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A MEKONG GIANT

CURRENT STATUS, THREATS AND PRELIMINARY CONSERVATION MEASURES FOR THE CRITICALLY ENDANGERED MEKONG GIANT CATFISH

Report prepared for WWF-Greater Mekong by Dr. Zeb Hogan
Department of Natural Resources and Environmental Science
University of Nevada, Reno, U.S

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Front cover photo: a Cambodian man observes a Mekong giant catfish on the Tonle Sap river. Fishermen captured this specimen, which weighed about 500 pounds (230 kilograms), as bycatch in a stationary bag net. It was later released. © Zeb Hogan.

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EXECUTIVE SUMMARY

Conservation Status: The Mekong giant catfish, *Pangasianodon gigas* (Chevey 1930), is one of the most endangered fish in Southeast Asia. It is listed on the IUCN Red List of Threatened Species as Critically Endangered A4abcd (IUCN 2011). The Mekong giant catfish is listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Appendix I of the Convention on Migratory Species (CMS).

Distribution: *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 (Smith 1945, Lenormand 1996, Roberts and Vidthayanon 1991). There is some evidence that Mekong giant catfish were very widely distributed and relatively abundant in the 1800's and early 1900's. Mekong giant catfish now appear limited to the Mekong and its tributaries in Cambodia, Lao PDR, and Thailand. The species has also been introduced into reservoirs and rivers in Thailand but these introductions have failed to result in self-sustaining populations (Hogan et al. 2001).

Population size: Evidence suggests that populations of Mekong giant catfish have been declining throughout the basin for the last several decades (Pavie 1904, Giles 1935, Smith 1945, Hogan et al. 2001, Hartmann et al. 2008). *P. gigas* is now very rare throughout its range and no significant catch has been reported from northeast Thailand, southern Lao PDR, or Vietnam since 1980. In northern Thailand, the catch of Mekong giant catfish has been declining steadily for the past 20 years (Hogan 1998). Basinwide catch numbers are difficult to ascertain but appear to have dropped from thousands of fish in the late 1880's (Pavie 1904), to hundreds of fish in the 1920's and 1930's (Giles 1935), to dozens of fish in the 1990's (Hogan et al. 2004), to less than 10 fish in recent times (Stone 2007).

Habitat and ecology: The ecology of the Mekong giant catfish is poorly understood. Most available information comes from catch records which indicate that Mekong giant catfish use a broad range of habitats throughout their life cycle. Juvenile fish have been reported from the Mun and Songkhram Rivers in Thailand and the Tonle Sap Lake in Cambodia. Adult fish are believed to inhabit deep water areas of the Mekong River especially during the dry season (Mattson et al. 2002). *P. gigas* is migratory, but the extent of migrations is unknown. Migrating adults have been recorded moving out of the flooded habitats of Tonle Sap Lake and into the Mekong at the end of the rainy season (October-December), moving over the Khone Falls in July and August (Mollot unpublished data), and making spawning migrations in northern Thailand and Lao PDR in late May and early June (Hogan et al. 2004). Genetic data indicate that all *P. gigas* in the basin may be part of one, panmictic population (Ngamsiri et al. 2007).

Reproduction: 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 has not been confirmed. *P. gigas* may also spawn in northern Cambodia since very young *P. gigas* are caught along with larval *Pangasianodon hypophthalmus* in a drift net fishery in Cambodia (MGCWG 2008). It is likely that *P. gigas* and *P. hypophthalmus* spawn at the same or nearby stretches of the Cambodian Mekong. Wild adults on spawning runs average 6-8 years of age and 150-250 kg (Mattson et al. 2002, Pholprasit and Tavarutmaneegul 1998).

Threats: The Mekong giant catfish, a rare, long-lived and relatively slow to mature species, is vulnerable to overexploitation (Boreman 1997, Allan et al. 2005, Olden et al. 2007). Recent analysis suggests that fishing has been a threat to the species for several decades (Smith 1945, Hogan 1998, Hartmann et al. 2008). The populations of Mekong giant catfish have declined significantly and do not appear to be capable of supporting intense, unregulated fisheries. Dams, navigations projects, and habitat destruction also threaten the giant catfish. In the Mun River, the largest tributary to the Mekong, a dam blocks the migrations of *P. gigas* and has isolated the Mun River from the remainder of the Mekong River Basin. Recent plans for mainstream dams on the Mekong represent a major new threat to the species (Baran et al. 2011). The Xayaburi dam in northern Lao PDR, for example, would likely act as an impassable barrier to very large fish like the Mekong giant catfish and could drive the Mekong giant catfish to extinction (Baran and Myschowoda 2009).

Conservation actions: Thai, Lao, and Cambodia laws regulate fishing for Mekong giant catfish. Harvest is illegal in Thailand and Cambodia (Sretthachuea 1995, MGCWG 2008). Recent changes to Lao law prohibit use or trade of Mekong giant catfish (Phouthavongs 2010). Since 2008, there has been a moratorium on targeted fishing for Mekong giant catfish. While this fishing moratorium has likely reduced mortality of adult fish, neither Mekong giant catfish abundance nor basin-wide harvest is closely monitored so the impact of the moratorium is unclear.

Conservation recommendations: Catches should be monitored to ensure that Mekong giant catfish are not subject to targeted fisheries. Incidental catch, which likely occurs to some extent throughout the basin, should also be monitored since incidental catch is one of the best and only sources of information about the distribution, life history, and abundance of *P. gigas*. Measures to identify and safeguard Mekong giant catfish migratory corridors and critical habitat are urgently needed. The Mekong giant catfish would also benefit from increased international cooperation, including a basin-wide management plan, since the species occurs in an international river and the species crosses international borders to complete its life cycle. Regional and international organizations and agreements, such as the Mekong River Commission and the Convention on Biological Diversity may be helpful to facilitate collaborative conservation measures.

Research Recommendations: The biology of captive Mekong giant catfish is relatively well understood (Pholprasit and Tavarutmaneegul 1998, Mengumpun 2000, Unakornsawat et al. 2001, Sriphairoj et al. 2007). Knowledge of the ecology of wild Mekong giant catfish, however, is lacking. A comprehensive research program – including study of the distribution, abundance, and life history – is urgently needed to provide science-based guidance on how to most effectively safeguard and restore populations of the Mekong giant catfish. 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 mainstream dams, development of methods to mitigate the impacts of mainstream dams, and further improvement of the artificial breeding program. In southern Lao PDR, Cambodia, and Vietnam, research priorities include monitoring of incidental catch, distribution surveys to determine the extent of occurrence of immature and mature giant catfish, tagging to study migratory behavior, and development of methods to reduce fishing mortality.

1. INTRODUCTION

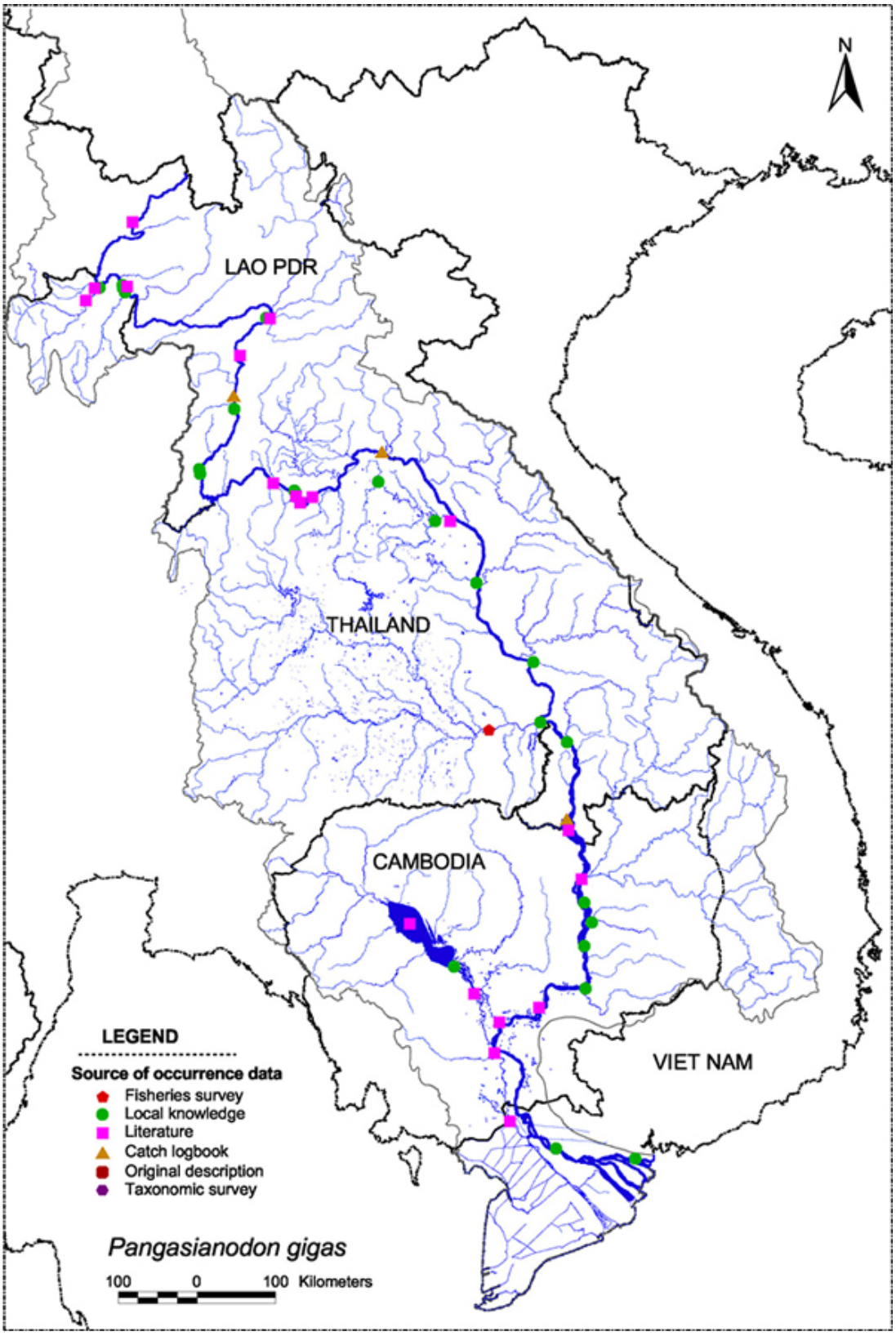
The Mekong giant catfish, *Pangasianodon gigas*, is one of the largest, rarest freshwater fish in the world, measuring almost three meters in length and weighing up to 300 kilograms (Hogan et al. 2004, Stone 2007). *P. gigas* is a Mekong endemic (i.e. it occurs naturally only in the Mekong River Basin). Historically, giant catfish inhabited the Tonle Sap Lake, the Tonle Sap River, and the Mekong and its major tributaries in Vietnam, Cambodia, Lao PDR, Thailand, and possibly Burma and southwestern China (Smith 1945).

The population of Mekong giant catfish has been declining steadily since the early 1900's. In the last two decades, the basin-wide catch has declined from approximately 70 fish in 1990 to less than 10 fish in recent years. Overharvest appears to be one reason for this decline (Baran and Myschowoda 2008). Other potential causes of this decline include habitat degradation, rapids blasting, dams, and genetic introgression with hybrid and captive bred stocks. Plans for mainstream dams are a significant new threat to Mekong giant catfish since mainstream dams could block migrations essential to the life cycle of the species (Baran and Myschowoda 2009).

The Mekong giant catfish has gained worldwide recognition because of its size, cultural significance, and the increasing threat posed by human activity. Kottelat and Whitten (1996) propose that *P. gigas* be used as a flagship species to promote conservation of freshwater habitats in Asia. Recent initiatives by the Mekong Giant Catfish Working Group, WWF, the Mekong River Commission, and the governments of Thailand, Lao PDR, and Cambodia seek a transboundary solution to the management and conservation of the Mekong giant catfish. Despite steps in the right direction, the Mekong giant catfish remains poorly understood and highly vulnerable to a wide range of ongoing threats.

The purpose of this report is to provide an up to date review of the status of the Mekong giant catfish, including information about the ecology of the Mekong giant catfish, threats to the species, an overview of past and current conservation measures and recommendations for future action.

The Mekong giant catfish is one of the largest and most endangered fish in Southeast Asia. This photo of a captive Mekong giant catfish was taken in an aquarium in central Thailand. © Zeb Hogan.



Map from report, "Distribution and Ecology of Some Important Riverine Fish Species of the Mekong River Basin. MRC Technical Paper No. 10." © Mekong River Commission.

2. DISTRIBUTION

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 (Smith 1945).

2.1 Past Distribution in Thailand and Lao PDR

Early records indicate that Mekong giant catfish were widely distributed and much more abundant in the late 1800's and early 1900's (Pavie 1904, Hartmann 2008). Pavie (1904) reports fishermen in Luang Prabang caught 1400 giant catfish in 1889 and 6000 giant catfish in 1890. He also states that "large numbers" of giant catfish were caught near Phnom Penh during this same period (Pavie 1904). In the 1920's and 1930's, 100-180 Mekong giant catfish were caught annually from the Thai-Lao Mekong near Nong Khai (Hartmann 2008). Around this same time, Giles (1935) 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 (opposite the Nam Ngum) in Nakorn Phanom, the Ah Hong rapids in Chaiburi (Nong Khai), the village of Tad Serm in Tambaw (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.

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 1. Seasonal distribution of Mekong giant catfish in three provinces in Thailand based on historical records (source Pholprasit and Tavarutmaneegul 1998).

Giant catfish catches began to decline in the late 1930's when the number of fish harvested decreased from hundreds to less than fifty per year. There were years when not a single fish was caught (Hartmann 2008). Since that time, the giant catfish has nearly disappeared from northeast Thailand (including Khemarat, Mukdahan, Nakorn Phanom, Nong Khai, and Chiang Khan). According to several accounts (Smith 1945, Phukasawan 1968, Mengumpum 2000), the giant catfish had disappeared from some stretches of Mekong River in northeast Thailand by 1940. During that time period, people counted their age by whether or not they were born before or after the disappearance of the Mekong giant catfish (Hartmann 2008).

More recently, the giant catfish has also disappeared from the catches in northern Lao PDR and Thailand. In Luang Prabang, the catch declined from about 12 fish per year to just 3 fish in 1968. No fish were caught in 1972, 1973, or 1974 (Davidson 1975). Since that time, no significant catch of *P. gigas* has been reported for the Luang Prabang area. In Chiang Khong, Thailand harvest peaked in 1990 at 69 fish and has been declining steadily since that time (Hogan 1998, Hogan et al. 2004). Catches have been very low (less than 10 fish) since 2000 and beginning in 2008 catches have been limited either by temporary moratoriums or a quota system (Sukumasavin 2010).

2.2 Past Distribution in Cambodia

Pavie (1904) and Durant (1940) provide anecdotal information about Mekong giant catfish in Cambodia with sporadic recordings from 1904 until present day. However, 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 (several natural history papers were published by the French in the 1930's and 1940's) or interviewing the oldest fishers about their recollections of past catches.

2.3 Present Distribution

Present Distribution

P. gigas occurs sporadically in the main channels of the Mekong River and its tributaries in Thailand, Lao P.D.R., and Cambodia. 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, the species is no longer a regular catch in northeast Thailand or Vietnam (see table 2).

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.	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	Pholprasit 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. More recently, Mollot (unpublished data) reported catch of 3-4 *P. gigas* per year from Hou Sahong near the Lao-Cambodian border.	Roberts 1993 Mollot, unpublished data
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 2. The status on the *P. 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 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 (Hogan et. 2001, Hogan et al. 2004). 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 3. Seasonal distribution of Mekong giant catfish in Cambodia (Hogan et al. 2001 and Tana, unpublished report).

Recently regular catches of Mekong giant catfish have also been reported from Kampong Cham in Cambodia and Hou Sahong in Lao P.D.R. In Kampong Cham, beach seiners caught 2-4 fish per year between January and March in 2005 and 2006. Likewise, Mollot (unpublished data) reported that fishermen from Hou Sahong in southern Lao P.D.R. catch 3-4 Mekong giant catfish in July and August of each year. Recent catches from Hou Sahong are believed to be the result of improvements made to traditional "li" traps. The traps are now made with better, stronger materials and so are able to withstand stronger currents and higher flows late into the rainy season (Mollot, unpublished data). Fishermen also report giant catfish occasionally in Neak Loeung, Kratie, Stung Treng, the Mun River, the Songkhram River, Luang Prabang, and Pak Beng. 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. Further interviews with fishermen in these areas may provide additional insight into the distribution, abundance, migration patterns, and conservation status of giant catfish.

3. POPULATION SIZE AND VIABILITY

3.1 Population Size

Based on catch data from Thailand, Lao PDR, and Cambodia, populations of the Mekong giant catfish are declining rapidly. The total number of fish in the basin is believed to have decreased by approximately 99% over the past 100+ years and by 80-90% over the past 30 years (Pavie 1904, Hogan et al. 2004). This downward population trend continues (with very few fish reported in the past 3-4 years) though the exact trend is difficult to ascertain. Fishing effort and catch reporting appear to have decreased over the last 3-4 years due to restrictions on fishing and reduction of monitoring efforts.

In Chiang Khong (Thai Mekong) and across the river in Huay Xai (Lao side), the 1990 catch of giant catfish totalled 69 fish. The catch from this stretch of river has declined steadily since 1990. Beginning in 2000, catch has been very low and in some years (e.g. 2001, 2002, 2003, and 2006) fishermen did not report a single fish. More recently, fishing activity has been limited both because the number of giant catfish fishermen has declined (due to a net buyback program in 2006) and because the Lao and Thai governments have outlawed harvest Mekong giant catfish.

In Cambodia, approximately 5-10 Mekong giant catfish are caught each year in the Tonle Sap River bagnet fishery, the Tonle Sap Lake, and beach seine fisheries in Kampong Cham. The total reported catch from the Tonle Sap River has decreased over the last ten years (from 11 fish to approximately 5 fish) but monitoring has not been consistent and so it is difficult to determine whether or not the decrease in reported catch represents a parallel decrease in actual catch. Giant catfish occur in the Tonle Sap Lake, where fishermen have reported 1-2 fish per year since 2000.

Mekong giant catfish captured at the dais, or floating bagnets, in the Tonle Sap River, Cambodia. Several Mekong giant catfish are captured each year in the Tonle Sap River, usually in October and November as the floodwater recedes, the Tonle Sap Lake empties, and fish like the Mekong giant catfish move from the flooded areas of the lake to the mainstream Mekong River. © Zeb Hogan.

3.2 Population Viability

While the exact population size and population trend of Mekong giant catfish is unknown, efforts have been made to estimate population size and trends based on catch records. Most notably, Lorenzen and Sukumasavin (2007) developed a mathematical model to reconstruct Mekong giant catfish dynamics since 1970. The model estimates spawner population size at 240 fish prior to 1983 (Lorenzen and Sukumasavin 2007). Lorenzen and Sukumasavin (2007) further state "intensification of the Chiang Khong / Houy Xai fishery then depleted the population by 80% to just 50 in 1995. The model predicts that the population has since recovered significantly, largely due to maturation of fish that were spawned prior to 1990. Lorenzen and Sukumasavin (2007) estimate current spawner abundance at 155-185 animals, depending on an unknown degree of compensation in the species' stock-recruitment relationship.

Natural spawner abundance in the absence of fishing has been estimated at 400-730 animals. This estimate is lower than an independent assessment of genetically effective population size (n = 2500) based on molecular genetic techniques (Lorenzen and Sukumasavin 2007, Ngamsiri et al. 2007).

The model predicts abundance to return to its pre-1980 levels if moderate 'historical' levels of fishing are maintained, but is unlikely to do so until well after 2050 (Lorenzen and Sukumasavin 2007). If fishing ceased completely, the model predicts population would increase faster and exceed its pre-1980 abundance by 2030. Given the species' longevity and late age at maturation (estimated by various researchers to be between 5-20 years), "reproductive failure due to environmental factors or depletion of the spawning stock would become evident in the spawner population only after

about 20 years" (MGCWG 2008). These findings indicate that recovery of Mekong giant catfish will likely be a long term process.

It is important to note that the results of this model are based on several assumptions and it is unclear whether or not these assumptions hold true for Mekong giant catfish. Therefore, while the model estimates trends in abundance and predicts population recovery (assuming limited harvest and no further deterioration of environmental conditions), the results of the model must be evaluated in the context of long term catch data and other information. Determining Mekong giant catfish abundance, or even basinwide catch, is difficult in the Mekong River Basin where fisheries are not always well monitored and fishing grounds can be remote and inaccessible.

Based on the little information that is available, catch of Mekong giant catfish appears to have dropped from thousands of fish in the late 1880's (Pavie 1905), to hundreds of fish in the 1920's and 1930's (Giles 1935, Hartmann 2008), to dozens of fish in the 1990's (Hogan et al. 2004), to less than 10 fish in recent times (Stone 2007). These numbers imply an order of magnitude decrease in population every few decades and an overall drop in population size by over 99%. While there is obviously some uncertainty associated with these numbers (which in certain cases are based on anecdotal accounts of natural historians), it is difficult to argue that Mekong giant catfish numbers have not dropped significantly over the past 100 years. Indeed, as early as 1930 there were calls for increased regulation of Mekong giant catfish harvest (Hartmann 2008, Smith 1945).

While Lorenzen and Sukumasavin (2007) believe that the population has now stabilized and may be growing again after a period of intense harvest of spawning fish in the late 1980's and early 1990's, a precautionary approach dictates that catch restrictions and conservation should be a priority until strong evidence exists that Mekong giant catfish populations have recovered.

Application of the IUCN criteria for extinction risk indicate that that Mekong giant catfish is Critically Endangered and at high risk of extinction. Even so, it is very difficult to accurately predict future population trends. Fish populations often behave unpredictably, especially in data poor situations, and population trends depend on a combination of factors including environmental conditions, fish fecundity, recruitment and fishing mortality.

3.3 Genetic Viability

Several recent studies have been conducted to determine the genetic population structure, population size, and genetic health of Mekong giant catfish populations (Na-Nakorn et al. 2006, Ngamsiri et al. 2007, Sriphairoj et al. 2007). Analysis of genetic population structure of Mekong giant catfish populations from northern Thailand and Cambodia indicate that Mekong giant catfish probably occur as one panmictic population, with little differentiation between upstream and downstream populations (Ngamsiri et al. 2007). This is consistent with the hypothesis that Mekong giant catfish are highly migratory and may be capable of moving long distances to spawn. It is not consistent, however, with the findings of Poulsen et al. 2000 who used local ecological knowledge to hypothesize that two separate populations (one upstream of Khone Falls and one downstream of Khone Falls) exist. Nonetheless, the majority of available evidence, including data indicating that pangasiid catfish are highly migratory (Hogan et al. 2007), reported catch of migrating fish out of the Tonle Sap and up the Mekong, the Mekong giant catfish's apparent ability to climb Khone Falls, evidence of spawning in northern Thailand and Laos, and genetic data showing one population, suggests one interbreeding population and one, if not more, spawning sites.

Genetic analysis of mitochondrial DNA indicated that Mekong giant catfish populations may be more robust than thought or Mekong giant catfish "carry the genetic signature of a historically larger population" (Na-Nakorn et al. 2006). Microsatellite analysis, however, suggests that genetic diversity of wild Mekong giant catfish is relatively low and effective population size based on genetic analysis is estimated at approximately 2500 individuals (Ngamsiri et al. 2007). This estimate is consistent with past estimates of catch (e.g. thousands of fish in the late 1800's) but is larger than the estimate made by Lorenzen and Sukumasavin (2007). Ngamsiri et al. (2007) recommend management of captive stocks of Mekong giant catfish to conserve genetic diversity and Sriphairoj et al. (2007) suggest a broodstock management plan to achieve those objectives. The MGCWG (2008a) presents a comprehensive review of the genetic viability of captive stocks of Mekong giant catfish. Six breeding plans were developed to maintain genetic variation (MGCWG 2008a)

4. BIOLOGY, ECOLOGY, AND HABITAT

4.1 Morphology

The Mekong giant catfish, *Pangasianodon gigas*, is one of the largest freshwater fish in the world, measuring almost three meters in length and weighing up to 300 kilograms (Hogan et al. 2004, Stone 2007). Most easy differentiated from other species by its size, lack of teeth and barbels (individuals over 50cm), and 8-9 pelvic fin rays. *P. gigas* has a broader head and mouth than its close relative, *P. hypophthalmus* (Roberts and Vidthayanon 1991).

4.2 Reproduction

Mekong giant catfish spawning behavior appears similar to that of most pangasiid catfish species, spawning at the onset of the rainy season. For example, fishermen report that *Pangasius sanitwongsei* spawns in May. Another pangasiid species, *Pangasius bocourti*, also spawns in May and June (Cacot 1999). The relative of the giant catfish, *Pangasianodon hypophthalmus*, spawning activity peaks in June and July (Cacot 1999). In northern Thailand and Lao PDR, *P. gigas* apparently spawns at the beginning of the rainy season in June. Mengumpun (2000) reports that giant catfish captured between April 17 and May 5 do not have fully developed eggs. Fish captured after May 5 can be induced to spawn using hormones. One fish captured in Chiang Rai Province (probably Chiang Khong town) on June 3, 1990 was ready to spawn without the use of hormones.

This Mekong giant catfish was also caught in the dais, or stationary bagnets, of the lower Tonle Sap River. In recent years, fishermen who operate the dais have agreed to release Mekong giant catfish when they are caught in their nets. © Zeb Hogan.

Age at maturation is variously reported as between 5-6 years (Pholprasit 1983), 6-8 years (Mengumpun 2000) and 16-20 years (MGCWG 2008). At Chiang Khong, 95% of Mekong giant catfish measured between 180 cm and 290 cm total length (Mengumpun 2000). MGCWG (2008) report average length at maturation is approximately 220 cm. Fish spawn

once per year and produce over 1,000,000 eggs. Mengumpun (2000) reports that a 178 kilogram female carried 13.5 kilograms of eggs and each kilogram contained 800,000 eggs.

The Thai Department of Fisheries began an artificial breeding program for *P. gigas* in 1983 (Pholprasit and Tavarutmaneegul 1998). Since 1983, the captive breeding program has had two phases. During the first phase (approximately 1983-2001) young fish were artificially reared from the sperm and eggs of wild *P. gigas* caught during their spawning migration up the Mekong River (Sretthachuea 1995). The adult fish, once captured, were subjected to a three-day hormone treatment to stimulate rapid development of the gonads. At the end of the three-day period, the eggs and sperm are extracted for artificial propagation. Millions of captive-bred fish were produced in this way between 1983 and 2001. During the second phase of the breeding program (beginning in 2001), the Thai Department of Fisheries was able to breed second generation captive Mekong giant catfish from captive-bred and reared broodstock (Unakornsawat et al. 2001). The first of these broodstock, two sixteen and seventeen year-old female fish weighing 54kg and 48kg, were induced to spawn using hormones and produced about 1.2kg of eggs (350,000 young fish).

While captive bred fish have been released into reservoirs throughout Thailand, there is no evidence that Mekong giant catfish living in reservoirs are able to reproduce.

4.3 Growth

While the giant catfish may be one of the fastest growing species of fish in the world, very little hard data is available on growth in the wild (Rainboth 1996) Phukasawn (1968) examined the dorsal spine of one 2.30 m, 135 kg giant catfish and estimated that the fish was six years old. In captivity, the growth of giant catfish is dependent on habitat and food. At the Phayao Fisheries Station, 17 year-old fish raised in ponds weighed about 50 kg. Average age at first maturity has been reported at between 5 and 20 years (Pholprasit 1983, Mengumpun 2000, MGCWG 2008), average age of parents at the time their young are born is estimated at between 5 and 10 years, and maximum life span in the wild is reported as over 60 years (WWF 2010). Using the methods developed by Cheung et al. 2005, and data available on Mekong giant catfish age and growth, the species is considered a relatively long-lived species with high intrinsic extinction vulnerability.

4.4 Diet

According to published accounts and reports of fishermen, the Mekong giant catfish eats algae and aquatic plants (Phukasawan 1968, Mengumpun 2000, Vidthayanon 2005). Fishermen state that the stomach of the giant catfish is sometimes filled with green liquid. In October 2002, the author of this report examined the stomach contents of a giant catfish from the Tonle Sap River. The stomach of the fish was empty, except for a small amount of green liquid. Young fish eat zooplankton, an abundant resource in floodplain habitat, and so young may be adapted to use floodplain and flooded forest (Polprasit 1983). In captivity, Mekong giant catfish adapt well to a variety of different foods, including fish meat, shrimp meat, and commercial fish food (Pholprasit and Tavarutmaneegul 1998).

4.5 Ecology

The ecology of the Mekong giant catfish, aMekong River endemic, is poorly understood. The species occurs in the main Mekong River and larger tributaries (Rainboth 1996). It is believed to be a migratory species but the extent of migrations, timing of migrations, and spawning locations are not well understood.

4.6 Habitat

Very little information exists on the habitat requirements of Mekong giant catfish. The information that is available comes from catch records documenting Mekong giant catfish of varying sizes in the Mekong River main channel and its larger tributaries.

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 mainstream Mekong between Chiang Saen and Phnom Penh also likely serves as a migratory corridor, though the exact timing and extent of migrations is unknown.

Adult fish inhabit the main channels of the Mekong River, Tonle Sap River, and the Tonle Sap Lake. Smaller fish (10-30 kg) occur in the Tonle Sap Lake and Tonle Sap River. Phukasawan (1968) reports a fish (approximately 1.0 m and 29 kg) from the main channel of the Mekong River at Nong Khai. Mengumpun (2000) states that 10-30 kg sized fish also occur in the main channel of the Mekong River at Loei (18 kg) and in the Mun River near Ubon Ratchathani (30 kg). Durand (1940) reports very small fish (1.2-4.5 cm) in Cambodia and Vietnam near the towns of Bac-Lieu, Chau Doc, Peam Chikang, Kampong Cham, and the Tonle Sap. Based on this distribution data and what is known about Mekong giant catfish spawning and growth, it appears that Mekong giant catfish spawn in the mainstream of large rivers (possibly only the Mekong).

5. THREATS

Threats to the Mekong giant catfish include overexploitation, habitat degradation, and potential habitat fragmentation by tributary and mainstream dams. Genetic introgression with captive bred stock and overharvest for captive breeding also potentially threatened Mekong giant catfish in the recent past but release of captive bred stock into the Mekong – and harvest of wild fish from the Mekong for captive breeding – has been suspended since 2005..

5.1 Fishing Mortality

Several recent studies suggest that, for long-lived organisms like the Mekong giant catfish, the survival of adults is the most important factor contributing to stock abundance (Crouse et al. 1987, Heppel 1997, Boreman 1997). Such species are often late to mature. Furthermore, large-bodied adults have few natural predators, and no mechanism exists to cope with high adult mortality (Boreman 1997). Thus, fishing mortality, especially high levels of fishing mortality of spawning adults, represents a potential threat to Mekong giant catfish persistence. In the Mekong River Basin, populations of the giant fish species have declined significantly in recent years. These species were more abundant before the introduction of highly efficient fishing gears in the 1960's and 1970's (Roberts 1993).

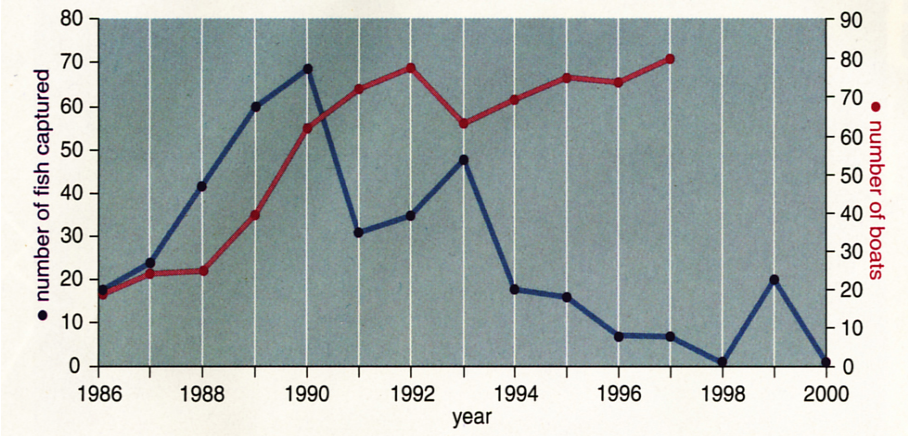
Fish Species	Maximum Length	Population Status	Source
P. gigas	3.0 meters	Critically Endangered	IUCN2011
P. sanitwongsei	2.5 meters	Critically Endangered	IUCN 2011
P. hypophthalmus	1.8 meters	Endangered	IUCN 2011
P. conchophilus	60 centimeters	Common	Roberts 1993

Table 4. Conservation status of pangasiid catfish in the Mekong River Basin. Populations of large-bodied species are declining, whereas related smaller-bodied species remain relatively common.

Until very recently, two main fisheries existed for Mekong giant catfish: the "mong lai" floating gill net fishery in northern Thailand and Lao PDR and the Tonle Sap bagnet fishery in Cambodia. The "mong lai" floating gill net fishery has not been fully operational for several years due to a combination of low catches and efforts to restrict fishing. Unmonitored, sporadic, incidental catch throughout the basin is now probably the largest source of fishing mortality of Mekong giant catfish. Without monitoring, it is very difficult to determine the level of fishing mortality that occurs in these "by-catch" fisheries.

Fisheries for giant catfish:

- The Tonle Sap River bagnet fishery. This fishery is one of the last places where giant catfish are caught on a regular basis. Without regulation, fishing mortality from bagnets equals approximately 5 fish per year. This number may have changed since 2006, the last year that catches were systematically monitored.
- The "mong lai" floating gillnet fishery in northern Thailand and Lao PDR. In the early 1990's catch from this fishery averaged 30-40 fish per year. Almost all of these fish were harvested, resulting in the single largest source of fishing mortality anywhere in the basin (until the fishery crashed in 2001). In recent years this fishery has not been fully operational.
- The Tonle Sap Lake fishing lots and barrages. Every year, fishermen catch a few giant catfish in the Tonle Sap Lake. The number of fish harvested, especially smaller sized fish, is probably much higher than the current best estimate of 1-2 fish per year.



Catch and boat number from the "mong lai" fishery for Mekong giant catfish in Chiang Khong, Thailand 1986-2000. The initial increase in catch and effort (number of boats) is followed by a steep decline in catch.

- 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*).
- Incidental by-catch in other fisheries, most notably large-mesh gill net fisheries along the Cambodian Mekong and bamboo fishing traps in Southern Lao PDR may equal as many as 10 fish per year.

5.2 Dam Construction

Mekong mainstream dams are a significant new threat to the Mekong giant catfish. Xayaburi dam, in particular, because of its location and status as potential first dam on the lower mainstream Mekong, warrants special consideration (for details, see Consulting and Engineering Management Company 2010). Based on catch records, genetics, and studies of other catfish in the family Pangasiidae, it appears likely that the Mekong giant catfish uses the stretch of river of the Xayaburi dam as a migration corridor (Hogan et al. 2004, Hogan et al. 2007, Na-Nakorn 2006). Adult fish likely pass this area on their migration from floodplain rearing areas to upstream spawning sites. There is a chance that the Mekong giant catfish spawns in this area. The Xayaburi dam could alter Mekong flows and disrupt spawning cues, block spawning migrations, and slow downstream dispersal (increasing mortality of young fish). Mortality is likely if fish pass through dam turbines. There are also important gaps in knowledge concerning the project's impact on sediment flows. The Mekong's rich sediment is essential for maintaining balance in the Mekong ecosystem, which is critical for sustainable fisheries and livelihoods. Based on experiences in the upper Mekong and many other river basins, the cumulative impacts of the dam are a serious threat to a rare, large-bodied migratory species like the Mekong giant catfish. Impacts from the dam could conceivably cause the extinction of the species. Mitigation measures for mainstream dams have not been fully developed. The Mekong giant catfish is migratory, needs specific cues to spawn, and cannot reproduce naturally in

reservoirs. This suggests that mitigation measures should include environmental flows, upstream fish passage for adult Mekong giant catfish, and downstream passage for young (and possibly adult) fish. As currently designed, the Xayaburi dam will be an essentially impassable barrier to large-bodied fish (ICEM 2010). Given the extremely large size of the Mekong giant catfish and other Mekong species mitigation measures should be developed to accommodate large, migratory catfish (and dozens of other migratory fish in the area). Recent studies suggest that such mitigation measures may not exist and will require large scale investment in new technology (Dugan et al. 2010).

5.3 Other Threats to Mekong Giant Catfish

Waterway modification - Removal of rapids, canalization of the river bank, and dredging alter river habitat and may negatively impact Mekong giant catfish. The stretch of river between Chiang Khong and Chiang Saen, Thailand is almost certainly spawning habitat for giant catfish. Potentially harmful river modifications in the area include port construction (Chiang Saen), rapids blasting (as part of the Mekong Navigation Improvement Project), and the construction of a bridge between Chiang Khong, Thailand and Bokeo, Lao PDR.

Clearing of flooded forest - The Tonle Sap Lake is a rearing ground for giant catfish. Fishermen report young giant catfish in fishing lots from January until May (this corresponds to the fishing season). As the forests of the Tonle Sap Lake are cleared for firewood and to make space for agriculture, the habitat and resources available to giant catfish decreases.

Harvest of fish for artificial breeding - The Thai Department of Fisheries (working in cooperation with the fishermen of Chiang Rai Province, Thailand and Huay Xai, Lao PDR) managed an artificial breeding program based on wild caught *P. gigas* between 1983 and 2005. Young fish were artificially reared from the sperm and eggs extracted from wild *P. gigas* caught during their spawning migration up the Mekong River. Once the eggs/sperm was extracted, the fish were sold for meat. While the artificial breeding program continues, wild fish are no longer needed as broodstock since the Thai Department of Fisheries has been artificially breeding Mekong giant catfish successfully in captivity in 2005.

Mekong giant catfish caught in the Tonle Sap River dais.The Tonle Sap Lake and River, and Mekong River between Vietnam and northern Thailand and Lao PDR represent the limit of distribution of Mekong giant catfish at this time. © Zeb Hogan.

Artificial propagation can be used to increase the population size of endangered species like the Mekong giant catfish. In fact, breeding programs have the potential to produce millions individuals for release into the wild and, in the case of rare species, this influx of artificially produced individuals can increase the population size substantially. Even so, the impacts of such supplementation programs are not necessarily beneficial. Without baseline information about the genetic diversity of a species, hatchery programs can have serious negative long-term impacts on wild populations. The potential problems associated with supplementation include sacrifice of wild fish to supply broodstock to hatchery programs, the loss of genetic diversity associated with the addition of large numbers of closely related individuals to a small wild population, the introduction of individuals not adapted to the environment, and the dilution of stock structure of otherwise genetically distinct and evolutionary significant populations. These problems highlight the importance of obtaining basic data on the genetic diversity and stock structure of wild and captive-bred populations to increase the likelihood of population persistence and decrease the chance of loss of evolutionarily significant genetic variability. Hatchery programs can also mask problems in the environment that hinder natural population persistence. In an altered or unhealthy environment, fish populations may decline rapidly if a hatchery program is suspended (as has been the case in the Caspian Sea with sturgeon).

Hybridization with captive-bred stocks - The Thai Department of Fisheries has released thousands of artificially reared fish into the Mekong since 1985. The potential problems with this practice (also known as supplementation)

include the loss of genetic diversity associated with releasing large numbers of closely related individuals into a small wild population. The Thai DOF has also hybridized giant catfish with river catfish (Pangasianodon hypophthalmus). Incidental or accidental release of these fish into the wild could result in hybridization with wild stock.

Year	Fish Produced	Fish Released	Location of Release
1983	16		
1984	130,000		
1985	107,000	12,294	Mekong River, Chao Phraya River, Kra Siew Reservoir, Nam Oon, Reservoir, Bang Pra Reservoir, Phumiphon Reservoir, Mae Puem Reservoir, Srinakarin Reservoir
1986	0	19,668	Mekong River, Chao Phraya River, Cheolarn Reservoir, Phumiphon Reservoir, Sirikit Reservoir, Nan Province
1987	10,000		
1988	110,000		
1989	200,000		
1990	300,000		
1991	395,000		
1992	590,000		
1993	590,000		
1994	410,000	12,364	Phumiphon Reservoir, Ubonrat Reservoir, Srinakarin Reservoir, Sirintorn Reservoir
1995	110,000	17,135	Lumtakong Reservoir, Kiritarn Reservoir, Utayanawan Reservoir, Huey Ta Pae Reservoir, Pluang Reservoir, Ubonrat Reservoir, Lumpao Reservoir
1996	90,000		
1997	50,000	10,000	Mekong River
1998	0		
1999	300,000	2,008	Sirikit Reservoir
2001	350,000*	10,000	Mekong River

Table 5. Artificially-reared giant catfish released in the Mekong River since 1985. This table may not include all giant catfish released by the Thai Department of Fisheries into the Mekong River.

5.4 Monitoring Threats

MGCWG (2008a) identified major threats to Mekong giant catfish and recommended monitoring of threats based on measureable indicators. Systematic monitoring of indicators has not occurred to date but could be implemented to better track major threats to Mekong giant catfish.

Threat category	**Indicator**
Harvest	• Change in targeted fishing effort for giant catfish • Change in catch from targeted fishing • Change in level of incidental catch • Indicator based on incidental culture of MGC in fish ponds (indicator of reproduction in wild)
Habitat	• Changes affecting geomorphology of likely spawning and nursing habitat • Changes in hydrology of likely spawning and nursing habitat and migration channels • Changes in levels of fragmentation of habitat
Captive breeding / aquaculture	• Changes in level of harvest of wild stocks for captive breeding • Genetic changes in captive stocks • Expansion of commercial aquaculture of giant catfish • Escapes of giant catfish from ponds or reservoirs with the Mekong watershed • Increasing promotion of hybrid catfish

Table 6. Indicators of threat (modified from MGCWG 2008).

6. MANAGEMENT AND POLICY

6.1 National Level Policy and Management

Thailand – In Thailand, fishing for Mekong giant catfish is illegal. Thai law, under Article 32 (5), (6), and (7) of the Fisheries Act (1947) prohibits the capture of giant catfish in the Mekong River, except with the written permission of the Director of the Department of Fisheries. Article 32 (5) (6) and (7) prohibits giant catfish fisheries in the Mekong River basin in the areas of Nongkai, Loei, Mukdaharn, Nakornpanom, Ubon Ratchathani, and Chaing Rai provinces – except with a written permission from the director of the Department of Fisheries. Up to 2005, The Thai Department of Fisheries issued special permits for the catch of giant catfish for an artificial breeding program. Since 2005 the Thai Department of Fisheries has considered issuing permits on a case by case basis, taking into account the wishes of the

community, ongoing research, and a management plan that typically sets a low quota in conjunction with a management plan based on population modeling.

Cambodia – The main institutions that deal with Fisheries issues are Department of Fisheries under the Ministry of Agriculture, Forestry and Fisheries. According to Khmer law, it is illegal to harvest, transport, or sell Mekong giant catfish without explicit permission from the Department of Fisheries. Harvest is difficult to control, however, 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.

Lao PDR – The government of Lao PDR, recognizing the importance of regulations to the management to fisheries, adopted comprehensive fisheries legislation in July 2009. Phouthavongs (2010) describes the legislation as "a framework for implementing, managing, monitoring, and inspecting captured fisheries and aquaculture. It aims to promote aquaculture, conserve and protect fisheries resources for sustainable development and ensure availability of fish....protection of aquatic resources is highlighted in chapter II (articles 9-12) and chapter III (articles 21-24)....the prohibition category lists species classified for protection and conservation which are not allowed to be used or traded." The Mekong giant catfish is included in the "prohibition category". The development of this fisheries legislation may be one reason that targeted fishing for Mekong giant catfish in Bokeo province Lao PDR has not occurred since 2009.

6.2 Regional Level Policy and Management

The Mekong Agreement and the Mekong River Commission are important tools for the management and conservation of Mekong River biodiversity, including the Mekong giant catfish. The Mekong Agreement states "that Parties shall co-operate in all fields of sustainable development, utilization, management, and conservation of the water and related resources of the Mekong River Basin, in a manner to optimize the multiple use and mutual benefits of all riparians and to minimize the harmful effects that might results from natural occurrences and man-made activities" (Coates et al. 2000). In the context of Mekong giant catfish management, 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" (Article 3). An agreement on management of flows to protect fisheries and biodiversity has also been developed under the auspices of the Mekong Agreement. In practice, the Mekong Agreement, and enabling organization, the Mekong River Commission, have been useful mechanisms to enhance international collaboration and develop methods to better protect species like the Mekong giant catfish.

6.3. International Policy and Agreements Relevant to Mekong Giant Catfish

The Convention on Biological Diversity (CBD) - The CBD was signed by 150 member countries at the Rio Summit in 1992 and is designed to promote sustainable development and protect biodiversity. As of 2011, 193 countries are party to the convention. The CBD makes specific reference to management of transboundary biodiversity, stating in Article 3 that parties "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 their national jurisdiction".

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – CITES was signed by 80 parties in 1973 to protect wildlife against over-exploitation, and to prevent international trade from threatening biodiversity. As of 2011, 175 countries are party to the convention, a legally binding agreement that helps protect many transboundary species through reduction of overexploitation driven by international trade. In the past, CITES has moved forward to promote regional agreements and activities aimed at improved management, control of illegal trade, and aquaculture of several endangered fish species (Valbo-Jorgensen and Marmulla 2008).

The FAO Code of Conduct for Responsible Fisheries -The FAO Code of Conduct for Responsible Fisheries deals mainly with good practice and policy development for freshwater and marine fisheries (FAO 1995). Many sections of the code are relevant to transboundary fish stocks and could be used as a framework by Mekong countries to develop management guidelines for Mekong giant catfish. The sections with implications for Mekong giant catfish include Article 6.12 and Article 7.1.3, among others.

Article 6.12 – "States should ... cooperate at sub-regional, regional and global levels ... to promote conservation and management, ensure responsible fishing and ensure effective conservation and protection of living aquatic resources throughout their range of distribution, taking into account the need for compatible measures in areas within and beyond national jurisdiction".

Article 7.1.3 – "For transboundary fish stocks, ... the States concerned ... should co-operate to ensure effective conservation and management of the resources. This should be achieved, where appropriate through the establishment of a bilateral, sub-regional or regional fisheries organization or arrangement".

7. RESEARCH

While the Mekong giant catfish has been the focus of several research initiatives over the past decade, most activities relevant to this review have occurred since 2000 under the auspices of the Thai Department of Fisheries, the Cambodian Department of Fisheries, the Mekong River Commission, the Mekong Wetlands Biodiversity Programme, and the Mekong Giant Catfish Working Group. Membership in the Mekong Giant Catfish Working Group is not fixed and currently includes representatives from the Cambodian, Lao and Thai fisheries agencies, the Mekong River Commission Fisheries Programme, the Network of Aquaculture Centres in Asia-Pacific (NACA), Kasetsart University, WWF, IUCN and Imperial College, London.

Main research activities over the past decade include studies of Mekong giant catfish abundance and distribution (primarily fish catch monitoring), captive breeding and genetics, and ecology (including fish tagging and telemetry).

7.1 Research on Abundance and Distribution

Information on abundance and distribution comes primarily from analysis of long-term catch records from northern Thailand and Lao PDR, as well as catch records and surveys conducted in Cambodia.

The Ban Hat Khrai Fishermen's Club in northern Thailand has kept detailed records of Mekong giant catfish catch since 1986. From 1986 until 2011 at least 412 adult Mekong giant catfish were captured in northern Thailand (Chiang Rai Province near Chiang Khong) and Bokeo Province, Lao PDR. The Ban Hat Khrai Fishermen's Club catch records are the best long-term data set available on the abundance of Mekong giant catfish. The Giant Catfish Fishermen's Club also kept records of the number of fishermen participating in the fishery, the length of the fishing season, and the total catch. The data suggests a decline in the abundance of Mekong giant catfish over the past 25 years.

Mekong giant catfish captured in the dai fishery on the Tonle Sap River. This fish was tagged and released as part of the Mekong Fish Conservation Project's activities focused on protection and study of the Mekong's large-bodied, endangered fish. © Zeb Hogan.

											oat #
											18
1987	24	24	0	0	8	16	262	124	15-Apr	n/a	20
1988	42	42	0	0	15	27	250	120	20-Apr	12-May	24
1989	60	59	1	0	16	44	282	124	26-Apr	24-May	40
1990	69	51	11	7	22	40	228	112	14-Apr	16-May	62
1991	31	22	8	1	18	12	240	128	26-Apr	26-May	72
1992	35	26	8	1	16	18	250	105	26-Apr	9-Jun	69
1993	48	30	18	0	23	25	258	130	30-Apr	4-Jun	69
1994	18	15	3	0	8	10	273	133	21-Apr	22-May	67
1995	16	11	4	1	6	10	253	121	29-Apr	15-May	67
1996	7	5	2	0	2	5	210	150	25-Apr	28-May	63
1997	6	1	5	0	3	3	220	144	11-May	n/a	57
1998	1	1	0	0	0	1	212	0	2-May	n/a	25
1999	20	15	5	0	16	4	270	156	6-May	20-May	28
2000	2	1	0	1	1	1	247	149	4-May	18-May	29
2001	0	0	0	0	0	0	0	0	n/a	n/a	n/a
2002	0	0	0	0	0	0	0	0	n/a	n/a	n/a
2003	0	0	0	0	0	0	0	0	n/a	n/a	2
2004	7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2005	4	n/a	n/a	n/a	n/a	n/a	293	n/a	27-Apr	10-May	n/a
2006	1	0	1	n/a	n/a	n/a	n/a	n/a	10-May	10-May	3-5
2007	1	1	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3-5
2008	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2009	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

2010	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2011	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 7. *P. gigas* catch data from 1986-2007, as reported by the Giant Catfish Fishermen's Club. Total number of fish, location of capture (Ban Hat Khrai, Thailand or Huay Xai, Lao PDR), total numbers of males and females, first and last date of capture, and number of boats in the fishery. Fishing has been limited since 2008. One Mekong giant catfish was tagged and released in 2008. In 2009, one Mekong giant catfish was captured and harvested before a fishing moratorium went into effect. No fishing was allowed in 2010 or 2011 (Source WWF).

The Cambodian Department of Fisheries, in partnership with the Mekong River Commission, the Mekong Fish Conservation Project, and the Mekong Wetlands Biodiversity Programme, monitored the catch of Mekong giant catfish in Cambodia from 1999 until 2008. The data indicate that Mekong giant catfish make a regular and predictable movement out of the Tonle Sap Lake, down the Tonle Sap River, and into the Mekong River each year. The data also indicate that Mekong giant catfish occur in the Tonle Sap Lake, the Tonle Sap River, and the Mekong River.

Date	Location	Total length (m)	Total weight (kg)	Tag number	Comments
25-10-99	2A	-	190 kg	-	Sold
19-11-99	2C	2.35 m	176 kg	-	sold, female
21-11-99	2C	-	163 kg	-	sold, male
23-11-99	2C	-	200 kg	-	Sold
24-10-00	2B	2.18 m	172 kg	-	sold, female
25-10-00	4A	-	180 kg	-	sold 300,000 R
28-10-00	1B	-	135 kg	-	sold 1,600 R / kg
28-10-00	1B	-	185 kg	-	sold, female
31-10-00	2D	-	270 kg	-	Released
5-11-00	2C	-	170 kg	-	Released
9-11-00	4A	-	200 kg	-	Sold
10-11-00	1D	2.10 m	160 kg	-	released, male
16-11-00	2C	2.35 m	260 kg	017	Released
26-11-00	2D	-	270 kg	-	Released
6-12-00	1C	2.64 m	268 kg	001	Released
24-10-01	2A	1.93 m	116 kg		Released
27-10-01	2A	2.09 m	185 kg		Released
27-10-01	2A	2.01 m	153 kg		Released
6-11-01	2A	2.20 m	200 kg		Released
7-11-01	2C	1.83 m	120 kg		Released
29-12-01	2C	1.40 m	62 kg		Released
18-2-02	13A	0.81 m	15kg		Released

20-10-02	2B	2.10 m	152 kg	-	Sold
1-11-02	4C	1.29 m	25 kg	094	Released
10-11-02	2A	2.56 m	-	064	released, died 12-11-02
18-11-02	2C	2.55 m	181 kg	116	Released
4-12-02	2A	2.05 m	88kg	291	Released
Dec 2002	Tonle Sap Lake (Lot 2)	-	70 kg	-	Sold
24-1-03	Tonle Sap Lake (Lot 6)	1.10 m	16 kg	998	Released
24-1-03	Tonle Sap Lake (Lot 6)	1.84 m	70 kg	999	Released
11-3-03	Prey Veng	-	170 kg	-	Sold
1 Dec 04	Dai 2D	0.64 m	3.4 kg	2890	Good
26 Oct 04	Dai 2D	1.79 m	90 kg	2124	Good
27 Oct 04	Dai 5C	2.60 m	230 kg	2111	Fish died
28 Oct 04	Dai 2A	2.53 m	200 kg	2139	Good
12 Nov 04	Dai 2D	2.50 m	200 kg	2966	Good
15 Nov 04	Chhong Khnease, Siem Reap	1.34 m	30 kg	2969	Good
15 Jun 05	Km 7 WWF/DoF	1.45 m	48 kg	2869	Good
15 Jun 05	Km 7 WWF/DoF	1.43 m	43 kg	2822	Good
15 Jun 05	Km 7 WWF/DoF	1.41 m	40 kg	2809	Good
15 Jun 05	Km 7 WWF/DoF	1.51 m	51 kg	2958	Good
25 Oct 05	Dai 3C	1.28 m	31 kg	2961	Good
8 Nov 05	Dai 2C	2.20 m		32	
9 Nov 05	K. Cham				Fish died
15 Nov 05	Dai 2B	2.02 m		3529	Good
16 Nov 05	Dai 4B	2.21 m		3233	Released, fish died 12km downstream 3 days after release
23 Nov 05	Dai 9C	2.40 m		-	Released immediately without tagging
4 Nov 06	Dai 3C	-	198 kg	-	Released
6 Nov 06	Dai 2D	-	168 kg	-	Released
12 Nov 06	Dai 2C	-	130 kg	-	Released
14 Nov 06	Dai 2A	-	182 kg	-	Released
23 Nov 06	Dai 2A	2.30 m	180 kg	3381	Released

27 Nov 06	Dai 2A	2.4 m	182 kg	-	Released
30 Nov 06	Prek Tamao	2.16 m	136 kg	3096	Released
5 Dec 06	Ro Ka Koung	2.06 m	88 kg	-	Released
8 Dec 06	Prek Tamao	2.40 m	198 kg	3356	Released
12 Dec 06	Prek Tamao	1.60 m	36 kg	3361	Released
13 Nov 07	Dai 2	2.4 m	200 kg		
27 Nov 07	Dai 2B	1.56 m	40 kg	3339	
29 Nov 07	Dai 2C	2.08 m	130 kg	3481	
03 Dec 07	Dai 2A	1.04 m	55	3325	
09 Jan 08	Cambodian Mekong near Kampong Cham)	1.63 m	70	3389	
12 Jan 08	Cambodian Mekong near Kampong Cham)	1.83 m	130		
21 Jan 08	Pusat (Tonle Sap Lake)	2.00 m	150		
21 Jan 08	Pusat (Tonle Sap Lake)		45		

Table 8. Giant catfish catch data from Cambodia 1999-2008. Location refers to the site of capture, usually one of 63 Tonle Sap River bagnets (1-15 A, B, C, D, E, or F).

The Cambodian Department of Fisheries also monitored catch of Mekong giant catfish in the bagnet fishery in 2011. Between October and December 2011, 6 Mekong giant catfish were caught and released from the bagnet fishery. The fish ranged in weight from an estimated 40-200 kilograms.

In addition to catch data, surveys have been completed to investigate the presence/absence of young Mekong giant catfish in aquaculture ponds in Cambodia. The presence of young Mekong giant catfish in Cambodian fish ponds is significant because these fish are harvested from the wild. The presence of young, wild Mekong giant catfish indicates that Mekong giant catfish are reproducing in the wild and might be used in the future as an index of abundance. A total of 11 fish farmers with 21 ponds around Phnom Penh, Kompong Cham and Kandal Provinces were interviewed. 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.

Date	**Names of farmer**	**Location**	**Number of ponds**	**Number of *P. gigas***	**Source of young fish**	**Date**
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 the Mekong River in 2000
01/05/06	Touch Buntha	K11. Prek Phnov,	2	N/A	Tonle Sap	

		PP.				
03/04/06	Meas Sophat	Doung village, Prek Phnov, PP.	3	2	Tonle Sap Great Lake	Raised in pond for 10 years (weight from100-130 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 present (weight 25-30 kg)
12/06/06	Chreang Senghou	Kruos village, Samrong District, PP.	3	N/A	Tonle Sap River	
09/06/06	Tang Chi	Kampong Prasat Commune, Mukampoul District, Kandal	3	6	Mekong River	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 were released. One fish remains in his pond
27/04/06	San Lim	Stung Cheang village, Prek Koy Commune, Kampong Cham	1	3	Mekong River	Released in the Mekong River in 2000 (weight: 35-35 kg)
Total	**11**		**21**	**46**		

Table 9. Mekong giant catfish in Cambodian aquaculture ponds.

7.2 Research on Captive Breeding and Genetics

Given the long history of captive Mekong giant catfish in Thailand, the biology of captive Mekong giant catfish is relatively well understood (Pholprasit and Tavarutmaneegul 1998, Mengumpun 2000, Unakornsawat et al. 2001, Sriphairoj et al. 2007). Captive breeding of Mekong giant catfish is conducted primarily by the Thai Department of Fisheries in collaboration with partner institutions. The information that follows was provided, in part, by the Thai Department of Fisheries though the Mekong Giant Catfish Working Group.

The Thai Department of Fisheries has been breeding and raising Mekong giant catfish in captivity since 1983. The Thai Department of Fisheries 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 Thai Department of Fisheries "potential producers" (facilities with broodstock that have not yet produced F2 offspring).

The captive breeding of Mekong giant catfish is well established and survival of hatchery fish in reservoirs appears satisfactory. On the contrary, preliminary data from tagging studies 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.

Research on Mekong giant catfish genetics is well advanced with several new studies published within the last decade (Na-Nakorn et al. 2006, Sriphairoj et al. 2007, Ngamsiri et al. 2007). Na-Nakorn et al. (2006) 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. While Na-Nakorn et al. (2006) reports high levels of genetic diversity in wild stocks of Mekong giant catfish, Ngamsiri et al. (2007) conducted a similar analysis using mitochondrial and microsatellite DNA and found low levels of genetic diversity in wild stocks of *P. gigas*. The differing results of these two studies are not conclusive and more research may be necessary.

Na-Nakorn et al. (2008) conducted a study of genetic diversity in captive stocks and found that levels of genetic diversity in captive stocks of *P. gigas* are similar to the levels of genetic diversity in wild stocks of *P. gigas*. Since the captive broodstock is thought to be a critical resource for any future efforts to rebuild the population, Na-Nakorn et al. 2008 developed 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. Na-Nakorn et al. 2008 provides an excellent overview of the current status of knowledge on the genetics of captive stocks of Mekong giant catfish and offers a number of recommendations on how to improve captive breeding efforts.

7.3 Research on Ecology and Migrations

Research in Cambodia: 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 stationary bagnets were bought from the dai operators, tagged and released. This buy and release approach provided a low cost, short-term solution to fishing mortality. The scheme did not harm the fisher's livelihood and provided an opportunity for additional research (e.g. tissue sampling for genetics studies).

Two Mekong giant catfish *P. gigas* and 11 closely related river catfish *P. hypophthalmus* were tagged with ultrasonic transmitters between 6 November and 1 December 2001. Three types of transmitters were used: the CART 16-3 combined acoustic/radio transmitter (Lotek Wireless Inc. Newmarket, Ontario, the Sonotronics CHP-87-L coded high power sonic tracking tag, and the Sonotronics DT-97 depth sensing ultrasonic transmitter (Sonotronics Inc., Tuscon, Arizona). The signal range of these transmitters varied between 1-2 km, depending on transmitter type and river conditions (Hogan et al. 2002). Each fish was also externally-marked with an individually numbered Carlin Dangler tag (Floy Tag and Mfg, Inc) labeled with the instructions "Please Return to the Department of Fisheries" in Khmer in Thai. Fishers were offered a reward of $1.25USD for the return of the tag to the Department of Fisheries.

A 17 kg river catfish (*P. hypophthalmus*) tagged 30 November 2001 was located twice in the Mekong River. The fish was first located by acoustic telemetry on 9 December 2001 in the Mekong River, approximately 10 km upstream from the confluence of the Tonle Sap, Bassac, and Mekong Rivers. The fish was later recaptured in the Mekong River on 8 February 2002 by a fisherman in Khoa Khngai village (near border between Kratie and Strung Treng provinces, Cambodia), approximately 320 km from the tagging site (and approximately 310km upstream from Phnom Penh. The fish was caught using a large mesh gill net. Overall, the river catfish moved approximately 320 kilometers in 70 days, an average swimming speed of 4.6 km•d-1. Between 30 November and 9 December 2001, the fish moved about 20 km, averaging about 2 km•d-1. The average movement rate increased between 9 December 2001 and 8 February 2002, when the fish moved approximately 5 kilometers per day.

This migration, the first documented movement of a pangasiid catfish from the Tonle Sap River to the upper reaches of the Cambodian Mekong River, is believed to be a critical step in the life cycle of several fish species (Hogan et al. 2004). Adult river catfish move into deep water areas of the Mekong River to survive the dry season, then migrate upstream and spawn with the onset of the first heavy rains in May and June (Tana, unpublished manuscript). Young fish then float downstream with the rising water, eventually finding their way into inundated areas during the rainy season. Inundated areas, such as the flooded forest of the Great Lake, may act as rainy season nurseries for young fish of several species, including river catfish and Mekong giant catfish (Hogan et al. 2004). This study highlights the need for further studies of fish migrations between the Tonle Sap Lake and the upper reaches of the Cambodian Mekong, including the Sekong, Srepok, and Sesan tributaries.

Research in Thailand and Lao PDR: 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 Mekong giant catfish migrations in the Mekong River Basin in northern Thailand and Lao PDR. The objectives of the project were to (1) determine the migration patterns and spawning sites of wild Mekong giant catfish in northern Thailand/northern Lao PDR, (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 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. Initial results of the study indicated 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 can survive tagging and moved upstream to an area between Chiang Khong and Chiang Saen before the signal was lost.

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 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.

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.

7.4 Future Research Priorities

Future research priorities include further studies on abundance, distribution, and ecology of the species as well as more applied research to inform management and mitigation. A comprehensive research program – including study of the distribution, abundance, and life history - is urgently needed to provide science-based guidance on how to most effectively restore populations the Mekong giant catfish. 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 mainstream dams, development of methods to mitigate the impacts of mainstream dams, and further improvement of the artificial breeding program. In southern Lao PDR, Cambodia, and Vietnam, research priorities include monitoring of incidental catch, distribution surveys to determine the extent of occurrence of immature and mature giant catfish, tagging to study migratory pathways, and development of methods to reduce fishing mortality. Monitoring of major threats – and indicators of those threats – is also important since it is difficult to track the conservation status of Mekong giant catfish without monitoring threats.

8. CONSERVATION

The Mekong giant catfish's size, iconic status, and presumed transboundary migrations and reliance on a variety of habitats make it an ideal flagship species for ecosystem conservation in the Mekong. The maintenance of the Mekong giant catfish's social and cultural importance has also been identified as a conservation-related goal. As such, the Mekong giant catfish has been identified at the national, regional, and international levels as a priority for conservation and management.

Several groups have taken an active interest in the conservation of Mekong giant catfish.

In 2003, The World Conservation Union (IUCN) re-evaluated the conservation status of the Mekong giant catfish as Critically Endangered. The IUCN changed the status of the giant catfish based on decreasing abundance and threats from fishing, habitat degradation, and genetic introgression with artificially bred stock. This change in status has served as a catalyst for further conservation action.

In 2005, the Mekong Giant Catfish Working Group was established and developed a conservation vision for Mekong giant catfish. The core conservation vision or goal incorporates the following elements:

1. Maintenance of a viable wild population of Mekong giant catfish and restoration of its historical distribution.
2. Maintenance of critical habitats and ecosystem processes in the Mekong basin.
3. Maintenance of a genetically representative captive population as 'insurance' against possible extinction in the wild.

Since 2000, the Mekong Fish Conservation Project, in cooperation with the Cambodian Department of Fisheries, conducts research, conservation, and education on vulnerable populations of migratory fish of the Mekong, notably the Mekong giant catfish, *Pangasianodon gigas*. The project has tagged and released over 40 giant catfish into the Tonle Sap River, Tonle Sap Lake, and Mekong River.

WWF Greater Mekong has been active in Mekong giant catfish conservation, working with the governments of Thailand and Lao PDR to develop more effective regulations regarding harvest of Mekong giant catfish. In 2009 the governor of Bokeo issued a letter to ban all targeted catch of the Mekong Giant Catfish in Bokeo until further notice. A letter from the governor of Chiang Rai was issued later in 2009 to ban all target catch of the Mekong giant catfish in Chiang Rai in

fishing season of 2009. Therefore only one MGC was caught in Chiang Rai in 2009 (before the ban was issued). In 2010 the Governor of Chiang Rai issued another letter to ban all catch in Chiang Rai in the fishing season of 2010. As a result no Mekong giant catfish were caught in Bokeo and Chiang Rai in 2010. More recently, the Lao Fisheries Law was approved by the Lao Parliament which makes all target catch of the Mekong giant catfish illegal in Laos. WWF Greater Mekong has also worked with partners in northern Thailand and Lao PDR to establish fish conservation zones. Four fish conservation zones have been established in Chiang Rai, two of which are believed to be a Mekong giant catfish spawning habitat.

Future conservation efforts focus will likely focus on the maintenance of a viable wild population of Mekong giant catfish, restoration of its historical distribution, protection of critical habitats, and maintenance of ecosystem processes in the Mekong basin. Catches should be monitored to ensure that Mekong giant catfish are not subject to targeted fisheries. Incidental catch, which likely occurs to some extent throughout the basin, needs to be closely monitored since incidental catch is one of the best and only sources of information about the distribution, life history, and abundance of *P. gigas*. Measures to identify and safeguard Mekong giant catfish migratory corridors and critical habitat are urgently needed. The Mekong giant catfish would also benefit from increased international cooperation, since the species occurs in an international river and the species crosses international borders to complete its life cycle. Regional and international organizations and agreements, such as the Mekong River Commission and the Convention on Biological Diversity may be helpful to facilitate collaborative conservation measures. Uncontrolled development of the Mekong River could have dire consequences for the few remaining giant catfish. A thorough study of the ecology and population biology is necessary to assess potential impacts of basinwide development (especially mainstream dams).

9. CONSERVATION OUTLOOK

While it is very difficult to track the abundance of Mekong giant catfish in real time, there is reason to believe that Mekong giant catfish population recovery is still possible, given the species demographic and genetic status. Indeed, a recent population model of Mekong giant catfish abundance predicts that Mekong giant catfish abundance may already be on the rise after a period of intense harvest between 1985 and 1995 (Lorenzen and Sukumasavin 2007). Several other factors also indicate a recovery might be possible. First, Mekong giant catfish remain widely distributed. Though very rare, Mekong giant catfish have been caught throughout Lao PDR, Thailand, and Cambodia within the past 20 years. Second, Mekong giant catfish spawning migrations remain intact – fish are still captured (at least within the last 5 years) migrating out of the Tonle Sap Lake, up the Mekong, over the Khone Falls, and along the Thai/Lao border in northern Thailand. Third, all life stages of Mekong giant catfish occur within the Mekong: very young fish have been caught in the fishery for larval *P. hypophthalmus* in Cambodia, juvenile fish have been reported from the Tonle Sap Lake and Songkhram River, and adults have been caught in the Tonle Sap River and the mainstream Mekong River in Cambodia, Thailand, and Lao PDR. Fourth, at least one study (Na-Nakorn et al. 2006) suggests that genetic diversity of Mekong giant catfish remains relatively high. Thus, the wild population has the capacity to recover without constraints from inbreeding depression or other negative pressures associated with low effective genetic population size, assuming current population size and genetic diversity can be maintained (Na-Nakorn et al. 2006).

Population recovery will depend on a number of factors, most importantly minimizing harvest mortality and maintenance of critical habitat and migration corridors. Over the past 10 years, major fisheries targeting Mekong giant catfish have been suspended or closed (including the floating gill net fishery in northern Thailand and Lao P.D.R. and one stationary bagnet row in Cambodia). This reduction in fishing mortality has undoubtedly improved the population status of Mekong giant catfish. Minimizing remaining harvest mortality will be more difficult, because few (if any) targeted fisheries for Mekong giant catfish exists. Today The Mekong giant catfish is typically caught as by-catch and so escapes organized efforts to monitor or regulate catch. This is especially problematic in cases where young fish are caught as part of a mixed stock fishery with other pangasiid catfish (e.g. the Tonle Sap fishing lots and the Mekong mainstream fishery for larval *P. Hypophthalmus*). In such cases, catches often go unrecognized and unreported. Population recovery will be contingent on identifying fisheries where Mekong giant catfish is harvested (whether targeted or as by-catch) and working with fishermen to reduce fishing mortality. This will be a challenge since it is often difficult to differentiate Mekong giant catfish from other pangasiids, especially at a young age. Maintenance of critical habitat and migration corridors is a larger-scale issue and requires international collaboration through institutions such as the Mekong River

Commission. Mainstream Mekong dams represent a major new threat to Mekong giant catfish critical habitat and migration corridors since they may block spawning migrations and restrict access to spawning grounds. Mainstream dams could conceivably cause the extinction of the species.

10. CONCLUSIONS

Without additional steps to protect the species, wild giant catfish may become extinct in the near future. The most immediate threat to giant catfish is fishing mortality. Mainstream Mekong dams are also a major new threat to Mekong giant catfish. Other threats include habitat loss, river modification, and hybridization with artificial bred fish. The lack of monitoring and management of giant catfish fisheries, combined with the continued decline of populations basinwide, exacerbates the already perilous situation of the species.

Based on a review of existing biological data, as well as policy and management options, it is clear that a long-term, transboundary conservation and research program is needed to maintain populations of wild Mekong giant catfish and their habitat. The conservation and research program should incorporate restrictions on fish harvest, monitoring of incidental catch, identification of migratory corridors, establishment of protected areas to protect spawning and rearing habitat, and the development of a conservation aquaculture program based on genetically representative captive broodstock.

The giant Mekong catfish is an important and charismatic species (Kottelat and Whitten 1996). As a flagship species, the giant catfish symbolizes the ecological integrity of the Mekong River and other freshwater ecosystems in Asia. Thus, the successful recovery of these species is an important part in the sustainable management of the Mekong River Basin.

A Mekong giant catfish that was captured in the dai fishery of the lower Tonle Sap River on October 21, 2002. The dais, or bagnets, are large cone-shaped nets that catch fish as they move out of the Tonle Sap Lake and into the Tonle Sap River and mainstream Mekong. Dais are not selective in terms of the fish that they catch and and so sometimes catch endangered species like Mekong giant catfish and giant carp as by-catch. These fish are often injured when they are caught and sometimes die before they can be released. © Zeb Hogan.

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*As at December 2011

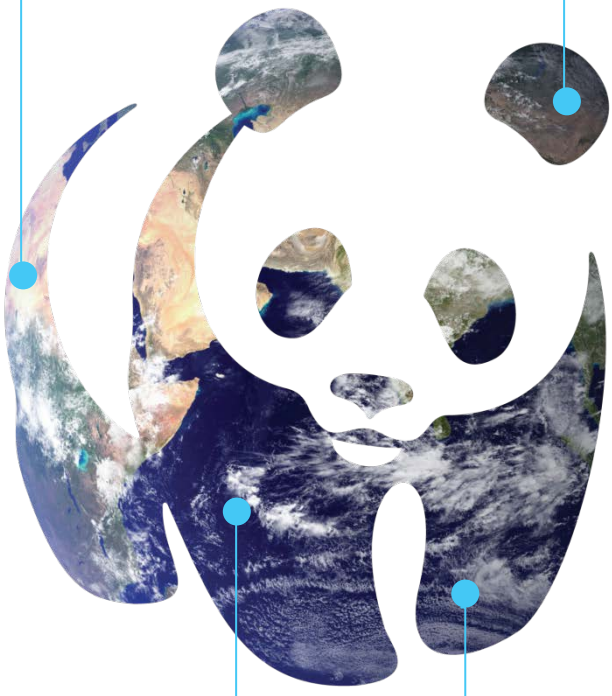
Greater Mekong in numbers

850

The Mekong river hosts more than 850 *species of fish*

1,584

Between 1997 and 2010, 1,584 new species were discovered in the Greater Mekong region



47-80%

Fisheries, especially from wild capture, make up between 47 and 80% of animal protein consumed by the people.

+1.4B

The value of capture fisheries in the Mekong river is estimated at $1.4 - $3.9 billion per year.

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To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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