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MWBP working papers on Mekong Giant Catfish, *Pangasianodon gigas*

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Mekong Wetlands Biodiversity
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Mekong Giant Catfish (*Pangasianodon gigas*) - Observation and Comments about Handling and Suggestions for Improvement

Technical information of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

BACKGROUND

Fishing mortality is a significant threat to the Mekong Giant Catfish as fishermen continue to catch and sell the fish despite the fact that the species is critically endangered. The Tonle Sap River bagnet (dai) fishery is one of the two places where wild Giant Catfish are caught on a regular basis. Without regulation, fishing mortality from bagnets equals approximately 5-10 fish per year.

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP), in cooperation with the Cambodian Department of Fisheries and the MRC Fisheries Programme, is re-implementing a Giant Catfish tag and release project in Cambodia in order to study the migratory behaviour of *P. gigas*. The tag and release programme was first implemented in 2001. The fish caught in the dais are bought from the dai operators, tagged and released. This buy and release approach provides a low cost, short-term solution to fishing mortality. The scheme does not harm the fisher's livelihood and provides an opportunity for additional research (e.g. tissue sampling for genetics studies).

During the 2004 dai season three out of five Giant Catfish caught in the dai fishery died after release (table 1). The continued mortality of a significant percentage of bagnet-caught Mekong Giant Catfish indicates that the methodology of the buy and release programme needs to be reworked.

Location	Tag Number	Length (cm)	Weight (kg)	Condition when released
Dai 2D	2890	64	3.4	good
Dai 2D	2124	179	90	good
Dai 5C	2111	260	230	Fish died
Dai 2A	2139	253	200	good
Dai 2D	2966	250	200	good
Chong Kneas, Siem Reap	2969	134	30	good

Table 1. Mekong Giant Catfish captured in the Tonle Sap River bagnet fishery and Tonle Sap Lake fishing lots, October – December 2004. Of the five Giant Catfish captured in the dai, one died before release because the bagnet owners would not sell the fish to the Department of Fisheries and two died after release, presumably due to capture stress.

It has been standard practice for the tag and release programme to rely on the bagnet operators to remove fish from the nets, transport them to holding area, and wait for our tagging team to arrive. Typically, the project uses "local" methods - fish are most often transferred from the net to the bottom of

a boat, and then taken to a net pen underneath or to the side of a floating house. The fish receive no medicine and are released immediately after tagging - in the belief that minimising handling time minimises stress. Up until now, the project has had no veterinarian.

The exact reason for the death of the Mekong Giant Catfish is unknown, but it seems that capture in the dai net harms the fish. Generally speaking, the size of the fish and its chances of survival are inversely correlated (i.e. the larger the fish, the less likely it is to survive).

Based on comments from Martin Gilbert (field veterinarian, WCS Cambodia), and Jim Robinett and the veterinarian staff of the Shedd Aquarium in Chicago (USA), the damage is likely done before the fish makes it to the tagging team. The problem may be severe lactic acidosis event due to overexertion during capture. If so, these mortalities are related to exertional rhabdomyolysis or "capture myopathy". This explains the slight delay in the actual death of the fish which is a typical feature of capture myopathy.

The presence/absence of lactic acidosis can be tested by sampling the fish's blood for pH, lactic acid, O_2, and CO_2 levels. Capture myopathy can also be confirmed by histological exam of the skeletal muscle from one of the dead animals. If the cause of death is capture myopathy, then the capture method must be modified and/or the fish need to be given intravenous injections of isotonic fluids and an alkalinising agent such as sodium bicarbonate or sodium acetate as soon as possible post-capture.

Other factors that could contribute to the poor health of the fish may include:
1) the length of time that the fish is in the dai;
2) handling of the fish as it is removed from the dai;
3) length of time that the fish is held after it is removed from the dai but before it is released;
4) the method that the fish is held (e.g. tied by rope through the mouth, etc.);
5) handling during tagging, measurement, and photography, including removal of the fish from the water for weight measurements, or;
6) disease/infection post-release.

Capture-related stress seems to be a more likely cause of mortality then post-capture stress, because mortality rates are about 50% regardless of whether or not efforts are taken to minimise post-capture stress.

RECOMMENDATIONS

The following steps may reduce future fish mortality (or at least reduce post-capture stress): 1) initiation of 24 hour surveillance of the dais by fisheries staff; 2) oversight by an on-call veterinarian available during the peak giant catfish season; 3) construction of a holding pen for rehabilitation of captured fish; 4) use of medicine to speed recovery; and 5) training of dai operators and labourers about gentle handling procedures post-capture. If these steps are not effective in limiting fish mortality, the suspension of dai operations from 15 October to 1 December every year would prevent Mekong Giant Catfish from being caught and killed in the dai fishery.

HOLDING PENS FOR REHABILITATION

1. Wooden Cage: The dai operators store fish using two methods, either in net pens underneath their floating houses or in floating wooden cages. To date, dai owners have not offered to keep the giant catfish in the cages underneath their house, perhaps because it would be nearly impossible to recapture the fish. Wooden cages do not seem like a good option because, in general, they are too small to allow the fish to swim freely. One variation on a wooden cage is the huge wooden "cage boats" that fish merchants use to transport fish from the Tonle Sap Lake to the Tonle Sap River. These cages can be in excess of 10 metres wide and 30 metres long.

2. Net Pen: The net pan is the traditional method of holding fish in the Tonle Sap Lake. Giant Catfish have been held in net pens in the Tonle Sap Lake for several weeks. Net pens may be the best option as holding pens for rehabilitation of Mekong Giant Catfish. The main constraint is finding a location for the net pen. The location would need to be large enough to hold a giant catfish, close to the dais, and secure.

3. Holding Pond: Giant Catfish have been held successfully in ponds in Cambodia and Thailand. The main constraint is finding a secure location for the holding pond. Water quality could also be a problem unless it is closely monitored.

4. Plastic Holding Tank: A large plastic tank could be partially submerged in the river next to the dais. Giant Catfish could be placed in the pond with clean, medicated water to observe recovery.

5. Sling for Holding the Fish: The Mekong River Commission Fisheries Programme (Chris Barlow) and others have recommended transporting the fish by stretcher rather than holding them on the end of a rope (figure 1). While it is easy enough to transport the fish by plastic trap, it is not that easy to use a stretcher for the largest fish. The largest fish are too massive to fit in a normal size stretcher or to be lifted by less than four adults. It also should be noted, as mentioned previously, that fish appear to be injured during capture, not during handling.

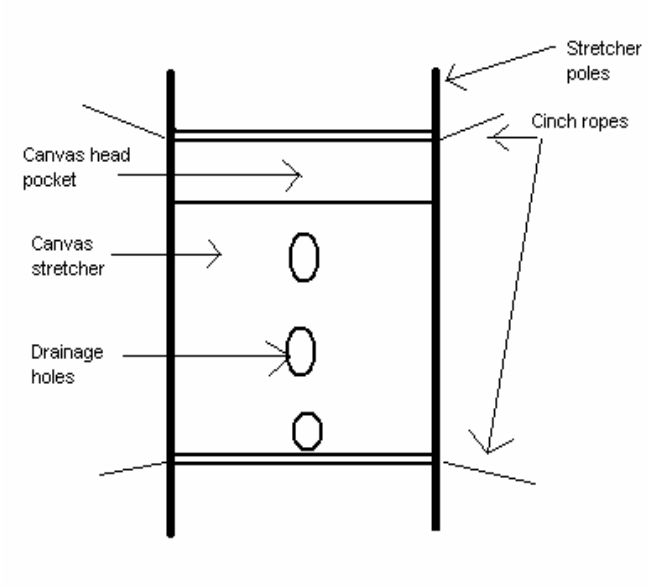

Figure 1: A simple sling for holding a fish during transport.

MEDICINE TO AID FISH RECOVERY

1. High dose anti oxidants: Vitamin B complex (3-5ml/100kg), Vitamin C, Vitamin E (10 IU/kg), Selenium
2. Anti-inflammatories: Banamine (0.3mg/kg), Dexamethasone (1-2 mg/kg)
   ATP Glucose Mn Mg Zn Injectable combination: Biosolomine
   NaHCO3 (parenteral and oral to a total dose of 2 meq/kg)
3. Cimetidine to decrease gastric acid secretion
4. Prophylactic antibiotic : potentiated penicillin and Amikacin (2.5mg/kg)

References Related to Capture Stress:

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The information above has been compiled by Dr. Zeb Hogan, catfish component coordinator of the MWBP with the help of the Mekong River Commission Fisheries Program, the Wildlife Conservation Society, and the Shedd Aquarium.

Summary

The Mekong Wetlands Biodiversity Programme (MWBP), in conjunction with the Thai Department of Fisheries (Thai DOF), the Lao Department of Livestock and Fisheries (LDLF), the National Geographic Society (NGS) Megafishes Project, and other stakeholders have initiated a one-year research project on fish migrations in the Mekong River Basin. The objectives of the project are to (1) determine the migration patterns and spawning sites of wild Mekong giant catfish in northern Thailand/northern Laos, (2) study the behavior of captive-bred Mekong giant catfish after release into the Mekong River (hatchery fish have been released into the river since 1985) and (3) capture and tag other large migratory catfish species (e.g. *Pangaius bocourti*, *Pangaius conchophilus*, *Bagarius yarrelli*, *Hemibagrus wyckiodies*, and *Wallago attu*) to identify migration patterns and critical habitat. Project results will help to identify key migration routes, distances traveled and potentially, spawning sites of these species.

The MWBP/DOF/NGS team is studying migrations of target fish primarily through the use of underwater acoustic biotelemetry. To date, 18 receivers have been installed along the Thai and Lao Mekong River from the Golden Triangle (Lao/Thai/Myanmar border) to Luang Prabang - a distance of approximately 300 km. Thirty-eight fish (18 hatchery-reared giant catfish, 1 wild Mekong giant catfish, and 19 wild fish of other species) have also been tagged and released into the Mekong River. Movements of the tagged fish are currently being recorded by the receivers. Data from the receivers will be downloaded approximately once per month for the next year (May 2006-April 2007). Initial results indicate that many of the tagged hatchery fish have moved downstream since release. At least one of the tagged wild fish has made a significant (30 km+) upstream movement.

This project is the first ever large-scale attempt to use underwater biotelemetry to study fish migrations in the Mekong River Basin. The project, if successful, has the potential to provide the high-quality scientific information on Mekong giant catfish and other Mekong River species which will increase our understanding of the Mekong River. The information collected can be used to identify threats to aquatic fauna in the Mekong River and develop strategies to help people dependent on the river for their livelihoods.

1. Introduction

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Vietnam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRC, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. The MWBP aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely. It is a five-year (2004-2009) intervention at three levels – regional, national and local.

The MWBP is a partnership between governments, aid agencies and NGOs, and provides a framework for complementary work for wetland conservation and sustainable livelihoods in the Lower Mekong Basin. One of the key components of the MWBP is the development and implementation of Species Conservation Action Plans (SCAP) for the flagship species of the MWBP.

The Mekong giant catfish (*Pangasianodon gigas*) has been selected as one of the flagship species of the MWBP. The MWBP has recently initiated the process of development and implementation of a Species Conservation Action Plan (SCAP) for the giant catfish. Through regional and national dialogue and partnership, the MWBP will develop the SCAP and build capacity for its implementation.

Fish migration studies are one component of the draft Species Conservation Action Plan for the Mekong giant catfish. Accordingly, the MWBP and other partners implemented a project in April 2006 to study the migratory behavior of Mekong giant catfish and other large, migratory catfish species of the Mekong River Basin. The objectives of the study are 1) to determine the migration patterns and spawning sites of wild Mekong giant catfish in northern Thailand/northern Laos, 2) to determine the behavior of captive-bred Mekong giant catfish after release into the Mekong River, and 3) to determine migrations patterns of other large-bodied fish species in northern Thailand/northern Laos.

2. Background and technical need

2.1 The Mekong Watershed

The Mekong is the largest river in Southeast Asia and in the twelfth largest in the world. The Mekong River Basin is approximately 800,000 square kilometers and includes parts of China, Myanmar and Vietnam, nearly one third of Thailand and most of Cambodia and Lao PDR. From its headwaters on the Tibetan Plateau, the Mekong River flows for 4,800 km through six distinct geographical regions, each with characteristic features of elevation, topography and land cover. There are over 100 different ethnic groups living within the basin's boundaries, making it one of the most culturally diverse regions of the world. Most of the basin's inhabitants are rural farmers and subsistence fishermen.

Over 60 million people depend on the Mekong and its tributaries for food, water, transport and other ecosystem services. Agriculture is the primary land use in the basin, contributing between 11% (Thailand) and 52% (Laos) of the national income. Like most areas of the world, the watershed is undergoing great change. The lower Mekong basin, including Cambodia, Thailand, Laos and Vietnam has been growing at about 5% to 8% annually since the 1990s. Potential consequences of human development activities and projects within the Mekong River include: (1) inter-basin water transfers (2) land-use change within the basin catchment (e.g. agricultural development, urbanization, deforestation, land drainage, flood protection); (3) corridor engineering (e.g. dams and weirs, channelization, dredging, mining); and (4) in-stream impacts (e.g. pollution, navigation, water abstraction, exploitation of native species, introduction of exotic species).

The Mekong River provides habitat for thousands of species of plants and animals, including one of the world's most diverse fisheries, second only to Brazil's Amazon River. Nearly 1,300 species of fish inhabit the waters of the lower Mekong River. Importantly, the Mekong River supports one of the largest inland capture fisheries in the world. The total annual catch from the lower Mekong (Cambodia, Lao PDR, Thailand and Vietnam) is estimated at 1.6 to 1.8 million metric tons with an estimated commercial value of more than US$1.4 billion dollars per year. Most of the information on fish migrations and habitat use in the Mekong River is inferred from catch statistics and local knowledge.

2.2 Study system

The study area includes the mainstem Mekong River and major tributaries between Chiang Saen, Thailand and the Luang Prabang, Laos. Our goal is to encompass a significant portion of the range of one or more species within this region, including critical spawning, feeding, and rearing habitats. Focal telemetry sites on the Mekong River include the village of Chiang Khong (Chiang Rai Province), the Thai-Lao border and the Ou River in Laos. Additional telemetry sites have situated near the mouths of major tributaries, at major fishing sites, and along narrow reaches of the Mekong River.

2.3 Focal species

The Mekong giant catfish, *Pangasianodon gigas,* is one of the largest freshwater fish in the world, measuring up to three meters in length and weighing in excess of 300 kilograms. Historically, *P. gigas* was distributed throughout the Mekong River Basin from Vietnam to Yunnan Province in China. Currently, *P. gigas* appears to be limited to the Mekong River and its tributaries in Thailand, Laos, and Cambodia. Recently, the giant Mekong catfish has gained recognition because of the increasing threat posed by human activity. Despite being listed as a critically endangered species, the fish are still caught and sold for meat in Cambodia, Laos, and Thailand. Because of its notoriety, Kottelat and Whitten (1996) propose that *P. gigas* be used as a flagship species to promote conservation of freshwater habitats in Asia.

Sanitwongsei's catfish (*Pangasius sanitwongsei*) is the second largest-bodied migratory catfish of Southeast Asia. Observational data suggest that Sanitwongsei's catfish populations are declining rapidly. Whereas wild Sanitwongsei's catfish were once fairly common in Thailand, local fishers report the disappearance of wild adults from Thailand over the past fifteen years. Today, young Sanitwongsei's catfish still occur along the Thai-Lao border in northeast Thailand but adults have all but disappeared according to local fishers. Unfortunately, no *P. sanitwongsei* were available for tagging in 2006.

Bagarius yarrelli, a Silurid catfish is native to the Mekong basin and is also found in the Indus and Ganges drainages, Xe Bangfai basin in Laos, and Indonesia. *B. yarelli* attains a maximum size of 200 cm standard length. The diet of *B. yarelli* consists primarily of prawns and to a lesser extent small fishes and aquatic insects. *B. yarelli* occurs in large rivers even with swift current and is thought never to enter small streams (Chan et al. 1999). It is found among boulders, often in whitewater where it is apparently indifferent to strong current. *B. yarelli* is sold fresh in markets, but is not considered a highly esteemed food fish. Nonetheless, large size, a wide geographic distribution, and suspected migratory life cycle make the species an excellent candidate model system for telemetry, life history and genetic studies because knowledge of adult spawning habitat, juvenile and larval rearing habitats and egg development remains largely unknown.

Pangasius bocourti and *Pangasius conchophilus* are close relatives of the Mekong giant catfish. Pangasius catfish migrations extend throughout the Mekong River Basin from the delta in Vietnam to Southern Yunnan in China. Anecdotal evidence suggests Pangasius (species pangasiids?) migrate long distances. *Pangasius bocourti*, is the most frequently captured species in northern Thailand and is the most widely cultured fish in Vietnam. *Pangasius conchophilus* may be the most common of the large-bodied pangasiids. Both species are seasonal spawners, grouping together to breed in northern Thailand at the beginning of the rainy season.

Hemibagrus wyckiodies (a large-bodied, red-tailed river catfish) and *Wallago attu* are predatory catfish that are thought to spawn within in the study area at the beginning of the rainy season. Very little is known about the ecology of these two fish species. Aside from *Bagarius yarrelli*, *Hemibagrus wyckiodies* and *Wallago attu* are the most two

common species in the April/May large mesh gill net fishery in northern Thailand (Mekong River).

Fish migrations and spawning behavior of these focal species is apparently closely correlated with the annual hydrograph (Paulsen et al. 2002). Most migratory fishes in the Mekong begin spawning migrations at the start of the annual flood and return at the end of the flood. *P. gigas, P. bocourti., P. conchophilus* and *B. yarrelli* exhibit a similar migratory pattern with spawning occurring before the rainy season. Catfishes are well suited to migrations studies because of their highly migratory behavior, adaptation to variations in river flow, and sensitivity to water quality. Their relatively large size also facilitates acoustic tagging. Despite these general patterns, the neither the precise timing of migrations, nor the extent of migrations by individual catfish species are known.

3. Methodology and results to date

3.1 Receiver installation and maintenance

The MWBP/NGS team installed a total of 18 receivers along the Mekong River. Seventeen of the receivers were installed in the main study area, a 100 kilometer reach of the Mekong River between the Golden Triangle and Pa Dai (the most downstream point of the Thai-Lao Mekong before it enters completely into Lao PDR). Two additional receivers were placed at the mouth of the Ou River, approximately 20 km upstream of Luang Prabang. Within the main study area, the team attempted to place receivers approximately every 5-10 kilometers, if a suitable site was available. Where possible, the team placed receivers near the mouths of tributaries, in deep pools, or in fish conservation zones.

The team considered three methods for deploying receivers; 1) anchor and rope, 2) bamboo raft, and 3) floating "dock". The anchor and rope method has been used in other studies and involves fixing the receiver to a rope and float that is fixed in the middle of the river with a heavy anchor. The MWBP/NGS team decided against this method after consulting with fishermen, who do not have experience using heavy anchors and large floats. The anchor and rope method was discarded in favor of two alternative "local" methods – attachment of the receivers to either a homemade bamboo raft or a pre-existing structure (i.e. a floating cage, restaurant, or house).

Final site selection for the receivers was decided based on a variety of factors, including suitability of river conditions (slow, deep water), availability of a local fisherman to monitor the receiver, and site location in relation to other receivers. Our goal was to encompass a significant portion of the range of one or more species within this region, including critical spawning, feeding, and rearing habitats.

The MWBP/DOF/NGS team attached 15 of 18 receivers to bamboo rafts constructed by local fishermen. The typical bamboo raft consisted of four bamboo logs approximately 2 m in length and 15 cm in diameter with a center pole to attach the receiver. The receivers were attached to the center pole with hose clamps and additionally secured with bailing

wire and nylon rope. The rafts were then placed in the river approximately 5-20 m from shore, depending on river conditions. The rafts were anchored using a rock attached to nylon rope affixed to the upstream end of the raft. A nylon rope was attached to the downstream end of the raft to connect it to shore. The raft position is currently being monitored by fishers who will adjust its position according to water level. Villagers/fishermen have been compensated 1000B/three months to monitor the raft.

The system of receivers is functioning very well to date and no receivers were lost or irreparably damaged during the first month of the project. Preliminary results indicate that some receivers detect more fish than others. In general, receivers in deep, slow moving water appear to have higher detection rates than receivers placed in shallow, swift flowing water. For example, the receiver at Huay Ian detected almost a (put actual number) dozen fish in May, whereas the receivers adjacent to Huay Ian recorded only a few (actual number) of these fish, despite the fact that the 12 (is this the almost dozen) fish almost certainly passed all three receivers. This finding has important implications for the study. First, it validates the high density of receivers used in this study, since not every receiver is detecting every fish. Second, it suggests that our most upstream and downstream receivers will probably not detect every passing fish. Therefore, some fish may leave the main study area without being detected. Third, it suggests that studies in deeper, slow moving reaches of river are may be successful than studies in shallow, wide, fast moving river sections.

Two receivers have been moved since first deployment. The Pa Kob receiver was moved because it was to close to the Pa Leh receiver and therefore unlikely to provide valuable information. The Jam Pong receiver was moved from a shallow, rocky area (where the receiver was damaged from contact with the river bottom) to slower, deeper water a few hundred meters upstream. The team may also move Meung Gan receiver since it has recorded few passing fish. The DOF suggested that we move the receiver far downstream (out of the current study area) to Chiang Khan or Nong Khai.

3.2 Receiver Testing

Both the VR2 and VR100 manual receivers were field tested to determine maximum detection ranges. Both systems performed well, though the manual receiver was able to detect a tag approximately 400 m distant compared to 200 m for the VR2. Both systems may perform less predictably when the tags are close to the limit of the detection range of the receivers. For example, based on earlier trials, the receivers may be able to detect our most powerful tags at a distance of up to 800 meters or more, but the chances of the receiver picking up the tag and recording the code are probably small. This highlights the need to place the receivers in as slow moving, quiet water as possible to maximize both the duration of "contact" between tag and receiver and the detection range.

3.3 Tagging methodology

The team worked with local fishers who captured large-bodied (≥ 5 kg) fish along the Mekong from the Golden Triangle (Chiang Saen) to the Thai-Lao border downstream of

Chiang Khong. The team located fish using two methods; (1) fishers contacted us by phone after they caught a large fish and 2) the tagging team traveled by boat actively looking for fishers who captured large fish. In general, the tagging team traveled by boat (usually upstream but sometimes downstream) for 6-8 hours per day and tagged 1-2 large fish tagged per day.

Fish were kept in the river before tagging. Once the tagging team arrived, fish were anesthesized using MS-222. Fish were then tagged with Vemco V16 and V13 acoustic transmitters (Vemco, Inc., Shad Bay, Nova Scotia) that transmit a unique, digitally coded signal. The V16 tags are cylindrical tags, 16 mm in diameter, either 65 or 90 mm in length, weigh 10 or 14 g in water and transmit a coded signal every 5-30 s. We also used V16 coded transmitters with depth sensors that transmit a pressure reading along with the coded signal. These tags are 16 mm in diameter, either 80 or 106 mm in length and weigh 12 or 16 g in water. The V13 tags are 13 mm in diameter, 36 mm in length, weigh 6 g in water and transmit a coded signal every 20-90 seconds. The V16 transmitters have a rated operating life of approximately 279-309 days, while the V13 transmitters have a rated operating life of approximately 1 year.

Transmitters were either surgically implanted into fish (in the case of smaller-bodied wild species and hatchery-raised Mekong giant catfish) or externally attached (in the case of larger wild fish). Large fish were tagged externally because larger fish had larger dorsal spines. The larger the dorsal spine, the easier and more secure the attachment. The tagging team also felt that surgery on large fish would be difficult due the tough skin and thick fat layer. The team was also concerned that the large number of people present during the tagging and release of the Mekong giant catfish may have made surgery impractical. Moreover, studies of external transmitters on other fish species have shown no significant differences in survival or growth between fish with and without transmitters.

After surgery, fish were placed in the river in a shallow area with good flow. When possible, the team released fish close to a fixed receiver to establish a "zero point" for the fish. The zero points provide information about how long the fish remains at the release site after tagging. The fish were released after they could swim independently and appeared fully recovered.

The team noted species-specific differences in the ease of implanting a transmitter and reactions to surgery. *P. gigas* (hatchery fish), while not obviously stressed during surgery, had extremely tough skin and thick muscle tissue. In general, tag implantation was difficult and the level of difficultly increased with fish size. *B. yarrelli*, like *P. gigas*, did not seem overly stressed by capture or surgery. *B. yarrelli* was, however, prone to excessive bleeding. While the bleeding did not lead to the death during tagging of any fish, our team recommends avoiding large incisions when tagging this species. *H. wyckiodies* reacted well to surgery and appeared to recover relatively quickly after tagging. *W. attu* was difficult to sedate and thus required longer exposure to the anesthetic. *P. bocourti* and *P. conchophilus* had the most noticeably adverse reactions to capture and to tagging. While all *P. bocourti* and *P. conchophilus* tagged appeared

outwardly healthy except for damage to their skin and mucus layer, the fish reacted violently when we attempted to place them in the sling and continued to struggle when sedated. During surgery, the fish usually underwent a series of spasms. These species seemed to recover well after surgery and were able to swim on their own when released. However, tagging-related stress may reduce their chances of survival.

3.4 Species composition and size of wild fish

A total of 20 wild fish were tagged between 5 May and 20 May 2006. Of the 20 fish, one was a wild Mekong giant catfish, *Bagarius yarrelli* was the most often tagged fish (n = 10), followed by *Hemibagrus wyckiodies* (n = 5), *Pangasius bocourti* (n = 2), *Wallago attu* (n = 2), and *Pangasius conchophilus* (n = 1). The largest wild fish tagged was the Mekong giant catfish that weighed approximately 200 kg. The smallest wild fish tagged was a *Hemibagrus wyckiodies* weighing 3 kg. The average weight for all the wild fish tagged was 19 kg. The average weight, excluding the Mekong giant catfish, was 7.3 kg.

3.5 Tagging hatchery fish

Two groups of hatchery-reared Mekong giant catfish were tagged and released. On 25 April personnel from the DOF tagged 20 fish at the Chiang Rai Fisheries Station. Fish were released at Pa Leh on 1 May, however due to extensive mortalities we only released 8 of the 20 tagged fish. We also tagged and released 10 fish at Pa Leh on 10 May.

After the 25 April tagging event, fish were held for one day in a cement holding tank then transferred to an earthen pond. The fish were held to allow the tagging team to better access the recovery and condition of the fish prior to release. The team was also concerned that surgery could result in mortality after release and thus tags would be lost.

Of the original 20 fish in the first group, there were 8 mortalities during the week that the fish were held at the Chiang Rai Fisheries Station and we sacrificed and additional 4 fish at the release site because we were worried that they were not in good enough condition to release. Generally speaking, the small fish were in good condition with clean sutures and no visible wounds. The larger fish were not in very good condition: most had wounds on their tails and around the suture area.

In retrospect, the Chiang Rai Fisheries Station pond was probably not a good place to hold the fish for observation and recovery. The water in the ponds, especially the small pond where the tagged Mekong giant catfish were held, was quite warm and the high water temperature probably further stressed the fish and exacerbated infection. Due to the high level of mortality of the fish group of fish (12 mortalities out of 20 fish), the team decided to tag a second group of fish on May 10th. These fish were tagged to bring the total sample size to approximately 20 fish. The second group was transported to the Mekong River prior to tagging and the fish were tagged and released in the field on the same day.

Both groups of fish were released at the Pa Leh receiver site because this site is in the middle of our study area and is surrounded by relatively deep, slow moving water. The receiver recorded the codes for all fish that were released at Pa Leh. Initial receiver data indicates that half of the fish (N = 4) from first group remained in the immediate area while other fish left the area immediately. Out of the eight fish from the first group, two fish of each size class remain in the area and two fish or each size class moved from the area. Of the ten fish in the second group (released on May 10th), eight fish moved away from the release site within 24 hours.

The results indicate that the receivers are working and releasing fish near a receiver provides an initial location of the fish and the timing of departure from the receiver's detectable area. For fish that stay in the immediate area of release, the receiver provides a record of these fishes general location. This may be especially important for captive fish, since captive fish of some species (e.g. trout) often stay at the release site for several days.

For fish that leave the receiver's range, we have an exact time that the fish left the area. This provides a starting point (exact time and location) for further efforts to relocate the fish by manual tracking. This is very important in a large, unstudied river like the Mekong, where locating fish and understanding their movements is difficult.

3.6 Recaptures

Three fish were reported as recaptured between 1 May 1 and 20 May. The tags of two of the fish, a hatchery wild Mekong giant catfish that had an external tag but apparently not an internal acoustic tag and a wild Mekong giant catfish, were not recovered. These fish are presumed dead. A *H. wyckiodies*, was recaptured one day after it was first tagged and released. This fish was released at the Pak Ing receiver on May 15, 2006.

3.7 Mekong giant catfish tag and release

On 11 May 2006, MWBP and the NGS Megafishes Project, working in conjunction with Chiang Rai Senator Tuenjai Deetes, the and DOF purchased, tagged, and released an approximately 200 kg Mekong giant catfish at Hat Khrai village, Chiang Rai, Thailand. The purchase of this fish was part of a multi-national effort to study the ecology and fisheries of the Mekong River.

The MWBP, NGS, and other partners purchased and released the fish for three reasons: (1) to honor his majesty the King of Thailand on the 60th anniversary of his ascension to the throne, (2) to save the fish's life, since the Mekong giant catfish is considered a rare species in Thailand, and (3) to study the migration of the fish as it moved upstream to spawn.

This fish was especially significant because it was the first tagged wild adult giant catfish ever released into the Mekong River. The effort to tag and release an adult Mekong giant catfish has been a very long and complicated process, involving many stakeholders and

almost 10 years of preparation. Given this great effort, the team was especially gratified when we were finally able to tag and release one fish with the help and support of many people and organizations throughout Thailand and abroad.

Unfortunately, the team learned afterward that the tagged Mekong giant catfish was caught and killed a short time after its release. This was very disappointing, because the fish appeared to have a good chance to survive. It was particularly disappointing because the fish was not only killed (after it had been bought from Lao fishers and released during a small ceremony on 11 May) but the tag was thrown into the river. The tag is of no value to non-scientists but it cost nearly $1,000 and the project cannot afford to replace it.

The fish was purchased at a fair price, released for science and to honor the King of Thailand. Even so, it was caught and killed 500m downstream of the release site and every indication suggests that those who killed the fish knew that their actions were wrong. The fishers did not tell anyone about the capture of the fish (even though they caught it within site of where it was released), they killed and butchered the fish quickly, and threw the project equipment in the river. Capture of the Mekong giant catfish is illegal in Thailand.

Had that fish survived, it would be provided by far the best scientific information ever available on Mekong giant catfish or any other Mekong river species. This information would have allowed for better understanding and management of the Mekong River. It would have been the last Mekong giant catfish caught in 2006 and the first fish ever tagged and released for conservation and research.

4. Collaborations

- Collaboration with local fishers and Mekong giant catfish fishermen's association
- Collaboration with the Thai Department of Fisheries
- Collaboration with the Lao Department of Livestock and Fisheries
- Collaboration with Senator Tuenjai and other stakeholders
- Collaboration with academic research institutions (University of Idaho, University of Nevada, Reno, Monterey Bay Aquarium)
- Collaboration with NGO's (WWF, MRC, Darwin Initiative)

5. Project highlights

- Project represents largest telemetry project in Mekong (and perhaps SE Asia) to date

- Outstanding and highly efficient cooperation with fishers living along the Mekong in Chiang Rai Province, especially in terms of receiver placement

- Large number of receivers increases chances of fish detection, overall study site extends from Golden Triangle to Luang Prabang in Laos

- All project objectives met during initial phase of the project : 19 receivers installed (both in Thailand and Laos), 38 fish tagged (wild Mekong giant catfish, hatchery giant catfish, and wild fish of other large-bodied species).

- Data collected to date answering important questions about wild fish migrations and the fate of hatchery reared giant catfish

- Local knowledge interviews have potential to validate telemetry results and vice-versa. Excellent opportunities for data collection from local fishers.

- At least one fish has moved out of the study area and into Laos, one fish is headed upstream towards Myanmar and China. Initial indications support hypothesis that northern Thailand/northern Laos, Myanmar, and China may be connected by one broad-scale migration pattern

6. Potential project limitations

- Fish supply

- Receiver placement

- Bureaucratic concerns

- Mekong giant catfish issues

- Cost and budget

7. Future work

7.1 Fish survival

7.2 Fish movement data

- VR2

- Manual Receiver

- Uptream movements

- Downstream movements

- Habitat utilization
- Spawning site identification

7.3 Receiver placement, detection efficiency, condition, and maintenance

Appendix 1. Photos

The receivers and raft were assembled on the river bank then carried into the river. This photo shows a typical raft: approximately 2 meters long, 1 meter wide. The back of the raft is anchored with a large rock and the front of the raft is tied off to a wooden post on the river bank.

The VR2 receiver is attached to the underside of floating bamboo rafts using hose clamps, bailing wire, and cable ties. This construction allows for easy data download, since the rafts can be flipped to quickly provide access to the receiver.

All wild fish were tagged with external plastic tags that read “Please return to the Department of Fisheries.

The release of a tagged hatchery-reared Mekong giant catfish on May 1, 2006.

Appendix 2. Field Season Schedule (April-May 2006)

18 April:	Arrival in Chiang Khong for meeting with Tawatchai and Senator Tuenjai
19 April:	Return to Bangkok for battery retrieval and supply purchase, meet with MWBP staff in Bangkok.
21 April:	Return to Chiang Khong to initiate telemetry project, meet with local NGO's, find car and boat for rental, meet translator, arrival of George Naughton (University of Idaho)
22-24 April:	Receiver installation
25 April:	Visit Chiang Rai Department of Fisheries to tag Mekong giant catfish
26-31 April:	Receiver installation
1 May:	Release hatchery Mekong giant catfish from Chiang Rai Fisheries Station
2-5 May:	Receiver installation, arrival of Peter Graf (University of Nevada, Reno) and Chuck Farwell (Monterey Bay Aquarium)
6-8 May:	Receiver installation, fish tagging, meetings with Alvin Lopez (MWBP) and Mark Bezuijen (WWF Living Mekong Program)
9 May:	Fish tagging and tracking, Zeb Hogan overnight bus to Bangkok
10 May:	Mekong giant catfish hatchery fish tagging and capture of wild Mekong giant catfish by Laos fishers at Ban Hat Khrai
11 May:	Tag and release of wild Mekong giant catfish
12-20 May:	Fish tagging and tracking, meeting with Thai Department of Fisheries officers in Chiang Rai
21 May:	Depart Chiang Khong, drive to Chiang Mai, fly Chiang Mai - Luang Prabang
22 May:	Meet Lao Department of Livestock and Fisheries officers, receiver installation at Ban Pak Ou (approximately 20km upstream from Luang Prabang)
23 May:	Report writing, fly Luang Prabang - Chiang Mai
24 May:	Report writing, fly Chiang Mai – Bangkok

Appendix 3. Contact List for Receiver Monitoring Team

Name of village	Name of contact person	Contact number
Ban Pak Ou (Laos)	Phouma Summanivong	856 (020) 5273416
Ban Pa Dai	Mr. Somrot Sornjula	07-187-6710/ 04-7407425
Ban Huay Leuk	Mr. Somrat	01-022-9156
Ban Jam Pong	Mr. Narong Chaiwong	01-9501464
Ban Pak Ing	Mr. Jan Boonpeng	None
Ban Had Krai	Mr. Sriwong Saengphet	None
Hua Wieng	Customs House restaurant	None
Ban Kaeng Kai	Uncle Mali Luangwiset	None
Ban Muang Kan	Uncle Apisit Withun	09-235-5984/09-2638-093
Ban Pa Pra	Uncle Sao	none
Ban Pa Lae	Mr. Thanom Prommin	none
Ban Sop Yap	Mr. Boonsong Kuenmamuang	04-949-3682
Ban Suan Dok	Mr. Somnuk Tana art	01-0205399
Barn Soap Kok	Mr.Boonkam Tana art	04-6160183
Ban Saew	Mr. Sanan Kaewkum	04-8096721
Ban Soap Kam	Mr. Tawan Pawandi	04-615-2618
Golden Triangle	Mr. Boonsri Thanu	09-431-0291/053-652056

Appendix 4. Contact List for Fisheries Staff (Thailand and Lao PDR)

Name	Phone Number	Affiliation	Email
Dr. Naruepon Sukumasavin	05-070-7838/02-579-7231	Department of Fisheries - Bangkok	naruepos@fisheries.go.th
Mr. Nutthapongwan Wannapat	01-873-2607	Chief of Chaiyaphum Fisheries Station	Nutthapong2002@yahoo.com
Mr, Wachira Kwangkhwang	06-0986-155	Chief of Pak-Mun Dam Unit	HLANFISH45@yahoo.com
Mr. Tewarit Wongsing	06-5877-690	Student from Chiang Mai University	Mickeykuri@hotmail.com
Mrs.Kittima Lewchalermwong	06-923-1792	Student from Chiang Mai University	squid_benz@hotmail.com
Mr. Khathawut Panboon(Oam)	01-8862280	Chiang Rai Fisheries Station	kpanboon@yahoo.com
Ubonrat Suntrarat(Kai)	04-0009189	Fisheries Biologist Udonthani Fisheries Station	Ubolrana@yahoo.com
Mr.Udomchai Arpakunanui	09-7008717	Chief of Chiang Rai Fisheries Station	nongluang@hotmail.com
Dongdavanh	020 2246324	Lao Dept of Livestock and Fisheries	
Kenchanh	020 5663420	Deputy of LDLF, Luang Prabang	
Xayaphanh Lasy	020 5570415	Deputy Director. Dept of Agriculture and Forestry	
Thong Say	020 5378772	Head of Livestock Unit, Luang Prabang	
Phouma Sommanivong	5173416	Fisherman in charge of receivers at Pak Ou	
Sourasay Phoumavong		Director, LARReC	sourasay@yahoo.com
Khamphet Roger		Deputy Director, LARReC	

Appendix 5. Contact List of Local Partners

Contact Name	Phone Number
Mr. Noi Boonjun (Lao Fisherman)	020-5089-709
Mr. Mingkwan Kaewkueomon (Lao Fisherman)	020-5089-108
Mr. Chaiya (Thai Fisherman)	05-0346312
Uncle Piak (Boat Driver)	09-2624707
Mr. Chaiwat (Driver)	09-5594135
Mr. Somkiet (Chiangkong Conservative Group)	09-9557890
Tangmo (Translator)	09-759-4709
Senator Tuenjai	01-5580707
Mr. Chalermchai	06-197-4699
Mr. Hoompeng PonDee	09-9973458
Mr. Somporn Boonruang	01-0245082
Mr. Pan Boonruang	09-8274-306
Mr. Sripun Dornmanee	04-950-4302
Mr. Pian	01-0308272
Uncle Ort	01-0267514
Mr. Sompong Chaiwana	09-835-7344

Appendix 6. List of Tagged Fish

Species	Origin	Tag #	Tag code	Total length (cm)	Total weight (kg)	Release site	Release date
P. gigas	hatchery	8777G	2015	95	7.5	Pa Lae	25-Apr-06
P. gigas	hatchery	8779G	2017	95	7.8	Pa Lae	25-Apr-06
P. gigas	hatchery	8780G	2018	87	6.4	Pa Lae	25-Apr-06
P. gigas	hatchery	8781G	2019	90	6.5	Pa Lae	25-Apr-06
P. gigas	hatchery	8674G	2023	62	1.9	Pa Lae	25-Apr-06
P. gigas	hatchery	8675G	2024	57	1.2	Pa Lae	25-Apr-06
P. gigas	hatchery	8679G	2028	64	2.2	Pa Lae	25-Apr-06
P. gigas	hatchery	8682G	2031	62	1.6	Pa Lae	25-Apr-06
B. yarelli	wild	8770G	2008	92.5	4.5	Hat Krai	5-May-06
H. wyckiodes	wild	8768G	2006	81	3.5	0.25 km upstream mouth Pak Eng	8-May-06
B. yarelli	wild	8765G	2003	72	n/a	Golden Triangle receiver site	9-May-06
W. attu	wild	8766G	2004	98	n/a	0.25 km upstream from Golden Triangle receiver	9-May-06
B. yarelli	wild	8769G	2007	82	4.2	Suan Dok	9-May-06
P. gigas	hatchery	8986G	2	89	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8987G	3	86	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8772G	2010	100	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8773G	2011	75	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8776G	2014	82	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8676G	2025	71	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8677G	2026	66	n/a	Pa Lae	10-May-06
P. gigas	hatchery	8678G	2027	68	n/a	Pa Lae	10-May-06
P. gigas	hatchery	9691G	2032	92.5	n/a	Pa Lae	10-May-06
P. gigas	hatchery	9692G	2033	95	n/a	Pa Lae	10-May-06
P. gigas	wild	8982G	4	200	240	Hat Krai	11-May-06
B. yarelli	wild	8771G	2009	77	3.9	Approximately 1 km upstream from Don Thi	11-May-06
B. yarelli	wild	8774G	2012	147	30	Pak Eng	13-May-06
P. bourcourti	wild	8775G	2013	93	9.5	Chiang Khong	14-May-06
H. wyckiodes	wild	8680G	2029	71	3	Pak Eng	14-May-06
W. attu	wild	8767G	2005	82.5	3.3	Sop Yap receiver	15-May-06
H. wyckiodes	wild	8782G	2020	90	5	Pak Eng	16-May-06
B. yarelli	wild	9693G	2034	84	5.6	1.0 km downstream from Don Thi	16-May-06
B. yarelli	wild	9694G	2035	96.5	6.3	1.5 km downstream from Suan Dok	16-May-06
B. yarelli	wild	9695G	2036	82	4.7	2 km downstream	16-May-06

Mekong Wetlands Biodiversity Programme
Catfish Component

Mekong Fish Migrations Study
Updated Project Report
September 2006

Appendix 7. Project Summary for Local Distribution

In April 2006, the Mekong Wetlands Biodiversity Programme, working with the Thai Department of Fisheries, the National Geographic Society Megafishes Project, and many other stakeholders initiated a project to study the ecology of Mekong River fishes in northern Thailand. This project is part of a basinwide research initiative to gather information about Mekong River fish, especially the Mekong giant catfish.

In northern Thailand, the project has three broad objectives: to determine the spawning site for the Mekong giant catfish, to study the ecology and behavior of other Mekong fish species, and to gather knowledge from local fishermen about the ecology and status of life in the Mekong River.

Our field team consists of representatives from the Thai and Lao Departments of Fisheries, several universities in the United States of America, an employee of the Monterey Bay Aquarium in California (USA), and almost two dozen residents of the riverside communities in Chiang Rai Province, Thailand.

During the next year, our team will periodically visit Chiang Khong and the other local communities. We will be tagging and tracking fish – both by boat and using a series of underwater receivers that monitor the movement of tagged fish.

By tagging and tracking fish, we can learn about their ecology: identify spawning areas and other important habitat, determine how fish respond to changes in river flow, and gather information about the health of Mekong River fisheries. This information can be in turn be better manage the river – both to identify threats to life in the Mekong River and to help find ways to keep the river healthy for those that depend on the river for their livelihoods.

Local people play a very important role in the project. We are working with fishermen closely not only to provide us with fish to tag, but also to help us learn about the ecology of the Mekong River. We ask all people that live along the Mekong River to please help us with our project. We hope to be able to talk with many fishers about their livelihoods and the status of fish in the river.

We also request that if anyone catches one of our tagged fish, please return the tag to the Department of Fisheries so that we can collect information from the tag.

Thank you very much.

Sincerely,

Dr. Zeb Hogan
Associate Research Biologist
Mekong Wetlands Biodiversity Programme

						from Suan Dok	
H. wyckiodes	wild	8983G	5	89.5	6.5	Pak Eng	17-May-06
H. wyckiodes	wild	6539G	2001	79	4.6	Pak Eng	17-May-06
P. bourcourti	wild	8985G	1	77	6.4	Hat Khrai	19-May-06
B. yarelli	wild	8984G	6	121	17.5	Don Thi	19-May-06
P. conchophilus	wild	6540G	2002	75	5.5	Hat Khrai	20-May-06

Final Report
On

Mekong Giant Catfish Conservation
(February-November 2006)

by

Em Samy, Thach Phanara, Zeb Hogan and Lieng Sopha

Cambodian Mekong Fish Conservation Project (CMFCP) / IFReDI/FA/MWBP

1 Introduction

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), The World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRCS, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands.

One of the key components of the MWBP is the development and implementation of conservation activities to better protect the flagship species of the MWBP. The Mekong Giant Catfish (*Pangasianodon gigas*) has been selected as one of the flagship species of the MWBP. The activities described in this report, and carried out by IFReDI, contribute to the ultimate goal of better protection for the Mekong Giant Catfish and other endangered Mekong species. The implementation of these activities were primarily the responsibility of the Cambodian Department of Fisheries (DOF), through IFReDI, the central and provincial DOF staff. A Technical Advisory Team, comprised of Alvin Lopez and Dr. Zeb Hogan, provided technical support to implementation of the contract.

During 2006, project activities were divided into four broad categories, 1) conservation, 2) research, 3) outreach, and 4) regional cooperation. Conservation activities focused on direct interventions that are necessary over the short-, medium- and long-term to address the most pressing direct threats to the remaining population of Mekong Giant Catfish and their habitat in the Mekong River. As such, activities addressed development

and enforcement of methods to reduce mortality, particularly through fisheries by-catch. This component also dealt with the development of a Species Conservation Action Plan for Mekong Giant Catfish, IUCN Red List Assessments of threatened fish species, and investigations into the feasibility of the development of freshwater conservation concessions and/or protected areas. Research consisted primarily of tag and recapture studies, pond surveys, and collection of catch statistics. Outreach activities focused on raising awareness and understanding of the importance of freshwater biodiversity. Outreach included such activities as the public release of endangered fish species, distribution of T-shirts and posters promoting endangered species conservation, and village level consultations to explain the project and its objectives. The regional cooperation component aimed to strengthen connection between fisheries experts in order to better protect transboundary species such as the Mekong giant catfish. This objective was accomplished through technology and data sharing, workshops, and the formation of regional partnerships.

For a complete list of activities, please refer to the contract between IUCN-The World Conservation Union and Inland Fisheries Research and Development Institute (IFReDI) Department of Fisheries, Cambodia. A list of deliverables is provided within the contract.

2 Results (report on deliverables in the MWBP/IFReDI contract)

2.1 Establishment of bagnet research and conservation zones (at bag net row #2)

The Tonle Sap River bagnets ("dai trey" in Khmer) operate from October to March. The bagnets, classified as a large scale commercial fishery in Cambodia, consist of 14 rows or stationary bagnets located in the lower portion of the Tonle Sap River. The bagnet fishery contributes significantly to the harvest of small fish used for the production of fish paste, a popular food of the Cambodian people. The Tonle Sap bagnet fishery is also a an excellent fishery for the long-term study of the migratory fish species, since fishing effort is constant and nearly the entire catch consists of migratory species. The fishery is one of the last places where large-bodied endangered species such as *Pangasianodon gigas* and *Catlocarpio siamensis* are caught on a regular basis. Therefore the bagnets have been the focus of research and conservation activities since 2000.

The Department of Fisheries has been monitoring the catch of bagnet row number 2 since 2000, to determine whether to abolish the row No 2 for the purpose of the fisheries conservation or maintain the fisheries for monitoring purposes. In2005, the Department of Fisheries decided to designate this dai row No 2 as a special concession of the Inland Fisheries Research and Development Institute (IFReDI) for monitoring and research purposes. The decision was approved by the Ministry and bagnet row No 2 is now under the supervision of IFReDI

In 2005, IFReDI contracted with Dai fishers row No 2 to provide information about catch. The contract was made before the start of the 2005 fishing season, on 20th October 2005. Twenty six endangered species were listed in Annex 1 for the conservation purposes. The contract stipulates that the Dai owners must release all endangered aquatic animals in Annex 1 when they are caught by the bagnet. However, the fishers tend to hide the capture and sell the fish. Thus, a longer term solution would be to delay the fishing season until December 1st and provide a small incentive to fishers in order to obtain catch data or fish for tag and release.

Figure 2.1: Dai fisheries in opening season

2.2 Four Monitoring Posts Established at Bagnet Row No 2

With the intention to collect scientific information on the endangered species and with assistance from Mekong Wetland Biodiversity Project (MWBP) and Mekong River Commission (MRC), the Inland Fisheries Research and Development Institute (IFReDI) has selected and deployed 8 staffs from the Fisheries Administration (FA) at dai row number 2 to monitor fish catch and enforce fishery law to conserve endangered species. According to the contract between the Fisheries Administration and the fishers (Annex 2), fishers must release endangered species when they are caught in the dai. Two monitoring staff stayed at each dai unit. The staff recorded data on catch weight, species, especially endangered species encountered in the catch, fish price, and value, and tagged and released fish. The dai fishers were also advised and trained on safe-handling of endangered species.

2.3 Tag and Release Report (including number of tagged fish, species, date, tag number, and location).

Fish tagging was carried out from October 25th to November 31, 2005. Fish were taken directly from the bagnet and transferred to a holding cage adjacent to the bag nets. We attempted to tag adult fish. Young fish were also tagged occasionally due to a scarcity of large fish. The minimum size of tagged fish was about 100 grams. Before tagging, length and weight of the fish were measured. Fish were then tagged with plastic disc or "spaghetti" tag applied either manually (in the case of a disk tag) or using a tagging gun. The tags were inserted into the dorsal musculature at the base of the dorsal fin, so that the nickel pin/t-bar attached firmly behind of the dorsal fin rays. Each tag was labeled with number and the disc tags were labeled with instructions in Khmer to return the tag for a reward . Tagged fish were placed in freshwater for a short period, and then released approximately 50 meters downstream of the tagging location. The tagging process took on average of ten minutes per fish, including the time necessary for recovery and release.

In 2005, it was very difficult to find the endangered species to tag. Dai owners did not like to have the fish tagged and released. The dai fishers wanted to keep the information on capturing the endangered species secret. They did not want report about capture of species which they were compelled to release. They did not want to cooperate with the

research program. Notably fewer fish were available to the release team after the after the dai fishers row No 2 signed a contract requiring them to release endangered species free of charge, Due to the new conservation policy of Cambodian Fisheries Administration, fisheries staff were only able to tag 4 giant catfish and approximately 30 other endanger species, as shown in the table below:

Table 2.3: List of Fish Tag and Release from 25th October 2005 to 23rd November 2005

No	Date	Species	Location	Tag #	L (cm)	W (Kg)
1	25-Oct-05	*Pangasianodon gigas*	Dai 3C	2961	128	31
2	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3289	43	1.2
3	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3205	44	0,9
4	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3298	42	0,9
5	02-Nov-05	*Pangasius larnaudiei*	Dai 2C	3211	51	2
6	08-Nov-05	*Pangasianodon gigas*	Dai 2C	32	2,20	
7	09-Nov-05	*Pangasianodon gigas*	K. Cham	No tag		
8	12-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3224	87	7
9	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3281	51	1.3
10	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3271	41	0,8
11	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3269	37	0,6
12	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3207	46	1,1
13	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3215	50	1,5
14	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3297	55	2,1
15	15-Nov-05	*Pangasianodon gigas*	Dai 2B	3529	2,02	
16	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3221	81	7
17	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3285	114	12
18	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3257	118	15
19	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3279	64	2
20	16-Nov-05	*Pangasianodon gigas*	Dai 4B	3233	2,21	
21	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3254	92	9
22	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3238	87	8
23	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3C	3537	95	9
24	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3290	115	13
25	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3263	96	10
26	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3222	86	8
27	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3245	83	8
28	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3212	85	7
29	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3253	76	4,4
30	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3256	113	13
31	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 2A	3227	0,63	2

Figure 2.3: Releasing Tagged Fish in Tonle Sap River Bagnet # 2

2.4 Tag Recapture Report (including survey locations and dates, number of tagged fish recaptured, species, tag number, date, and location).

Surveys for tag recaptures were conducted by project staff, provincial fisheries officers throughout the country. The project staff conducted surveys for tagged fish about once every 15 days. The survey started from February 1, 2006 until June 10, 2006. The survey location covered the area of Tonle Sap Lake, Tonle Sap River, Bassac River, and Mekong River. Fishermen were also instructed to return tags from the recaptured fish to nearby Fisheries office and sent to Fisheries Administration (please see instruction in the form for collecting tag recapture, it is in Khmer language in Annex 3). The tag recapture is shown in the table below:

Table 2.4: List of the Tag Recapture from 22nd October to March 2005

No	Date	Species	Location				Tag #	Catch by	Location
			Commune	District	Province	Distance from PP			
1	14-Jan-05	Unknown	Near Dai No 3				1569	Gillnet	
2	01-Jan-05	*Probarbus jullieni*	Phoung thouc 1	Hong Ngu	Dong Thap	VN	2383	Trapnet	Mk down
4	10-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	2249	Gillnet	Mk down
5	30-Dec-05	*Probarbus jullieni*	Lvea Em	Kien Svay	Kandal		2273	Gillnet	Mk down
6	23-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	2323	Gillnet	Mk down
7	30-Jan-05	*P. hypophthalmus*	Lvea Em	Kien Svay	Kandal	15	3047	Gillnet	Mk down
8	30-Jan-05	*P. hypophthalmus*	Lvea Em	Kien Svay	Kandal	15	1741	Gillnet	Mk down
9	30-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	1096	Gillnet	Mk down
10	29-Jan-05	*C. microlepis*	Lvea Em	Kien Svay	Kandal	15	2279	Gillnet	Mk down
11	10-Jan-05	*Pangasius larnaudiei*	Tan phouc 2	Hong Ngu	Dong Thap	VN	2515	Dai trey Linh	Mk down
12	Last year	*Pangasius larnaudiei*	Near Dai 2				1807	Gillnet	Tonle Sap
13	19 Nov.05	*P. hypophthalmus*	Arey Khsat				3254	Gillnet	Tonle Sap

14	18 Nov.05	*P. gigas*	Lvea Em	Kien Svay	Kandal	15	3233	Death	Mk down
15	23 Nov.05	*P. hypophthalmus*	Near Dai No 2				2923	Gillnet	Tonle Sap
16	24 Nov.05	*P. hypophthalmus*	Near Dai No 3				3253	Castnet	Tonle Sap

Note: The number of tag returns will increase, because the project is still collecting tags.

Date and location of the tag survey

- Chaktomuk (quarter bra) 5 times in 2006
- Phnom Penh to Neak Loung, 14th - February- 06th 2006
- Mekong upstream, from Phnom Penh, Kompong Cham, Kratie to Stung Treng Province, 06th to 12th June 2006.
- Mekong downstream, from Phnom Penh, Neak Loung to Viet Nam border from 8th to 12th February 2006.
- Bassac River from 17th to 18th March 2006
- Tonle Sap River from 22nd to 26th March 2006

2.5 Endangered Species Catch Report (including all available information on all endangered fish species captured in Cambodia in 2005)

Table 2.5: List of Species Tagged and Released from 15th June 2005 to 04th January 2006

No	Date	Species	Location	Tag #	L(cm)	W(kg)	Condition
1	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2822	143	43	Release
2	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2809	141	40	Release
3	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2958	151	51	Release
4	01-Jul-05	*Catlocarpio siamensis*	Chaktokmuk	2530	93	15	Release
5	01-Jul-05	*Catlocarpio siamensis*	Chaktokmuk	2227	91	14	Release
6	22-Jul-05	*Catlocarpio siamensis*	Lot 3 Pursat	2976	1.34	18	Release
7	22-Jul-05	*Catlocarpio siamensis*	Lot 3 Pursat	2953	1.42	68	Release
8	28-Jun-05	*Catlocarpio siamensis*	Lot 7 Pursat	NA		78	Release
9	25-Oct-05	*Pangasianodon gigas*	Dai 3C	2961	128	31	Release
10	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3289	43	1.2	Release
11	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3205	44	0,9	Release
12	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3298	42	0,9	Release
13	02-Nov-05	*Pangasius larnaudiei*	Dai 2C	3211	51	2	Release
14	08-Nov-05	*Pangasianodon gigas*	Dai 2C	32	2.20		Release
15	09-Nov-05	*Pangasianodon gigas*	K. Cham				Fish died
16	12-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3224	87	7	Release
17	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3281	51	1.3	Release
18	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3271	41	0,8	Release
19	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3269	37	0,6	Release
20	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3207	46	1,1	Release
21	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3215	50	1,5	Release
22	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3297	55	2,1	Release
23	15-Nov-05	*Pangasianodon gigas*	Dai 2B	3529	2.02		Release
24	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3221	81	7	Release
25	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3285	114	12	Release

26	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3257	118	15	Release
27	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3279	64	2	Release
28	16-Nov-05	*Pangasianodon gigas*	Dai 4B	3233	2.21		Release and fish died
29	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3254	92	9	Release
30	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3238	87	8	Release
31	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3C	3537	95	9	Release
32	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3290	115	13	Release
33	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3263	96	10	Release
34	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3222	86	8	Release
35	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3245	83	8	Release
36	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3212	85	7	Release
37	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3253	76	4,4	Release
38	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3256	113	13	Release
39	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 2A	3227	63	2	Release
40	07-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3258	111	12	Release
41	09-Nov-05	*Pangasianodon gigas*	K. Cham	No	2.39	165	Release
42	18-Dec-05	*Pangasianodon gigas*	K. Chhnang	No	140	37	DNA Sample
43	29-Jan-05	Stingray	Koh Prak, Stung Treng	3220	187	130	Release
44	11-Dec-05	Stingray	K. Cham	3204	150	65	Release
45	08-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3201	50	1	Release
46	08-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3355	42	1.2	Release
47	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3320	66	2.8	Release
48	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3306	100	11.6	Release
49	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3333	60	2	Release
50	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3526	68	2.6	Release
51	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3076	120	12	Release
52	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3086	90	6	Release
53	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3058	86	7	Release
54	16-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3051	150	13	Release
55	16-Dec-05	*Pangasianodon hypophthalmus*	Dai 3A	3082	120	12	Release
56	17-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3313	120	11.2	Release
57	19-Dec-05	*Pangasianodon gigas*	K. Cham	NA	250	180	Release
58	12-Dec-05	*Pangasianodon gigas*	K. Cham	NA	190	120	Release
59	09-Dec-05	*Pangasianodon gigas*	K. Cham	NA	239	165	DNA Sample
60	21-Dec-05	*Pangasianodon hypophthalmus*	Dai 3C	3075	115	12	Release
61	21-Dec-05	*Pangasianodon hypophthalmus*	Dai 3C	3083	97	10	Release
62	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3063	70	3.4	Release
63	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3074	92	6.2	Release
64	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3067	88	7	Release
65	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3092	100	11	Release
66	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3100	70	3.9	Release
67	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3061	73	4	Release
68	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3090	59	2.4	Release
69	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3091	74	4.5	Release
70	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3077	90	7.5	Release
71	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2D	3097	84	8	Release

72	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2D	3094	74	6	Release
73	29-Dec-05	*Probarbus jullieni*	Dai 2B	3539	32	0.6	Release
74	30-Dec-05	*Probarbus jullieni*	Dai 2D	3236	28	0.4	Release
75	30-Dec-05	*Probarbus jullieni*	Dai 2D	3261	35	0.7	Release
76	30-Dec-05	*Probarbus jullieni*	Dai 2D	3292	39	1.3	Release
77	8-Dec-05	*Probarbus jullieni*	Dai 2C	3255	42	1.2	Release
78	01-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	6068	105	13.5	Release
79	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	3073	102	14	Release
80	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	3056	67	3.5	Release
81	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3A	3066	103	12	Release
82	03-Jan-06	*Pangasianodon hypophthalmus*	Dai 2B	3078	82	6.4	Release
83	03-Jan-06	*Pangasianodon hypophthalmus*	Dai 2C	3081	80	4.5	Release
84	04-Jan-06	*Pangasianodon hypophthalmus*	Dai 4A	3093	118	13	Release

Table 2.5.1:Summary table of catch and release of three focal species in Cambodia 2005-2006.

Year	Species	Total number
2005	*Catlocarpio siamensis*	5
	Pangasianodon gigas	13
	Pangasianodon hypophthalmus	42
2006	*Catlocarpio siamensis*	1
	Pangasianodon gigas	7
	Pangasianodon hypophthalmus	33
Grand total		101

2.6 Red List of Status Reports of Endangered Fish Species Based on Local Knowledge

The Cambodia conservation team with the assistance of MWBP/MRC conservation project has gathered available data and information on endangered species, including local knowledge surveys and input from provincial fisheries officers, to develop a list of endangered species for Cambodia. Twenty one freshwater fish species are defined as threatened. A list of threatened species is given in the table below:

Table 2.6: Threatened Freshwater Fish of Cambodia (based on what ??)

No	Scientific Name	FAO name	Genus	Family	Status
1	*Scleropages formosus*	Asian bonytongue	*Scleropages*	Osteoglossidae	R
2	*Pangasianodon gigas*	Mekong giant Catfish	*Pangasianodon*	Pangasiidae	R
3	*Catlocarpio siamensis*	Giant barb	*Catlocarpio*	Cyprinidae	R
4	*Probarbus jullieni*	Seven-line barb	*Probarbus*	Cyprinidae	VU
5	*Probarbus Labeamminor*	Thinlip barb	*Probarbus*	Cyprinidae	VU

6	*Probarbus Labeamajor*	Thicklip barb	*Probarbus*	Cyprinidae	VU
7	*Balantiocheilos melanopterus*	Bala sharkminnow	*Balantiocheilos*	Cyprinidae	EN.
8	*Puntius partipentazona*		*Puntius*	Cyprinidae	EN.
9	*Wallago leeri*		*Wallago*	Siluridae	R
10	*Bagarius yarrelli*	Goonch	*Bagarius*	Sisoridae	R
11	*Bagarius suchus*	Crocodile catfish	*Bagarius*	Sisoridae	R
12	*Glyptothorax fuscus*		*Glyptothorax*	Sisoridae	R
13	*Osphronemus gouramy*	Elephant ear gourami	*Osphronenmus*	Osphronemidae	R
14	*Bagarius bagarius*	Goonch	*Bagarius*	Sisoridae	R
15	*Lycothrissa crocodilus*	Sabretoothed thryssa	*Lycothrissa*	Engraulidae	VU
16	*Bangana behri*		*Bangana*	Cyprinidae	VU
17	*Tenualosa thibaudaeui*	Laotian shad	*Tenualosa*	Clupeidae	R
18	*Mekongina erythrospila*		*Mekongina*	Cyprinidae	VU
19	*Puntioplites bulu*		*Punioplites*	Cyprinidae	EN.
20	*Datnioides microlepis*	Finescale tigerfish	*Datnioides*	Lobotidae	EN.
21	*Hemibagrus wyckioides*		*Hemibagrus*	Bagridae	VU

Note: EN. is endangered, VU is vulnerable and R is rare,

2.7 Mekong Giant Catfish Pond Survey Report

Eleven fish farmers with 21 ponds around Phnom Penh, Kompong Cham and Kandal Provinces were interviewed. The results of the survey are in the table below:

Table 2.6 1: Giant Mekong Catfish encountered in pond culture

Date	Names of farmers	Location	No of Ponds	No of GMC	Source of Larvae	Comments
10/05/06	Moui Lyna	K7, Chraing Chamres 2, PP.	2	10	Tonle Sap River	
10/05/06	Ta Ren	K7, Chraing Chamres 2, PP.	2	2	Mekong River	Released in River in 2000
01/05/06	Touch Buntha	K11. Prek Phnov, PP.	2	N/A	Tonle Sap	Unknown species ?
03/04/06	Meas Sophat	Doung village, Prek Phnov, PP.	3	2	Tonle Sap Great Lake	Raised in Pond for 10 years (weight from100 to 130 Kg)
14/06/06	Pin Setha	Doung village, Prek Phnov, PP	2	16	Tonle Sap and Tonle Sap Great Lake	Raised from 1996 to the presence (weight 25-30kg)
12/06/06	Chreang	Kruos village,	3	N/A	Tonle Sap	Started raising for 20

	Senghou	Samrong District, PP.			River	years with *P. hypophthalmus*, but only for one year, it was sold out.
09/06/06	Tang Chi	Kampong Prasat Commune, Mukampoul District, Kandal	3	6	Mekong River	Took 2 samples for DNA , weight 1.8-2Kg, raised for 2 years
08/06/06	Tang Ngy	Prek Koy village, Roka Kaung Commune, Kandal	2	2	Mekong River	Died after harvesting *P. hypophthalmus*
08/06/06	Noun Lour	Pong Ro village, Angkor Ban Commune, Kampong Cham	1	4	Mekong River	Got information from local villagers
09/03/06	Sok Then	Pong Ro village, Angkor Ban Commune, Kampong Cham	1	1	Mekong River	Last year, 3 fish was released with no tag and still remained one fish in his pond
27/04/06	San Lim	Stung Cheang village, Prek Koy Commune, Kampong Cham	1	3	Mekong River	Released without tag to the Mekong River in 2000 (weight: 35-35 Kg)
Total	**11**		**21**	**46**		

Figure 2.6: Integrated Pond Culture *P. hypophthalmus* and *P. gigas*. In the photo on the right, a farmer named Mr. Tang Ngi holds up a small *P. gigas* from his pond at Prek Koy village, Roka Kaung Commune, Kandal Province)

2.8 Giant Mekong Catfish Mortality Rate and Cause Analysis

According to surveys, fishers indicated that the high number of Giant Mekong catfish died because of human activities in the Mekong, Tonle Sap River and Tonle Sap Lake.

Many fish were harvested for food during the Khmer Rouge regime (1975 to 1979). Mekong giant catfish were shot by Khmer and Vietnamese soldiers in the 1980's and accidentally killed by the use of dynamite fishing.

In Cambodia, fishing appears to be a major cause of mortality of Mekong giant catfish. The following fishing methods have been identified as causes of harvest-related mortality:

1. The Tonle Sap River bagnet fishery (Dai fishery). From 1999 to 2005, at least 13 Mekong Giant catfish died after capture in Tonle Sap River bagnet fishery.

2. Seine netting and large-mesh size gillnets. From 1989 to 1999, it was reported that one or two Mekong Giant Catfish were caught and sold every year. Last year two Giant Catfish were caught, one was sold and another one died before it could be tagged and released. Kampong Cham Provincial Fisheries Office took this fish and preserved it for display.

3. Tonle Sap Lake fishing lots. One or two giant catfish appear to be caught every year in the Tonle Sap Lake fishing lots.

4. Harvest of fish for pond culture. Mekong giant catfish are harvested along with several other species in a multi-species fishery targeting very young *Pangasianodon hypophthalmus*. Pond owners typically only raise the fish for 1 or 2 years, during which time it's very difficult to differentiate between *P. hypophthalmus* from *P. gigas*, and so a small number of *P. gigas* are sold together with *P. hyphopthalmus*. (Note: For the first 1 or 2 years, *P. hypophthalmus* look very similar to *P. gigas*. After 3 years, pond owners can differentiate the two species, because *P. gigas* grows faster than *P. hyphopthalmus*).

Additional threats include habitat degradation, the use of destructive fishing methods (electro-fishing and dynamite fishing) and harvest of larval fisher in the closed fishing season. Further upstream, dams and river channel modification may be causing indirect mortality of the Mekong Giant Catfish, but this does not seem to be a problem in Cambodia.

Table 2.7. Mekong Giant Catfish mortality recorded from 25th October, 1999 to October 2006

Year	Species	Location	No of fishes	Remarks
1999	*Pangasianodon gigas*	Bagnet Fisheries Tonle Sap	4	sold
2000	*Pangasianodon gigas*	Bagnet Fisheries Tonle Sap	5	sold
2002	*Pangasianodon gigas*	Bagnet Fisheries Tonle Sap	1	Sold
2002	*Pangasianodon*	Fishing lot No 2 Tonle Sap	1	Sold

	gigas	Lake		
2003	*Pangasianodon gigas*	Lower Mekong River in Prey Veng	1	Sold
2004	*Pangasianodon gigas*	Bagnet Fisheries in Tonle Sap River	2	Fish died
2005	*Pangasianodon gigas*	Kampong Cham	1	Fish died
2005	*Pangasianodon gigas*	Kien Svay, Kandal	1	Fish tagged and died after release
Total			16	

Summary Papers:

In the survey on tag recapture, distribution, and mortality of Mekong Giant Catfish, fishers reported that 7 or more Mekong Giant Catfish have been caught by seine net as listed in the table below:

No	Date	Location where the fish is died	Died in	Length (m)	Weight (Kg)	Comments
1	25-10-99	Dai fisheries row 2A Phnom Penh	Dai fisheries		195	Dai owner sell to fish vendor
2	19-11-99	Phnom Penh Dai fisheries row 2C	Dai fisheries	2.35	176	Dai owner sell to fish vendor
3	21-11-99	Phnom Penh Dai fisheries row 2C	Dai fisheries		163	Dai owner sell to fish vendor
4	23-11-99	Phnom Penh Dai fisheries row 2C	Dai fisheries		200	Dai owner sell to fish vendor
5	26-11-00	Phnom Penh, front of Wat Phnom Pagoda, Tonle Sap River	Dai fisheries	2.24	276	Dai owner gave out to make fish sculpture and fish Marquette
6	24-10-00	Phnom Penh Dai fisheries row 2B	Dai fisheries	2.18	172	Dai owner sell to fish vendor
7	25-10-00	Phnom Penh Dai fisheries Row 4A	Dai fisheries		180	Dai owner sell to fish vendor
8	28-10-00	Phnom Penh Dai fisheries Row1B	Dai fisheries		135	Dai owner sell to fish vendor
9	28-10-00	Phnom Penh Dai fisheries Row 1B	Dai fisheries		185	Dai owner sell to fish vendor
10	09-11-00	Phnom Penh Dai fisheries Row 4A	Dai fisheries		200	Dai owner sell to fish vendor
11	06-11-01	Phnom Penh Dai fisheries Row 2A	Dai fisheries	2.20	200	Gave to DoF to make Marquette kept in storage.
12	20-10-02	Phnom Penh		2.10	152	Dai owner sell to fish vendor

		Dai fisheries Row 2B	Dai fisheries			
13	Not sure -12-2002	Lot No 2 Tonle Sap Lake, Battambang Province	Lot fisheries		70	Lot owner sell to fish vendor
14	10-11-02	Phnom Penh Dai fisheries row 2A	Dai fisheries	2.20	185	Gave to DoF to make Marquette kept in storage
15	06-11-03	Phnom Penh Dai fisheries Row 3C	Dai fisheries	2.57	185	Died at Chrauy Ampil commune, Kandal Province. buried underground by local people
16	11-03-03	Prek Ta Loap community, Leuk Dek district, Kandal province	Seine net	1.68	165	Fisherman sold to fish vendors at Neak Loeung, then gave to DoF to make fish sculpture and given to Archaeologist, Royal University of Fine Art, Phom Penh
17	27-10-04	Phnon Penh Dai fisheries Row 5C	Dai fisheries	2.60	230	Died in dai fisheries Not use for any thing
18	13-11-04	Phnom Penh, Front of Hotel Chachktokmock River	Dai Fisheries 2D	2.66	168	Not good condition, kept long time in dai fisheries, taken picture, video and fish bone
19	30-10-04	Kbal Kok community, Kean Svay district, Kandal province	Dai Fisheries 2D	2.40	200	Died after release a few days. Not so good condition, kept in dai fisheries long time, the local people made Pra hok
20	20-03-04	=	Not cause		>100	Seen dead by local people last year at Kok Koe community, Lvear Em district, Kandal province
21	2003	=	Not cause		>150	seen dead by local people at Khbal Chrauy Village, Chrauy Chongva Commune, Phnom Penh, then was made to fish oil
22	17-06-05	Kampong Pur village, Raka Kaung 2, commune, Mukampoul District, Kandal Province	Sein net		>160	Pourv Fisher said Vietnamese fisher caught the giant catfish.

Figure 2.8: Left: A Young, pond-cultured *P. gigas* that died after harvest. Right: A Mekong giant catfish caught by seine net in Kampong Cham Province in 2005.

2.9 Mekong Giant Catfish Distribution Survey (based on catch data and local knowledge)

The survey of Mekong Giant Catfish distribution was conducted by Mekong Giant Catfish conservation staff in cooperation with provincial fisheries officers. Surveys were conducted with fishers along the Mekong River, around Tonle Sap Lake, Tonle Sap and Bassac River.

The majority of survey focused on the provinces along upstream Mekong River from Phnom Penh to the Laos border and Mekong downstream from Phnom Penh to Vietnam border. The second focus was along Tonle Sap River, Tonle Sap Lake and pond culture across the country. The results of the field survey are as in the below table:

Table 2.8: List of Commune, District and Provinces, Mekong Giant Catfish Distributed and Caught every years by Fishers

Mekong Up stream from Phnom Penh	Mekong Downstream from Phnom Penh to Vietnam border	Tonle Sap River and Tonle Sap Lake from Phnom Penh	Pond culture through out the Country
Phnom Penh • Reusey Chrauy, •Rokakaung Commune Kompong Cnham Province •Kampong Pour, Rokakoy, Angkorban, Kong Meas district • Kok Sotin district	Phnom Penh •Kok norea (Koh norea Island Kandal Province (Left river) •Arey Khsat commune •Koh koe commune •Koh Prak •Lvea Em district (Right river)	Phnom Penh •Dai fisheries (Dai fisheries along Tonle Sap River, Row 2-5 and 9) •Prek Kdam commune Kompong Chhnang province •Kompong Prasat commune •Kompong Tralach	Kandal province, 18 Km from Phnom Penh, Commune Chraing chamres. Roka Kaung commune. Kampong Cham Province.

•Tonlebet commune, Thbung Khmum district) • Kompong Svay commune (Koh Chmar district). Kra Tie Province •Chloung district •KohPres •Sombo district •Koh Ampil commune •Koh Rongoe commune •Koh Khnar commune SturngTreng •Koh Thbung khla •Koh Srolay •Seam bok commune	Kien Svay district •Dey et commune •Neak loung •Preak Taloep commune •Preak dach commune •Kho om Som Nor Prey Veng Province •Peam Raw district •Peam Chor district •Prey Chea Anlong Krom village •Phom they commune	district •Kong chhnang •Chnork Trou Sem Reap province •Chong Kheas commune •Lot Number 2 Battam Bang province •Preak toul commune •Fishing lot number 2	

It is very difficult to collect data on Mekong Giant Catfish distribution from areas shown in the above table. When the project staff interviewed local people, fishermen only answered with reference to the past 20 years. Currently there is very little information related to Mekong Giant Catfish after the fisheries policy change.

Summary of Primary Analysis of The Distribution Data

a.Tonle Sap River

- Phnom Penh, Dai fisheries along Tonle Sap River (Bagnet fisheries # 2 caught 2-6 Mekong Giant Catfish every year and other bagnet caught 1 to 4 fish every year.
- Phnom Penh Roka kaung commune 2004, 2 Giant Catfish, one released with the tag and fish sold

b.Tonle Sap Lake

- Kompong Chhnang province, fishing lot #2, 1 Giant Catfish
- Battambang province, fishing lot # 2 Prek Toul: 2 Giant Catfish caught and sold in1998-1999
- Siem Reap province, Chong Khneas commune: One Mekong giant catfish released by the Mekong Fish Conservation Project in 2004.

- Other remaining location in the above table, Mekong Giant Catfish reported by fishers, but the project could not get specific information from fishers.

c. Mekong upstream from Phnom Penh

- Kampong Cham Province, Kompong Pour: 3 Mekong Giant Catfish caught using seine nets
- 30 km from Phnom Penh, Reusey Chrauy commune , 2 Mekong Giant Catfish 2004
- Kompong Cham, Kompong Pour, Roka Koy, Angkor Ban communes Kong Meas district have caught 1 to 3 every year.
- Kratie and Stung Treng Provinces: No information.

d. Mekong downstream from Phnom Penh

- Koh Norea Island caught 1 Mekong Giant Catfish in 1988
- Neak loung Prey Veng Province, 1 fish caught at Peam Ro district.

e. Pond culture

According to country-wide surveys, the ratio between *Pangasianodon hypophthalmus* and *Pangasianodon Gigas* in the culture is about 1000:1. Pond farmers said around 3 to 4 Mekong Giant Catfish may occur in each pond. A few pond owners stated that they kept fish in ponds for 10-15 years, after which time the fish attained sizes between 100-140 kilograms.

Figure 2.6: White spots on the map are location of Mekong Giant Catfish distribution

2.7. Mekong Giant Catfish DNA Samples

Six tissue samples of Mekong Giant Catfish were sent to Thailand for DNA analyzes.

Table 2.7. Fin Clip of Mekong Giant Catfish for DNA analyzes

No	Date	Location	Weight (Kg)	Length (m)	Remarks
1	18 Dec 2005	Fishing lot 2, Kompong Chhnang Province	36		Fish released (Sent)
2	19 Dec 2005	Kompong Cham Province	180	2.20	Released (Sent)
3	09 Nov 2005	Kompong Cham Province	200	2.14	Fish died (Sent)
4	25 Oct 2005	Bagnet fisheries #3, Tonle Sap River	220	2.20	Fish died (Sent)
5	11 Jun 2006	Pong culture, Chraing Chamres, Phnom Penh	36		Not yet sent
6	11 Jun 2006	Pong culture, Chraing Chanres, Phnom Penh	16		Not yet sent
7	13Aug 2006	Pond culture, Roka Kaung 30 Km from P.P	2		Not yet sent

2.10 Report on designation of giant barb, *C. siamensis*, as Cambodia's "National Fish"

As part of the Royal Decree No. NS/RKT/0305/149 Dated March, 21, 2005 the Giant barb (*Catlocarpio siamensis*) was designated as a national fish of Cambodia. The Khmer common name is "Trey Kahor or Trey Kbal Lan or Trey Koalreang". Giant Mekong Barb is one of the largest freshwater fish in the Kingdom of Cambodia. It can attain weights of 150-300kg, has body length of 2-3m, and has large scales covering whole body, except the head and fin. The body has two different colors, scales above the lateral lines are clear gray, and under the lateral line is silver. Article 18, Chapter II, protects this species of Royal decree No 33 on Management of the Fisheries Sector. At present, the Department of Fisheries has encouraged hatcheries and breeding stations to conduct research and experimentation on breeding and incubation in order to stock the fish in natural water bodies and use for aquaculture.

Since 2000, the Department of Fisheries has cooperated with the project for the Management of the Freshwater Capture fisheries of Cambodia of the Mekong River Commission and Mekong Fish conservation Project funded by Mekong Wetland

Biodiversity Programme (MWBP) to tag and release into the wild barb captured in bagnet fisheries in the Tonle Sap River, in order to study its migration and growth. The giant barb occurs throughout the Cambodian Mekong River and the Tonle Sap Lake. In ancient times the Giant bard was carved on the wall of temples at Angkor Wat (see figure 2.9.1). Its scales were once used for making a type of shuttlecock for a popular Khmer sport.

Figure 2.9.1 Photo of Giant barb carved at Angkor Wat about 1000 years ago

Figure 2.9.2 Giant barb caught at Dai fisheries number 2

The giant barb is a very large, but non-aggressive. It is tasty and popular Cambodian food. The reasons for encouraging hatcheries and breeding stations to carry out breeding and incubation experiments are to disseminate the findings to fish farmers because the fish feeds on natural foods, grows fast, and the brood stock can be maintained. It is said to occur in the deep pools of the Mekong River, some of which have been established as protected areas to conserve endangered species. While it remains a commercial fish species, it is also threatened by fishing and has been categorized as an endangered species in Thailand.

As part of the Mekong Fish Conservation Project, and cooperation between the Mekong Wetlands Biodiversity Project and IFReDI, 31 C. siamensis have been released since 2003.

Table 2.9: *Catlocarpio siamensis* tagged and released from 2003 to 2006

No	Date	Species	Location	D.Tag #	TL (cm)	TW (kg)	Condition
1	31/Oct/03	Catlocarpio siamensis	Dai 2B	1051	132	51	good
2	31/Oct/03	Catlocarpio siamensis	Dai 4C	1061	120	36	not good
3	2/Nov/03	Catlocarpio siamensis	Dai 2B	1075	138	53	O.K.
4	3/Nov/03	Catlocarpio siamensis	Dai 3C	1074	118	34	good
5	3/Nov/03	Catlocarpio siamensis	Dai 2D	1093	131	60	good
6	4/Nov/03	Catlocarpio siamensis	Dai 2A		39	0.60	good
7	4/Nov/03	Catlocarpio siamensis	Dai 4C	1052	115.5	36.5	good
8	6/Nov/03	Catlocarpio siamensis	Dai 2B	1086	163	95	O.K.
9	6/Nov/03	Catlocarpio siamensis	Dai 2B	1136	74	9	good
10	8/Nov/03	Catlocarpio siamensis	Dai 2B	1068	127	42	good
11	8/Nov/03	Catlocarpio siamensis	Dai 4D	1056	146	78	not good
12	10/Nov/03	Catlocarpio siamensis	Dai 2D	1160	152	81.50	O.K.
13	15/Nov/03	Catlocarpio siamensis	Dai 2D	1111	158	94	O.K.
14	22/Nov/03	Catlocarpio siamensis	Dai 3A	1159	91	18.8	O.K.
15	23/Nov/03	Catlocarpio siamensis	Dai 2B	1146	117	40	good
16	24/Nov/03	Catlocarpio siamensis	Dai 2A	1124	106	25	not good
17	2/Jan/04	Catlocarpio siamensis	Dai 2A		80	10.00	good
18	23/Nov/04	Catlocarpio siamensis	Dai 2B	2806	142	73,5	good
19	22/Oct/04	Catlocarpio siamensis	Dai 2A	2119	133	52	good
20	25/Oct/04	Catlocarpio siamensis	Dai 2A	2138	107	29	good
21	27/Oct/04	Catlocarpio siamensis	Dai 3A	2136	121	31	good
22	6/Nov/04	Catlocarpio siamensis	Dai 2D	3035	96	19	good
23	12/Nov/04	Catlocarpio siamensis	Dai 2A	2955	136	55	good
24	13/Nov/04	Catlocarpio siamensis	Dai 2A	2983	152	82	good
25	16/Nov/04	Catlocarpio siamensis	Dai 2A	2974	137	57	good
26	23/Nov/04	Catlocarpio siamensis	Dai 2B	2806	142	73,5	good
27	1/Jul/05	Catlocarpio siamensis	Chac tok muk	2530	93	15	good
28	1/Jul/05	Catlocarpio siamensis	Chac tok muk	2227	91	14	good
29	22/Jul/05	Catlocarpio siamensis	Lot 3 Porsat	2976	1.34	18	good
30	22/Jul/05	Catlocarpio siamensis	Lot 3 Porsat	2953	1.42	68	good
31	28/Jun/05 2006	Catlocarpio siamensis No	Lot 7 Porsat	No		78	good

2.11 Development of Freshwater Research and Conservation Zones (especially in previously identified protected areas such as the Tonle Sap Lake Biosphere Reserve, Ramsar sites, and bagnet row #2)

No new freshwater research and conservation zones have been established for Mekong Giant Catfish conservation, except at Tonle Sap bagnet fishery # 2. According to old fisheries law (and new fisheries law chapter 5 article number 18 to article number 25 pages 14) such conservation zones have already been established by Department of Fisheries.

The following table lists the name and locations of 8 protected areas in the Provinces around Tonle Sap Great Lake:

Provinces	**Battambang**	**Pursat**	**Kompong Thom**	**Siem Reap**
Name of Protection areas	Prek Toal	Dey Ro Neat	Pi Stuon	Kompong Phluk
		Raing Til	Ba Lot	
		Kampong Prak		
		Chrauy Sdey		

The project has also cooperated with DoF staff and Mekong Dolphin Conservation Project to develop protected areas encompassing the deep pools along Mekong at Kratie and Stung Treng Provinces.

2.12 Mechanisms for greater regional cooperation on Mekong Giant Catfish conservation

a. National cooperation

- Cooperated with Dai fishers, fishing lot holders, all relevant provincial fisheries offices, all relevant agencies, and fisheries communities to disseminate information about the tagging program and provide project posters and T-shirts. We asked fishers to contact us immediately, whenever the Mekong Giant Catfish is caught.
- Held meetings among Cambodian MWBP working team to follow the progress of project activities.
- Shared information with Mekong Dolphin Conservation Project regarding priority conservation zones that have been established.

b. Regional Cooperation

-Participated with network partners to share information and in discussions in 3 workshops in Phnom Penh, Bangkok and in Lao PDR organized by MWBP.

2.13 Endangered fish species team (this team would participate in Red Listing workshops, Mekong Giant Catfish meetings, and other meetings relevant to endangered species issues).

Department of Fisheries staff have worked on the conservation of the giant species of the Mekong for many years, particularly focused on the bagnet fisheries and but also focused on other the fisheries along the Mekong River. The team continues to work and increase activities as it is assisted by the Mekong Wetland Biodiversity Programme (MWBP). The working team is familiar with the work and recognized by the Director General of the Cambodian Fisheries Administration (FA). Researchers and the representative of the Inland Fisheries research and Development Institute (IFReDI) Fisheries Administration, Cambodia have participated in the regional network activities to

collect data and information required, to share information, ideas, and discuss the regional trans-boundary issues in workshops and meetings of MWBP for regional cooperation.

2.14 Official Cambodian government Mekong Giant Catfish Conservation Strategy

The Cambodian Conservation team and other relevant officers under the Fisheries Administration have been working in accordance with all policies and regulations relevant to the conservation of the endangered species. A list of endangered fish has been developed and proposed to the Ministry of Agriculture, Forestry and Fisheries for approval and action. The Royal decree on the National fish symbol of the Kingdom of Cambodia designated the giant barb, an endangered species, for conservation purposes. The project staff is preparing a draft in Khmer about Mekong Giant Catfish policy for submission to FA Director. Some articles in the Cambodian fisheries law address conservation and obligate fishers to conserve endangered species. When the endangered species are been caught, they must be released immediately.

2.15 Permanent fisheries conservation office established within Cambodian Department of Fisheries (DoF)

Office number 212 second floor of Inland Fisheries Research and Development Institute (IFReDI) is designated as the Mekong Giant Catfish Conservation office.

2.16 Educational awareness posters

It is imperative that local fishing villages are made aware of the importance of Mekong Giant Catfish and others endangered species. The project visited schools, fishing villages, commune offices, Provincial fisheries Units, fish landing sites and fish markets, and schools along Mekong, Tonle Sap, Basac River and Tonle Sap Great Lake. During visit, the project staff explains them as following:

According to the Mekong Giant Catfish distribution survey based on catch data and local knowledge survey the project's main objectives are as follows:

- Educate local fishermen, community representatives and students about fisheries regulations, the old fisheries law, the proposed new fishery law, Prakas (regulations) N.o 02 of MAFF on the prohibition of illegal fishing gears (incl. electric, dynamite fishing and less than 1.5 cm small mesh size net), the order of Prime Minister, proposed Royal Decree.
- Increase awareness of local communities about the result of previous survey activities, Giant Catfish biology, the importance of protecting the biological habitats of Mekong Giant Catfish, the importance of Giant Catfish/fishes for future generations.
- Educate and distribute the protocol for stranded and by-caught Mekong Giant Catfish
- Distribute other important educational materials, such as: Children books and poster on Mekong River Giant Catfish
- Disseminate the guidelines on the temporary demarcation of core conservation zones for Mekong Giant Catfish conservation,

to protect the small remaining Mekong Giant Catfish population from accidental catch in gillnet and provide fish stock for sustainable use.

- Explain handling procedures for Mekong Giant Catfish, present them information about Mekong Giant Catfish habitat and Mekong Giant Catfish distribution.
- Request feedback about fisheries policy.
- Remind fishers that the project will not buy Mekong Giant Catfish for release since Article 18, Chapter II of Royal decree No 33 on Management of the Fisheries Sector states that any captured Mekong giant catfish must be released immediately without condition.
- Establish contact with all relevant agencies in respective countries regarding the status of Mekong Giant Catfish and potential for collaboration.
- Distribute educational awareness materials such as project T-shirts, posters, children books (Khmer name Sam nang and Trey Riech, Sam nang and Mekong Giant Catfish).
- Photo document all activities of the project during field visits.

Figure 2.16 Distribution of posters, children books and T-shirts to fishers at Roka Kong Commune and Angkor Ban commune, Kompong Cham province

1.17. Project T-Shirts

The Project produced 500 t-shirts with two logo ideas and three sizes (L, M S, half for giant catfish and half for giant barb). These species were selected as requested by Deputy of IFReDI and Deputy of DoF Cambodia, because the giant barb has been selected as the national flagship species for Cambodian people.

The result of designing and producing T-shirt as shown below:

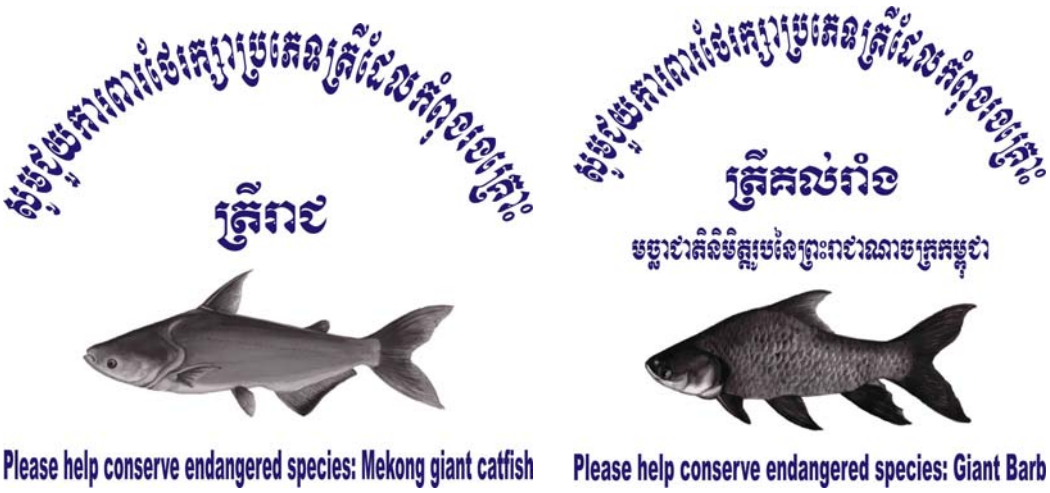

Figure 2.17.7. Two kinds of the project T-shirt logos (looking from the back site)

Figure 2.17: Front site of the project T-shirt logo, when Project staff provided to Cham fisher at Angkor Ban commune, Kompong Cham Province

2.17 Mekong Giant Catfish video for use in media campaigns

The project produced video for use in media campaigns. In 2007, the project will continue to produce in Khmer language video media.

2.18 Photographs and Documentation of Mekong Giant Catfish and activities

Photographs were taken for project activities and kept (please, see Annex 5)

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DRAFT

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

Photo © Bunchong Chumnongsittathum

Second Working Group Meeting
Phnom Penh
12-13 December 2005

Citation:

Citation: MGCCG (2005b). Development of a Species Conservation Action Plan for the Mekong Giant Catfish: December 2005 Workshop Report. Mekong Giant Catfish Conservation Strategy Report

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.

Further information, key documents and other reference material will be made available throughout the process in the dedicated web site www.mekonggiantcatfish.org.

Contents

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 the 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 Table1.

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 MCG 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 aactivities 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 off 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 Intiative 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
P. gigas 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	*P. gigas* 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 *P. gigas* in February and March. The occurrence of fish is 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 requirement 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 of 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

Pangasianodon gigas (wild samples)	15 fish	11 loci
Pangasianodon gigas (hatchery samples)	7 hatchery (4-38 fish/hatchery)	7 loci
Pangasianodon hypophthalmus	1 pop(19 fish)	8 loci
Pangasius sanitwongsei	2 pop(10-38 fish)	8 loci
Pangasius larnaudii	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 away 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 theimportance 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 Law[2] (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 reverie 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 fishermen 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.

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	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. Surveys of commercial fishing gears (lots, barrages, and dais) and also raise awareness, and train in handling. Funding: MWBP and possibly Darwin (for fishing gears). Constraints: Staff time and logistics
Migration studies to identify spawning sites and other critical habitat	Zeb Hogan	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. It may also be possible to tag in Cambodia but a good source of healthy fish needs to be identified. Funding: MWBP. 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.
Red listing for giant fish species	Chavalit	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. Funding: MWBP Constraints: Data is very difficult to collect. Local knowledge data may not be accurate.
Reduction of post-capture mortality	Zeb Hogan, Khun Boonrien, Senator Tuanjai	Approaches: Work through local and central governments to protect giant catfish in Chiang Khong. Funding: Constraints:
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	Approaches: Valuation as awareness building, working through Funding: Constraints: No money for valuation work. Money is needed to follow up with this activity.
Community-based research and conservation	Khun Boorien and Chiang Khong Conservation	Approaches: Funding:

	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:

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.

		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 it 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 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 *Pangasianodon hypophthalmus*.	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 *Pangasianodon hypophthalmus.*	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

Development and Implementation of a Species Conservation Action Plan for the Giant Catfish, *Pangasianodon gigas*, of the Mekong River Basin

Final Report for the Mekong Wetlands Biodiversity Programme
February 2007

Cover photo: A Mekong giant catfish caught and released along the Mekong River in Kampong Cham Province, Cambodia, December 2006.

Report prepared by Dr. Zeb Hogan with contributions from Alvin Lopez, Em Samy, Tach Phanara, Heng Kong, and Kai Lorenzen.

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Executive Summary

Between June 2005 and December 2006, the Mekong Wetlands Biodiversity Programme, working in conjunction with the Thai Department of Fisheries, the Cambodian Department of Fisheries, the Mekong River Commission, and other partners, supported several activities focused on the conservation of the critically endangered Mekong giant catfish, *Pangasianodon gigas*.

The primary objective of these activities was the development and implementation of a species conservation action plan (SCAP) for the Mekong giant catfish. Acknowledging the fact of the critical status of the giant catfish, the MWBP placed an emphasis on contributing to priority conservation actions on the ground parallel to the contributing to the development of the SCAP and long term conservation strategy.

Key outputs of this project include participatory assessment of conservation options for giant catfish, development of a global conservation strategy for Mekong giant catfish, conservation assessments of key Mekong fish species, technical, logistical, and financial support for national-level conservation initiatives, publication of reports and background information on the Mekong giant catfish, and ecological and migration studies to provide information for better management of the Mekong giant catfish and other endangered species.

The species conservation action planning (SCAP) process and development of a conservation strategy for the Mekong Giant Catfish was initiated at an inception workshop in Bangkok in August 2005. At the second regional meeting of the Mekong Giant Catfish Regional working group in December 2005, the group identified preliminary conservation action priorities. The final Species Conservation Action Plan is scheduled for completion in March 2007.

In addition to the species conservation action planning process, project staff developed and implemented several priority conservation actions in the field. In Cambodia, the Department of Fisheries implemented a monitoring program for endangered species. The monitoring program resulted in improved handling of Mekong giant catfish and the release of several dozen endangered fish. The Cambodian Department of Fisheries also conducted a tag and release program to better understand the migratory behavior of large-bodied Mekong fish, and carried out nationwide surveys to assess the conservation status of the Mekong giant catfish and other threatened species. As a result of these surveys, it appears that most large-bodied species qualify as endangered under IUCN criteria. In Thailand, a large scale telemetry project was designed and implemented by the Thailand Department of Fisheries, the Lao Department of Livestock and Fisheries, and MWBP staff. The telemetry project included over 300 kilometers of the Mekong River between Chiang Saen, Thailand and Luang Prabang, Laos. This stretch of river is thought to be critical spawning habitat for Mekong giant catfish. Preliminary results suggest that captive-bred Mekong giant catfish probably die after release. Other large bodied species migrate long distances within the study area and may use the Thai-Lao Mekong as spawning habitat.

1 Introduction

The Mekong river basin consists of many unique ecosystems and provides habitat to a wide array of globally threatened species such as Irrawaddy Dolphin, Sarus Crane, Siamese Crocodile, and the Mekong Giant Catfish. These four species have been selected as flagship species for the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme as they fulfill one or more criteria for selection of flagships. These species:

- inhabit a broad diversity of important wetlands and therefore are representative of threatened wetland habitats and their associated fauna
- are regional in distribution and trans-boundary in nature
- provide an opportunity for enhancing regional collaboration for conservation and management of biodiversity and ecosystems

An integrated approach in the conservation of flagship species is an important tool to address the issue of ecosystem and biodiversity conservation as a whole.

This document aims to report on the results of 1 ½ years of work toward the development and implementation of species conservation action plan for the Mekong giant catfish, *Pangasianodon gigas*.

2 Background

The Mekong giant catfish is the most endangered fish in SE Asia. IUCN Red List - Critically Endangered (2003 update). *P. gigas* is a Mekong endemic. Historically, Mekong giant catfish occurred throughout the large rivers of the Mekong River Basin in Vietnam, Cambodia, Lao PDR, Thailand, and possibly Burma and southwestern China. The Mekong giant catfish now appears limited to the Mekong and its tributaries in Cambodia, Lao PDR, and Thailand.

In Cambodia, the Mekong giant catfish moves out of the flooded habitats of Tonle Sap Lake at the end of the rainy season (October-December). During the dry season, the species inhabits deep water areas of the Mekong River. *P. gigas* is migratory, but the extent of migrations is unknown. Little is known about the spawning behavior of wild *P. gigas*. There is strong evidence that the species spawns in northern Thailand in June, but the precise time and location of this spawning activity have not been confirmed.

Fishing is the most easily identifiable threat to *P. gigas*. The Mekong giant catfish is very rare and the species can no longer support any fishing pressure. Dams, navigations projects, and habitat destruction also threaten the giant catfish. Measures to safeguard the Mekong's natural waterways are urgently needed. The uncontrolled development of the Mekong River, most notably in China, could have dire consequences for the few remaining giant catfish.

While the giant catfish appears close to extinction, the implementation of a species action plan is a critical first step to the conservation of the species. Research may also provide clues about how to

restore populations the giant fish. In northern Thailand and Lao PDR, research priorities include identification of spawning grounds, additional distribution surveys (upstream into China and downstream to Luang Prabang and Xayabouri), assessment of the impacts of the Mekong Navigation Improvement Project, and further improvement of the artificial breeding program. In southern Lao PDR, Cambodia, and Vietnam, research priorities include distribution surveys to determine the extent of occurrence of giant catfish, tagging to study migratory pathways, and opportunistic research on biology and genetics.

3 Results

3.1 Overview

The flagship species approach enabled MWBP to address threats to key species through capacity building, education, outreach, research, and direct conservation action. Key outputs of this project include participatory assessment of conservation options for giant catfish, development of a global conservation strategy for Mekong giant catfish, conservation assessments of key Mekong fish species, technical, logistical, and financial support for national-level conservation initiatives, publication of reports and background information on the Mekong giant catfish, and ecological and migration studies to provide information for better management of the Mekong giant catfish and other endangered species.

3.2 Specific Objectives and Outputs

The results of the project focused on four specific objectives and fifteen outputs. These objectives were met by the MWBP catfish component and its partner organizations.

Sp. Objective 1. To determine the conservation status and develop conservation strategies for the endangered fish of the Mekong River Basin, especially the Mekong giant catfish.

Output 1. A Species Conservation Action Plan (SCAP) for Mekong giant catfish

The species conservation action planning (SCAP) process and development of a conservation strategy for the Mekong Giant Catfish was initiated at an inception workshop in Bangkok in August 2005. Workshop participants agreed to form a joint conservation strategy working group, and outlined a medium-term process to develop an overarching conservation strategy for the Mekong giant catfish. It was felt that building a conservation strategy process around the informal and voluntary cooperation of existing organisations and projects would offer the best scope for developing an integrated, overarching strategy. This approach aims to circumvent the political and administrative problems likely to arise in any more formal setup involving multiple organisations with a remit to 'conserve the giant catfish'. By establishing a multi-stakeholder consultative process not 'lead' by any organisation in particular, it was hoped that many organisations will be able to 'buy into' the joint strategy.

Recognizing that a range of institutions are already working on various aspects of giant catfish related issues, the conservation strategy aims to achieve the greatest possible effectiveness of these conservation activities of all stakeholders. This strategy will therefore be 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.

Acknowledging the fact of the critical status of the giant catfish, the MWBP placed an emphasis on contributing to priority conservation actions on the ground parallel to the contributing to the development of the Action Plan and long term conservation strategy. The development of the Species Conservation Action Plan, pilot implementation of conservation activities, and review is occurring in phases parallel to the strategy development meetings of the Mekong Giant Catfish Conservation Group.

At the second regional meeting of the Mekong Giant Catfish Regional working group in December 2005, it was decided that the outcomes of the meeting would be taken as preliminary conservation action priorities. These priorities would form the basis of a preliminary conservation action plan whilst the process of developing a joint conservation strategy for the Mekong Giant Catfish continues. Therefore, what the MWBP was referring to as a SCAP is essentially an interim conservation strategy highlighting priority actions, key institutions to lead on the relevant actions and identifying key information gaps that would contribute to the process of completing the conservation strategy that is currently scheduled for March 2007.

Photo 1. The Mekong giant catfish working group, December 2005, Phnom Penh.

One of the biggest challenges in developing a conservation strategy for the giant catfish is the many 'unknowns' that currently exist. For this reason, priority research options were identified.

The December 2005 workshop identified the following as the conservation vision for the action plan and strategy. The core conservation vision or goal incorporates the following elements:

1. The maintenance of a viable wild population of Mekong giant catfish and the restoration of its historical distribution.
2. Maintenance of a genetically representative captive population is crucial as 'insurance' against possible (if not likely) extinction in the wild.
3. 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.

Priority conservation actions are those activities that have been identified by the Giant Catfish Working Group as important but are not included into existing projects. 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 immediate 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.
In developing the long-term conservation strategy, there are further points to consider. This includes a key question – are we developing a conservation strategy or a species recovery plan? The vision statement clearly indicates that the conservation strategy might include elements of species recovery planning. If that is the case, then there are important questions to prepare us for the process. These questions are essentially assessments on the several areas. We may have already addressed some of them.

Biological assessment: What are the recovery implications for the species' demographic/ genetic status?

- Is the giant catfish's current biological status more or less conducive to recovery?
- How many extant populations appear viable?
- Are small or isolated populations highly persistent?
- What is the current vs. former distribution of the giant catfish throughout its range?
- Is the giant catfish locally abundant but absent from a large proportion of its former range?
- Can populations be restored in historical locations?
- Is the species declining rapidly? Has it stabilized?
- What intrinsic biological factors are limiting to its recovery?
- Is habitat availability or quality a limiting factor?
- Is much known about the giant catfish's response to management interventions?

- Overall, what is the prospect of the giant catfish being ultimately self sustaining in the wild?

Threats assessment: What are the recovery implications of the threats facing the giant catfish?

- Has all information on threats been collected?
- What threats require the most immediate response and has this been addressed?
- Are the combined effects of multiple threats the primary concern?
- Are some threats (e.g. climate change) beyond the scope of the recovery effort?
- Which threats are range wide and which are local?
- What is the species known response to the threats facing it?
- If threats to habitat are a key factor, what are the opportunities for protection?
- Overall, to what extent can the threats facing the species be reduced or eliminated?

The MWBP has been a key player in the development of the SCAP. At the 2nd working group meeting discussions revolved around the development of a preliminary conservation action plan for the giant catfish. The outcome of that discussion has been presented above. According to the initial scheduling, Phase B of the MWBP was to commence in July 2006 and would focus on implementation of the activities contained in the conservation action plan. However, due to a change in the GEF resource allocation framework, the possibility of an MWBP Phase B is uncertain at this point of time. Due to this uncertainty, it is critical that the conservation strategy that is being developed through this joint process identifies funding options either through participating institutions or externally for implementation of the priority activities.

Output 2. "Red List" assessments of key Mekong species

Several species of migratory, large-bodied species occur in the Mekong River Basin. These species are especially vulnerable due to their large size, migratory behavior, and reliance on several different habitat types to complete their life cycle. An assessment of the conservation status of large-bodied species was conducted to establish a baseline for populations of these fish. Without these assessments, it would be very difficult to determine population trends or to work toward the conservation of these species. Conservation assessments also serve to raise awareness about the existence and importance of Cambodia's unique assemblage of large-bodied fishes.

In 2006, a local knowledge survey of the Cambodian Mekong was conducted to examine the catch trends and assess the conservation status of Cambodia's large-bodied freshwater fish. The assessments included the following species:

Pangasianodon gigas
Pangasianodon hypophthalmus
Pangasius sanitwongsei
Catlocarpio siamensis
Probarbus jullieni
Himantura chaophraya
Bagarius yarrelli
Wallago attu

To assess the IUCN conservation status of large-bodied fish of the Cambodian Mekong, interviewers incorporated three main criteria into their questions for fishers:

1. population number and trend (based on harvest as an index of abundance)
2. past and present distribution
3. threats

To assess the status of large-bodied species using local knowledge, an interview form was used to gather specific knowledge about each species related to these three criteria. Fishers were interviewed systematically to gather the best quality data possible.

Photo 2: Local knowledge interviews in Cambodia, December 2006.

Based on local knowledge surveys and other available information, preliminary assessments of key species are as follows:

The Mekong giant catfish, Pangasianodon gigas, was listed as critically endangered in 2003. Historical reports indicate that the species was abundant in the early 1900s. However, in the 1970's, local fisheries began to report the disappearance of the species. Current population size is unknown, but a decline of more than 80% over the last thirteen years can be estimated from past and current annual catch records, qualifying the species for Critically Endangered under criterion A. Fishing effort in the Mekong Basin area in general is increasing. Fishing effort specifically for *P. gigas* in the Mekong River remains constant, although it may be increasing in some areas, such as Tonle Sap Lake. Habitat loss and degradation are also serious threats to *P. gigas*. There has been increasing siltation of the Mekong mainstream through past deforestation practices in the northern parts of the Mekong River area. The planned destruction of rapids in the stretch of the Mekong River in the northern Lao PDR, northern Thailand and southern China may also pose a serious threat to the species' spawning habitat. The loss of migratory routes through the construction of

dams (for example, the Pak Mun Dam in Thailand) may also have a negative impact on fish abundance in the river. The Thai Department of Fisheries has been releasing captive-bred individuals since 1985. Since 2000, approximately 10,000 captive-bred fish have been released into the Mekong. The fish have also been hybridized with *P. hypophthalmus*. Given the ongoing threats to the species and its habitat, the population decline rate seen over the last thirteen years is not expected to diminish over the next two generations. Therefore, the species is listed by the IUCN as Critically Endangered A4bcde.

The river catfish, *Pangasianodon hypophthalmus,* though not currently listed on the IUCN Red List of threatened and endangered species, has been nearly extirpated in the Chao Phraya River. In the Mekong River, populations of river catfish have declined significantly in the Thai and Laos Mekong. Cambodian fishers (age 40+, n=43) estimate that overall catch of *P. hypophthalmus* has declined by 68% since 1980. Individually, many fishers report that catch per fisher has declined by as much as 99% since 1980 from several tons per season to 10-100 kilograms per season. While adult fish are still present in the fishery, fishers have not caught the largest class of fish (35-80 kilograms) since 1972. Fishers in the Tonle Sap River report that catches of river catfish (Pangasianodon hypophthalmus) have dropped by 90% in the largest fishing lots of the Tonle Sap Lake – from about 100 MT 20 years ago to just 5 or even 1 MT today. Based on this information, P. hypophthalmus should be listed as endangered under IUCN criteria due to rapid and significant population decline over the past 20 years.

Sanitwongsei's catfish, Pangasius sanitwongsei, is one of the largest freshwater fish in the world, once attaining lengths in excess of 2.5 meters. *Pangasius sanitwongsei* once occurred in the Chao Phraya River and its tributaries and the Mekong River from Chiang Saen to Vietnam. Smith (Fishes of Siam, 1945) reports that capture of P. sanitwongsei up to 3 meters long was relatively common prior to 1920. By 1945, the longest fish observed measured 2.5 meters and the average size of a fish reaching the Bangkok market was 40-60cm.

Photo 3. *Pangasius sanitwongei*: a poorly studied, but highly threatened fish of the Mekong River.

P. sanitwongsei is now considered extirpated from the Chao Phraya River in Thailand. Up until 1995, *P. sanitwongsei* was a regular, though rare, catch in Chiang Khong, Thailand. In 1997, juvenile fish occurred along Thai-Lao Mekong where they were captured using small hooks and sold live for stocking in submerged cages and ponds. Fishers in Chiang Khong and Chiang Saen (Thai Mekong) report that P. sanitwongsei is now rarer than the critically endangered species *P. gigas*. Once a common catch in April and May in Chiang Khong, fisher have not harvested an adult *P. sanitwongsei* since 2003. In Cambodia, fishers report that since 1980, catches have dropped by over 60%. Juvenile fish make up almost the entire catch. The largest fish reported by fishers were 50, 60 (n=2), and 80 kilograms – all well below the maximum size reported for the species and all caught over 20 years ago. Average fish size and average seasonal catch have both decreased by over 50% since 1980.

Due to its large size and migratory behavior, *P. sanitwongsei* is vulnerable to overfishing. Large, spawning fish are taken from the Mekong River between Chiang Khong and Chiang Saen, Thailand. Young fish are harvested for food and aquaculture throughout the Mekong, particularly along the stretch of river from Nong Khai to the confluence of the Mekong and Mun Rivers (NE Thailand). Dams and disturbance of the fish's spawning habitat may also represent a significant, though poorly understood threat. Based on catch trends, *P. sanitwongsei* should be listed as endangered or critically endangered according to IUCN criteria. The lack of information about this species makes it difficult to determine the population status.

The giant barb, Catlocarpio siamensis, is the largest Cyprinid in the world. The giant barb once attained a maximum size of 300cm and 300kg, though nowadays fish measuring 1.5 m and weighing approximately 100 kg are extremely rare. In Cambodia, interviews fishers report that no fish larger than 150 kilograms have been harvested since 1994. Five fishers reported catching fish of that size between 1970 and 1994. Average size of fish has decreased by 89%. Total catch per fisherman has decreased by over 95%. Fishermen estimate a 78% decline in total harvest since 1980. In the Tonle Sap River bagnet fishery, catches of adult fish have dropped from 4-5 per net per year in the 2001 and 2002 to 2-3 fish in 2003, 1 fish in 2004, and no fish in 2005. While it is difficult to determine if this decline is indicative of the population as a whole, this data, when taken together with catch data from other areas, may indicate a significant decline in populations of adult fish. Based on catch data, the giant carp should be listed as endangered according to IUCN criteria. Populations have declined by 80-90% over the past 20 years.

The seven-striped barb, Probarbus jullieni is one of the largest freshwater fish species in Southeast Asia, reaching up to 70 kg in weight and 1.65 m in length. P. jullieni occurs in the Mekong, Chao Phraya, and Pahang and Perak basins of Malaysia. Cambodian fishers (age 40+, n=43) estimate that overall catch of *P. jullieni* has declined by 71% in the Cambodian Mekong since 1980. The average size of fish has dropped from 3.8kg in 1980 to 1.3kg in 2006. A fisher from Kratie reported that he caught a fish weighing 60kg in 1967. In recent times, fishers report that the largest fish weigh about 20kg. The IUCN considers *P. jullieni* to be endangered, based on shrinking distribution and population decline. This assessment seems justified considering that fishers report a population decline of 71%. Moreover, large fish have virtually disappeared from the catch in many locations and some fishers say that *P. jullieni* no longer occurs in their area.

The giant stingray, Himantura chaophraya may be the largest freshwater species on Earth. It attains a size of 2.4m disk width and 600 kg. According to limited accounts of fishers, populations in Thailand have declined significantly over the past 50 years. Cambodian fishers (age 40+, n = 36) report a 62% decline in catch since 1980. The average size of an individual fish has dropped from 23.2kg in 1980 to 6.9kg in 2006. The maximum size of a fish any fisher reported in an average season dropped from 175kg in the 1980's to 60kg in recent times. Average catch per fish has dropped from 306.2kg / season to 27.6kg / season in 2006. Seven fishers report that they can no longer catch stingray in their area. While fishers still harvest large fish (over 100kg), fishers report that very large fish over 300 kg have not been seen since 1984. The giant stingray is currently listed as vulnerable by the IUCN. Populations of this fish have been negatively impacted by fishing and habitat destruction. While populations of giant stingray in northern Australia are relatively healthy, the possibility of extinction in the wild for some subpopulations, including the Mekong population, is considered high due to the high age at first maturity and low fecundity of the species.

The goonch, *Bagarius yarrelli* is a large catfish that occurs throughout the Mekong River, especially in rapids areas of the main Mekong River and the largest tributaries. In the Mekong, it can attain sizes over 2m and 100 kg. *B. yarrelli* is still caught the Mekong River in northern Thailand and Laos, though large adults are extremely rare. During one month of monitoring along the Mekong River between Chiang Saen and Chiang Khong, Thailand (May 2006), the largest fish harvested by fishers weighed 30 kg. *B. yarrelli* is threatened by over-harvest throughout its range and by increased development in the upper and middle Mekong. Based on available data, it appears that populations of *B. yarrelli* in the Indus and Ganges drainages have declined significantly since 1980.

The wallago catfish, *Wallago attu* occurs in freshwaters from Pakistan to Vietnam. W. attu is a large, predatory catfish, attaining lengths of up to 2.4m. In India, the species is threatened by over-harvest, habitat degradation, and pollution. Due to these threats and declining abundance, the species has been listed as endangered in India. In the Cambodian Mekong, fishers report a decline in abundance of 58% since 1980. In the Tonle Sap Lake, the lower Mekong, and Kampong Cham areas, fishers report a decline of 71% since 1980 whereas in the Kratie and Stung Treng areas, fisher report a decline of 42%. The largest fish reported by Cambodian fishers was an 80kg specimen from 1990. Fishers also reported fish up to 60kg as recently as 2006. Based on IUCN criteria, *W. attu* should probably be listed as endangered. Cambodia appears to be home to one of the healthiest remaining populations of *W. attu*. Still, populations have declined by 58% according to interviews with fishers.

Output 3. A review of the effectiveness of the existing policies and regulations (i.e. fishing restrictions, freshwater protected areas, community fisheries, captive breeding) as conservation tools

Harvest of the Mekong giant catfish is illegal in Thailand and Cambodia. Nonetheless, fishers harvest Mekong giant catfish from the Thai and Cambodian Mekong every year, due in part because of flexibility in the law but also due to the difficultly of enforcing the law throughout Cambodia and Thailand.

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. Between 1983 and 2005, Thai Fisheries Department granted permission to harvest Mekong giant catfish to the fishermen in Chiang Khong. In exchange for permission to catch the giant fish, the fishermen agreed to allow officials from the Fisheries Department to extract eggs and sperm from each specimen. The Fisheries Department used the eggs and sperm to artificially breed *P. gigas*.

According to Khmer law, it is illegal to harvest, transport, or sell Mekong giant catfish and other endangered species. Yet harvest is difficult to control, since many Mekong giant catfish are captured incidentally as by-catch of other fisheries. In the absence of a better solution, fishers that catch Mekong giant catfish accidentally have been asked them to release them unharmed back to the river. While many fishers seem to comply with the request (to release the fish), some fish are injured as a result of capture and may not survive.

Cambodian fisheries law chapter 5 article number 18 to article number 25 pages 14) recognized eight freshwater conservation zones established by Department of Fisheries.

Provinces	Battambang	Pursat	Kompong Thom	Siem Reap
Name of Protected areas	Prek Toal	Dey Ro Neat	Pi Stuon	Kompong Phluk
		Raing Til	Ba Lot	
		Kampong Prak		
		Chrauy Sdey		

Table 1. The names and locations of eight protected areas. All of the protected areas are located in the provinces around Tonle Sap Great Lake.

Special protected areas have also been created in the deep pool areas of the upper Cambodian Mekong River in Kratie and Stung Treng. These special protected areas restrict the use of certain fishing gears, such as large mesh gill nets, in order to safeguard Irrawaddy dolphins. In practice, these special protected areas probably also reduce fishing pressure on large-bodied fish like the Mekong giant catfish.

The Thai Department of Fisheries runs the main captive breeding programme for giant catfish. Spawning in captivity of wild Mekong giant catfish captured in Chiang Khong has been carried out since 1983. There are now some 20,000 offspring of wild parents in captivity, mostly in Thai Department of Fisheries 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 raises principally for restocking of natural populations and broodstock. There is also a developing private aquaculture industry for Mekong giant catfish for food, ornament and recreational fishing. Some 4800 tagged, captive reared Mekong giant catfish ranging in size from 1 g to 5-6 kg have been released into the Mekong, but no recaptures have been reported.

Based on a review of existing policies and management actions, it is clear that a long-term, transboundary conservation and research program is needed to attain the goals established by the Mekong giant catfish working group, which include the maintenance of populations of wild populations and their habitat. The conservation and research program should incorporate restrictions on fish harvest, monitoring of incidental catch, establishment of protected areas to protect spawning and rearing habitat, and the development of a conservation aquaculture program based on genetically representative captive broodstock. While such a program may seem unrealistic at this time, the Mekong Wetlands Biodiversity Programme has made solid progress in implementing these goals. Hopefully future organizations will be able to continue this important work.

Output 4. A status report on the past and present distribution of Mekong giant catfish

Past Distribution

In his 1935 article, *An Account of The Ceremonies and Rites Performed When Catching the Pla Buk: A Species of Catfish Inhabiting the Waters of the River Mekong, the Northern and Eastern Frontier of Siam*, F.H. Giles reports giant catfish in numerous localities in Thailand, including the Mun River near Suwanwari, the rapids and deep pools of Khemarat, Don Tamngern in Mukdahan, the village of Nong Kung in Nakorn Phanom, the Ah Hong rapids in Nong Khai, the village of Tad Serm (Nong Khai), the "lake" (a section of the Mekong River) Nong Chieng San about 70 km downstream of Chiang Khan, the village Ta Ban Wang near Kok Pai (Chiang Khan), Don Khai about 2 km upstream of Chiang Khan, Luang Prabang, and Chiang Saen. In southern Laos, fishermen reported a few fish caught each year in the Khone Falls area until 1993. Durand (1940) notes that Cambodian fishermen harvested giant catfish at the confluence of the Tonle Sap River and the Mekong River. Fishermen also report Mekong giant catfish from the Tonle Sap Lake in Cambodia. Mekong giant catfish also apparently occurred in Vietnam, though the author has heard of no recent captures of the species in that country.

Since 1935, the giant catfish has disappeared from the fishery northeast Thailand (including Khemarat, Mukdahan, Nakorn Phanom, Nong Khai, and Chiang Khan) and Lao PDR (Luang Prabang). According to several accounts (Smith 1945, Phukasawan 1969, Mengumpum 2000), the giant catfish began to disappear from northeast Thailand around 1940. In Luang Prabang, the catch started to decline in 1965 (Davidson 1975).

Chiang Rai	Nong Khai	Ubon Ratchathani
P. gigas occurred from late April until June. Fish migrate upstream during this time.	*P. gigas* occurred two times per year: once from late October until December and again from late April until June.	*P. gigas* occurred in July and August.

Table 2. Seasonal distribution of Mekong giant catfish in Thailand based on historical records (source Pholprasith and Tavarutmaneegul 1997)

Recently, the giant catfish has also disappeared from the catches in far northern Thailand. In Chiang Khong, fishermen have not captured a fish since 2000. This fishery was once one of the largest in the basin, but catches have been declining for over ten years.

Present Distribution

P. gigas occurs in the main channels of the Mekong River and its tributaries in Cambodia. Small populations probably also exist in northern Thailand and Lao PDR. The species is no longer a regular catch in northeast Thailand, southern Laos, or Vietnam (see table 2).
Based on catch data, the abundance of *P. gigas* appears to be declining throughout the basin. The range *of P. gigas* is also shrinking. Fish have disappeared from sites where they were once caught. For example, fishermen in Vietnam, northeast Thailand, and southern Laos no longer report the species.

Location	Status (based on catch data)	Source
Chiang Khong, Northern Thailand	The catch has declined from a peak of 69 fish in 1990 to just 7 fish in 1997. This year (2001) no fish were caught in Chiang Khong.	Srettacheua 1995, Hogan 1998
Luang Prabang, Lao PDR	The catch declined from about 12 fish per year to just 3 fish in 1968. No fish were caught in 1972, 1973, or 1974. Since that time, no significant catch of *P. gigas* has been reported for the Luang Prabang area.	Davidson 1975
Nong Khai Province, Northeast Thailand	In the early 1900's, 40-50 fish were caught per year. Since that time, however, the number of fish has declined. By 1970, *P. gigas* occurred only rarely as by-catch of beach seine fisheries. Today, very few *P. gigas* are reported from Nong Khai Province.	Pholprasith and Tavarutmaneegul 1998
Khone Falls, Southern Lao PDR	Three to four fish reported by fishermen before 1993, almost all caught in the first half of the year. No fish were reported in 1993 and no *P. gigas* have been reported since that time.	Roberts 1993
Tonle Sap River, Cambodia	Four fish were captured in the bagnet (dai) fishery in 1999 and eleven fish reported in 2000. Fishermen report that they catch a few *P. gigas* each year.	Hogan *et al.* 2001
Mekong Delta, Vietnam	Once abundant in the delta, *P. gigas* is now very rare. No significant fishery for this species exists in Vietnam.	Lenormand 1996

Table 3. The status on the Mekong giant catfish *Pangasianodon gigas* in the Mekong River Basin.

The Tonle Sap Lake and Tonle Sap River appear to be important habitat for the giant catfish. The Tonle Sap Lake, and especially fishing lot number 2, may sustain a significant population of young (rearing) fish, while the Tonle Sap River is a migratory corridor for mature fish moving to the Mekong River.

As water levels begin to drop in October and November, giant catfish move out of the Tonle Sap Lake and into the main channel Mekong River. Giant catfish inhabit the deep pools of the Mekong during the dry season, and probably spawn in the Mekong River either in the Stung Treng area or in the upper Mekong near Chiang Khong, Thailand.

Tonle Sap Lake	Tonle Sap River	Kampong Cham	Kratie / Stung Treng
P. gigas occurs in December, January, and February. Fish probably inhabit the lake during other months as well. Young giant catfish are harvested from fishing lots together with *P. hypophthalmus* in April and May.	*P. gigas* migrates down the Tonle Sap River from late October until December.	Fishers have reported the catch of several adult giant catfish in Kampong Cham in 2005 and 2006. Most of these fish were caught between November and February.	Fishermen report *P. gigas* in February and March. The occurrence of fish is this area has not been confirmed but is highly likely (based on many years of anecdotal information).

Table 4. Seasonal distribution of Mekong giant catfish in Cambodia (Hogan *et al.* 2001 and Tana unpublished report).

Fishermen report giant catfish occasionally (once every few years) in Kratie, Stung Treng, the Khone Falls, the Mun River, the Songkhram River, Luang Prabang, and Pak Beng. Fishers have also reported several fish (2-4 per year) in Kampong Cham in 2005 and 2006. Kampong Cham appears to be a major area of capture of *P. gigas*. Further interviews with fishermen in these areas may provide additional insight into the distribution, abundance, migration patterns, and conservation status of giant catfish.

Fishermen occasionally report giant catfish in the far north of Thailand, the Songkhram River (Thailand), the Mun River (Thailand), and Neak Loeung (Cambodia). While these reports have not been verified, it is likely that the giant catfish, though extremely rare, remains widespread throughout the basin. The precise area of extent of occurrence of *P. gigas* is difficult to determine given the current knowledge about the distribution of the species. A basinwide survey is needed to determine the true distribution of *P. gigas*.

Location	Remarks	Source
Chiang Saen, Thailand	In 1990, fishermen caught 5-6 giant catfish at Chiang Saen.	Boonrien Jinarat, personal communication, February 23, 2003
Ban Saew/Ban Suandok, Thailand	In May-June 2002, fishermen caught two giant catfish. Both fish weighed over 100kg	

Location	Remarks	Source
Songkhram River, Thailand	Fishermen occasionally report small giant catfish	
Mun River, Thailand	On January 4, 2002, fishermen caught a 116kg giant catfish	Chianarong Srettacheua, personal communication, January 2002
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 *Pangasianodon hypophthalmus*.	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 *Pangasianodon hypophthalmus.*	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
Kratie, Cambodia	February - April, 2003 fishermen caught 1-2 large giant catfish	Isabel Beasley, personal communication, April 2003
Kampong Cham, Cambodia	November – December 2005, fishers reported two adult fish November – January 2006, fishers reported three adult fish	Data based on field visit and interviews with fishers
Neak Loeung, Cambodia	On March 11, 2003, fishermen caught a 170kg giant catfish (using a gill net)	Nicolaas van Zalinge, personal communication, March 11, 2003

Table 5. Anecdotal reports of Mekong giant catfish since 2000.

Output 5. A report on the migration patterns and spawning sites of Mekong giant catfish

The Mekong Wetlands Biodiversity Programme (MWBP), in conjunction with the Thai Department of Fisheries (Thai DOF), the Lao Department of Livestock and Fisheries (LDLF), the National Geographic Society (NGS) Megafishes Project, and other stakeholders initiated a one-year research project on fish migrations in the Mekong River Basin. The objectives of the project were to (1) determine the migration patterns and spawning sites of wild Mekong giant catfish in northern Thailand/northern Laos, (2) study the behavior of captive-bred Mekong giant catfish after release into the Mekong River (hatchery fish have been released into the river since 1985) and (3) capture and tag other large migratory catfish species (e.g. *Pangaius bocourti*, *Pangaius conchophilus*, *Bagarius yarrelli*, *Hemibagrus wyckiodies*, and *Wallago attu*) to identify migration patterns and critical habitat.

The MWBP/DOF/NGS team studied migrations of target fish primarily through the use of underwater acoustic biotelemetry. Nineteen receivers were installed along the Thai and Lao Mekong River from the Golden Triangle (Lao/Thai/Myanmar border) to Luang Prabang - a distance of approximately 300 km. Thirty-eight fish (18 hatchery-reared giant catfish, 1 wild Mekong giant catfish, and 19 wild fish of other species) were tagged and released into the Mekong River. Movements of the tagged fish are currently being recorded by the receivers. Data from the receivers is downloaded approximately once every 3 months through April 2007.

Initial results of the study indicate that 1) tagged hatchery fish move downstream after release, 2) other species of large-bodied fish move between deep water habitats between Chiang Saen and Chiang Khong and seem to prefer areas of the river near tributaries, and 3) wild Mekong giant catfish will be very difficult to tag without the close cooperation of local fishers, the Thai Department of Fisheries, and the Lao Department of Livestock and Fisheries.

The downstream movement of tagged hatchery fish likely indicates that these fish did not adapt well to the river environment. This result is not surprising considering that hatchery fish, once released, are rarely seen again. Our telemetry results suggest that these fish probably die, possibly because they are not able to find food in their new environment. It may also be possible that they are not able to adapt to the strong flows of the Mekong River and are eventually forced downstream with the current. Wild fish, especially *Bagarius yarrelli and Wallago attu*, were observed moving upstream after tagging. These fish seemed to move upstream short distances and often favored deep water areas or stretches of river near the mouths of major tributaries. At least one of the tagged wild fish has made a significant (30 km+) upstream movement. The final results of the study will not be available until the study is completed in May 2007. It should be noted that the premature closure of the MWBP program made completion of this study difficult due to lack of funds. No funds have been available for this research since December 2006.

Despite the obstacles encountered during the telemetry study, it is clear that Mekong giant catfish spawn in the northern Thailand and Lao Mekong at the beginning of the rainy season in June. In Cambodia, adult fish move out of the Tonle Sap Lake at the end of the rainy season in November. Adult fish also move up the mainstream Mekong in central Cambodia in December and January. These fish are apparently migrating to spawn, somewhere upstream of the Kampong Cham/Kratie area. Young fish make use of flooded habitats such as the Tonle Sap Great Lake and low lying tributaries such as the Mun and Songkhran Rivers. Pond owners in Cambodia report that young river catfish (*Pangasianodon hypophthalmus*) and Mekong giant catfish have been collected out of the Tonle Sap Great Lake. It seems likely that the river catfish and the Mekong giant catfish share many life history characteristics, since they are harvested from similar locations, at similar times, and at similar stages of their life history.

There is at least one spawning site for Mekong giant catfish in the northern Thailand and Lao Mekong. There may also be other spawning sites along the river – certainly many adult fish are captured in Cambodia and so there may be a spawning site in the mainstream Mekong in Cambodia. If not, then perhaps Mekong giant catfish migrate the length of the Mekong and spawn in Thailand and Laos. While such a long distance migration may seem unlikely, it is worth noting that other species of pangasiid catfish migrate 700+ kilometers and they are reports of adult catfish moving over Khone Falls in Laos.

Output 6. An assessment on the genetics of wild giant catfish

The MWBP project provided DNA samples to professor Uthairat Na-Nakorn of the Fish Genetics Laboratory at Kasetsart University in Bangkok. Her laboratory assessed the level of genetic diversity present in wild populations of Mekong giant catfish and found that the level of genetic variation in giant catfish populations is similar to that of related catfish species. Dr. Na-Nakorn's study "indicates that either wild populations of Mekong giant catfish may be more robust than originally thought or present wild populations carry a genetic signature of a historically larger population."

While Dr. Na-Nakorn found high levels of genetic diversity in wild stocks of Mekong giant catfish, she did not find correspondingly high levels of genetic variation in captive stocks of *P. gigas*. Since the captive broodstock is thought to be a critical resource for any future efforts to rebuild the population, it is very important to develop a captive breeding strategy that maximizes genetic variation in the captive stock and maintains the current level of genetic diversity in wild Mekong giant catfish populations.

Sp. Objective 2. To minimize the cost, and maximize the benefits, of conservation, exploitation, and aquaculture of stocks of endangered Mekong fish.

Output 7. An established buy and release program for endangered species

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) in cooperation with the Cambodian Department of Fisheries and the MRC Fisheries Programme implemented a giant catfish tag and release project in Cambodia in order to study of the migratory behavior of *P. gigas*. The tag and release program was first implemented in 2001. The fish caught in the dais are bought from the dai operators, tagged and released. This buy and release approach provides a low cost, short-term solution to fishing mortality. The scheme does not harm the fisher's livelihood and provides an opportunity for additional research (e.g. tissue sampling for genetics studies).

In 2005, the buy and release programme was modified because the Department of Fisheries decided to designate this dai row No 2 as a special concession of the Inland Fisheries Research and Development Institute (IFReDI) for monitoring and research purposes. The decision was approved by the Ministry and bagnet row No 2 is now under the supervision of IFReDI. According to the new guidelines, endangered species like the Mekong giant catfish can no longer be purchased from dai operators. Rather, the dai operators are required to provide endangered species for release free of charge.

In 2005, the Mekong Wetland Biodiversity Project (MWBP) and Mekong River Commission (MRC), the Inland Fisheries Research and Development Institute (IFReDI) selected and deployed 8 staff from the Fisheries Administration (FA) at dai row number 2 to monitor fish catch and enforce fishery law to conserve endangered species. According to the contract between the Fisheries Administration and the fishers, fishers must release endangered species when they are caught in the dai. Two monitoring staff stayed at each dai unit. The staff recorded data on catch, weight,

species (especially endangered species encountered in the catch), fish price, and value. The dai operators were also advised and trained on safe-handling of endangered species.

Fish tagging was carried out from October 25th to November 31, 2005. Fish were taken from the bagnet and transferred to a holding cage adjacent to the bag nets. We attempted to tag adult fish. Young fish were also tagged occasionally due to a scarcity of large fish. The minimum size of tagged fish was about 100 grams. Before tagging, length and weight of the fish were measured. Fish were then tagged with plastic disc or "spaghetti" tag applied either manually (in the case of a disk tag) or using a tagging gun. The tags were inserted into the dorsal musculature at the base of the dorsal fin, so that the nickel pin/t-bar attached firmly behind of the dorsal fin rays. Each tag was labeled with number and the disc tags were labeled with instructions in Khmer to return the tag for a reward. Tagged fish were placed in freshwater for a short period, and then released approximately 50 meters downstream of the tagging location. The tagging process took on average of ten minutes per fish, including the time necessary for recovery and release.

In 2005, it was very difficult to find the endangered species to tag. Dai operators did not like to have the fish tagged and released, because in 2005 they were not compensated for released fish (i.e. they did not want report the capture of species which they were then compelled to release). They did not want to cooperate with the research program. Notably fewer fish were available to the release team after the after the dai fishers row No 2 signed a contract requiring them to release endangered species free of charge, Due to the new conservation policy of Cambodian Fisheries Administration, fisheries staff were only able to tag 4 giant catfish and approximately 30 other endangered species, as shown in the table below:

No	Date	Species	Location	Tag #	L (cm)	W (Kg)
1	25-Oct-05	*Pangasianodon gigas*	Dai 3C	2961	128	31
2	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3289	43	1.2
3	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3205	44	0,9
4	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3298	42	0,9
5	02-Nov-05	*Pangasius larnaudiei*	Dai 2C	3211	51	2
6	08-Nov-05	*Pangasianodon gigas*	Dai 2C	32	2,20	
7	09-Nov-05	*Pangasianodon gigas*	K. Cham	No tag		
8	12-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3224	87	7
9	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3281	51	1.3
10	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3271	41	0,8
11	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3269	37	0,6
12	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3207	46	1,1
13	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3215	50	1,5
14	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3297	55	2,1
15	15-Nov-05	*Pangasianodon gigas*	Dai 2B	3529	2,02	
16	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3221	81	7
17	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3285	114	12
18	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3257	118	15
19	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3279	64	2
20	16-Nov-05	*Pangasianodon gigas*	Dai 4B	3233	2,21	
21	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3254	92	9

22	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3238	87	8
23	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3C	3537	95	9
24	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3290	115	13
25	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3263	96	10
26	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3222	86	8
27	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3245	83	8
28	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3212	85	7
29	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3253	76	4,4
30	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3256	113	13
31	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 2A	3227	0,63	2

Table 6. Species tagged and released along the Tonle Sap River, 2005.

Surveys for tag recaptures were conducted by project staff and provincial fisheries officers throughout the country. The project staff conducted surveys for tagged fish about once every 15 days. The surveys were conducted from February 1, 2006 until June 10, 2006. The survey location covered the Tonle Sap Lake, Tonle Sap River, Bassac River, and Mekong River. Fishermen were instructed to return tags from recaptured fish to the nearest Department of Fisheries office. Tagged fish recaptures are shown in the table below:

Date	Species	Location				Tag #	Catch by	Location
		Commune	District	Province	Distance from PP			
14-Jan-05	Unknown	Near Dai No 3				1569	Gillnet	
01-Jan-05	*Probarbus jullieni*	Phoung thouc 1	Hong Ngu	Dong Thap	VN	2383	Trapnet	Mk down
10-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	2249	Gillnet	Mk down
30-Dec-05	*Probarbus jullieni*	Lvea Em	Kien Svay	Kandal		2273	Gillnet	Mk down
23-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	2323	Gillnet	Mk down
30-Jan-05	*P. hypophthalmus*	Lvea Em	Kien Svay	Kandal	15	3047	Gillnet	Mk down
30-Jan-05	*P. hypophthalmus*	Lvea Em	Kien Svay	Kandal	15	1741	Gillnet	Mk down
30-Jan-05	*Pangasius larnaudiei*	Lvea Em	Kien Svay	Kandal	15	1096	Gillnet	Mk down
29-Jan-05	*C. microlepis*	Lvea Em	Kien Svay	Kandal	15	2279	Gillnet	Mk down
10-Jan-05	*Pangasius larnaudiei*	Tan phouc 2	Hong Ngu	Dong Thap	VN	2515	Dai trey Linh	Mk down
Last year	*Pangasius larnaudiei*	Near Dai 2				1807	Gillnet	Tonle Sap
19 Nov.05	*P. hypophthalmus*	Arey Khsat				3254	Gillnet	Tonle Sap
18 Nov.05	*P. gigas*	Lvea Em	Kien Svay	Kandal	15	3233	Death	Mk down
23 Nov.05	*P. hypophthalmus*	Near Dai No 2				2923	Gillnet	Tonle Sap
24 Nov.05	*P. hypophthalmus*	Near Dai No 3				3253	Castnet	Tonle Sap

Table 7. List of tag recaptures from 22nd October to March 2005.

The dates and location of the tag surveys:

- Chaktomuk (quarter bra) 5 times in 2006
- Phnom Penh to Neak Loung, 14th - February- 06th 2006

- Mekong upstream, from Phnom Penh, Kompong Cham, Kratie to Stung Treng Province, 06th to 12th June 2006.
- Mekong downstream, from Phnom Penh, Neak Loung to Viet Nam border from 8th to 12th February 2006.
- Bassac River from 17th to 18th March 2006
- Tonle Sap River from 22nd to 26th March 2006

No	Date	Species	Location	Tag #	L(cm)	W(kg)	Condition
1	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2822	143	43	Release
2	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2809	141	40	Release
3	15-Jun-05	*Pangasianodon gigas*	K7 Ch. Chamres	2958	151	51	Release
4	01-Jul-05	*Catlocarpio siamensis*	Chaktokmuk	2530	93	15	Release
5	01-Jul-05	*Catlocarpio siamensis*	Chaktokmuk	2227	91	14	Release
6	22-Jul-05	*Catlocarpio siamensis*	Lot 3 Pursat	2976	1.34	18	Release
7	22-Jul-05	*Catlocarpio siamensis*	Lot 3 Pursat	2953	1.42	68	Release
8	28-Jun-05	*Catlocarpio siamensis*	Lot 7 Pursat	NA		78	Release
9	25-Oct-05	*Pangasianodon gigas*	Dai 3C	2961	128	31	Release
10	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3289	43	1.2	Release
11	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3205	44	0,9	Release
12	31-Oct-05	*Pangasius larnaudiei*	Dai 2D	3298	42	0,9	Release
13	02-Nov-05	*Pangasius larnaudiei*	Dai 2C	3211	51	2	Release
14	08-Nov-05	*Pangasianodon gigas*	Dai 2C	32	2.20		Release
15	09-Nov-05	*Pangasianodon gigas*	K. Cham				Fish died
16	12-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3224	87	7	Release
17	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3281	51	1.3	Release
18	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3271	41	0,8	Release
19	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3269	37	0,6	Release
20	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3207	46	1,1	Release
21	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3215	50	1,5	Release
22	14-Nov-05	*Pangasius larnaudiei*	Dai 2D	3297	55	2,1	Release
23	15-Nov-05	*Pangasianodon gigas*	Dai 2B	3529	2.02		Release
24	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3221	81	7	Release
25	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3285	114	12	Release
26	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3257	118	15	Release
27	16-Nov-05	*Pangasianodon hypophthalmus*	Dai 4D	3279	64	2	Release
28	16-Nov-05	*Pangasianodon gigas*	Dai 4B	3233	2.21		Release and fish died
29	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3254	92	9	Release
30	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3238	87	8	Release
31	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3C	3537	95	9	Release
32	17-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3290	115	13	Release
33	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3263	96	10	Release
34	18-Nov-05	*Pangasianodon hypophthalmus*	Dai 4B	3222	86	8	Release
35	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3245	83	8	Release
36	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 3D	3212	85	7	Release
37	22-Nov-05	*Pangasianodon hypophthalmus*	Dai 2B	3253	76	4,4	Release

38	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 4C	3256	113	13	Release
39	23-Nov-05	*Pangasianodon hypophthalmus*	Dai 2A	3227	63	2	Release
40	07-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3258	111	12	Release
41	09-Nov-05	*Pangasianodon gigas*	K. Cham	No	2.39	165	Release
42	18-Dec-05	*Pangasianodon gigas*	K. Chhnang	No	140	37	DNA Sample
43	29-Jan-05	Stingray	Koh Prak, Stung Treng	3220	187	130	Release
44	11-Dec-05	Stingray	K. Cham	3204	150	65	Release
45	08-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3201	50	1	Release
46	08-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3355	42	1.2	Release
47	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3320	66	2.8	Release
48	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3306	100	11.6	Release
49	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 4A	3333	60	2	Release
50	14-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3526	68	2.6	Release
51	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3076	120	12	Release
52	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3086	90	6	Release
53	15-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3058	86	7	Release
54	16-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3051	150	13	Release
55	16-Dec-05	*Pangasianodon hypophthalmus*	Dai 3A	3082	120	12	Release
56	17-Dec-05	*Pangasianodon hypophthalmus*	Dai 4B	3313	120	11.2	Release
57	19-Dec-05	*Pangasianodon gigas*	K. Cham	NA	250	180	Release
58	12-Dec-05	*Pangasianodon gigas*	K. Cham	NA	190	120	Release
59	09-Dec-05	*Pangasianodon gigas*	K. Cham	NA	239	165	DNA Sample
60	21-Dec-05	*Pangasianodon hypophthalmus*	Dai 3C	3075	115	12	Release
61	21-Dec-05	*Pangasianodon hypophthalmus*	Dai 3C	3083	97	10	Release
62	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3063	70	3.4	Release
63	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3074	92	6.2	Release
64	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3067	88	7	Release
65	28-Dec-05	*Pangasianodon hypophthalmus*	Dai 4D	3092	100	11	Release
66	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3100	70	3.9	Release
67	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3061	73	4	Release
68	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2B	3090	59	2.4	Release
69	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3091	74	4.5	Release
70	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2C	3077	90	7.5	Release
71	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2D	3097	84	8	Release
72	31-Dec-05	*Pangasianodon hypophthalmus*	Dai 2D	3094	74	6	Release
73	29-Dec-05	*Probarbus jullieni*	Dai 2B	3539	32	0.6	Release
74	30-Dec-05	*Probarbus jullieni*	Dai 2D	3236	28	0.4	Release
75	30-Dec-05	*Probarbus jullieni*	Dai 2D	3261	35	0.7	Release
76	30-Dec-05	*Probarbus jullieni*	Dai 2D	3292	39	1.3	Release
77	8-Dec-05	*Probarbus jullieni*	Dai 2C	3255	42	1.2	Release
78	01-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	6068	105	13.5	Release
79	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	3073	102	14	Release
80	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3D	3056	67	3.5	Release
81	02-Jan-06	*Pangasianodon hypophthalmus*	Dai 3A	3066	103	12	Release
82	03-Jan-06	*Pangasianodon hypophthalmus*	Dai 2B	3078	82	6.4	Release
83	03-Jan-06	*Pangasianodon hypophthalmus*	Dai 2C	3081	80	4.5	Release

84	04-Jan-06	*Pangasianodon hypophthalmus*	Dai 4A	3093	118	13	Release

Table 8. List of Species Tagged and Released from 15th June 2005 to 04th January 2006.

Year	Species	Total number
2005	*Catlocarpio siamensis*	5
	Pangasianodon gigas	13
	Pangasianodon hypophthalmus	42
2006	*Catlocarpio siamensis*	1
	Pangasianodon gigas	7
	Pangasianodon hypophthalmus	33
Grand total		101

Table 9. Summary table of catch and release of three focal species in Cambodia 2005-2006.

Output 8. Improvement of landing facilities and holding facilities for the giant catfish to reduce post-harvest mortality

Fishing mortality is a significant threat to Mekong giant catfish. The Tonle Sap River bagnet (dai) fishery is one of the few places where wild giant catfish are caught on a regular basis. Without regulation, fishing mortality from bagnets equals approximately 5-10 fish per year.

Due to the predictable catch of Mekong giant catfish at the Tonle Sap River bagnets, a tag and release programme was established in 2001. Fish captured in the dai are tagged and released back to the Tonle Sap River. During the 2004 dai season, however, three out of five giant catfish caught in the dai fishery died after release. The continued mortality of a significant percentage of bagnet-caught Mekong Giant Catfish indicates that the methodology of the buy and release program needs to be reworked.

It has been standard practice for the tag and release program to rely on the bagnet operators to remove fish from the nets, transport them to holding area, and wait for the tagging team to arrive. Typically, the project uses "local" methods - fish are most often transferred from the net to the bottom of a boat, and then taken to a net pen underneath or to the side of a floating house. The fish receive no medicine and are released immediately after tagging - in the belief that minimizing handling time minimizes stress. The project has no veterinarian.

The exact reason for the death of the Mekong giant catfish is unknown, but it seems that capture in the dai net harms the fish. Generally speaking, the size of the fish and its chances of survival are inversely correlated (i.e. the larger the fish, the less likely it is to survive).

Based on comments from Martin Gilbert (field veterinarian, WCS Cambodia) and Jim Robinett (veterinarian, Shedd Aquarium USA), the damage is likely done before the fish makes it to the tagging team. The problem may be severe lactic acidosis event due to overexertion during capture. If so, these mortalities are related to exertional rhabdomyolysis or "capture myopathy". This explains the slight delay in the actual death of the fish which is a typical feature of capture myopathy.

The presence/absence of lactic acidosis can be tested by sampling the fish's blood for pH, lactic acid, O_2, and CO_2 levels. Capture myopathy can also be confirmed by histological exam of the skeletal muscle from one of the dead animals. If the cause of death is capture myopathy, then the capture method must be modified AND/OR the fish need to be given intravenous injections of isotonic fluids and an alkalinizing agent such as sodium bicarbonate or sodium acetate as soon as possible post-capture.

Other factors that could contribute to the poor health of the fish may include: 1) the length of time that the fish is in the dai, 2) handling of the fish as it is removed from the dai, 3) length of time that the fish is held after it is removed from the dai but before it is released, 4) the method that the fish is held (e.g. tied by rope through the mouth, etc), 5) handling during tagging, measurement, and photography, including removal of the fish from the water for weight measurements, or 6) disease/infection post-release.

Capture-related stress seems to be a more likely cause of mortality then post-capture stress, because mortality rates are about 50% regardless of whether or not efforts are taken to minimize post-capture stress.

The following steps may reduce future fish mortality (or at least reduce post-capture stress): 1) initiation of 24 hour surveillance of the dais by fisheries staff, 2) oversight by an on-call veterinarian available during the peak giant catfish season, 3) construction of a holding pen for rehabilitation of captured fish, 4) use of medicine to speed recovery, and 5) training of dai operators and laborers about gentle handling procedures post-capture. If these steps are not effective in limiting fish mortality, the suspension of dai operations from October 15 to December 1 every year would prevent Mekong Giant Catfish from being caught, and killed, in the dai fishery.

Photo 4. A plastic recovery pen for Mekong giant catfish.

Holding Pens for Rehabilitation:

Wooden Cage: The dai operators store fish using two methods, either in net pens underneath their floating houses or in floating wooden cages. To date, dai owners have not offered to keep the giant catfish in the cages underneath their house, perhaps because it would be nearly impossible to recapture the fish. Wooden cages do not seem like a good option because, in general, they are too small to allow the fish to swim freely. One variation on a wooden cage is the huge wooden "cage boats" that fish merchants use to transport fish from the Tonle Sap Lake to the Tonle Sap River. These cages can be in excess of 10 meters wide and 30 meters long.

Net Pen: The net pan is the traditional method of holding fish in the Tonle Sap Lake. Giant catfish have been held in net pens in the Tonle Sap Lake for several weeks. Net pens may be the best option as holding pens for rehabilitation of Mekong Giant Catfish. The main constraint is finding a location for the net pen. The location would need to be large enough to hold a Giant Catfish, close to the dais, and secure.

Holding Pond: Giant Catfish have been held successfully in ponds in Cambodia and Thailand. The main constraint is finding a secure location for the holding pond. Water quality could also be a problem unless it is closely monitored.

Plastic holding tank: A large plastic tank could be partially submerged in the river next to the dais. Giant Catfish could be placed in the pond with clean, medicated water to observe recovery.

Sling for holding the fish: The Mekong River Commission Fisheries Programme (Chris Barlow) and others have recommended transporting the fish by stretcher rather than holding them on the end of a rope (figure 1). While it is easy enough to transport the fish by plastic trap, it is not that easy to use a stretcher for the largest fish. The largest fish are too massive to fit in a normal size stretcher or to be lifted by less than four adults. It also should be noted, as mentioned previously, that fish appear to be injured during capture, not during handling.

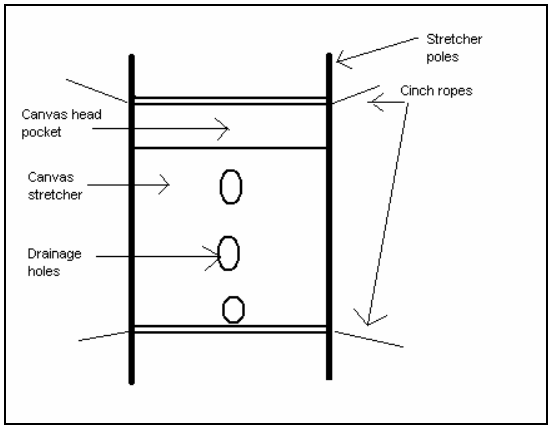

Figure 1. A simple sling for holding a fish during transport.

Medicine to Aid Fish Recovery:

1. High dose anti oxidants: Vitamin B complex (3-5ml/100kg), Vitamin C, Vitamin E (10 IU/kg), Selenium
2. Anti-inflammatories: Banamine (0.3mg/kg), Dexamethasone (1-2 mg/kg)
   ATP Glucose Mn Mg Zn Injectable combination: Biosolomine
   NaHCO3 (parenteral and oral to a total dose of 2 meq/kg)
3. Cimetidine to decrease gastric acid secretion
4. Prophylactic antibiotic : potentiated penicillin and Amikacin (2.5mg/kg)

References Related to Capture Stress:

Manire et al. 2001. Serological changes associated with gill-net capture and restraint in three species of sharks. *Trans Am Fish Soc* 130: 1038-1048.

Cliff G, Thurman GD. 1984. Pathological and physiological effects of stress during capture and transport in the juvenile dusky shark, Carcharhinus obscurus. *Comp Biochem Physiol* 78A: 167-173.

Wells RMG, Davie PS. 1985. Oxygen binding by the blood and hematological effects of capture stress in two big game-fish: mako shark and striped marlin. *Comp Biochem Physiol* 81A: 643-646.

Wells et al. 1986. Physiological stress responses in big gamefish after capture: observations on plasma chemistry and blood factors. *Comp Biochem Physiol* 84A: 565-571.

Output 9. Socio-economic impact assessment of effects of implementation of proposed conservation measures for 'threatened' species.

When discussing conservation measures and enforcement of existing laws against harvest of endangered species, there is often a lack of understanding of the costs and benefits associated with enforcement. Therefore project staff initiated an economic assessment of effects of implementation of proposed conservation measures for the Mekong giant catfish.

In 2006, two conservation measures were proposed: 1) a fishing moratorium for Mekong giant catfish in Chiang Khong, Thailand and 2) a regulation obligating dai #2 operators on the Tonle Sap River to release endangered species caught in their nets. An analysis of the costs and benefits associated with the fishing moratorium and net buy back was outside the scope of this current project. An simple analysis of the costs and benefits associated with the net buyback is available from Alvin Lopez (MWBP ecologist). To assess the costs and benefits associated with the regulation obligating dai operators to release endangered species, the project gathered information on the total fish catch from bagnet 2A during the 2005-2006 season.

Month	Fish for sale/ Kg	Fish for Food /Kg	Fish for Feed /Kg	Fish for Cage Culture /Kg	Fish for Release/ Kg	Total Caught Kg/Month
Oct/2005	213.85	172.1	105.6	no	no	491.55
Nov/2005	197.55	151.44	344.6	12.31	2	707.905
Dec/2005	363.50	173.89	538.60	31.37	13.75	1,120.74
Jan/2006	300,836.15	307.50	1,166.60	48.59	no	302,358.79
Feb/2006	14,306.90	465.90	651	2.87	no	15,426.67
Total	315,917.95	1,270.83	2,806.40	95.14	15.75	320,105.65

Table 10. Total catch from bagnet 2A during the 2005-2006 season.

During the 2005-2006, season bagnet 2A harvest 320,000 kilograms of fish. Endangered species constituted less of than 1,000 kilograms of this catch, or less than 1%. Nonetheless, endangered species often sell for a higher price per kilogram than many other species of fish. Taking into account price differences, endangered species probably constitute between 1-5% of the total value of the catch per year.

Mont	Species /Month	Species For Sale	Species for food	Species for fish feed	Species for cage culture	Endangered species
Oct/2005	41	31	17	11	Not	1
Nov/2005	48	31	28	18	7	1
Dec/2005	44	27	32	19	8	2
Jan/2006	53	28	41	23	5	

Feb/2006	38	23	31	25	4	
Total Fish species	53	28	41	29	8	3

Table 11. Fish species caught in bagnet 2A during the 2005-2006 season.

It is also worth noting that only 2,300 kilograms of fish were harvest during the months of October, November, and December. Considering that endangered species are only captured during these month, one option may be to postpone the start of the bagnet fishing season until December 1st or even January 1st each year. From an economic perspective, a December 1 opening may be more viable since in some years the December harvest can be substantial.

The use of a monitoring team to enforce fisheries regulations did not seem to be a cost effective solution. The total costs for the monitoring team were about $8,000 dollars, nearly as much as the total value of the catch in the dai during that period. Moreover, it was unclear whether or not the monitoring teams actually improved compliance of bagnet operators.

Number	Order	Family	Genus	Species	Khmer Name
1	Siluriformes	Pangasiidae	*Pangasianodon*	*Pangasianodon hypophthalmus*	Trey pra
2	=	=	=	*Pangasianodon gigus*	Trey reach
3	Cipriniformes	Ciprinidae	*Probarbus*	*Probarbus jullieni*	Trey trawsak

Table 12. Endangered species caught in bagnet 2A during rhe 2005-2006 season.

Given these findings, the best options may be: 1) voluntary release of endangered species by bagnet operators, 2) postponement of the bagnet fishing season until December 1 each year, or 3) installation of a large fish excluder device to avoid incidental harvest of endangered species.

Output 10. Captive breeding (including translocation/ supplementation) options assessed

The captive breeding component of the SCAP process is being carried out by the Thai Department of Fisheries in conjunction with the Darwin Project (Imperial College). The following information was presented at the December meeting of the Mekong giant catfish working group in December 2005.

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 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.

It is also worthwhile to note that preliminary data suggest that hatchery reared Mekong giant catfish do not survive when released into the wild. Thus, more study is necessary to determine how to ensure the survival of hatchery fish released into the wild. Without a better understanding of this problem, it is unlikely that supplementation will result in larger stocks of wild Mekong giant catfish.

Sp. Objective 3. To continuously communicate, educate and raise awareness on giant catfish and aquatic resource and biodiversity conservation issues - targeted at local communities, tourists, children, and a range of other key stakeholders.

Output 11. Publication of a book on the Mekong giant catfish

The Mekong Fish Conservation Project published a children's book on the life cycle of Mekong giant catfish in 2004. This book has been distributed to thousands of school children throughout Cambodia.

Photo 5. The cover of the children's book, Samnang and the Giant Catfish.

The publication of academic book was not possible due to the insufficient time and funds in 2006.

Output 12. Creation and distribution of educational tools for use by local communities, tourists, children, and government officials.

The project created a book, posters, and T-shirts for distribution to local people. The project also visited schools, fishing villages, commune offices, provincial fisheries units, fish landing sites, fish markets, and schools along Mekong, Tonle Sap, Basac River and Tonle Sap Great Lake. During these visits, the project staff presented fisheries regulations to local fishermen, community representatives and students, informed local communities about the results of previous survey activities, provided information about giant catfish biology, and explained the importance of protecting Mekong giant catfish and its habitat.

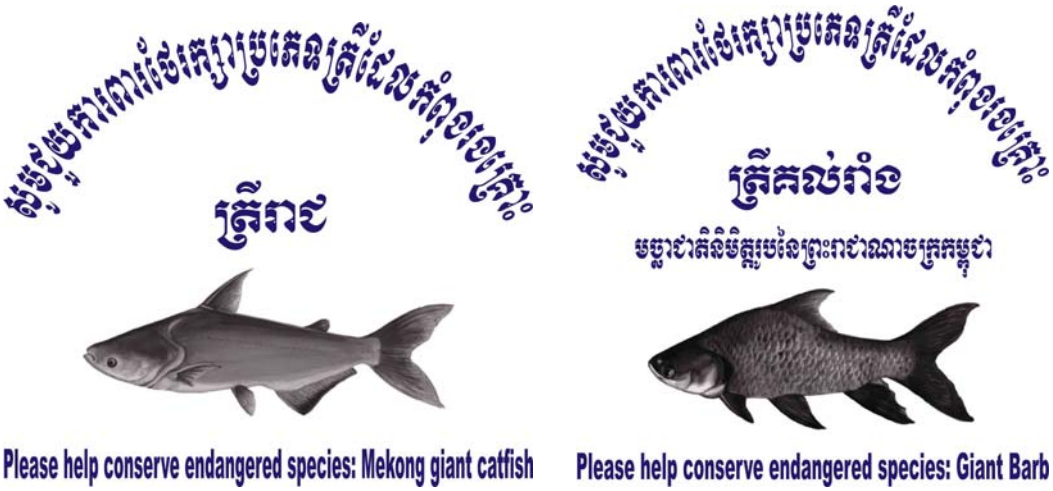

Photo 6. The back of the t-shirts created by the MWBP catfish component.

Output 13. Partnerships established with local and international media and appropriate events organized.

The catfish component of the MWBP worked with several media outlets to promote the conservation of the Mekong giant catfish. Notably, the project developed a strong partnership with the National Geographic Society, produced video for broadcast on Cambodian television, and participated in several media events.

2005 news from the Mekong Wetlands Biodiversity Programme Mekong Giant Catfish Component:

Giant catfish gets microchip behaviour study
Independent Online, South Africa - Jul 16, 2006
... tagged fish has made significant (more than 30km) upstream movement," said Zeb Hogan, the program's conservation-group scientist. The giant catfish is known to ...

Giant catfish carry high-tech tags
Bangkok Post, Thailand - Jul 15, 2006
The Fisheries Department has tagged 19 giant catfish with microchips and released them in the Mekong River in an attempt to unravel the mysteries of the ...

Fertility clinic on the Mekong
Nation Multimedia, Thailand - Jul 15, 2006
... species, and in 2001 researchers ensured that artificially bred catfish could produce ... study is now underway led by conservation-group scientist Zeb Hogan under ...

Giant Catfish Protected From Fishing in Thailand
National Geographic, D.C. - Jul 10, 2006
... "[This] is the most significant development in the conservation of the Mekong giant catfish in the last ten years," said Zeb Hogan, an associate research ...

2005 press releases from the Mekong Wetlands Biodiversity Programme Mekong Giant Catfish Component:

1. Scientists Meet in Phnom Penh to Develop Species Conservation Action Plan for Mekong Giant Catfish and other Threatened Species

Scientists from Thailand, Laos, and Cambodia, as well as international experts met in Cambodia on December 12-13 to develop a draft Species Conservation Action Plan for the critically endangered Mekong Giant Catfish. The first day of the meeting was devoted to reviews of current knowledge on the Mekong Giant Catfish and updates of activities of participants in 2005. On the second day of the meeting, participants worked to identify priority activities and develop a draft Species Conservation Action Plan.

Participants agreed that to the overall conservation objectives of 1) maintenance of a viable wild population, 2) restoration of historical distribution, 3) maintenance of a genetically representative captive population, and 4) protection of critical habitats and ecosystem processes. Participants also agreed to institute a joint conservation planning process built around series of joint workshops, research activities, conservation interventions, and policy and outreach activities. Future conservation activities include further development of captive breeding and focused interventions to reduce fishing mortality.

International experts included representatives from the Network of Aquaculture Centres in Asia-Pacific, the Mekong River Commission (MRC), the Food and Agriculture Organisation of the United Nations, the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme, the World Wildlife Fund, and the Imperial College of London.

2. New Fishing Ground Discovered for Endangered Mekong Giant Catfish

The Department of Fisheries Cambodia and the Mekong Wetlands Biodiversity Programme announced that they have discovered a significant and previously unidentified fishing ground for the critically endangered Mekong Giant Catfish. The fishing ground, located along the Mekong River in Kampong Cham Province, has produced five Mekong giant catfish in the past two years and four in the last month – equal to the harvest from the other identified fishing grounds in Cambodia and in the Golden Triangle area of Thailand and Laos.

The catches also support the hypothesis that Mekong giant catfish move up the Mekong to spawn. “We are considering tagging the fish to track them to their spawning grounds,” said Dr. Zeb Hogan, a fisheries biologist with the Mekong Wetlands Biodiversity Programme.

The Department of Fisheries requires that fishers immediately release Mekong giant catfish after capture. All fish except one seem to have survived capture and release. The Mekong Wetlands Biodiversity Programme and the Department of Fisheries are working with fishers so that they report the catch of Mekong giant catfish. The new program may be one reason for the high reported catch of Mekong giant catfish this month.

3. World’s First Freshwater Conservation Concession Established to Protect “King of Fish”

Cambodian Department of Fisheries and Mekong Wetlands Biodiversity Conservation and Susutainable Use Programme (MWBP) have formed a partnership to create the world's first freshwater conservation concession.

Recently pioneered as an innovative means to protect endangered species, the freshwater conservation concession is designed to reduce the exploitation rate of fisheries by obtaining the commercial rights to fishing in a specified area. In this case, these fishing rights have become limited fishing rights – the option to alter or cease commercial fishing in favor of research and conservation.

The concession has been established as the first step in a new effort to study and protect Cambodia's freshwater biodiversity, including Earth's largest freshwater fish the Mekong giant catfish. The Mekong giant catfish, also known as the "King of Fish" in Khmer language, is Southeast Asia's largest and rarest fish. It can grow up to three meters in length and attain a weight of nearly 300 kilograms. The Mekong giant catfish is listed as critically endangered by the World Conservation Union (IUCN).

4. Overfishing of Inland Waters Threatens Giant Fish and Rural Poor

Overfishing of inland waters is a neglected crisis, warns Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme biologist Dr Zeb Hogan, and co-authors in this month's cover story of the journal *BioScience*. The article titled "Overfishing of Inland Waters" (Bioscience, December 2005) highlights the impact that overfishing may have on the largest fish species as well as millions of poor people dependent on subsistence fishing for their livelihoods.

Roughly two-thirds of the reported catch from inland waters comes from Asia, and the authors illustrate the intensity of fishing pressure with examples from the Mekong River. The Mekong giant catfish, possibly the world's largest freshwater fish at 300 kg, is seriously threatened. But as large, high value fish disappear, most fishing pressure falls on the small minnows, called trey riel, which are harvested by a variety of traps and nets from a flotilla of boats and floating villages. The Cambodian currency, the riel, derives its name from the fish.

The paradox is that overexploitation may not lead to short-term decline in catch even when individual species, and long-term sustainability of the overall fishery, are highly threatened. It is often the largest fish species which disappear first as fishers become more dependent on smaller sized, short-lived species. The disappearance of the largest fish is a warning sign that overall fisheries may be in danger of collapse.

To meet the complementary goals of sustaining yields while maintaining biodiversity, the authors suggest four principles to guide fisheries management: sustainability of yields, maintenance of biodiversity, critical habitat/process protection, and fairness of distribution of the socio-economic benefits of aquatic resources.

The authors of the paper include Robin Abell, World Wildlife Fund in Washington, D.C.; Zeb Hogan, Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme/University of Wisconsin; Carmen Revenga, The Nature Conservancy; Brad Taylor, University of Wyoming;

Robin Welcomme of the Long Barn in Suffolk, England; and Kirk Winemiller of Texas A&M University.

5. National Geographic Deutschland and Deutsche Lufthansa nominate Mekong Giant Catfish for the UNEP/CMS Award

A study of the ecology and conservation of the Mekong giant catfish was the recipient of the first ever UNEP/CMS Thesis Award. The award was given to the American scientist, Dr. Zeb Hogan, for his doctoral thesis work on the critically endangered fish – and one of the world's largest.

The research on the critically endangered Mekong Giant Catfish (*Pangasiidae*) made a significant contribution to improve its conservation status under the Convention for Migratory Species. The study had high relevance to the vision and goals of UNEP/CMS to protect and improve the conservation status of migratory animals. The extraordinarily long migratory journey of the pangasiid catfish up the Mekong River was a key discovery. The study also aided in the development of conservation strategies and included local stakeholders such as fishermen. Such research may help develop methods for sustainable use of the species.

The prize on migratory species was donated by Deutsche Lufthansa and National Geographic Deutschland and will continue on a triennial basis.

Sp. Objective 4. To develop effective partnerships, secure appropriate financial resources, and establish necessary institutional arrangements for implementation of the giant catfish species conservation action plan.

Output 14. Effective coordination and implementation arrangements in place between the MWBP and project partners, including the Cambodian, Lao, and Thai governments, the Mekong River Commission, the Mekong Catfish Conservation Project (Kai Lorenzen), WWF, and others.

The catfish component of MWBP assisted in the coordination and implementation of agreements by participation and planning in meetings of the Mekong giant catfish working group, developing and implementing a research program in conjunction with Inland Fisheries Research Institute of Cambodia, cooperating with the Thailand Department of Fisheries and Lao Department of Livestock and Fisheries to conduct a migration study in the upper Mekong, and working with organizations such as the Mekong River Commission, the World Wildlife Fund, and Wildlife Fund Thailand toward an agreement to stop fishing for Mekong giant catfish in Chiang Khong, Thailand.

The Mekong giant catfish working group outlined a medium-term process to develop an overarching conservation strategy for the Mekong giant catfish. It was felt that building a conservation strategy process around the informal and voluntary cooperation of existing organisations and projects would offer the best scope for developing an integrated, overarching strategy. This approach aimed to circumvent the political and administrative problems likely to arise in any more formal setup involving multiple organisations with a remit to 'conserve the giant catfish'. By establishing a multi-stakeholder consultative process not 'lead' by any organisation in particular, it is hoped that many organisations will be able to 'buy into' the joint strategy. Unfortunately, with the end of MWBP, it is unclear whether or not coordination between

stakeholders will continue. Only WWF and the MRC seem positioned to facilitate this coordination, but it is unclear whether or not they are willing to accept the role of facilitator.

Output 15. Detailed annual work plans and budgets prepared with appropriate financial resources mobilized in order to develop and implement the SCAP.

The catfish component of MWBP produced the following major reports on 2005-2006 activities:

1. "Development and Implementation of a Species Conservation Action Plan for the Giant Catfish, *Pangasianodon gigas*, of the Mekong River Basin: Project Implementation Plan, July 2005 – June 2006"

2. "Contract between IUCN-The World Conservation Union and the Cambodian Department of Fisheries, December 2005."

3. "Current Status, Threats, and Preliminary Conservation Measures for the Mekong Giant Catfish, *Pangasianodon gigas"*

4. "Development of a Species Conservation Action Plan for the Mekong Giant Catfish: December 2005 Workshop Report"

5. Mekong Wetlands Biodiversity Programme Catfish Component: Mekong Fish Migrations Study, September 2006

6. "Development and Implementation of a Species Conservation Action Plan for the Giant Catfish *Pangasianodon gigas*, of the Mekong River Basin: Final Report for the Mekong Wetlands Biodiversity Programme, February 2007"

"Final Report on Mekong Giant Catfish Conservation, Inland Fisheries Research Institute of Cambodia, December 2006"

4 Conclusions

The MWBP project, in collaboration with several partners, made significant progress toward the conservation of Mekong giant catfish during the 2005-2006 period. In fact, this period represents the most significant period of action toward the protection of Mekong giant catfish ever, considering the number of activities and stakeholder involved in the development and implementation of the conservation strategy over the past 18 months. During this time, the Mekong giant catfish working group was formed and held three meetings, Thai and Lao fishers agreed to stop fishing for Mekong giant catfish, a large scale telemetry project was designed and implemented in the upper Mekong River, and several important surveys were conducted in Cambodia. As a result of the project, the Mekong giant catfish is both better understood and better protected than it was just a few years ago.

Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), the World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRCS, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. MWBP aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely. It is a five-year (2004-2009) intervention at three levels – regional, national and local – with demonstration wetland areas in each of the four countries: in the Songkhram river basin, Thailand; in Attapeu province in southern Lao PDR; in Stung Treng, Cambodia; and in the Plain of Reeds in the Mekong Delta, Viet Nam. The programme aims to:

- Improve coordination for wetland planning from regional to local levels
- Strengthen policy and economic environments for wetland conservation
- Generate and share information
- Train and build capacity for the wise use of wetlands
- Create alternative options for sustainable natural resource use and improve livelihoods

MWBP is a partnership between governments, aid agencies and NGOs, and provides a framework for complementary work for wetland conservation and sustainable livelihoods in the Lower Mekong Basin.

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