

Captive bred larvae are stocked in the concrete tank for the first 5-10 days at 2000 fry/ m3. The first feeding occurs when the fish are 2-3 day old. Fish are fed with *Moina sp.* or *Artemia sp.* for the first 10 – 15 days. After 10 days, stocked in the earthen pond at 40,000 – 80,000 fry/pond. Survival rate is between 5–10 %.

At a 250 rai of private farm in Chiang Rai, the size of nursing pond is between 1600 – 4800 m2. Stocking densities are 5 fingerlings (4 inches in length) per 4 sq.m. The fingerling preferred pellet feed with high protein content. Fish can grow up to 1-2 kg for first 6 months of nursing period. The grow-out pond is approx. 3.2 hectares and grow out period is up to 5 years.

The stocking density in the 4th year is 1 fish / 10 m2 and the production is ranging from 14 to 16 kg for 4-year old fish. The grow-out period is up to 5 years for 25-30 kg of marketable size. The survival rate is up to 90 %. The supplementary feed contain 25-40% protein depend on the age/size of the fish. Farm gate price is 100 – 120 baht/kg for whole fish

Despite the success of the Thai DoF at breeding and raising Mekong giant catfish in captivity, a number of constraints remain to the adoption of wide-spread breeding of Mekong giant catfish. Constraints include the lack of a proper broodstock management plan, the lack of breeding and nursing facilities, a low survival rate in the hatchery, and lack of cryopreservation technique.

4.2.9 Principles of conservation and recovery planning, including review of US species recovery plans.

The principles of Conservation and recovery planning discussed here are primarily taken from a paper by Trombulak *et al.* (2004) who conducted a thorough review of conservation literature.

Summarised below are relevant sections from Trombulak *et al.* (2005) under the 'Thematic area 5' he classifies as "Protection and Restoration of Biological Diversity, Ecological Integrity, and Ecological Health":

The conservation of nature requires a combination of strategies, including the protection of endangered species, ecological reserves, control of human actions that hurt ecosystems, ecosystem restoration, captive breeding, control of non-native species, and conservation biology education.

Principle 1: Endangered species protection: Species at risk of extinction require protection from exploitation and loss of habitat.

- Single-species protection activities focus on identifying the factors that led to the decline in population size and on remediation of those factors.
- Individual species may be helped by protection activities that target a species alone, or they may be helped by protection activities that include multiple species or entire communities.
- Given the stochastic effects on population sizes from both natural and human causes, species protection activities must necessarily take place in a climate of uncertainty.

Principle 2: Ecological reserve systems: Areas that are designated for conservation need to be established in such a way that they collectively cover the full range of ecosystem types and can protect the species present there from premature extinction.

- Ecological reserve systems are sets of areas managed in such a way that their primary function is to protect a species or group of species from extinction and to promote natural ecological and evolutionary processes.
- Such reserve systems are designed to include area sufficient for the target species to be viable with limited human intervention and for natural processes to occur.
- The effectiveness of reserve systems is influenced by their context, including the stresses placed on them by actions taking place outside of the system, actions taking place inside of the system, and the degree to which the organisms present in the reserves perceive them to be connected.
- The design and management of ecological reserves must address the predicted effects of global climate change on the system or species they are intended to protect.

Principle 3: Human uses of nature: Human uses of nature can be modified so that the impacts on ecological systems are lessened.

- Human enterprises should be more harmoniously integrated within the context of their natural environments, rather than segregated from them.
- Modifying ways in which humans use nature so that they more completely mimic natural ecological processes can lessen the impact of these uses on biological diversity, ecological integrity, and ecological health.
- The impact of human uses of nature on biological diversity, ecological integrity, and ecological health can be lessened by a reduction of the magnitude of human impacts in both space and time.
- Although biological reserves and national parks are often an essential component of conservation strategy, the ultimate success of conservation depends on refashioning human activities to coexist with biological diversity and ecological systems.

Principle 4: Ecosystem restoration: Ecosystems that have been degraded through changes in function and species composition need to be restored to as close to their natural (as contrasted to culturally modified) conditions as possible.

- Ecosystems that have been degraded through human modification can, in some cases, be restored through elimination of the external stresses, reintroduction of native species, removal of exotic species, and restoration of ecological processes.
- The extent to which a restoration effort is considered "successful" depends on the goals identified. No effort can ever restore exactly the natural ecosystem in its composition, structure, and function.

- An ability to promote restoration should not be seen as a justification for promoting habitat destruction elsewhere.

Principle 5: Augmentation of natural populations: Species at risk of extinction can, in some cases, benefit from having their populations increased through the introduction into the wild of individuals bred in captivity.

- Species and subspecies on the brink of extinction in the wild may be helped through breeding in facilities such as zoos, aquaria, botanical gardens, and captive breeding facilities.
- Care must be taken to maintain genetic diversity from generation to generation and to mimic selective pressures the organisms would encounter in nature. For animals, habituation to humans should be minimized.
- Captive breeding programs for conservation are expensive and therefore are not practical for all species. For some species, they may be biologically unfeasible. For some endangered species, however, captive breeding may be the only strategy available to prevent immediate extinction.

Principle 6: Management of harvests: The numbers of individuals from species that are harvested in nature need to be controlled so that the harvest does not significantly increase the probability that the species will go extinct.

- Indiscriminate harvesting can accelerate or cause extinction.
- Control of harvesting, through outright bans in the case of rare, threatened, or endangered species; through controls of harvest of vulnerable age or stage classes; through limits on the number of individuals harvested; through limits on the length of time over which harvesting can occur; and through establishment of “no-take” reserves, may promote species persistence.
- To prevent extinction through over-harvesting of species, societies must be willing to regulate harvesting guided by a biological understanding of population demography.

Principle 7: Management of non-native species: Efforts must be made to decrease the probability that non-native species will become introduced or successfully established, and efforts need to be made to eliminate established non-native species whenever possible.

- Non-native species are one of the prime threats to native species and ecosystems worldwide.
- Non-native species can be spread either accidentally or intentionally.
- Most introductions of nonnative species are probably unsuccessful, but a few have had devastating consequences both ecologically and economically.
- After a non-native species becomes established, it is difficult if not impossible to completely eradicate it.
- The ability of a non-native species to establish itself is influenced both by its own characteristics (e.g., reproductive biology) and the condition of the natural community into which it is being introduced (e.g., ecologically healthy communities tend to be less vulnerable to invasion).

Principle 8: Political participation: Understand and participate in the realm of human politics and policy, making sure to insert the importance of maintaining native biodiversity into public discourse.

- Understand the processes and structures by which public policy is established—including laws, administrative regulations, and channels for lobbying.
- Be familiar with the people who play key roles at a variety of geographic levels, from local to international.
- Share knowledge and expertise of conservation biology with policy makers whenever opportunities arise or can be created.

Principle 9: Education: Conservation education needs to occur at all levels in all societies so that humans can better learn to coexist with nature.

- Conservation education programs seek to develop in people a deeper understanding of the importance and tools of conservation biology.
- Education is most successful when it focuses on developing knowledge, skills, and attitudes in a way that gives people extended direct experience.
- Conservation biologists have a unique set of knowledge, skills, and concerns to share with others.

The US Species Recovery Plans

The U. S. Fish and Wildlife Service Endangered Species Program (<http://endangered.fws.gov/recovery>) coordinates the development of recovery plans for endangered species. The ultimate goal of the Endangered Species Act (ESA) is the recovery (and subsequent conservation) of endangered and threatened species and the ecosystems on which they depend. A variety of methods and procedures are used to recover listed species, such as protective measures to prevent extinction or further decline, consultation to avoid adverse impacts of Federal activities, habitat acquisition and restoration, and other on-the-ground activities for managing and monitoring endangered and threatened species.

A three year study, the Society for Conservation Biology (SCB) in cooperation with the FWS, analyzed a number of aspects of FWS recovery plans (Clark *et al*, 2002; Crouse *et al*. 2002)¹. A number of strengths and weaknesses were identified in past and current recovery plans. Key conclusions were:

What is Working?

- Species with recovery plans in place for longer time periods show more improvement in status
- Most recovery plans are being implemented to some extent
- High priority recovery actions are more likely to be implemented than lower priority actions
- Identification of threats in plans builds on listing documents

What has Improved?

- Use of active management is increasing
- Emphasis on monitoring species is increasing
- Recovery criteria are increasing in specificity
- Scientific tools, such as population viability analysis, adaptive management, and meta-population analysis, are being used more frequently

What Needs More Improvement?

- Explicit addressing and monitoring of threats
- Diversity of contributors (while keeping teams small)
- Monitoring of species trends, threats, implementation, effectiveness of implementation, and recovery criteria
- Internal consistency of plans, i.e., connecting biological information to recovery criteria/actions
- Inclusion of new science and theories
- Elimination of taxonomic biases
- Prioritization of species' plans for implementation and revision
- In multi-species plans, addressing of individual species needs, revisions, and implementation

¹ Clark, J. Alan and Erik Harvey. 2002. Assessing multi-species recovery plans under the Endangered Species Act. *Ecological Applications* V. 12, No.3, pp. 655-662.

Crouse, Deborah T., Loyal A. Mehrhoff, Mary J. Parkin, Diane R. Elam, Linus Y. Chen. 2002. Endangered species recovery and the SCB study: A U.S. Fish and Wildlife Service perspective. *Ecological Applications* V. 12, No.3, pp. 719-723.

- Addressing of needs for critical habitat management, where designated

Lessons from the experiences above can be used in developing the Conservation Strategy and Action Plan for the Mekong Giant Catfish.

4.2.10 Social, economic and cultural importance of giant catfish in Chiang Khong

Each year, adult catfish, up to three meters long, migrate up the Mekong through Laos, arriving in Chiang Khong, Thailand in April and May. Traditionally the fishing season started in mid April and lasted until late May. Before the harvest begins, fishermen conduct a ritual to pay respect to the guardian spirit protecting the river. The ritual pays respect to the river and gives strength to the fishers. During the ritual, fishers provide offerings to the spirits, including pig heads, rice whiskey, red flowers, tobacco, incense, and, candles.



Hundreds of visitors come to Chiang Khong to see Mekong giant catfish. The town is well known because it is the last place in Thailand where the Mekong giant catfish is caught in any appreciable numbers. One fish can be sold for as much as \$3,000. Fish are sold to provincial markets, local restaurants, and consumed locally. Local restaurants, local accommodations, souvenir shops, local vendors, and travel agents benefit from the fact that the Mekong giant catfish is a tourist attraction.

The fishermen still believe that there are giant catfish because there are sightings of the fish every year. Fishermen report that they see giant catfish at the surface of the water. Fishermen also report that giant catfish hit small mesh gill nets (but are not caught). According to one villager, Chiang Khong the start of the giant catfish fishing season is based on downstream sightings of giant catfish.

The fish migrate together and spawn when the female is ready. Giant catfish like to spawn in confluence areas (i.e. where a tributary enters into the Mekong River). They spawn in areas where warm water mixes with cool water.

Even after the giant catfish has spawned, it continues to migrate upstream looking for food. Giant catfish migrate upstream to spawn in April, May, and June. They migrate downstream in August when river flow is high. Giant catfish from Chiang Khong usually have empty stomachs. The stomachs of some catfish contain greenish water.

The main activities surrounding the giant catfish include the giant catfish ritual, the giant catfish museum, the Thai Department of Fisheries giant catfish breeding program. Fishermen believe that

the giant catfish ritual, in which the whole village participates, will continue even if the giant catfish disappears. The giant catfish museum is currently non-operational.

Not many people fish for giant catfish anymore because populations have declined. The fishermen believe that giant catfish catches have decreased due to port construction, rapids blasting, and unnatural fluctuations in water flow. Also, giant catfish catches have declined because many people in Chiang Khong own land (about 85% of the population) and these people spend time farming instead of fishing.

4.2.11 Policies and legal frameworks in relation to the Conservation and Management of the Mekong Giant Catfish.

The principal impact on fish biodiversity and fisheries often do not originate from the fishery itself but from outside the fishery. Regulations and legislations directed at fisheries and fish biodiversity often include protected species conservation areas, permitted fishing gears etc. However, the conservation and sustainable use of fisheries resources and their habitats are often under the control of a wide range of interests of superior social and financial implications to society.

Within the scope of this section, it was therefore not possible to limit the discussion to legal instruments directed solely at the giant catfish. In addition to specific discussions on the legal instruments directly related to Giant catfish, other pieces of policy and legislation that would have some impact on the conservation and management of giant catfish have been noted and discussed. The scope however is limited to those policies and legal instruments that have an impact on the MGC critical habitats, migration pathways and life cycle.

There are a wide range of relevant policies and legal instruments that affect the conservation and management of fish biodiversity and fisheries in the Mekong Basin. In actual fact, all policy or legal instruments that have either a positive or negative impact on the ecological integrity of the Mekong and its ecological processes will have an impact on the survival of the Giant Catfish and other migratory fishes. These would include the policies and legal instruments at the various scales - international, regional, national, provincial and even local level regulations. In some of these laws there is specific mention of MGC but others refer to fisheries, fish biodiversity, migratory fish in general or even just ecosystem level policies. All of these have implications on the Mekong Giant Catfish. The information presented here is in no way exhaustive but provides an indication of the complexity of policies and legal issues at different scales and some of the driving forces behind them while attempting to put it in the context of the trans-boundary migratory fish species such as the MGC.

National Level policies and legal instruments

Cambodia

The main institutions that deal with Fisheries issues are Department of Fisheries under the Ministry of Agriculture, Forestry and Fisheries. Under the new Fisheries Law² (2006), the MGC is recognized as an Endangered Species. This piece of legislation includes important elements such as the development of a National Fisheries Management Plan which incorporates key species and habitat conservation principles. In Article 23, however, it specifies that transporting, processing, buying, selling, and stocking endangered fishery resources is still possible with permission.

Specific regulations are in place to facilitate the implementation of the Fisheries Law. These regulations include the need to release specified endangered fish species if they are captured. This includes the MGC.

The mandate of other institutions would also have an impact of the fisheries resources these include The Ministry of Environment (e.g. with jurisdiction of Ramsar sites along mainstream Mekong and in the Great Lake. MGC is known to occur in both sites), the Ministry of Water

² Information in this section is based on a review of the 'unofficial' translated version. Inconsistencies will need to be clarified through further consultation.

Resources, the Ministry of Tourism, the Ministry of Rural Development, the Ministry of Industry, Mines and Energy, the Committee for the Development Co-operation and the Cambodian National Mekong Committee.

Besides the new Fisheries Law, ICLARM (1999) provides an overview of important laws, including laws for basic rights and land use, for aquatic ecosystems and aquatic resources management. These include:

- The constitution of the Kingdom of Cambodia, 1993
- Land Law, 1992, Law on Land Management, Urbanisation and Construction, 1994 and Law on Investment
- Law on Forestry Management or Forestry Law, 1988
- Law on Environmental Protection and Natural Resource Management, 1996.
- Royal Decree on the Creation and Designation of Protected Areas, 1993
- Sub-decree No 06 on River Navigation, 1986
- Draft Sub-decree on Protected Areas Management, 1998
- Draft Sub-decree on Water Pollution Control, 1998
- Draft Sub-decree on Environmental Impact Assessment, 1998
- Declaration on the licensing of Tourist Boats, 1996.

Lao PDR

Due to the non-existence of specific legislation related to fisheries, the Forestry Law (1996) is the most relevant piece of legislation. There is no specific mention of Giant Catfish within the Forestry Law but relevant 'Articles' make reference to wildlife and fish. E.g. Article 39 indicates that the State is responsible for categorising the Protection status of species; whilst Article 40 mentions that some endangered species are subject protection. Hunting is prohibited unless having the permission from concerned authorities or in case obvious necessary. The MGC is not afforded any protection status in Lao PDR under any specific legislation.

Thailand

In Thailand, fishing for Mekong giant catfish is illegal. Thai law, under Article 32 (5), (6), and (7) prohibits the capture of giant catfish in the Mekong River, except with the written permission of the Director of the Department of Fisheries. The Mekong giant catfish may also be protected by the Wildlife Protection and Conservation Act (February 25, 1992) and CITES.

Announcement by the Thai Ministry of Agriculture and Cooperatives Prohibition of Giant Catfish Catching in the Mekong River

The Ministry of Agriculture and Cooperative recognizes that Giant Catfish is the biggest freshwater fish in the world, endemic only to the Mekong River, and in the status of near-extinct. Currently, there are a lot of fishermen attempting to catch the fish for sale for consumptive purpose. These caught fish are in reproductive age, with eggs and sperms that is ready for the reproduction. If this uncontrolled catching continues, the Ministry concerns that it may leads to the future reduction or extinction of Giant catfish population. Thus the Ministry thinks it should specify protection and conservation measures for Giant catfish in the Mekong River to maintain the abundance of the population, to allow the fish a chance to proliferate before they are caught for consumption or for sale.

Under the article 32 (5) (6) and (7) of the Fisheries Act (1947), the Minister of Agriculture and Cooperatives declares the following:

1. Absolutely prohibiting anybody to conduct Giant catfish fisheries in the Mekong river - in the area of Nongkai, Loei, Mukdaharn, Nakornpanom, Ubonratchathani, and Chaingrai provinces - except with a written permission from The Director of The Fisheries Department or officials that the Director empowers

2. Specify the types, size, number, and time that the fisheries will be permitted – following the Director of the Fisheries Department's specification.

3. Under the article 60 of the Fisheries Act (1947), this announcement will become effective thirty days after the date of declaration.

Declared on July 2, 1990

Mr. Chareon Kanthawong
Deputy Minister of Agriculture and Cooperatives

Up to 2005, The Thai Department of Fisheries used to issue special permits for the catch of Giant catfish to improve the genetics of the MGC. However, it is unlikely that they would continue issuing permits for this purpose given the critical situation of MGC in the wild. In 2006, an agreement was signed by the fishers for cessation of Catfish fishing in Chiang Khong, Northern Thailand.

Regional level policies, agreements and legislative instruments:

The Mekong Agreement (1995)

The Mekong Agreement of 1995 is the foundation for the Mekong River Commission (MRC) and is therefore of paramount importance to the four member countries. In the context of fisheries and trans-boundary natural resource management, specific provisions are relevant. In Article 3, parties agree "To protect the environment, natural resources, aquatic life and conditions, and ecological balance of the Mekong River Basin from pollution and other harmful effects". One drawback is that the two upstream countries, China and Myanmar, are not signatories. Thus, stocks with distribution ranges beyond the jurisdiction of the four member countries are not fully considered by this legal instrument.

Upper Mekong Navigation Improvement Agreement

The Lancang-Mekong Navigation Channel Improvement Project, funded by the Chinese government, is part of a grand scheme to allow large ships to freely navigate from Simao, China to Luang Prabang in Lao PDR. The agreement between the four Upper Mekong countries, China, Lao PDR, Myanmar and Thailand was signed on 20 April 2000 with a view towards developing international passenger and cargo transportation on the Lancang-Mekong to promote and facilitate trade and tourism and to strengthen cooperation in commercial navigation. In 2001 navigation under the Agreement officially started.

This agreement and the activities that are underway has significant implications on the critical habitats and spawning grounds of the MGC.

The project was divided into 3 phases for implementation.

- The 1st phase is to remove 11 major rapids, shoals and 10 scattered reefs and the setting-up of 100 navigation marks, 106 markers and 4 winches then the waterway will be navigable for vessels of at least 100-150 DWT (Dead Weight Tonnage) for at least 95% of the year.
- The 2nd phase is to remove 51 rapids and shoals, allowing the waterway to be navigable for vessels of at least 300 DWT for at least 95% of the year.
- The 3rd phase, after canalization of the waterway it can be navigable for vessels of 500(4 DWT for at least 95% of the year).

Agreement on the procedures concerning the maintenance of flows on the Mekong mainstream (22 June 2006).

The flow procedures are required under the provisions of the 1995 Mekong Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, which formed the MRC.

The agreement requires the member states to co-operate in the maintenance of acceptable minimum monthly flows in the dry season; acceptable natural reverse flow of the Tonle Sap during the wet season; and prevention of peak flows greater than those which occur naturally.

The procedures clarify the related provisions of the Mekong Agreement through further defining the objectives, principles and scope of their application, as well as the roles and responsibilities required of the various parties for their implementation, including the MRC Council, the MRC Joint Committee, the National Mekong Committees and the MRC Secretariat.

Other Regional Policies

A number of other infrastructure investment/ development programmes for the Mekong Region are underway through ADB and World Bank. These include the Mekong water transfer projects that could potentially interfere with the flow regime and therefore the migration cycle of the giant catfish. A recent study by Baran *et al.* (2005) has confirmed that rise in water levels and changes in discharge trigger catfish migrations (see also Hogan *et al.* 2005)

International: Multi-lateral environmental agreements and other international fisheries related agreements

Convention on Biological Diversity (CBD): Ecosystem Approach

One of the most important international legal frameworks of relevance for the management of migratory, transboundary species is the Convention on Biological Diversity (CBD). All six riparian countries of the Mekong Basin have signed and ratified the Convention. The CBD commits the states to the objective of "...the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources...". It further makes special reference to the need for states to manage transboundary stocks (e.g. Article 3: "...contracting parties shall ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction"). The Convention specifically refers to the cooperation, among contracting parties, in research, management and monitoring of biodiversity, including migratory, transboundary elements of biodiversity.

The CBD has adopted an "ecosystem approach" as the primary framework for action under the Convention, cutting across all thematic areas of the Convention, including inland water ecosystems. Under its auspices, twelve principles for an ecosystem approach have been developed (UNEP, 1998). These principles include: management should be decentralised to the lowest appropriate level (Principle 2), ecosystem managers should consider the effect of their activities on adjacent and other ecosystems (Principle 3), conservation of ecosystem structure and functioning (Principle 5), the approach should be undertaken at the appropriate scale (Principle 7), the approach should seek the appropriate balance between conservation and use of biological diversity (Principle 10), the approach should consider all forms of relevant information, including scientific and indigenous and local knowledge and practices (Principle 11) and the approach should involve all relevant sectors of society and scientific disciplines (Principle 12).

The CBD is a very comprehensive, legally binding international instrument and, importantly, also includes the establishment of a financial mechanism for the provision of financial resources to developing country parties (Article 21 of the CBD).

Convention on Migratory Species (CMS): Species Approach

Another relevant international legal instrument of relevance is the Convention on the Conservation of Migratory Species of Wild Animals (CMS). This Convention dates back to the United Nations Conference on the Human Environment in 1972, which specifically recognised the need for countries to conserve wild animals that migrate across international borders. This recognition catalysed the subsequent adoption of CMS eleven years later in 1983. The CMS is a framework Convention under which contracting parties (nations) can develop specific measures for individual species or species groups within their range.

The CMS is, by nature, based on a species approach to conservation, but it also recognises the importance of preserving habitats and ecosystems as a means to conserve migratory animal species. The Convention lists endangered migratory species (i.e. species of high priority for the Convention) in its Appendix I and species with “unfavourable conservation status” in its Appendix II. The Mekong Giant Catfish is one of the four fish species world-wide listed on Appendix I

In the context of the Mekong Basin, the main shortcoming of the CMS is that none of the six riparian nations have signed the Convention although efforts are underway to increase its profile in the region. There are also ongoing efforts to increase the integration between the CMS and the CBD. Specifically, the vision is that the CMS should become the special instrument for the implementation of the CBD with regard to migratory species (Glowka, 2000).

The Ramsar Convention on Wetlands

All Mekong riparian States (apart from Lao PDR) are signatories to the Ramsar Convention on wetlands. Signatories are obliged to make wise use of their wetlands and aquatic ecosystems within their territories and trans-boundary systems. Specific criteria is provided for the nomination of wetlands or aquatic ecosystems based on threatened fish species (of which the MGC qualifies) or if wetlands are important for particular life cycles of fish. In addition, at the most recent Conference of Parties (COP 9 in Kampala, Uganda, 2005), a resolution was passed on the conservation, production and sustainable use of fisheries resources.

The Code of Conduct for Responsible Fisheries

The Code of Conduct for Responsible fisheries (adopted on 31 October 1995 by the FAO Conference), sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code recognises the nutritional, economic, social, environmental and cultural importance of fisheries, and the interests of all those concerned with the fishery sector. The Code takes into account the biological characteristics of the resources and their environment and the interests of consumers and other users. States and all those involved in fisheries are ‘encouraged to apply’ the Code and give effect to it.

The Code is global in scope, and is directed toward members and non-members of FAO, fishing entities, sub-regional, regional and global organizations, whether governmental or non-governmental, and all persons concerned with the conservation of fishery resources and management and development of fisheries, such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries.

Although the Code provides principles and standards applicable to the conservation, management and development of all fisheries, there seems to be a bias towards marine fisheries. In 1997, FAO developed further guidelines for responsible inland fisheries. However, the drawback is that these are not legally binding.

4.2.12 MRC planning process for basin development and its implications for giant catfish conservation

The Mekong River Commission development policy is influenced by its riparian member countries and focuses mainly on economic growth and poverty reduction. Within this context, capture fisheries are not seen as a growth sector. Nonetheless, aquatic productivity supports the livelihoods of millions of fishers and other users – users that may threaten aquatic biodiversity depending on the type and level of resource exploitation. In the medium to long-term, it is acknowledged that a healthy river ecosystem provides many valuable ecosystem services and so the river should be managed sustainably to maintain these essential services. The Mekong River Commission also has a mandate to “protect the environment, natural resources, aquatic life and conditions, and ecological balance.”

The Mekong River Commission is divided into several Programmes - some more relevant than other to the conservation of the Mekong giant catfish. For example, the Water Utilization Programme, the Environment Programme, and the Fisheries Programme all contain components relevant to the sustainable management of the river for biodiversity. The Fisheries Programme in particular, and the Fisheries Programme Technical Advisory Body more specifically, have shown great interest in the conservation status of endangered species like the Mekong giant catfish. The MRC Technical Advisory Body was created in 2000 and consists of senior officers from fisheries agencies and National Mekong Committees. The TAB integrates fisheries information into government policies and plans, furthers concepts of regional fisheries management, and commissions studies, publications (newsletter, briefing documents) and educational exchanges.

Institutionally, the MRC has stated that the Mekong giant catfish is a culturally (as opposed to economically) important species, which needs protection as a 'flagship' of Mekong River. The giant catfish is important for biodiversity as a unique representative of the Mekong ecosystem, however not likely to have a key-stone role. The Mekong River Commission has also advocated the maintenance of important wetland habitats to benefit the giant catfish. Overall, the MRC and TAB take the position that the Mekong giant catfish is very important and significant in cultural terms and also for global biodiversity.

4.2.14 Principles of economic valuation of giant catfish

It is widely recognized that the Mekong Giant Catfish has economic value as a fishery resource. This value can be quantified by production and market price of the fish. However, the Mekong giant catfish also has social and cultural value as an emblematic species that figures prominently in local festivals and religious ceremonies throughout the lower Mekong Basin. The Mekong giant catfish also has value as a "tourist attraction" where visitors can view the catfish and the communities associated with fishing for it. These latter values are more difficult to quantify and will depend on local perceptions, customs and priorities. Furthermore, the habitat on which the Mekong giant catfish depends has value, not only as a home for the catfish, but as a provider of ecosystem services on which the catfish, other aquatic species and human communities depend.

Conservation strategies can be expensive and therefore must be justified in terms of costs and benefits, i.e. value of the resource. Quite often however, the true and complete value (economic, social, cultural and ecosystem) of a resource is not adequately or accurately determined and therefore conservation programmes may appear financially unjustified, i.e. not cost-effective, or other activities that have high and easily calculated economic benefits may appear more justified (e.g. hydro-electric development).

The values of fishery resources and endangered species have been broadly summarized as:

- Use value
- Option value
- Existence value
- Bequest value

The sum of these values is the Total Economic Value (TEV). These values have also been stated in terms of "direct use values" and "indirect use values". In developing conservation strategies for the Mekong giant catfish, it will be essential to determine accurately the TEV of this critically endangered species so that wise decisions can be made and conservation efforts can be instigated and funded appropriately.

There are a range of valuation techniques that try to assess the direct and indirect use, or economic and non-economic, values of fishery resources (Table 1). A basic economic value of the Mekong giant catfish can calculate from simple production and price information that is readily available in the Mekong Basin. These simple calculations have been modified to account for the depletion of natural stocks of catfish and to account for the natural capital of fishery resources and the environment. Not all Mekong giant catfish are valued the same; consumers prefer the large size of mature wild fish. Therefore the thousands of farmed catfish available have a lower market value than the large catfish from the Mekong River (Table 2).

The direct use value of the Mekong giant catfish as a recreational fishing or tourist resource can also be calculated from direct observation of numbers of fishers/tourists participating in the activity and the financial contributions made to local businesses. Such activities may be extremely important for a specific local community, but may not be regionally very important in the case of Mekong giant catfish.

The indirect use values are more difficult to determine and several methodologies have been developed to assist. The most common methods to determine indirect values are:

- Contingent valuation – survey of how much people are willing to pay for an activity or event, e.g. to protect the catfish, to fish for it, to view it, etc.
- Conjoint analysis – determines value by asking people to value a range of features about a certain activity in order to determine combination of features that will be most valuable, e.g. value of a catfish fishing festival, community festival, private fishing trip, private eco-tour, value of text book on catfish, etc.
- Travel costs – how much are people willing to spend or do spend to travel to participate in an activity.
- Hedonistic pricing – value of characteristics associated with the catfish in addition to the value of the catfish itself, e.g. value of a large, highly migrating fish that is known throughout the world.

A combination of the above methodologies can be used to determine the TEV of the Mekong giant catfish. In addition, values or benefits can be apportioned to local, on-site benefits, and global, offsite benefits. The local fisher guiding a group of tourists around Chiang Khong would value the catfish in one way and in local currency, whereas a fish enthusiast in the UK or USA who knows this is one of largest freshwater fish in the world, would place a different value on it and base that value in foreign currency. Both sources of information are necessary for the TEV of Mekong giant catfish.

The Mekong Basin also has value as a source of direct economic resources such as the catfish, and as an ecosystem that provides valuable functions in the region. Valuation of ecosystems and ecosystem services involves the same methodologies as valuation of individual species, but because of the increased scale, it is much more complicated. The Mekong giant catfish is an icon for the entire Mekong Basin; it is an emblematic species that requires a healthy unobstructed river environment. Thus, protecting viable populations of Mekong giant catfish will also help protect other fishery resources and ecosystem functions in the Basin. Valuation of the entire Mekong Basin would be beyond the scope of the present initiative, but would be a valuable exercise.

Direct use values can be calculated from market surveys and direct observation and some of this information is available. Surveys (Annex 1) and analyses of indirect use values or for activities not yet established, e.g. eco-tourism and recreational fishing, will need to be undertaken at specific areas along the Mekong River. Table 1 needs to be completed with specific amounts of money identified for each category of value. Where information specific to the Mekong giant catfish is lacking, surrogate information can be used, e.g. information on other large catfish and recreational fishing or eco-tourism activities.

Valuation of fishery resources must be viewed in an appropriate context, i.e. they must take into account local economic realities. For example, a Mekong giant catfish that a fisherman sells to the Thai or Cambodian Department of Fisheries for US\$2 000 has tremendous local value when you consider that many fishers in S.E. Asia make less than US\$2/d. Thus, a \$2 000 fish represents wages for a thousand days' work in S.E. Asia; translating such a value to fishers in the USA that make \$200/d would mean that the fish would have a comparable value of \$200 000 in the USA. Thus, value estimates must be adjusted for the local cost of living and wage structure.

It is often stated that conservation efforts and especially endangered species recovery programmes are often not justified in economic terms. However, in reality, when TEV of

endangered species is calculated, it becomes apparent that fishery resources and emblematic species such as the Mekong giant catfish are extremely valuable at both local and global scales. Accurate calculation of the TEV for the Mekong giant catfish is essential in order to develop a viable conservation programme that will be acceptable by resource managers, the private industry and local communities along the Mekong River. The surveys, eco-tourism and even recreational fishing in reservoirs, would be excellent mechanisms to help raise awareness of key issues and plans for the catfish. Surveys should include people from outside the Mekong Basin in light of the fact that the Mekong giant catfish is such an emblematic species and a natural heritage of humanity. It is unlikely that the catfish plays a significant role as a keystone species in the Mekong and therefore it will have relatively small value as a provider of ecosystem services.

5 Toward a Species Conservation Action Plan

5.1 Conservation vision

Workshop participants agreed on a draft conservation vision for the Mekong giant catfish. This conservation vision can be used to guide the development of a Species Conservation Action Plan. The core conservation vision or goal of the Mekong Giant Catfish Conservation Group is the maintenance of a viable wild population of Mekong giant catfish and the restoration of its historical distribution. Maintenance of a genetically representative captive population is crucial as ‘insurance’ against possible (if not likely) extinction in the wild. Maintenance of critical habitats and ecosystem processes in the Mekong basin is clearly important if a wild population is to be maintained. The presumed transboundary migrations and reliance on a variety of habitats of the MGC make it an ideal flagship species for ecosystem conservation in the Mekong. In this context, maintenance of the MGC’s social and cultural importance is in itself a goal of conservation initiatives.

To achieve this goal, the Mekong Giant Catfish Conservation Group has initiated a series of joint workshops with the aim of developing a Species Conservation Action Plan for the Mekong giant catfish. The SCAP process consists, among other activities, of identifying and implementing priority research and conservation actions. One of the main goals of the December 2005 workshop was to further identify conservation and research priorities and to differentiate between activities 1) already included in existing projects, 2) important but not included in existing projects, and 3) either not important or not attainable in the short-term.

5.2 Identification of conservation options

The following conservation options were identified at the December 2005 workshop. This will form the basis of the preliminary action plan but it is acknowledged that the following list may not be comprehensive and a prioritisation is required. It is expected that the August 2006 workshop might address some of the prioritisation issues.

Table 5: Conservation and research options identified at the workshop

Research	Wild population conservation	Captive breeding & aquaculture	Habitat and ecosystem management	Communication, Networking, and Awareness Raising
Collation of existing information about giant catfish	Establishment of protected areas for giant catfish conservation	Broodstock collection	Identification of critical habitat	Establishment of Mekong Giant Catfish Working Group
Determination of distribution and abundance in the wild (current, past, age structure) / Field surveys	Management of existing protected areas to protect giant catfish	Genetic and demographic management of captive population	Flow and migration study, based on MRC flow data/model and Cambodian DoF dai catch/migration data	Workshops to discuss issues relevant to Mekong giant catfish conservation
Develop population model	Special fisheries areas	Testing of wild fish for possible hatchery	Tools for habitat management and planning	Presentation of the progress of the working

		parentage	(IRBM, EIA): review and establish relevance to Mgc	group at a higher policy level
Determine genetic population structure	Special river status	Release of captive fish into natural habitat	Other site-based approaches	Ceremonial release
Determine level of incidental catch of larval and juvenile fish	Identification of sources of fishing mortality	Post-release monitoring to establish best release size and habitat	Other large-scale approaches	Re-opening of Chiang Khong aquarium
Pond surveys in Cambodia	Determination of methods to reduce fishing mortality	Aquaculture		Children's book on fish conservation
Red listing for giant fish species	Implementation of methods to reduce fishing mortality	Development of sperm cryopreservation		Fishing ponds as means of awareness and income creation, "watch and eat"
Reduction of post-capture mortality	Buy and release			Mekong giant fish website
Economic/catch analysis of dai fishery	Legal instruments: CBD, CITES			Construct a Giant Conservation Center in northern Thailand
Environmental cues for migration and spawning assessed on captive fish	Catch quotas			
Environmental cues for migration and spawning assessed on wild fish	Limit the fishery of giant catfish to every other year and implement a maximum allowable catch of 30 fish			
Development of monitoring strategy	Postpone the start of the giant catfish fishing season			

5.3 Prioritization of conservation options

Table 6. Current status research and conservation activities

Research/Conservation Options	Included in pre-existing project	Important, not included in existing project	Not important/not achievable in short-term
Research			
Collation of existing information about giant catfish	Y		
Determination of distribution and abundance in the wild (current, past, age structure) / Field surveys		Y	
Develop population model	Y		
Determine genetic population structure of wild fish	Y		
Migration studies to identify spawning sites and other critical habitat		Y	
Determine level of incidental catch of larval and juvenile fish		Y	
Pond/cage surveys in Cambodia	Y		
Red listing for giant fish species		Y	
Reduction of post-capture mortality	Y	Y	
Economic/catch analysis of dai fishery	Y		
Environmental cues for migration and spawning assessed on captive fish	Y		
Environmental cues for migration and spawning assessed on wild fish		Y	
Development of monitoring strategy			Y
Larval fish sampling for Mekong giant catfish during spawning season		Y	
Valuation study on Mekong giant catfish		Y	
Community-based research and conservation		Y	
Mekong giant catfish diet of wild fish		Y	
Study on survival of Mekong giant catfish fish fry	Y		
Aquaculture survey for hybrids		Y	
Information about historical change in fishing practices		Y	
Development of identification methods for young giant catfish		Y	

Deep pool hydroacoustic survey in Laos		Y	
Wild population conservation			
Establishment of protected areas for giant catfish conservation		Y	
Management of existing protected areas to protect giant catfish		Y	
Special fisheries areas (dai fishery)	Y		
Special river status (north-eastern Cambodia)	Y		
Identification of unknown sources of fishing mortality		Y	
Determination of methods to reduce adult fishing mortality		Y	
Implementation of methods to reduce adult fishing mortality		Y	
Buy and release		Y	
Legal instruments: CBD, CITES, CMS	Y		
Catch quotas			Y
Limit the fishery of giant catfish to every other year and implement a maximum allowable catch of 30 fish			Y
Postpone the start of the giant catfish fishing season		Y	
Species conservation action plan for additional species			Not achievable but giant catfish plan may be relevant to other species
Large fish excluder devices	Y		
Captive breeding & aquaculture			
Broodstock collection from available captive stock	Y		
Genetic and demographic management of captive population	Y		
Testing of wild fish for possible hatchery parentage	Y		
Release of captive fish into Mekong River	Y		
Post-release monitoring to establish behaviour best release size, and habitat		Y	
Aquaculture	Y		
Development of sperm cryopreservation		Y	Difficult to find funding, but otherwise achievable
Habitat and ecosystem management			
Identification of critical habitat		Y	
Flow and migration study, based on MRC flow data/model and Cambodian DoF dai catch/migration data			Y, contact Eric Baran
Tools for habitat management and planning (IRBM, EIA): review and establish relevance to Mgc	Y		
Tonle Sap Lake Biosphere Reserve, community protection area		Y	
Special protected area status for Khone Phi Long and Sob Kok		Y	
Other large-scale approaches (deep pool conservation and relevance of BDP and WUP to fisheries conservation)	Y		
Communication, Networking, and Awareness Raising			
Establishment of Mekong Giant Catfish Working Group	Y		
Workshops to discuss issues relevant to Mekong giant catfish conservation	Y		
Presentation of the progress of the working group at a higher policy level		Y	
Ceremonial release to Mekong River and Reservoir	Y		
Re-opening of Chiang Khong aquarium			
Children's book on fish conservation	Y		
Media outreach to raise awareness		Y	
Fishing ponds as means of awareness and income creation, "watch and eat"			
Mekong giant fish website	Y		

5.4 Priority activities and obstacles to implementation

Priority activities, in the context of this SCAP workshop, are those activities that have been identified by the workshop participants as important but are not included in existing projects.

Where possible, workshop participants identified potential anchors, approaches, funding, and constraints for these activities.

Generally speaking, activities related to captive breeding and aquaculture activities, as well as activities related to direct conservation interventions to aid wild populations, have been well integrated into existing projects. Activities related to the study of the ecology and habitat requirements of wild populations were deemed important by the workshop participants, but many such activities are not currently included in existing projects. Therefore, research to inform conservation and management of wild populations stands out as the most important priority for the future. It may also be important to note that both the Darwin Initiative and the Mekong Wetlands Biodiversity Programme are both projects of limited duration and so measures should be taken to ensure that priority activities continue in the longer term.

Table 7. Priority research and conservation options

Research/Conservation Options	Possible Anchor	Approach, funding, and constraints
Research		
Determination of distribution and abundance in the wild (current, past, age structure) / Field surveys	Em Samy, Lieng Sopha	<p>Approaches: Local knowledge interviews (Thailand, Laos, and Cambodia) including information about fishing gears. In the case of Chiang Khong, number of rounds of fishing is better measure than number of boats. The model may help us predict the population size if we have good information about fish catch.</p> <p>Surveys of commercial fishing gears (lots, barrages, and dais) and also raise awareness, and train in handling.</p> <p>Funding: MWBP and possibly Darwin (for fishing gears).</p> <p>Constraints: Staff time and logistics</p>
Migration studies to identify spawning sites and other critical habitat	Zeb Hogan	<p>Approaches: Wild fish may be available in Chiang Khong, but wild fish caught and released in the past have died. If Chiang Khong fish are released the protocol will need to be improved (Chavalit and Senator Tuanjai). Captive fish should be available if the receivers are available as well. There are currently three receivers in the Mekong.</p> <p>It may also be possible to tag in Cambodia but a good source of healthy fish needs to be identified.</p> <p>Funding: MWBP.</p> <p>Constraints: Fish needed to tag. Captive fish behaviour may not be representative of wild fish. Battery life of the tags may not be long enough. The detection range may not be long enough to detect fish. It may not be possible to identify sites for receivers.</p>
Red listing for giant fish species	Chavalit	<p>Approaches: Mapping of distribution of giant fish species. The data for the mapping comes from museum records and scientific papers. Data gaps can be filled using local comprehensive local knowledge surveys.</p> <p>Funding: MWBP</p> <p>Constraints: Data is very difficult to collect. Local knowledge data may not be accurate.</p>
Reduction of post-capture mortality	Zeb Hogan, Khun Boonrien, Senator Tuanjai	<p>Approaches: Work through local and central governments to protect giant catfish in Chiang Khong.</p> <p>Funding:</p> <p>Constraints:</p>
Environmental cues for migration and spawning assessed on wild fish	Bunchong, Zeb Hogan	
Larval fish sampling for Mekong giant catfish during spawning season	Bunchong	
Valuation study on Mekong giant catfish	Devin, Tawachai, Madu (MWBP), Khamphet	<p>Approaches: Valuation as awareness building, working through</p> <p>Funding:</p> <p>Constraints: No money for valuation work. Money is needed to follow up with this activity.</p>
Community-based research and conservation	Khun Boorien and Chiang Khong Conservation	<p>Approaches:</p> <p>Funding:</p>

	Group	
		Constraints:
Mekong giant catfish diet of wild fish		
Aquaculture survey for hybrids	Naruepon, Uthairat	
Information about historical change in fishing practices	Kai	Approaches: Series of PRA exercises to look at changes in fishing gear and fishing gear use over the past 50 years. Funding: Darwin Initiative but run through the MRC Fisheries Programme. Constraints:
Development of identification methods for young giant catfish	Em Samy, AT/Thai DoF	Approaches: Funding: Constraints:
Deep pool hydroacoustic survey in Laos	LARReC	
Wild population conservation		
Establishment of protected areas for giant catfish conservation	Tawatchai	
Management of existing protected areas to protect giant catfish	Zeb Hogan, Lieng Sopha	
Identification of unknown sources of fishing mortality	Tawatchai, Em Samy	Approaches: Funding: Constraints:
Determination of methods to reduce adult fishing mortality	Em Samy, Zeb Hogan, Devin Bartley	
Implementation of methods to reduce adult fishing mortality	Em Samy, Zeb Hogan, Devin Bartley	
Buy and release		
Postpone the start of the giant catfish fishing season	Em Samy, Lieng Sopha	
Large fish excluder devices	Devin Bartley	Approaches: Funding: Constraints:
Captive breeding & aquaculture		
Post-release monitoring to establish behaviour best release size, and habitat	Thai DoF, Japanese researchers, and MWBP	
Development of sperm cryopreservation	Chumnarn	
Habitat and ecosystem management		
Identification of critical habitat		
Tonle Sap Lake Biosphere Reserve, community protection area	Lieng Sopha	
Special protected area status for Khone Phi Long and Sob Kok	Senator Tuanjai	Approaches: Funding:

		Constraints:
Communication, Networking, and Awareness Raising		
Presentation of the progress of the working group at a higher policy level	Senator Tuanjai (MP meeting) and Sourasay (MRC TAB), Kai Lorenzen	
Media outreach to raise awareness	Senator Tuanjai and Simon Wilkinson	MWBP/MRC office in Laos should work with the media to increase awareness. It is important to work with local media, national media, and international media. Constraints: FAO, MRC, and MWBP may not be able to work easily with the media. MRC and FAO have their own methods of distributing information, usually internally.

6 Preparation for the third meeting of the MGCCG, August 2006

Given the number of activities and partners currently involved in giant catfish conservation and research, it is important to monitor and evaluate activities at each Mekong Giant Catfish Conservation Group Workshop. Given the structure of the December 2005 workshop, it seems useful to monitor and evaluate activities of three categories: 1) activities that have already been accomplished (these activities are important to monitor to catalogue the progress of the Mekong Giant Catfish Conservation Group; 2) activities that have been identified as priorities and are included in existing projects (these activities are important to monitor to catalogue incremental progress toward objectives and to ensure that all activities are moving forward in a coordinated manner, and 3) activities that have been identified as priorities but are not included in existing projects (these activities are important to monitor in order to identify funding opportunities, possible anchors, and ways to further integrate these priorities into the Species Conservation Action Plan.

Activities that have been identified as important and are including in existing projects are included in table 7. Activity anchors should provide brief updates on their work at the August 2006 meeting in Vientiane.

Table 8. Brief reviews for August 2006 workshop

Activity	Anchor
Collation of existing information about giant catfish	Zeb Hogan and Kai Lorenzen
Development of population model	Kai Lorenzen, Naruepon Sukumasavin, Zeb Hogan
Determination of genetic population structure of wild fish	Uthairat Na Nakorn
Migration studies to identify spawning sites and other critical habitat	Zeb Hogan and Naruepon Sukumasavin
Pond/cage surveys in Cambodia	Em Samy and Tach Phanara
Reduction of post-capture mortality	Tuanjai Deetes, Bunrian Chinarat, Zeb Hogan
Economic/catch analysis of dai fishery	Zeb Hogan and Em Samy
Environmental cues for migration and spawning assessed on captive fish	Naruepon Sukumasavin, Bunchong Chumnongsittathum
Larval fish sampling for Mekong giant catfish during spawning season	MRC Fisheries Programme and Thai DOF
Establishment of special fisheries areas	Lieng Sopha and Zeb Hogan
Determination of relevance of legal instruments (CBD, CITES, CMS) to giant catfish conservation	Alvin Lopez
Assessment and improvement of captive breeding & aquaculture	Uthairat Na Nakorn, Wongpathom Kamornrat, Naruepon Sukumasavin, Chumnarn Pongsri, Bunchong Chumnongsittathum, Kai Lorenzen
Net buyback program	Tuanjai Deetes, Bunrian Chinarat, Alvin Lopez, Tawatchai Rattanasorn
Mekong giant fish website	Simon Wilkinson

Appendix 1: Meeting arrangements and agenda

Second Meeting of the Mekong Giant Catfish Working Group
December 12-13, Himawari Hotel, Phnom Penh

Monday December 12 2005

- 8:45 Registration
- 9:00 Welcome and opening remarks (**MC**)
- 9:15 Speech by the Director, Department of Fisheries, Cambodia (**Mr. Sam Nuov**)
- 09:30 Introduction of participants
- 09:45 Introduction of workshop schedule and objectives (**Alvin Lopez**)
- 10:00 Update on activities since August meeting (**Kai Lorenzen and Zeb Hogan**)
- 10:30 *Coffee break*
- 11:00 Presentations of reviews of existing knowledge (10-15 minutes each)
- Spatial population structure and migrations (**Zeb Hogan**)
- Fisheries catch data, recent and historical (**Zeb Hogan, Chavalit Vidthayanon, Em Samy, Sompanh Phanousith**)
- Country reports on catfish history and status (**Em Samy, Sompanh Phanousith**)
- Principles of population modelling and assessment (**Kai Lorenzen**)
- Principles of captive breeding and enhancement (**Devin Bartley, Kai Lorenzen**)
- Principles and potential of cryopreservation (**Chumnarn Pongsri**)
- 12:30 *Lunch break*
- 13:30 Presentation of reviews of existing knowledge, cont.
- Compilation of genetic information, sample analysis, guidelines for future sampling (**Uthairat Na Nakorn, Wongpathom Kamornrat**)
- Compilation of information on the Thai captive breeding programme and aquaculture (**Naruepon Sukumasavin, Chumnarn Pongsri, Bunchong Chumnongsittathum, Kai Lorenzen**)
- Giant catfish aquaculture regional overview (**Mike Phillips**)
- Principles of conservation and recovery planning, including review of US species recovery plans and Convention on Migratory Species (**Alvin Lopez**)
- Social, economic and cultural importance of giant catfish in Chiang Khong (**Chavalit Vidthayanon**)
- Legal aspects of giant catfish conservation (**Alvin Lopez, Zeb Hogan**)

MRC planning process for basin development and its implications for giant catfish conservation (**Niklas Mattson**)

Principles of economic valuation of giant catfish (**Devin Bartley**)

Additional presentations as appropriate

15:00 *Coffee/tea break*

15:30 Synthesis of existing knowledge and identification of knowledge gaps (**Group**)

17:00 Close

19:00 Conference dinner

Tuesday December 13 2005

9:00 Overview of outputs from August workshop (**Kai Lorenzen**)

9:30 Overview of conservation options

10:00 Identification of future conservation priorities

10:30 *Coffee break*

11:00 Presentation and prioritization of conservation options (**Zeb Hogan and Alvin Lopez**)

12:30 *Lunch break*

13:30 Discussion of future activities, including obstacles to implementation of priority conservation options

15:00 *Coffee/tea break*

15:30 Development of draft plan for future action

17:00 Closing Remarks

Appendix 2: Participants

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Appendix 3: Opening Remarks

Mr. Sam Nuov, Deputy Director of the Department of Fisheries

Good morning ladies and gentlemen,

On behalf of the Department of Fisheries of Cambodia, and myself, I would like to welcome you to Cambodia for the Second Regional Meeting of the Mekong Giant Catfish Working Group.

This meeting, following in the footsteps of the Joint Inception and Planning Workshop in Bangkok on 23-24 August 2005, continues the process of exchange information on the current state of the Mekong giant catfish. These workshops lay the foundations for the development of an overarching conservation strategy for the Mekong giant catfish and other endangered species.

The biodiversity of the Mekong River is an amazing rich yet underappreciated resource and your work here – to identify methods to protect the Mekong's biodiversity and most specifically the Mekong Giant Catfish – is of great importance.

In this regard, the Cambodian Department of Fisheries is very happy to co-host this meeting with the Mekong Wetlands Biodiversity Programme. The Cambodian Department of Fisheries looks forward to cooperation with all the stakeholders present at this meeting to find innovative solutions to problems facing the Mekong and its aquatic life. We hope that the decisions made during this workshop will be achievable and have great impact on the conservation of the Mekong giant catfish and other threatened species.

The outcomes of your efforts at this workshop will help to achieve the greatest possible effectiveness of the combined conservation activities focused on Mekong giant catfish. This strategy is based on practical solutions, information exchange, and coordination of activities conducted by different organizations; the effective use of research, and the effective synthesis of conservation activities with local, national, and regional policy processes.

To this end, I understand that the organizations represented at this workshop have agreed to institute a joint conservation planning process built around these requirements. This process will certainly be of great usefulness to the conservation of the Mekong Giant Catfish, one of the world's largest and most endangered species, and a species that is very important to Cambodia.

Cambodia is one of the only places where wild Mekong giant catfish still occur. Mekong giant catfish occur and have been caught in all main river areas throughout Cambodia, including the Tonle Sap Lake, the Tonle Sap River, and the Mekong River. The recorded catch of fifty-one Mekong giant catfish in Cambodia between 1999 and 2005 indicates that Cambodia is home to a globally significant population of Mekong giant catfish. Moreover, catch data indicates that all life history stages are present in Cambodia, showing that breeding may occur within the country. And even if giant catfish do not breed in Cambodia, the presence of all life history stages means that Cambodia, and especially the Tonle Sap Lake-Tonle Sap-Mekong River system, is an important area for the rearing and growth of Mekong giant catfish. This system is also very important for almost every other large-bodied, endangered fish of the Mekong River Basin.

While Mekong giant catfish appear very rare and reports of catches are fragmented, catches in the Tonle Sap River have declined only slightly in the past five years. This may indicate that the population of Mekong giant catfish in Cambodia is still healthy enough for restoration. That is to say, it is not too late for giant catfish in Cambodia. We should not give up on the discussion about how to best protect wild populations.

In this context, I am happy to report that a range of conservation initiatives are already underway. Activities to study and protect giant catfish and other endangered species are being carried out not only in Cambodia, but also by organizations including the fisheries departments of Laos and Thailand, the Mekong River Commission, the Mekong Wetlands Biodiversity Project, the Network of Aquaculture Centers in Asia-Pacific, WWF Indochina, and Imperial College London.

The Cambodian Department of Fisheries is actively promoting sustainable fisheries practices and freshwater biodiversity conservation policies. We are doing this through the various branches of

the Department of Fisheries and also through partnerships with organizations like the Mekong Wetlands Biodiversity Program. With regards to protection of Mekong giant catfish, we have instituted a strong policy on the catch of Mekong giant catfish in Cambodia, requiring fishers to release fish immediately upon capture.

In addition, we have established a full-time endangered species monitoring and enforcement team, removed some commercial nets in the Tonle Sap River, implemented an endangered species catch data collection program, constructed a tank for Mekong giant catfish rehabilitation, trained our monitoring team in handling and release of threatened fish, and drafted a joint project implementation plan between the Mekong Wetlands Biodiversity Programme and the Cambodian Department of Fisheries to better define Mekong giant catfish-related activities in Cambodia in 2006.

Perhaps most exciting, the Cambodian Department of Fisheries has designated bagnet row #2 as a special research and conservation fishery. The bagnet owners have signed a contract that they will release endangered species when they are captured in the bagnet.

The importance of the conservation of Mekong biodiversity cannot be understated, especially considering the Mekong River, and especially the Mekong River in Cambodia, remains one of the most productive and diverse rivers on Earth. Over 1,000 species of fish occur in the river and millions of people depend on the Mekong's bounty for food, water, and transportation.

Despite the high level of diversity and productivity of the Mekong River, recorded catches of most large-bodied species have declined dramatically over the past 20 years, and it is on this basis that the many species has been designated as threatened.

According to several accounts, the number of giant catfish started to decline around 1940. More recently, catch of Mekong giant catfish has also dropped in one of the last known fishing grounds in northern Thailand.

The same trend appears to be taking place with other, large-bodied species of Mekong fisheries. Anecdotal and published records point to the steep decline of the catch of large species such as the river catfish (*Pangasianodon hypophthalmus*), the giant carp (*Catlocarpio siamensis*), the seven-striped barb (*Probarbus jullieni*), Sanitwongsei's catfish (*Pangasius sanitwongsei*), and the giant stingray (*Himantura chaophraya*).

Fishers in the Tonle Sap River report that catches of river catfish (*Pangasianodon hypophthalmus*) have dropped by 90% in the fishing lots of the Tonle Sap Lake – from about 100 MT 20 years ago to just 5 or even 1 MT today.

While the shift from large bodied species to smaller species is very difficult to demonstrate, it is clear that small, low-value fish now dominate, whereas anecdotal evidence indicates that larger, migratory species have declined due to fishing pressure.

The paradox is that overexploitation of a fishery may not be marked by declines in total yield, even when individual species populations, and long-term sustainability of the overall fishery, are highly threatened. Indeed, one of the symptoms of intense fishing in inland waters is the collapse of populations of particular species even as overall fish production rises. This has important implications for species like the Mekong giant catfish and other vulnerable species, since in a mixed stock fishery, these species disappear first and sometimes without notice.

One key question is: is it possible to protect aquatic biodiversity and maintain a productive fishery? We have to believe that it is possible. Indeed, we may discover in the end that biodiversity protection and productive fisheries go hand-in-hand.

Nonetheless, to be successful we will need to identify practical methods to protect aquatic biodiversity that do not have significant detrimental effects on fisheries production or on the economy, since sustainable economic growth is a key development goal of the region.

We must also think about the conservation of species like the Mekong giant catfish in the context of future national and regional development – and find solutions that are compatible with other development goals, such as the continued growth of the aquaculture and export sectors, further capacity building for our young fisheries professionals, and increased opportunities for ecotourism and environmental education.

Of course, a group such as this cannot hope to tackle every issue but for conservation solutions to be practical, they must also fit into a broader context and not detract from the economic and social goals of the region. In this sense, your job is a difficult one. The challenge of the participants of this workshop is to find conservation solutions that will work and meet the needs of a variety of interests, protect endangered species, and foster sustainable development.

How can we protect endangered species and yet still maintain a productive fishery? How can we hope to manage a fishery, when it is shared by several countries? How can we educate the public about the importance of the conservation of endangered river species when so many people are dependent on fishing for their livelihood or cultural identity? These are some of the difficult questions that I hope you will consider during this workshop. By examining these challenges and working, step by step, it should be possible to find workable solutions.

In one sense, this workshop is already an indication of success, since the effort to conserve the Mekong giant catfish will benefit significantly from the close cooperation of experts from all countries of the lower Mekong River Basin and beyond. Cambodia, for example, has one of the world's most productive fisheries. We believe that visitors from other regions can learn valuable lessons from the experiences we have had in managing our fishery.

Before I conclude I would like to thank you once again in your participation in this working group. I would also like to acknowledge the support provided by the staff of the Cambodian Department of Fisheries and the Mekong Wetlands Biodiversity Programme. They have worked hard to organize this workshop to make it a success.

I am gratified to see that so many fisheries biologists and other experts are interested in the conservation of the Mekong river catfish. The participants of this workshop include a diverse group of stakeholders with many viewpoints on conservation. I urge you to put these differences to constructive use and share your opinions and knowledge on the status and management of the Mekong giant catfish, thereby contributing to the conservation of this unique species.

I am confident that the participants of this workshop will discover innovative solutions to the obstacles confronting the conservation of the Mekong Giant Catfish and other endangered fish species. You are working towards an important, worthwhile, and attainable goal. I am sure you will be able to identify effective ways to accomplish your objective and develop a draft Species Conservation Action Plan for Mekong Giant Catfish.

In that spirit, I have the honor to declare the Second Regional Meeting of the Mekong Giant Catfish Working Group open from now on. You have my best wishes for a productive workshop. Thank you for your attention.

Appendix 4. Mekong giant catfish catch data from Cambodia

No	Date	Location	Tag #	TL (m)	TW (kg)	Condition
1	25 Oct 99	2A	-	-	190	sold
2	19 Nov 99	2C	-	2.35	176	sold, female
3	21 Nov 99	2C	-	-	163	sold, male
4	23 Nov 99	2C	-	-	200	sold
5	24 Oct 00	2B	-	2.18	172	sold, female
6	25 Oct 00	4A	-	-	180	sold 300,000 R
7	28 Oct 00	1B	-	-	135	sold 1,600 R / kg
8	28 Oct 00	1B	-	-	185	sold, female
9	31 Oct 00	2D	-	-	270	released
10	5 Nov 00	2C	-	-	170	released
11	9 Nov 00	4A	-	-	200	sold
12	10 Nov 00	1D	-	2.10	160	released, male
13	16 Nov 00	2C	17	2.35	260	released
14	26 Nov 00	2D	-	-	270	released
15	6 Nov 00	1C	1	2.64	268	released
16	24 Oct 01	2A		1.93	116	released
17	27 Oct 01	2A		2.09	185	released
18	27 Oct 01	2A		2.01	153	released
19	6 Nov 01	2A		2.20	200	released
20	7 Nov 01	2C		1.83	120	released
21	29 Dec 01	2C		1.40	62	released
22	18 Feb 02	13A		0.81	15	released
23	20 Oct 02	2B	-	2.10	152	sold
24	1 Nov 02	4C	94	1.29	25	released
25	12 Nov 02	2A	64	2.56	-	released, died 12-11-02
26	18 Nov 02	2C	116	2.55	181	released
27	4 Dec 02	2A	291	2.05	88	released
28	Dec 02	Tonle Sap Lake (Lot 2)	-	-	70	sold

29	24 Jan 03	Tonle Sap Lake (Lot 6)	998	1.10	16	released
30	24 Jan 03	Tonle Sap Lake (Lot 6)	999	1.84	70	released
31	11 Mar 03	Prey Veng	-	-	170	sold
32	27 Oct 03	Dai 2C	1100	92 in	155	good
33	3 Nov 03	Dai 2D	1062	2.35	237	not good
34	3 Nov 03	Dai 4C	1060	2.38	146	O.K.
35	3 Nov 03	Dai 2B	1060/1096	2.38	146	O.K.
36	6 Nov 03	Dai 3C	1076	2.57	185	not good
37	7 Nov 03	Dai 5C	1107	2.35	160	O.K.
38	12 Nov 03	Dai 2C	1198	2.20		O.K.
39	27 Nov 03	Dai 2A	1192	2.16	111	O.K.
40	1 Dec 04	Dai 2D	2890	0.64	3,4	good
41	26 Oct 04	Dai 2D	2124	1.79	90	good
42	27 Oct 04	Dai 5C	2111	2.60	230	Fish died
43	28 Oct 04	Dai 2A	2139	2.53	200	Good
44	12 Nov 04	Dai 2D	2966	2.50	200	Good
45	15 Nov 04	Chhong Khnease, SR	2969	1.34	30	Good
46	15 Jun 05	K 7 WWF/DoF	2869	1.45	48	Good
47	15 Jun 05	K 7 WWF/DoF	2822	1.43	43	Good
48	15 Jun 05	K 7 WWF/DoF	2809	1.41	40	Good
49	15 Jun 05	K 7 WWF/DoF	2958	1.51	51	Good
50	25 Oct 05	Dai 3C	2961	1.28	31	Good
51	8 Nov 05	Dai 2C	32	2.20		
52	9 Nov 05	K. Cham				Fish died
53	15 Nov 05	Dai 2B	3529	2.02		Good
54	16 Nov 05	Dai 4B	3233	2.21		Released, fish died 12km down stream 3 days after release
55	23 Nov 05	Dai 9C	No	2.40		Released immediately without tagging

Location	Remarks	Source
Tonle Sap Lake (Khong Khnease)	On November 15, 2004, DoF released a 30kg fish from a small bamboo pen. Fishers caught the giant catfish earlier in the year somewhere in the Tonle Sap Lake. The fish was in the same pen as several hundred <i>Pangasianodon hypophthalmus</i> .	Zeb Hogan and Em Samy
Tonle Sap Lake (Lot #6)	On January 24, 2003, two giant catfish (15kg and 70kg) were released from fishing lot #6 in the Tonle Sap Lake. These fish were in a bamboo fence pen with several hundred <i>Pangasianodon hypophthalmus</i> .	Zeb Hogan
Tonle Sap Lake (Lot #2)	Fishers report that a 70kg fish was caught and sold in the area around fishing lot #2 in December 2002. The fish may not have been caught inside the fishing lot, but just outside it in the Prek Tuol area.	Fisherman at Prek Tuol, December 2002
Neak Loeung	On March 11, 2003, fishers caught a 170kg giant catfish (using a gill net).	Nicolaas van Zalinge, personal communication, March 11, 2003.
Kampong Cham	On November 9, 2005, fishers caught an approximately 170kg fish using a two-boat circular seine.	Zeb Hogan and Tach Phanara
Kratie	February - April, 2003 fishers caught 1-2 large giant catfish.	Isabel Beasley