

Imperial College
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Development of a conservation strategy for the critically endangered Mekong giant catfish



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Joint inception and planning workshop
Bangkok
23-24 August 2005

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Preparation of this document

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Executive summary

(1) The Mekong giant catfish *Pangasianodon gigas* is one of the world's largest freshwater fish, and a charismatic animal revered throughout the lower Mekong region. The species is listed as critically endangered in the 2003 IUCN Red List.

(2) A range of conservation initiatives for the Mekong 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 joint conservation strategy workshop was held at NACA, Bangkok, 23-24 August 2005. The purpose of the workshop was to exchange information on the current state of the Mekong giant catfish and the relevant conservation and research activities of key organisations, and to establish a joint planning process aimed at developing an overarching conservation strategy for the Mekong giant catfish.

(4) The status of the wild population remains somewhat uncertain. Recorded catches have declined dramatically over the past 20 years, and it is on this basis that the population has been designated as critically endangered. Fishing pressure is perceived as the most important reason for past population decline. There remain substantial uncertainties however with regards to trends in fishing effort and the level of catches of juveniles and early life stages (which are not easily distinguished from the more abundant river catfish *P. hypophthalmus*). There is a large captive population of about 20,000 individuals derived almost entirely from wild parents. This captive population will be a major resource for species conservation if it is managed appropriately. Habitats are only moderately degraded at present, but plans for hydropower and navigation development may pose significant threats in the future.

(5) Current conservation measures focus on the reduction of incidental fishing mortality through a buy-and-release scheme in Cambodia, and a well established captive breeding programme in Thailand. Various initiatives aimed at conserving Mekong habitats and the wider ecosystems, while not focused on the giant catfish as such, often make reference to it as a flagship species. An initial appraisal of these conservation measures suggests that reduction in fishing mortality through buy-and-release is potentially effective and relatively cheap, but remains a short-term measure. The captive breeding programme provides a crucial 'insurance' for species survival if, as seems likely, the wild population continues to decline. The release of captive bred or commercially cultured giant catfish may, however, pose a further threat to wild population viability if inadequately managed. Habitat and ecosystem conservation are important to safeguarding the long-term survival of the population, even though habitat degradation is unlikely to have played a major role in the historical decline of the species.

(6) It was noted that both the current status of the wild population and the effectiveness of current and possible future conservation measures are poorly known. Focused research is urgently required to provide a basis for the development of an effective conservation strategy. The key research priorities identified are: (a) quantitative assessment of the status of the wild population and the reasons for its apparent decline; (b) quantitative assessment of the likely effectiveness of different conservation measures including harvest reductions, supportive breeding/re-introduction, and habitat conservation; (c) development of genetic and demographic management strategies for the captive population; (d) quantification of harvest and fishing mortality of juveniles; (e) identification of migration routes and critical habitat for different life stages; (f) development of improved handling protocols to maximise survival of fish released after capture; and (g) economic evaluation of conservation measures.

(7) An overarching, basin-wide conservation strategy for the Mekong giant catfish should be developed in order to maximise the effectiveness of conservation measures. This strategy should be based on better information exchange and coordination of activities conducted by different organisations; effective use of research to resolve key uncertainties, and effective engagement of conservation planning with regional, national and local policy processes. The organisations represented at the workshop agree to institute a joint conservation planning process built around these requirements. At the core of the process will be a series of joint workshops, interspersed with specific research, policy and outreach activities by contributing organisations.

(8) Key future workshops in the conservation strategy planning process are 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. Further information, key documents and other reference material will be made available throughout the process in the dedicated web site www.mekonggiantcatfish.org.

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Glossary

Domestication	The alteration of an organism's genotype by humans, either on purpose or inadvertently, to meet the needs of humans. Domesticated species is one <i>in which the evolutionary processes have been altered by humans to meet their needs</i> (Convention on Biological Diversity).
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
MGC	Mekong giant catfish
MRC	Mekong River Commission
NACA	Network of Aquaculture Centers in Asia-Pacific
Risk	Probability of a hazard occurring coupled with the impact if it does occur.
Risk analysis	Hazard identification, risk assessment, risk management, and risk communication
Selection	The process of keeping a certain portion of a population or group of fish for grow-out, or for breeding in the next generation. It can be part of a genetic improvement programme where fish with a certain characteristic, e.g. color of growth rate, are kept, or it can be inadvertent, e.g. where only fish that can live and breed in the culture environment survive to reproduce the next generation.
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 captive breeding, reduction in harvest, and conservation/restoration of critical habitat.

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, and some measures may be conflicting or detrimental. The current workshop was organized as a first step towards addressing these issues through the development of an overarching conservation strategy.

The main purpose of the inception meeting was to exchange information on relevant activities undertaken by the different partners, and agree on a mode of operation and work plan for the joint development of a conservation strategy.

The workshop schedule is reproduced in Appendix 1. Briefly, the workshop started with presentations on MGC-related activities by the organisations represented, followed by a sequence of thematic sessions covering the current status of the giant catfish, an appraisal of conservation measures, information and research requirements, and the outlining of a joint work plan.



Figure 1: Workshop participants. From left to right: Rob Shore, Devin Bartley, Bunchong Chumnongsittathum, Chavalit Vidthaianon, Chumnarn Pongsri, Niklas Mattson, Em Samy, Nguyen Van Trong, Simon Wilkinson, Thuy Nguyen, Zeb Hogan, Sompanh Phanousith, Wongpathom Kamonrat, Mike Phillips, Pedro Bueno, Alvin Lopez, Uthairat Na Nakorn, Kai Lorenzen.

2 Organisations represented and Mekong giant catfish-related activities

2.1 Overview

An overview of the organisations represented and their MGC related activities is given in Table 1. It was felt that the workshop has succeeded in bringing together most of the organisations currently involved in MGC conservation. Participants noted, however, that it will be necessary to strengthen links with water resources, hydropower and navigation planners and other stakeholders who, while not currently engaged in MGC conservation activities, will have major impacts on future threats to the MGC.

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 are 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.

Web: www.maff.gov.kh/departments/dof.html

Department of Fisheries, Thailand

Line department responsible for all aspects of fisheries management in Thailand. The DoF has a mandate primarily to promote fisheries production, but is increasingly involved in conservation activities. The MGC has little relevance to production, but attracts a great deal of public interest. The DoF runs the main captive breeding programme for giant catfish. Spawning in captivity of wild MGC captured in Chiang Khong has been carried out since 1983. There are now some 20,000 offspring of wild parents in captivity, mostly in DoF stations. In addition many individuals have been stocked into reservoirs and public ponds. Since 2004 the first captive reared fish have spawned successfully, thus producing second generation captive fish. The latter are reared mostly for aquaculture purposes, while first generation captive offspring from wild parents is raised principally for restocking of natural populations and broodstock. There is also a developing private aquaculture industry for MGC for food, ornament and recreational fishing. Some 4800 tagged, captive reared MGC ranging in size from 1 g to 5-6 kg have been released into the Mekong, but no recaptures have been reported.

Maintenance of the captive population is difficult and expensive given the large size of the fish and the need to keep a reasonably large broodstock to maintain genetic diversity. At present, 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.

Web: www.fisheries.go.th

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 use Lao boats. There is no management of this fishery from the Lao side.

FAO Fisheries Department

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

The FAO Code of Conduct for Responsible Fisheries obliges its signatories to:

- Conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management
- Promote the use of appropriate procedures for the selection of broodstock and the production of eggs, larvae and fry
- 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

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, and fish health.

FAO also undertakes a number of specific projects:

- Addressing the Quality of Information on Inland Fisheries (AQUIIF) (RAPI)
- Strengthening Capacity in Fisheries Information-Gathering for Management (RAPI)
- Re-opening of Migration Routes for Salmon and Other Migratory Fish in Estonian Rivers (FIRI)
- Technical Guidelines on Fish Health and Disease Diagnosis (FIRI/NACA et al.)

The following areas of concern are identified with respect to the MGC:

- Genetic resource management
 - Conservation
 - Optimize effective population size
 - Minimize inadvertent and domestication selection
- Habitat protection
 - Rehabilitation
 - Protect critical habitats
- Fish health
- CITES implementation and eventual de-listing
- Responsible fisheries & aquaculture development

Web: www.fao.org/fi/default.html

Imperial College London (ICL) Darwin Project

The Division of Biology at Imperial College London is a leading academic centre for research into pure and applied population biology. The aquatic resource ecology group conducts research on tropical inland and coastal fisheries, aquaculture, and aquatic conservation biology. Imperial College 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.

Web: www.aquaticresources.org and www.imperial.ac.uk

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.

Web: www.ku.ac.th

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.

Web: www.mrcmekong.org

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.

Web: www.enaca.org

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.

Ongoing work has focused on the drafting of a status report, brochure and poster, and a framework for the development and implementation of the SCAP. A multi-sectoral catfish SCAP meeting is

planned for December 2005. A proposal for a telemetry project has been prepared, and the project is due to start in 2006. A tagging and release programme in Cambodia is being supported financially and through the development of improved catfish handling procedures. Monitoring and assessment are carried out for the dai fisheries in the Tonle Sap river (Cambodia) and the fishery in the upper Mekong (Chiang Khong, Thailand, and upriver in the Lao PDR). In addition the MWBP is exploring the possibility of working with Thai DoF on a migration and spawning study in Northern Thailand.

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

Wider issues

- The rapid decline in catfish populations is often attributed to the dramatic changes that have occurred in the basin recently, and their greater impacts.
- Changes that have occurred have lacked appropriate planning, and often ignored assessment of alternative options, or conducting comprehensive impact assessments.
- This lack of planning has impacted on the ecosystems of the Mekong and lead to far reaching impacts related to biodiversity and livelihoods.

Web: www.mekongwetlands.org

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.

Web: www.wwfindochina.org

2.3 Coordination of activities and information exchange

Whereas there are many activities relating to MGC conservation, implemented by government, academic and non-governmental organisations, there is no systematic coordination or information exchange. Many participants were of course aware of at least some of the other participant's activities, but all also 'discovered' new and useful information relevant to their own activities. A need for better coordination and information exchange was thus strongly felt by all participants. This will be brought forward into the conservation strategy process (Section 6).

3 Giant catfish status, conservation objectives and measures

A brainstorming session was held to discuss indicators of giant catfish population status, threats, conservation objectives and options (Table 2). The wild population is believed to have declined dramatically over the last 20 years, the most important indicator of this being a decline in catches and an apparent contraction in the population's spatial distribution. Annual catches have declined from several hundred specimens in the middle of the 20th century to fewer than 10 at present. Regular catches are now obtained only in two locations: the targeted 'spawning' fishery of Chiang Khong (Thailand) and the dai fisheries in the Tonle Sap river (Cambodia). Captures of large and easily recognized specimens elsewhere are very rare, but there may be occasional catches of smaller specimens that are not distinguished from the similar looking river catfish (*P. hypophthalmus*). Care must be taken in interpreting the catch trends, however, as the vulnerability of MGC to targeted and incidental fishing and trends in effective fishing effort are poorly understood. It is possible for example, that the use of gear types to which the Giant catfish is vulnerable (very large mesh gill nets) has declined. Given that all information on wild population status is based on fisheries catches, poor knowledge of effort patterns implies a high level of uncertainty about population status. Information on the general biology and ecology of the wild population is also poor.

Table 2: Indicators of giant catfish population status, threats, conservation objectives and conservation measures identified at the workshop

	Wild population	Captive breeding	Habitat	Social, economic, political
Status indicators	<ul style="list-style-type: none"> Catch decline Effort decline? Genetic resources unknown Age/size structure unknown Reduced spatial distribution Status of "proxy species" Ecology poorly known 	<ul style="list-style-type: none"> Large captive population in farms, reservoirs Captive breeding technology available 	<ul style="list-style-type: none"> Habitat status in main stems and tributaries Seen as only moderately degraded at present, but may change dramatically May be critical habitat requirements (juveniles, spawning etc) that are presently unknown 	<ul style="list-style-type: none"> Socio-economic and cultural importance Conservation measures in different countries
Threats	<ul style="list-style-type: none"> Overfishing: targeted, incidental, early life stages Lack of knowledge on ecology 	<ul style="list-style-type: none"> Hybridization Lack of genetic resource management Disease Promotes complacency, false sense of security "irresponsible, wrong approach" Aquaculture development, escapees 	<ul style="list-style-type: none"> Dams in Lancanjan Blasting of rapids for navigation Levees Siltation 	<ul style="list-style-type: none"> Lack of coordination among and within countries and sectors Lack of legal protection Lack of awareness
Aims	<ul style="list-style-type: none"> Prevent extinction in wild Maintain viability of wild population Maintain or restore distribution in natural range 	<ul style="list-style-type: none"> Maintain genetically representative captive population for species conservation and possible future enhancement, rebuilding 	<ul style="list-style-type: none"> Maintain critical habitats and processes 	<ul style="list-style-type: none"> Maintain social, economic and cultural importance Create a model agreement for transboundary fisheries resources Ecotourism Flagship species for biodiversity conservation
Options	<ul style="list-style-type: none"> Reduce targeted and incidental fishing mortality Buy and release Protected areas 	<ul style="list-style-type: none"> Supplementation from wild spawners Broodstock from wild spawners or wild larvae Restock continuously or don't restock while wild population is extant Collect all wild caught fish for broodstock? Stock enhancement 	<ul style="list-style-type: none"> Habitat protection and rehabilitation Freshwater protected areas Giant catfish as indicator species of habitat integrity 	<ul style="list-style-type: none"> Communication, awareness creation, education Valuation of species and habitat Regional cooperation framework EIA of development projects ("catfish friendly development")

There is now a large captive population of MGC comprising some 200,000 individuals in 20 age groups, most of these first generation offspring of wild parents. Although genetic management of the captive population requires further attention, the current population is large, diverse and as yet only moderately domesticated. It is thus a key resource for species conservation, ensuring species persistence and enabling supplementation or re-introduction of the wild population. The habitat of MGC in the Mekong basin is seen as only moderately degraded, but this may change dramatically with the proposed construction of run of the river dams and removal of obstacles to navigation.

The main threat to the conservation of MGC in the wild, and reason for past population decline is likely to be incidental and targeted harvesting, although other possibilities such as critical habitat damage cannot be ruled out. Increasingly, however, interactions between captive-bred or commercially cultured MGC and the wild population may become an important threat. Lack of genetic resource management, intentional hybridization between MGC and other pangasiid catfish, and possible transfer of diseases are key risks. In terms of habitat degradation, the construction of dams and blasting of rapids in the upper Mekong (Lancangian) are likely to represent the greatest threats at the moment. Lack of specific legal protection and in particular, coordination among sectors and countries was felt to contribute to the overall severity of threats.

The aims of MGC conservation were defined at the level of the species itself, but it was recognized that this is reciprocally linked to the conservation of the wider Mekong ecosystem. Clearly, maintenance of a viable wild population and restoration of its historical distribution is a core conservation goal for the MGC. 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.

Key conservation options are identified as reductions in fishing mortality through fishing restrictions or protected areas; supplementation or re-introduction from the captive broodstock, identification of critical habitat requirements and habitat protection or restoration. Such measures may be supported by awareness building and economic valuation, the development of a regional cooperation framework, and environmental impact assessment of infrastructure projects.

4 Preliminary appraisal of conservation measures

A synthesis and preliminary appraisal of current and potential conservation measures was carried out with a view to identifying research and information requirements. All measures were appraised in terms of their likely benefits, costs, and potential risks to the wild stock (Table 3). It was noted early on that there was little 'hard' information on the effectiveness of any of the conservation measures,

Of the current measures aimed at reducing exploitation of the wild population, a broad reduction in fishing mortality through gear restrictions is likely to be most effective, but very costly in terms of loss of catch of associated species. Buy and release is a good short-term measure and relatively cheap, but its effectiveness hinges on low post-capture mortality. Protected areas are expensive to set up and maintain. Depending on their design, protected areas may serve to reduce harvest, protect essential habitat, or both. The presumed long-distance migratory habits of the MGC may limit the effectiveness of protected areas in reducing harvest in principle. On the other hand, the bulk of reported catches occurs in only two locations (Chiang Khong and a particular area of the Tonle Sap river) and protection of these areas from harvesting would thus effectively reduce known MGC catches. Essential habitats for the wild MGC population are unknown and therefore, it is not possible to identify any specific areas for habitat protection. On the whole it appears that there is limited scope for measures to reduce incidental fishing mortality on the giant catfish. The only fishery targeting the species (in Chiang Khong, Thailand), could be regulated relatively easily at least in principle. However, there are real or perceived conservation benefits from the fishery in terms of broodfish supply to the Thai captive breeding programme and public awareness creation about the species.

Captive breeding raises a complex set of issues surrounding broodstock collection and management, and the release of captive bred fish into natural habitats. Broodstock collection itself is important to raise the diversity of the captive stock, but this involves a reduction in the wild spawning stock unless broodstock collection is a byproduct of an existing fishery. Careful genetic management of the captive stock is essential if its diversity is to be maintained, and this carries relatively high research and management costs. Release of captive-bred individuals into the wild can aid maintenance of the wild population and its genetic diversity, but may also be detrimental if diversity in the captive stock is compromised or if there are detrimental ecological interactions between wild and released captive bred fish. In conclusion, captive breeding is likely to be a key element of a MGC conservation strategy, but careful analysis and management of the programme is essential if benefits are to outweigh risks.

Habitat and ecosystem management is seen as a key element of an MGC conservation strategy, given that a viable natural population can only be maintained or re-established if the habitat remains suitable to support the species. Large-scale, possibly basin-wide initiatives are seen as both more effective (given the MGC life cycle), and more feasible than small-scale initiatives such as protected areas given that critical habitat requirements are presently unknown. The latter point may seem surprising, but there was widespread agreement among participants that the trans-national mechanisms provided by the MRC and other organisations, associated with significant international support, provide excellent opportunities for habitat conservation on a large scale.

Table 3: Preliminary appraisal of conservation measures and their perceived benefits, costs and risks to the fish population

Measure	Benefits	Costs	Risks to fish
Wild population management			
Protected areas	<ul style="list-style-type: none"> Potentially effective, particularly if important sites are identified in future (spawning, nursery grounds) but Mgc is long-distance migrant 	<ul style="list-style-type: none"> Difficult and costly to set up and maintain 	<ul style="list-style-type: none"> None
Reduce fishing mortality	<ul style="list-style-type: none"> Potentially very effective 	<ul style="list-style-type: none"> Loss of catch of MGC (not very significant), and associated species (more significant) 	<ul style="list-style-type: none"> Low
Buy and release	<ul style="list-style-type: none"> Effective but short-term measure only 	<ul style="list-style-type: none"> Low 	<ul style="list-style-type: none"> Post-capture mortality May encourage complacency
Legal instruments: CBD, CITES	<ul style="list-style-type: none"> Mandates conservation action, prohibits international trade of wild MGC 	<ul style="list-style-type: none"> Costs of monitoring, implementation, low 	<ul style="list-style-type: none"> None
Captive breeding & aquaculture			
Broodstock collection	<ul style="list-style-type: none"> Collecting "wild genes" 	<ul style="list-style-type: none"> Removal of fish from wild (but may be byproduct of capture for other purposes) 	<ul style="list-style-type: none"> High to wild population (but may be byproduct)
Captive broodstock	<ul style="list-style-type: none"> Insurance Can be managed, manipulated Can be used for biological studies 	<ul style="list-style-type: none"> Costs of maintenance and management to maintain genetic diversity 	<ul style="list-style-type: none"> Low
Release into natural habitat	<ul style="list-style-type: none"> Persistence/increase in wild population Maintains fishery in river, reservoirs etc Can help to avoid inbreeding if wild population is small 	<ul style="list-style-type: none"> Production costs (higher than in aquaculture due to measures to produce fish of wild genotype/phenotype) Costs of tagging Costs of release 	<ul style="list-style-type: none"> Potentially significant Ecological interactions Genetics: inbreeding in hatchery, domestication, possibly wrong founder stock Disease transmission to wild stock
Aquaculture	<ul style="list-style-type: none"> Reduces demand for wild fish, but farmed fish has lower price and less demand Survival of species as domesticated animal 	<ul style="list-style-type: none"> Low 	<ul style="list-style-type: none"> Ecological and genetic interactions with wild stocks Diseases Hybridisation of Mgc with rived catfish common in aquaculture, escaping hybrids!
Habitat and ecosystem management			
Site-based	<ul style="list-style-type: none"> Long-term Manageable level May do little to protect migratory species 	<ul style="list-style-type: none"> Difficult to establish due to existing local arrangements 	<ul style="list-style-type: none"> Low
Large-scale	<ul style="list-style-type: none"> Allows to address large-scale ecosystem processes and functions May be easier to influence than site-based management because less established 	<ul style="list-style-type: none"> Expensive, but funding is available at international level, ongoing initiatives 	<ul style="list-style-type: none"> Low

5 Research and information requirements

Following on from the preliminary appraisal of conservation measures, research and information requirements were identified for each of the core areas (wild population, captive population, habitat/ecosystem, and social/economic issues). This resulted in a very extensive list of research questions (Table 4).

These questions were prioritised on the basis of immediate relevance to conservation planning and feasibility of research within the time and budgetary limitations of the organisations present. It must be realized in particular that whilst ecological field studies on the habitat requirements, migrations etc. of the giant catfish are highly desirable, the small number of wild fish caught per year means that in practice the scope for such studies is extremely limited.

The following research priorities were identified:

- Analysis of wild population dynamics: historical/potential abundance, recent trends, sustainable catch, and likely responses to various conservation measures
- Genetic and demographic management of captive population to maintain diversity and representativeness of wild population for supplementation or re-introduction
- Migration study using biotelemetry
- Costs of various conservation measures (both direct and indirect, e.g. catch forgone in the case of fishing restrictions).

In addition to these research priorities, a strong need was identified for the collation and synthesis of existing information on the giant catfish. This will be achieved through a concerted effort of the organisations present, aiming to provide a synthesis for the next workshop in December 2005 (see 6.4).



Figure 2: Identification of research and information requirements at the workshop

Table 4: Research and information requirements identified during the workshop

Wild population	Captive breeding, gene banking, aquaculture	Habitat	Social, economic, political
<ul style="list-style-type: none"> • Population abundance in wild: current, historical/potential, age structure • Review or develop population assessment methods: data analysis, modelling, hydroacoustics • Population spatial structure and migrations (genetic markers?) • Biochemical/genetic markers for species identification of Mgc in mixed samples • Level of incidental catch of juveniles and larvae, and how to reduce it • Establish presence of early life stages from pond surveys in Cambodia (ponds stocked with wild pangasiid fry). • Protected area: where and how large (link to critical habitat) • Fisheries assessment: sustainable catch? • Post-capture mortality and how to reduce it • Gill nets • Dai nets • Ceremonial release implications 	<ul style="list-style-type: none"> • Genetic analysis of captive stocks, (re-) construction of a stud book • Testing of wild fish for possible hatchery parentage • Genetic and demographic management of captive population (genetic tools!) • Genetic, physiological, and behavioural quality of hatchery output and implications for post-release survival: potential improvements • Establishing and improving post-release survival through better hatchery production and and release practices • Post-release monitoring to establish best release size and habitat • Domestication effects an how to minimize them: culture conditions, diets, etc. • Population biology of mixed wild-hatchery stock • Potential for sperm cryopreservation • Gamete collection without sacrificing wild parents (already possible in captive populations) • Biological studies to establish environmental influences on life history etc. • Current and projected extent of Mgc farming and ranching in the region • System characteristics with respect to risks of escape, disease transmission, hybridization • Diseases in captive and wild stocks • Implications of international transfers for diplomatic reasons 	<ul style="list-style-type: none"> • Identification of critical habitat • Telemetry study of wild and released captive fish • Nursery habitat study, linked to incidental harvest study • Flow and migration study, based on MRC flow data/model and Cambodian DoF dai catch/migration data • Micro-level interactions between fish behaviour and environment, how does this link to larger scale phenomena? • Environmental cues for migration and spawning assessed on captive fish • Fish passage facilities suitable for pangasiid catfish • Tools for habitat management and planning (IRBM, EIA): review and establish relevance to Mgc • Mekong Basin Planning Process, IBFM, River Health Study (all MRC): relevance to Mgc? 	<ul style="list-style-type: none"> • Value of Mgc: economic, social, cultural • Use and existence value • Costs of fishing restrictions: economic, social, cultural • Who will bear these costs? • Costs of alternative captive population maintenance schemes • Feasibility of recovering incremental costs of Mgc conservation from GEF • Increase awareness of Mgc and fisheries as a whole • How can exploitation of Mgc be influenced: institutional arrangements • Laws • Informal rules • How are these made • Ecotourism potential • Fishing ponds as means of awareness and income creation, “watch and eat” • Traditional knowledge regarding Mgc

6 Conservation strategy development

The workshop discussions clearly identified a number of issues that should be addressed in order to strengthen MGC conservation:

- The MGC is a critically endangered, large, transboundary species of great symbolic importance to the conservation of the Mekong ecosystem.
- A wide variety of conservation measures are implemented by different organisations. Most of these are limited in scale and of unknown effectiveness. Better coordination, evaluation and targeting of conservation measures is expected to improve effectiveness.
- There is a great deal of scattered information relevant to MGC conservation which should be exchanged, synthesized and brought to bear on conservation practices and policies
- A scientific evaluation of population status and the effectiveness of conservation measures is urgently required to provide a basis for targeting of conservation efforts.
- Whilst harvest restrictions and the captive breeding programme are cornerstones of current efforts to preserve the species, habitat and ecosystem conservation are key to safeguarding its long-term future in the wild. It is thus crucial for MGC conservation efforts link with and influence wider policy processes.
- An overarching conservation strategy should be developed, based on the above elements of coordination, information exchange, research and policy impact.

6.1 Conservation strategy process

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. At the core of the process will be a series of joint workshops, interspersed with specific research, policy and outreach activities by contributing organisations.

Conservation strategy process

Partner 1 Partner 2 Partner 3 Partner 4 ...

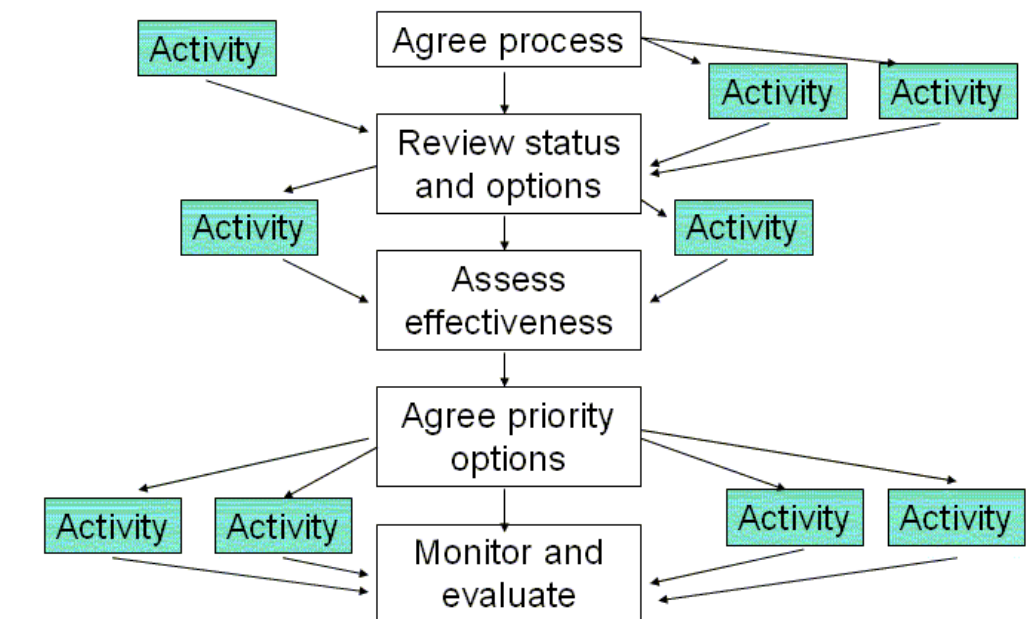


Figure 3: Outline of conservation strategy process

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 is hoped that many organisations will be able to 'buy into' the joint strategy.

A discussion ensued at this point as to the degree to which the strategy should be entirely open-ended and defined by the stakeholder process, or guided by 'established principles of conservation science'. Opinions in this regard varied widely, from those advocating an entirely stakeholder-defined process to those insisting that a strategy not grounded in principles of conservation science could not possibly be called a conservation strategy. This issue could not be resolved during the workshop. In practice, it is clear that the strategy process will have to be responsive to both stakeholder opinions and scientific principles. Conservation scientists are well represented in the strategy group, and the adoption of particular approaches and principles will have to be negotiated throughout the process. It was noted also that no universal set of principles of conservation science was easily identifiable even to those supporting the primacy of the subject. It was thus resolved to conduct a review of relevant principle and approaches for the next workshop.

6.2 Working group

The working group is the core driver of the strategy process. It is an informal and open group of individuals engaged in MGC conservation through practice, policy, research or information exchange. The initial composition of the conservation strategy working group is as follows:

Devin Bartley (FAO); Bunchong Chumnonsittathum (Thai DoF); Zeb Hogan (MWBP) co-chair; Wongpathom Kamonrat (Thai DoF); Alvin Lopez (MWBP); Kai Lorenzen (Imperial College London, Darwin project leader); Niklas Mattson (MRC-AIMS); Uthairat Na Nakorn (Kasetsart University); Thuy Nguyen (NACA); Sompanh Phanousith (Lao DLF, MRC-AIMS); Mike Phillips (NACA); Em Samy (Cambodian DOF); Rob Shore (WWF Living Mekong Programme); Naruepon Sukumasavin (Thai DOF, Darwin project coordinator) co-chair; Nguyen Van Trong (RIA2, MRC-AIMS); Chavalit Vidthayanon (WWF Thailand).

Further members may join the group as appropriate.

6.3 Work plan

A work plan has been defined for a 1.5 year period, covering the period for which funding has been secured from the Darwin Initiative and the MWBP.

Table 5: Overview of the medium-term work plan for conservation strategy development

Core workshops	Other relevant meetings	Research and information activities	Outputs
Inception and planning workshop, Bangkok 23-23 August 2005			
	MRC steering group meeting, September 2005 MRC Technical Meeting, Ubon, November 2005	(1) Collation and review of relevant information (see separate table)	Presentations and brief contributions to a joint status and options report
Species conservation action plan (SCAP) meeting, Phnom Penh, December 2005			Status and options report SCAP report
	Local workshop at Chiang Rai, May 2006 MRC Fisheries Programme annual meeting, Ho Chi Minh, June 2006	(2) Quantitative assessment of population status and conservation options (3) Genetic inventory of captive population and development of breeding plan (4) Basinwide field surveys (5) Migration and spawning study (6) Review and implementation of measures to reduce fishing mortality	Quantitative assessment of status and options
Quantitative assessment and strategy evaluation workshop, Vientiane, August 2006			Conservation strategy evaluation report
		(7) Assess institutional framework and costs of implementing conservation measures (8) Adaptive management strategy development	
Long-term strategy workshop, Bangkok, December 2006			Conservation strategy implementation report
Launch of conservation strategy, basinwide, March 2007			Conservation strategy document

6.4 Research and information activity details

A total of eight major activities were prioritized as contributions to the overall conservation strategy development process. Most of these activities will involve multiple partners and funding sources. However, a lead institution is identified for each activity in order to facilitate coordination.

(1) Collation and synthesis of existing information

See section 6.6. (Includes MWBP implementation plan activities 1, 3, 10, 15 and 16)

(Lead institution: MWBP; Funding: MWBP and others)

(2) Quantitative assessment of population status and conservation options

Model development and quantitative analysis of data to estimate parameters and test hypotheses about population status and threats. Development of model for captive bred/wild population interactions. Projections of population development given alternative conservation measures and scenarios of future fishing pressure and environmental state. Consolidation of scenarios, incorporation of cost-benefit information and results from captive breeding procedures study. (Incorporates MWBP implementation plan activity 2 with respect to MGC).

(Lead institution: Imperial College London; Funding: Darwin project)

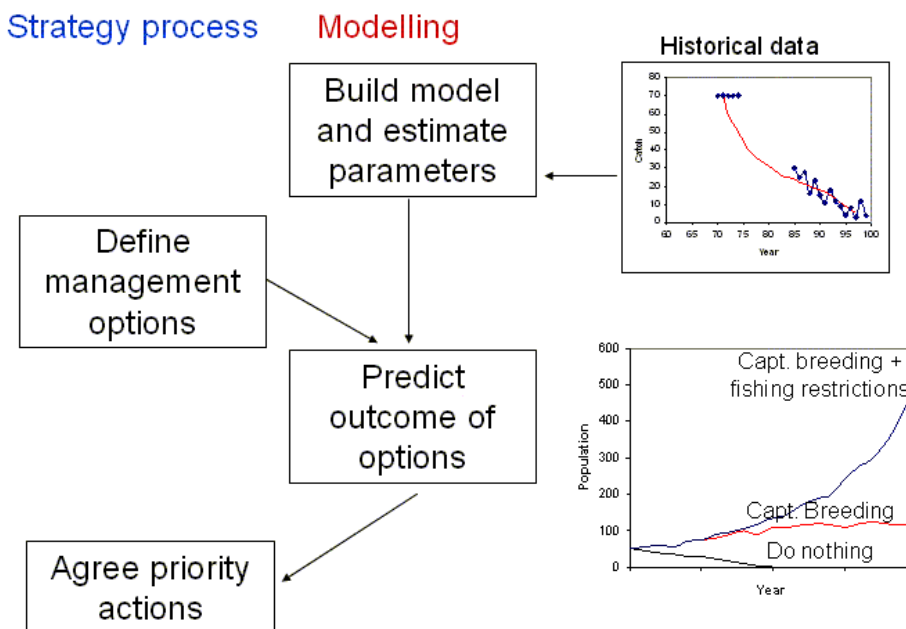


Figure 4: Outline of quantitative assessment process

(3) Genetic inventory of captive population and wild population samples, and breeding plan development

Genetic inventory of captive population based on microsatellite and mt DNA analysis. Development of a breeding strategy to maintain genetic variation in the captive population.

(Incorporates MWBP implementation plan activities 6 and 9).

(Lead institution: Thai DoF and Kasetsart University; Funding: Darwin project)

(4) Basin wide field surveys on MGC

Field surveys to assess the occurrence of MGC in fisheries catches in selected locations throughout the basin.

(MWBP implementation plan activity 4 with respect to MGC).

(Lead institution: MWBP; Funding: MWBP)

(5) Migration and spawning study

Biotelemetry study to determine migratory corridors and spawning sites.

(MWBP implementation plan activity 5 with respect to MGC).

(Lead institution: MWBP; Funding: MWBP)

(6) Review and implementation of measures to reduce fishing mortality

Identification of causes of mortality, determination of the number of fish deaths each year, assessment of methods to reduce mortality of wild fish, and Implementation of methods to reduce mortality of wild fish. (MWBP implementation plan activity 7).

(Lead institution: MWBP and MRC Fisheries Programme; Funding: MWBP)

(7) Assess institutional framework for and costs of implementing conservation measures

Assess costs and benefits associated with enforcement. The following information will be made available:

1. General benefits accrued from conservation of endangered species
2. Current fisheries laws applicable to endangered aquatic species
3. Current benefits accrued from harvest of endangered species
4. Costs associated with enforcement of law against illegal harvest of endangered species

(Incorporating MWBP implementation plan activity 8).

(Lead institution: MWBP; Funding: MWBP)

(8) Development of adaptive management policies

Identification of key uncertainties pertaining to recovery strategy; Development of monitoring strategy; Definition of alternative pathways and decision rules for review of strategy in the light of monitoring results.

(Lead institution: Imperial College London; Funding: Darwin project)

6.5 Communication

Communication within the Working group and with relevant stakeholders will be through a number of means.

Working group Reports

These reports will document the key outcome of the conservation strategy process. The following main reports are anticipated:

Conservation strategy inception and process report (2005, this report). Report detailing the initial strategy discussions and the agreed strategy process as devised during the inception workshop.

Species conservation action plan (SCAP) report (2005). Synthesis of current knowledge on giant catfish conservation and identification of priority actions for implementation and/or evaluation. This report will include the various reviews initiated in the inception meeting, and reflect discussions at the SCAP workshop (Phnom Penh, December 2005).

Conservation strategy evaluation report (2006). This report will present results of the evaluation of conservation status and priority actions. A draft will be made available prior to the quantitative assessment and strategy evaluation workshop (Vientiane, August 2006), and the report finalized based on workshop discussions.

Conservation strategy implementation report (2006) Detailed plan for implementation of the long-term conservation strategy. This will draw on the draft action plan, the evaluation of options, and extensive discussions with key stakeholders.

Conservation strategy (2007) Summary document outlining the conservation strategy, the process of its development, and the commitments made by stakeholders to implement the strategy.

These core reports will be published jointly by the members of the MGCWG.

Website

NACA will set up and maintain a project web site, <www.mekonggiantcatfish.org>. The site will contain all core reports, and supporting documents that may be made available by the MGCWG and its members. The possibility of opening an electronic discussion forum has also been considered. All MGCWG members are invited to establish reciprocal links between their institution's and the MGCWG web site.

Newsletter

The MGCWG will establish a regular column in the NACA newsletter, material from which may also be reproduced in other newsletters as appropriate. The idea of a separate MGCWG newsletter has been discussed but it was felt that contributions to established newsletters would achieve greater impact.

Local and national stakeholders

A range of communication products will be developed for local and national stakeholders.

Regional bodies

A number of regional bodies, such as the technical advisory board (TAB) of the MRC Fisheries Programme will be kept informed of the MGCWG. Normally this will be done by MGCWG members represented on such bodies.

6.6 Priority actions in preparation of the next (SCAP) workshop

Brief review papers and presentations should be prepared on key aspects of MGC conservation.

Each review should aim to:

- Synthesize existing information
- Highlight key information requirements
- Make suggestions for future work
- Outline implications for conservation

Table 6: Reviews to be prepared for the SCAP workshop

Topic	Anchor
Spatial population structure and migrations	Zeb Hogan
Fisheries catch data (recent and historical)	Zeb Hogan, Chavalit Vidthayanon, Nguyen van Trong, Em Samy, Sompanh Phanousith
Country reports on catfish history and status	Nguyen van Trong (Vietnam); Em Samy (Cambodia), Sompanh Phanousith (Lao PDR)
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, Amrit Bart (?)
Compilation of genetic information, sample analysis, guidelines for future sampling	Uthairat Na Nakorn, Wongpathom Kamornrat, Thuy Nguyen
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	Rob Shore, 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, MWBP legal advisor
MRC planning process for basin development and its implications for giant catfish conservation	Niklas Mattson
Principles of economic valuation of giant catfish	Devin Bartley

Appendix 1: Meeting arrangements and agenda

The meeting was held from 23 to 24 August at KU Home, Kasetsart University, Ladyao, Chatuchak, Bangkok 10900.

Tuesday 23 August 2005

09:00 Welcome and introduction of participants
09:15 Introduction to Darwin project and workshop objectives
09:45 Presentations by project partners on giant catfish-related activities
10:30 *Coffee/tea break*
11:00 Presentations by project partners on giant catfish-related activities
12:30 *Lunch break*
13:30 Giant catfish status indicators and conservation objectives
15:00 *Coffee/tea break*
15:30 Giant catfish status indicators and conservation objectives
17:00 Close

19:00 Workshop dinner at Pola Pola restaurant

Wednesday 24th August

9:00 Conservation measures: benefits, costs and risks
10:30 *Coffee/tea break*
11:00 Research priorities
12:30 *Lunch break*
13:30 Outlining of joint work plan to address identified issues and incorporate ongoing and new activities
15:00 *Coffee/tea break*
15:30 Discussion on collaborative arrangements and general wrap up
16:30 Close of workshop

Appendix 2: Participants

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Appendix 3: Press release

Experts gather to save giant catfish

Experts have gathered in Bangkok to devise a plan to save the giant Mekong catfish from extinction. The giant catfish, one of the world's largest freshwater fish and an icon of the Mekong River, is deemed to be close to extinction in the wild. Its precarious status is thought to be due to excessive fishing and, to a lesser extent, damage to its natural habitat.

The meeting will help coordinate various conservation initiatives that are underway in Mekong basin countries by both government agencies and private conservation organizations. Current efforts to save the catfish include captive breeding and restocking programs, and buy-back schemes where fishermen are paid to release captured fish alive. With only a handful of fish caught each year, very little is known about the biology of the giant catfish. Even the locations of its spawning grounds remain a mystery.

In the past there has been little coordination between conservation initiatives and their effectiveness is unknown. The new project aims to change this by bringing together the major players to develop an overarching conservation strategy for the giant catfish. Participants include the Network of Aquaculture Centres in Asia-Pacific; the Mekong River Commission (MRC); the Food and Agriculture Organization of the United Nations; the Mekong Wetlands Biodiversity Program operated by the United Nations Development Program, the International Union for the Conservation of Nature and MRC; the Imperial College of London; and the Fisheries Departments of Cambodia, Laos and Thailand. The project, which aims to develop a comprehensive conservation strategy within two years, is co-funded by the Darwin Initiative.

Pedro Bueno, Director General of NACA, says: "This is an exciting regional initiative to save one of the world's most endangered fishes from extinction. The catfish doesn't know national boundaries, and we need to work together within the Mekong basin to conserve it effectively. Bringing together expertise in all aspects of conservation, from fisheries management to captive breeding, will help us to develop a joint strategy to conserve this magnificent animal."

Additional measures to conserve the catfish could include modifying fishing practices to reduce accidental catch, establishing protected areas, genetic analysis to determine if there is a single or multiple stocks, conducting a genetic inventory of captive populations and establishing a 'gene bank' of frozen eggs and sperm.