Catch and Culture

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INSIDE

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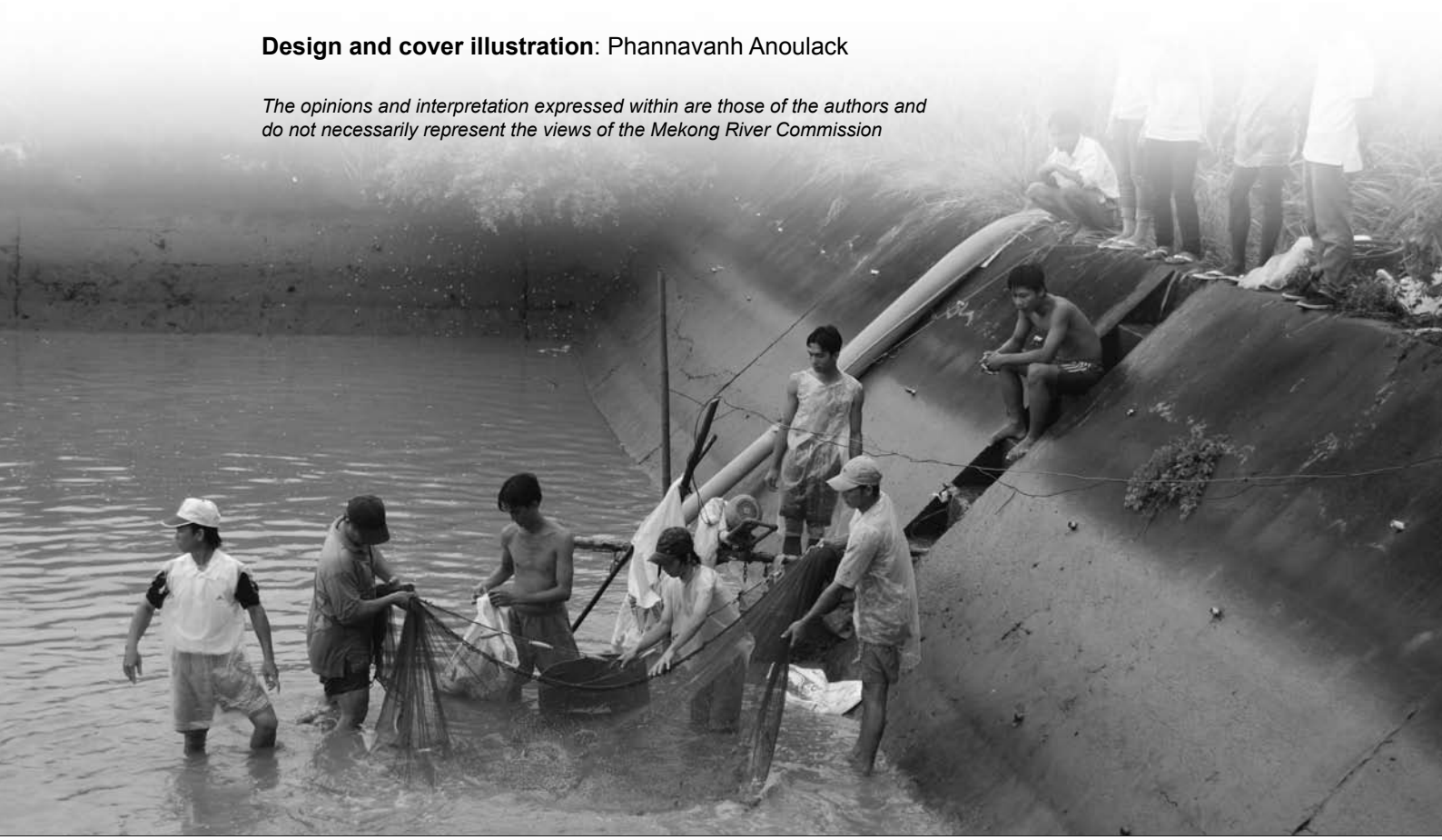
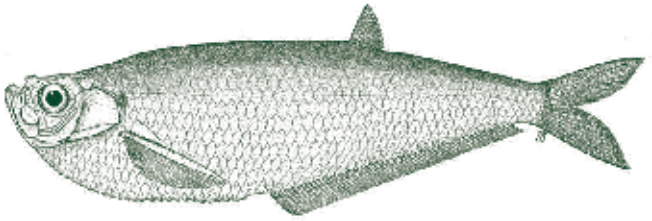


Editorial



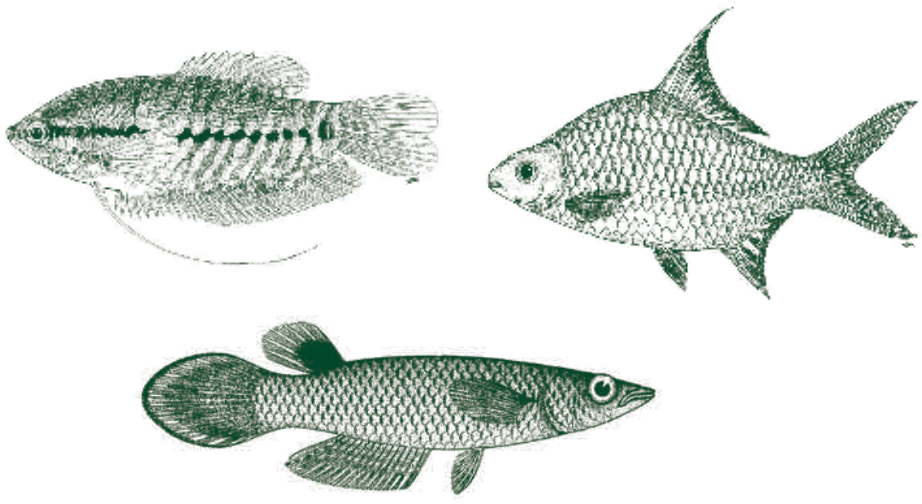
In this issue of *Catch and Culture,* we take a detailed look at recent developments with genetic research into fish and crustacean species in Viet Nam. In addition to selective breeding programmes for tilapia, catfish and giant freshwater prawns, we feature an update on the sex-reversal technique developed for the giant prawn which is now being applied on a commercial basis. With European consumers increasingly choosy about what they eat, we also examine efforts to get small-scale catfish farms in the Mekong Delta to improve their management practices.

Elsewhere in this issue, we document the discovery of several new fish species in two Lao tributaries of the Mekong and highlight the 29 species of freshwater aquatic animals now considered endangered under Cambodian law. We also look at efforts to maximise the benefits of aquaculture and how mobile hatcheries are being used to mitigate the impact of declining fish catches in northeast Thailand. Other topics include ricefield fisheries, how catfish processors have been coping with the global economic downturn and the recent announcement that a Vietnamese fishery has become the first in Southeast Asia to be certified as sustainable by the UK-based Marine Stewardship Council. We also have a brief summary of the Tenth Technical Symposium on Mekong Fisheries in Pakse in November.

Amid recent proposals for mainstream dams, our lead article is devoted to recent modelling work to predict the minimum passage requirements to sustain populations of fish species that migrate upstream to spawn. In addition to engineering solutions that will need to be considered by hydropower developers, the model shows that any attempts to improve the downstream survival of fish passing through mainstream dams should focus on adults of large species as they return to their feeding and refuge habitats after spawning.

The special insert in this edition is a behind-the-scenes look at the typical start of a trading week for an international fish trading company in Ho Chi Minh City, a key part of its global network spanning four continents.

Finally, we take this opportunity to wish all of our readers good health and prosperity in the coming Year of the Tiger which starts in mid-February in Viet Nam and in mid-April in Cambodia, Lao PDR and Thailand.



Modelling the **impacts** of mainstream **dams** on highly **migratory fish** species

Amid recent proposals for mainstream dams, the Mekong River Commission and the WorldFish Center have developed a model to predict the minimum upstream passage requirements to sustain populations of ten fish species that migrate upstream to spawn. The model shows that the minimum success rates for upstream passage through fish ladders, locks or other structures will vary according to species size, the number of dams the fish have to cross and—to a lesser extent—the proportion of adult fish returning downstream which can be safely diverted away from dam turbines through spillways, bypass channels or sediment sluices. The model also shows that any attempts to improve downstream survival should focus on adults of the large species as they return to their feeding and refuge habitats after spawning in areas further upstream. Maintaining populations of some larger species may not be viable.

Not all species of fish caught in the Lower Mekong Basin are threatened by mainstream dams. Some have limited migrations that may not be impaired. Others may adapt easily to changes in habitat. The species most likely to be affected are those that migrate long distances between critical spawning, feeding and refuge habitats—either to complete their life cycles or to exploit seasonal variations in habitats. To see which species are threatened, a recent study used a framework based on environmental guilds—subsets of species that respond similarly to environmental change—and data from catch monitoring programmes. As reported in *Catch and Culture* (Vol 14, No 3), the preliminary findings were that mainstream dams threatened 58 highly migratory species amounting to about 40% of the weight of all 233 species recorded in MRC catch surveys (see Tables 1, 2 and 3). The threatened species are estimated to be worth more than $1 billion a year. According to the IUCN "Red List", they include 5 of the 11 Mekong species threatened with extinction—the Mekong giant catfish (*Pangasianodon gigas*), the Mekong stingray (*Dasyatis laosensis*) Jullien's barb (*Probarbus jullieni*), the Laotian shad (*Tenualosa thibaudeaui*) and the thicklip barb **(***Probarbus labeamajor***).**

'Threatened species are estimated to be worth more than $1 billion a year'

For detailed modelling, the authors of the study—Ashley Halls from the MRC Fisheries Programme and Mrigesh Kshatriya from the WorldFish Center—chose 12 species representing different families, migratory

Dr Halls addressing the annual meeting of the MRC Fisheries Programme in Siem Reap in June

Photo: Lem Chamnap

Carps (Cyprinidae) threatened by mainstream dam development

A typical carp

Carps at risk accounted for 24% of MRC catch surveys in 2003-04. All the threatened species spawn in the main channel. Some reside in the channel all year whereas others seasonally exploit the floodplain to feed. Among the six selected for modelling (in bold below), three are large species which were found to be particularly vulnerable to the downstream passage effects of dams. These are the violet giant barb (*Cosmochilus harmandi*), the goldfin tinfoil barb (*Hypsibarbus malcolmi*) and the already endangered Jullien's barb (*Probarbus jullieni*).

	English name	Scientific name	Khmer	Lao	Thai	Vietnamese	% of catch
1	**Siamese mud carp**	***Henicorhynchus siamensis***	**Trey rieltob**	**Pa soi hua lam**	**Pla soi khao**	**Ca linh ong**	**8.1**
2	**Lesser silver mud carp**	***Henicorhynchus lobatus***	**Trey rielongkam**	**Pa soi huapo**	**Pla soi lord**	**Ca linh thuy**	**4.1**
3	**Violet giant barb**	***Cosmochilus harmandi***	**Trey kampoulbay**	**Pa mak ban**	**Pla ta kark**	**Ca duong bay**	**2.9**
4	**Pelagic river carp**	***Paralaubuca typus***	**Trey slakrussey**	**Pa taap**	**Pla fab**	**Ca thieu mau**	**1.7**
5	**Goldfin tinfoil barb**	***Hypsibarbus malcolmi***	**Trey chhpin**	**Pa pak nouat**	**Pla jard**	**Ca hong nhau**	**1.5**
6	Soldier river barb	*Cyclocheilichthys enoplos*	Trey chhkaok	Pa chok	Pla choke	Ca coc	1.1
7	Apollo shark minnow	*Luciosoma bleekeri*	Trey bangkouy	Pa siew ao	Pla seu aaw	Ca long tong muong	1.1
8	Serrated anal-spine carp	*Puntioplites proctozysron*	Trey chrakeng	Pa sa kang	Pla sa gang	Ca danh	0.6
9	Small-scale river carp	*Cirrhinus microlepis*	Trey pruol	Pa phon	Pla nuan chan	Ca duong	0.4
10	Lagler's barb	*Hypsibarbus lagleri*	Trey chhpin	Pa pak pay	Pla park nuad	Ca lai	0.4
11	Siamese long-fin carp	*Labiobarbus siamensis*	Trey archkok	Pa lang kon	Pla khui ram, sah	Ca linh ria	0.4
12	Striped river barb	*Mekongina erythrospila*	Trey pa se-ee	Pa sa-ee	Pla sa-ee	Ca da song	0.3
13	**Jullien's barb***	***Probarbus jullieni***	**Trey trawsok**	**Pa ern tadeng**	**Pla yee sok tong**	**Ca tra soc**	**0.3**
14	Golden barb	*Hypsibarbus wetmorei*	Trey chhpin krahom	Pa pak dalyeung	Pla park khum	Ca me vinh	0.3
15	Mekong giant barb	*Cyclocheilicthys furcatus*	Trey chhkaok ploeung	Pa va hua buk	Pla choke mhai	Ca coc vay	0.3
16	Two-headed carp	*Bangana behri*	Trey pava mookpee	Pa va ho kham	Pla wha nah naw	Ca trang beri	0.2
17	Blunt-nosed minnow	*Amblyrhynchichthys truncatus*	Trey kombot chramos	Pa dta po	Pla ta min	Ca trao trao	0.2
18	Bangana	*Bangana* sp.	?	?	?	?	0,2
19	Thicklip barb	*Probarbus labeamajor*	Trawsok sor	Pa ern khao	Pla earn hang mum	Ca tra soc moi	0.1
20	Black-striped garra	*Garra fasciacauda*	Trey chongwa	Pa sai dtan	Pla lia hin	Ca da soc	<0.1
21	Mud carp	*Cirrhinus prosemion*	Trey phkakor	Pa gaang	Pla gang	Ca troi lui	<0.1
22	Hard-lipped barb	*Osteochilus waandersi*	Trey kros	Pa kang lai	Pla rong mai tub	-	<0.1
23	Bulu barb	*Puntioplites bulu*	Trey kanhchrea	Not Available	Pla tum	Ca danh bong	<0.1
24	Mud carp	*Cirhinnus molitorella*	Trey phka kor	Pa gaang	Pla gang	Ca troi trang	<0.1
25		*Puntioplites waandersi*	Trey chrakreng	Pa sa kang	Pla ka mung	Ca danh vay	<0.1
26	Giant predatory carp	*Aaptosyax grypus*	Trey pasanak	Pa sa nak yai	Pla sa nak	Ca chao dai	<0.1

* endangered species (EN) on the IUCN red list of threatened species, facing a "very high" risk of extinction in the wild

behaviour and life history strategies. In the absence of reliable parameter estimates for the small-scale tongue sole (*Cynoglossus microlepis*) and the giant river prawn (*Macrobrachium rosenbergii*), these species were dropped from the study. For the remaining 10 species, Dr Halls and Dr Kshatriya developed a model to describe the dynamics of populations in response to two variables. The first variable was passage success rates for species migrating upstream through fish ladders, locks or other structures to reach critical spawning habitats. The second was the mortality rates for adults and juveniles returning downstream through turbines, spillways, bypass channels or sediment sluices to reach feeding and refuge habitats. Downstream mortality rates were predicted using a "blade strike" model developed for Kaplan type turbines that feature in most of the mainstream dams proposed in the lower basin. In simulations, the proportion of adults returning downstream through the turbines varied from 25% to 100%. The remainder were assumed to pass downstream unharmed via bypasses, spillways or sediment sluices.

Downstream mortality

The authors presented their findings to the 16th annual meeting of the Mekong Fisheries Programme in Siem Reap in June. For species returning from upstream spawning areas, the model predicts relatively low downstream mortality rates for five small species from the carp, algae eater and loach families. These are

Shark catfishes (Pangasiidae) threatened by mainstream dam development

Shark catfishes at risk accounted for about 8% of MRC catch surveys in 2003-04. The 15 threatened species all reside in the main channel of the Mekong. The two selected for modelling (in bold below) are both large species which were found to be particularly vulnerable to the downstream passage effects of dams. These are the sharp-nosed catfish (*Pangasius conchophilus*) and the critically-endangered Mekong giant catfish (*Pangasianodon gigas*).

A typical shark catfish

	English name	Scientific name	Khmer	Lao	Thai	Vietnamese	% of catch
1	**Sharp-nosed catfish**	*Pangasius conchophilus*	**Trey ke**	**Pa pa ot**	**Pla saai yu phueak**	**Ca hu**	**2.1**
2	Mollusc-eating catfish	*Helicophagus waandersii*	Trey prakandor	Pa na nu	Pla yon nhu	Ca linh ong	1.6
3	Pangasius kunyit	*Pangasius kunyit*	-	Pa nyang	-	Ca tra kunit	0.9
4	Long-barbel catfish	*Pangasius macronema*	Trey chwiet	Pa yawn	Pla yon	Ca sat soc	0.8
5	Not available	*Pangasius polyuranadon*	Trey chwiet	Pa nyon hang hian	Pla sang ka wang	Ca dua	0.6
6	Black-spotted catfish	*Pangasius larnaudii*	Trey po	Pa peung	Pla tay pho	Ca vo dem	0.6
7	Krempf's catfish	*Pangasius krempfi*	Trey prabonglao	Pa suey hang leuang	Pla suey sor	Ca bong lau	0.5
8	Sutchi river catfish	*Pangasianodon hypophthalmus*	Trey pra	Pa suey mak mai	Pla sa whaai	Ca tra song	0.4
9	Bocourt's catfsih	*Pangasius bocourti*	Trey prakchau	Pa yang	Pla yang	Ca ba sa	0.3
10	Short-barbel pangasius	*Pangasius micronema*	Trey po	Pa yawn	Pla yon youk	Not available	0.1
11	Red-finned catfish	*Pangasius pleurotaenia*	Trey chwiet	Pa nyong thong kaom	Pla sa whaai	Ca sat bay	0.1
12	Yellowtail catfish	*Pangasius pangasius*	Trey pra	Pa suau kheo	Pla sa whaai	Ca tra song	<0.1
13	Long-barbel catfish	*Pangasius siamensis*	They chwiet	Pa yawn	Pa sangka ward leuang	Cat sat siem	<0.1
14	Pangasius	*Pangasius* spp.	?	?	?	?	<0.1
15	**Mekong giant catfish***	*Pangasianodon gigas*	**Trey reach**	**Pa beuk**	**Pla beuk**	**Ca tra dau**	**<0.1**

* critically endangered species (CR) on the IUCN red list of threatened species, facing an "extremely high" risk of extinction in the wild

the Siamese river carp (*Henicorhynchus siamensis*), the lesser silver mud carp (*Henicorhynchus lobatus*), the spotted algae eater (*Gyrinocheilus pennocki*), the pelagic river carp (*Paralaubuca typus*) and the tiger botia (*Botia helodes*). Assuming all individuals pass through the turbines, downstream mortality rates are predicted to range from about 2% to 15% for each dam crossed. But if only 25% pass through the turbines and the remaining 75% are safely diverted though spillways, bypass channels or sediment sluices, the downstream mortality rates fall to less than 5% for each dam crossed. On the other hand, spawning adults of five large species from the carp and river catfish families suffer very high mortality rates if they pass through the turbines. For each dam crossed, the downstream mortality rate is predicted to be 35% for the goldfin tinfoil barb (*Hypsibarbus malcolmi)*, 70% for the violet giant barb (*Cosmochilus harmandi*) and 80% for the sharp-nosed catfish (*Pangasius conchophilus*). For Jullien's barb and the Mekong giant catfish, the probability of mortality is 100%.

Minimum upstream passage to sustain populations

To determine minimum upstream passage to maintain viable populations in the wild, the study combined various assumptions. These included the number of dams crossed—one, two or three—as well as the presence or absence of a fishing ban, the reproductive potential of the species and the proportion of adult fish migrating downstream that could be safely diverted away from turbines. Viable populations are those that maintain their size or grow through time despite the foreseeable effects of demographic, environmental and genetic events and natural disasters.

'Large species are particularly vulnerable to mainstream dams'

To maintain viable exploited populations of small species based on their downstream mortality rates, the model predicts that fish ladders, locks or other structures would need to pass 60-87% of adults migrating upstream in the case of a single dam. If adult fish are obliged to cross two or more dams to reach their critical spawning habitats, the minimum upstream passage requirement for each of the dams in the cascade would be 80-95%. For these small species, the minimum requirements are relatively insensitive to the proportion of adults migrating downstream via the turbines. Moreover, the model predicts that attempts to

reduce the minimum upstream passage requirements by lowering downstream mortality rates will not be effective for these species.

On the other hand, the model predicts that large species are particularly vulnerable to mainstream dams, especially Jullien's barb and the Mekong giant catfish. Even if 75% of adults migrating downstream are diverted away from turbines and upstream migrations are 100% successful, the model predicts that mainstream dams will have a "terminal impact" on exploited populations of these two species. Maintaining viable populations of the Mekong giant catfish requires a complete ban on fishing and near-perfect engineering solutions with all adults migrating downstream diverted away from the turbines and upward passage success rates of 90-100%. In the case of one dam, exploited populations of the other three species will remain viable only if at least 75% of the adults migrating downstream are diverted away from turbines and if more than 80% of the fish succeed in migrating upstream to spawn. In the case of two dams, only the sharp-nosed catfish is predicted to persist, albeit only if at least 75% of the adults migrating downstream are diverted away from the turbines and as long as more than 90% of the fish migrating upstream succeed in crossing each dam. If three dams have to be crossed or if reproductive potential is low, no large species are predicted to persist.

'Any attempts to improve downstream survival should focus on the adults of the large species'

With increased fishing to feed a growing population and the prospect of multiple dams across the mainstream, the authors conclude that fears surrounding the persistence of the Mekong giant catfish and other large species appear warranted.

Other migrating fishes threatened by mainstream dam development

Apart from carps and shark catfishes, species from other families* threatened by mainstream dam development accounted for about 6% of MRC catch surveys in 2003-04. Most of these 17 species at risk spawn in the main channel of the Mekong although some loaches also reside in the main channel. Among other species, the herring and anchovy species reside in estuarine waters but spawn in freshwater while the eel, tarpon and prawn species reside in freshwater but spawn in marine waters.

A typical loach

The two species selected for modelling, the spotted algae eater (*Gyrinocheilus pennocki*) and the tiger botia (*Botia helodes*), both in bold below, are both small species which were found to be relatively less vulnerable to the downstream passage effects of dams.

	English name	Scientific name	Khmer	Lao	Thai	Vietnamese	% of catch
1	**Spotted algae eater**	***Gyrinocheilus pennocki***	**Trey smok**	**Pa ko**	**Pla soi nampheung**	**Ca bam da**	**1.6**
2	Giant freshwater prawn?	*Macrobrachium* sp.	Bongkorng	Gung goang	Goong	Tom	1.5
3	Small-scale tongue sole	*Cynoglossus microlepis*	Trey andat chhke	Pa pai	Pla yord muang	Ca luoi trau mac	1.3
4	**Tiger botia**	***Botia helodes***	**Trey kanhchrouk**	**Pa kheo kai**	**Pla mhu laai**	**Ca heo rung**	**0.7**
5	Redtail loach	*Botia modesta*	Trey kanhchrouk krahom	Pa mu man	Pla mhu khao	Ca heo vach	0.4
6	Crocodile catfish	*Bagarius suchus*	Trey krawbey	Pa kae ngua	Pla khae ngu	Ca chien nam	0.3
7	Mekong bachcha	*Clupisome sinensis*	Trey chwiet prak	Pa yown ta loh	Pla yawn thong	Ca sat truong hoa	0.2
8	Mekong freshwater stingray**	*Dasyatis laosensis*	Trey bawbel	Pa fa hang	Pla fah lai	Ca duoi bong lao	0.1
9	Botia	*Botia* sp. cf. *lecontei*	Trey kanhchrouk	Pa mou	Pla moo	Ca heo	0.1
10	Harmand's sole	*Brachirus harmandi*	Trey andat chhke	Pa pe	Pla bai mai pay	Ca luoi meo	<0.1
11	Laotian shad**	*Tenualosa thibaudeaui*	Trey kbok samlui	Pa mak phang	Pla mark phang	Ca chay be	<0.1
12	Sabertooth thrysa	*Lycothorssa crocodilus*	Trey chmar krorpoeu	Pa sa nak	Pla maew	Ca top	<0.1
13	Glass catfish	*Kryptopterus bicirrhis*	Trey kes prak	Pa pi kai	Pla kang pra ruang	Ca tren mong	<0.1
14	Pacific tarpon	*Megalops cyprinoides*	-	-	Pla taleuak san	Ca chao bien	<0.1
15	Botia	*Botia* sp. cf. *beauforti*	Trey kanhchrouk	Pa mou	Pla moo	Ca heo	<0.1
16	Toli shad	*Tenualosa toli*	Trey kbok	Pa mak phang	Pla talum pook	Ca chay xo	<0.1
17	Giant mottled eel	*Anguilla marmorata*	Trey chlok	Pa lai phai	Pla eian hu	Ca chinh hua	<0.1

* Algae eaters (Gyprinocheilidae), prawns (Palaeomonidae), tongue fishes (Cygnoglossidae), loaches (Cobitidae), sisorid catfishes (Sisoridae), schilbeid catfishes (Shilbeidae), stingrays (Dasyatidae), soles (Soleidae), herrings (Clupeidae), anchovies (Engraulidae), sheatfishes (Siluridae), tarpons (Megalopidae) and eels (Anguillidae)

** endangered species (EN) on the IUCN red list of threatened species, facing a "very high" risk of extinction in the wild

Minimum requirements for upstream fish passage to sustain wild populations

The model predictions below show minimum%ages of migrating fish that are required to pass upstream through future mainstream dams to maintain viable populations. The table shows ten fish species which migrate upstream to reach critical spawning habitats in the Lower Mekong Basin. Viable populations are those with a good chance of surviving despite the foreseeable effects of demographic, environmental and genetic events and natural disasters. The minimum success rates for upstream passage through fish ladders, locks or other structures vary according to species size, the number of mainstream dams the fish have to cross and, to a lesser extent, the proportion of adult fish migrating downstream which can be safely diverted away from dam turbines through spillways, bypass channels or sediment sluices. Diverting fish away from turbines has greater impact on the minimum upward passage rates needed to maintain populations of large species, which the study defined as those that exceed a maximum size of at least 50 cm.

Species	Length	Khmer	Lao	Thai	Vietnamese	1 dam	2 dams	3 dams
Lesser silver mud carp *Henicorhynchus lobatus*	15 cm	Trey rielongkam	Pa soi huapo	Pla soi lord	Ca linh thuy	86-87 %	93-94 %	95-96 %
Siamese mud carp *Henicorhynchus siamensis*	20 cm	Trey rieltob	Pa soi hua lam	Pla soi khao	Ca linh ong	72-73 %	85-86 %	90-91 %
Pelagic river carp *Paralaubuca typus*	21 cm	Trey slakrussey	Pa taap	Pla pab	Ca thieu mau	70-71 %	84-85 %	89-90 %
Spotted algae eater *Gyrinocheilus pennocki*	28 cm	Trey smok	Pa ko	Pla soi nam pheung	Ca bam da	60-61 %	78-80 %	85-88 %
Tiger botia *Botia helodes*	30 cm	Trey kanhchrouk	Pa kheo kai	Pa mhu laai	Ca heo rung	72-75 %	86-90 %	91-95 %
Goldfin tinfoil barb *Hypsibarbus malcolmi*	50 cm	Trey chhpin	Pa pak nouat	Pla jard	Ca hong nhau	* 80-91 %	Not viable	Not viable
Violet green barb *Cosmochilus harmandi*	100 cm	Trey kampoulbay	Pa mak ban	Pla ta kark	Ca duong bay	** 85 %	Not viable	Not viable
Sharp-nosed catfish *Pangasius conchophilus*	120 cm	Trey ke	Pa pa ot	Pla saai yu phueak	Ca hu	*** 90 %	Not viable	Not viable
Jullien's barb *Probarbus jullieni*	150 cm	Trey trawsok	Pa em tadeng	Pla yee sok tong	Ca tra soc	Not viable	Not viable	Not viable
Mekong giant catfish *Pangasianodon gigas*	290 cm	Trey reach	Pa beuk	Pla beuk	Ca tra dau	Not viable	Not viable	Not viable

* To maintain viable populations, at least 50% of adult fish migrating downstream are diverted away from turbines. If no fish are diverted, the minimum upstream passage would have to be 99% and accompanied by a fishing ban to sustain the population of this species.

** To maintain viable populations, at least 75% of adult fish migrating downstream are diverted away from turbines. If only 50% of fish are diverted, the minimum upstream passage would have to be 97% and accompanied by a fishing ban to sustain the population of this species. If no fish are diverted, the population is not viable.

*** To maintain viable populations, at least 75% of adult fish migrating downstream are diverted away from turbines. If fewer fish are diverted, the population is not viable.

By reducing diversity and the size structure of the community, mainstream dams have the potential to affect the integrity and functioning of the ecosystem. The overall value of the catch may also decline if large, valuable highly-migratory species no longer persist at levels that are economically attractive. Populations of small species that respond rapidly to environmental variation may also decline further, reducing their resilience to climate change and leading to greater fluctuations in annual landings.

Mitigation

The study found that populations of larger species are more likely to respond to efforts to divert adults migrating downstream away from turbines and towards spillways, bypass channels or sediment sluices. For smaller species, such efforts appear to have little impact on minimum upstream passage requirements. For either small or large species, strategies to improve the survival of juvenile fish migrating downstream are likely to generate only marginal benefits, often after very high costs. So any attempts to improve downstream survival should focus on the adults of the large species. Published estimates of fish passage mortality (mainly for juvenile stages) are in the order of about 7% to 30% for dam turbines and from 1%

to 12% for other routes (bypasses and spillways). As for fish migrating upstream, the authors were unable to find evidence of engineering solutions that have achieved the minimum passage rates required to sustain even the small species.

'Conservation of fish diversity in tropical systems including the Mekong is likely to raise significant engineering challenges'

Whether considering downstream survival or upstream passage, the authors note that conservation of fish diversity in tropical systems including the Mekong is likely to raise significant engineering challenges for species with different behaviours and swimming capacities, which is often determined by body size. Moreover, the hypothesis that dams built in the upper reaches of rivers have less impact than those downstream assumes that the distribution of spawning habitats is either uniform throughout the range of the species, skewed towards downstream reaches or absent from upstream reaches (for related research into spawning habitats, see *Catch and Culture*, Vol 15, No 1). It also assumes that at least one discrete population of the species exists in the system. According to the authors, information about the distribution of spawning habitats and population structures in the basin is inadequate to determine if these assumptions are reasonable for most of the species examined. So regardless of their location, all dams should be regarded as a potentially significant threat to the viability of fish populations in the Mekong, particularly those of large species. Furthermore, fewer options to mitigate the barrier effects of dams may exist in the upper reaches of the basin, particularly where the channel is flanked by hills or mountains with steep channel gradients requiring higher dams.

Future work to improve the model

With the study now complete, the authors have proposed a second phase of modelling. This could include different assumptions about the distribution of spawning (and other critical) habitats along the mainstream and seasonally-determined population growth that reflects annual variations in water flow or other climate-dependent variables on growth, survival and reproductive success. Since the ten species modelled so far migrate entirely in freshwater, it was proposed that future models include freshwater fish that reproduce in the estuary or at sea to see if such catadromous species respond to mainstream dams in the same way. They also proposed a short-term basinwide survey to provide more reliable fishing mortality estimates for the model species and a short-term biological survey to estimate fish fecundity at length. To determine the population structure of threatened species, the authors note that mitochondrial DNA analysis appears to be promising, requiring little time and effort. Such analysis of mitochondria—the specialised structures in cells responsible for respiration and energy production—has already been conducted on two of the small model species, the Siamese mud carp and lesser silver mud carp (see *Catch and Culture*, Vol 12, No 3). To determine the population structure of the vulnerable species, a proposal is being prepared with Murdoch University for funding from the Australian Centre for International Agricultural Research to undertake further DNA-based research. Any future model development should also aim to update the existing blade-strike mortality model with turbine rotation speeds typical of the actual projects proposed for the Mekong once they have been specified by the developers and engineers.

Why do large tropical species have higher downstream mortality rates than salmon?

Attempts to mitigate dam impacts on Pacific salmon populations in the Columbia River in North America have been relatively successful compared with mitigation attempts in tropical systems—but only after 30 years of research and development at a cost of more than $7 billion (see *Catch and Culture*, Vol 15, No 1). An important reason for this success is that salmon are strong swimmers capable of negotiating ladders or bypasses. Another important reason may be that Pacific salmon is a semelparous species that dies shortly after spawning and is therefore not subject to the high downstream mortality rates predicted for large Mekong species. In river systems such as the Mekong, adults of medium and large-sized iteroparous species—those that reproduce more than once in their lifetime—may need to undertake several spawning migrations to maintain viable populations. It is these large fish that suffer significant mortality rates during their downstream passage through dams.

Selective **tilapia** breeding aims to improve **seed quality**, diversify **production**

Viet Nam has begun supplying Mekong Delta hatcheries with two strains of tilapia bred by the Research Institute for Aquaculture No. 2. The first , developed with the WorldFish Center and a Dutch university, aims to address problems related to inbreeding. The second, part of a collaborative venture with a Norwegian company, aims to do likewise while helping farmers to diversify their production in brackish waters of the delta.

Throughout the tropics, Nile tilapia *(Oreochromis niloticus)* is one of the most popular fishes for farming as well as stocking into dams and reservoirs. Native to the inland waters of Africa, this mouth-brooding species was introduced to Thailand from Japan in 1965 and to Vietnam from Taiwan in 1973 (and also from the Philippines and Thailand in 1994). Nile tilapia is now established in rivers and dams throughout the region. The Thai government hatchery in Khon Kaen has reared and distributed the GIFT strain of the species, named after the Genetic Improvement of Farmed Tilapia project of the WorldFish Center in the Philippines between 1988 and 1997. It has also been further developing the strain to meet local conditions (see MRC Technical Paper No. 9).

In 2005, the Research Institute for Aquaculture No. 2 (RIA 2) in Ho Chi Minh City began the first selective breeding programme for Nile tilapia in the Mekong Delta. At the time, another breeding programme for sutchi river catfish (*Pangasianodon hypophthalmus*) had already been running for several years (see page 13) although a separate programme to selectively breed the giant freshwater prawn *(Macrobrachium rosenbergii)* was still two years away (see page 14). “Tilapia has been imported into Viet Nam for a long time,” said Trinh Quoc Trong, a deputy director at the National Breeding Centre for Southern Freshwater Aquaculture in Cai Be in Tien Giang province. “We didn’t have good broodstock, quality management or seed control. The quality of seed has probably deteriorated because of inbreeding. The most harmful consequence of inbreeding is on traits such as growth and the health of the fish. So the idea is to improve the quality of the seed here in the Mekong Delta and the rest of Viet Nam.”

Nile tilapia strain

Working with the WorldFish Center and Wageningen University in the Netherlands, the project started with a base population of 50 full-pedigree families (1,200 individuals) from the 10th-generation of the GIFT strain developed in the Philippines. Supplied by the Malaysian headquarters of the WorldFish Center in Penang, the families were tagged and placed in two ponds with different environments. After reaching

Widely cultured

Tilapia are freshwater species indigenous to Africa. They are among the most widely cultured species in the world and are currently produced in Africa, Asia, Europe and the Americas. Tilapia are grown in a wide range of production systems spanning from very extensive pond cultures to extremely intensive cage or tank culture. About 2.3 million tonnes are produced every year of which three-quarters is farmed. The main producer is China with 80% of its production consumed within the country. Other leading producers are Egypt, Indonesia, Thailand and the Philippines. The main import market is the United States, which has recently seen soaring imports. The European Union and Japan are also important markets. Demand for fresh and frozen fillets has increased rapidly in the high-price markets for white fish, while frozen whole tilapia show average growth.

Sources: Akvaforsk Genetics Center, World Wildlife Fund

maturity, the project team selected 50 males and 100 females based on their estimated breeding value (EBV) heritability for bodyweight. Each male was mated to two females to produce 50 paternal half-sib families in accordance with the GIFT mating design[1] which allows phenotypic and genetic parameters to be calculated to estimate breeding values. Upon reaching 10 grams, 60 individuals from each family were tagged and transferred to a communal pond where they grew until harvesting size.

The programme is ongoing and currently has the capacity to produce 10,000 future broodstock and 15,000 fingerlings a year. So far, two generations have been established, the first in 2007 and the second in 2008. In early 2009, RIA 2 supplied a private hatchery in My Tho, acting as a multiplier, with broodstock which had produced 32 tonnes of fingerlings within a couple of months. The second generation had reached maturity by August this year, when RIA 2 and leading local feed supplier Proconco held a workshop for 25 farmers and producers at the breeding centre in Cai Be. By the end of 2009, RIA 2 was expecting to be supplying the genetically-improved tilapia to commercial farmers with the aim of marketing adult fish at 300-500 grams.

* * *

Red-throat tilapia *(O. urolepis mossambicus)*, also a mouth brooder, is one of the most widespread species used for farming and stocking reservoirs in the Mekong Basin. Native to southern Africa, it was introduced to Thailand from Malaysia in 1949 and to Viet Nam from Africa in 1951 and from the Philippines in 1955, the same year it was introduced from Thailand to Laos. The species may have formed established stocks in the basin including throughout the Mekong Delta. Two hybrids, known simply as “red tilapia”, have also been introduced. One is a cross between the red-throat tilapia and the Nile tilapia. It was introduced from Latin America via Florida. The second, a hybrid of Nile tilapia and another species known as hornorum tilapia (*O. hornorum*) is bred in central Thailand. Red tilapia is popular in Thailand and Lao PDR where it is farmed in cages (see MRC Technical Paper No. 9). Cage farming the hybrid species is also popular in the Mekong Delta. But like Nile tilapia in Viet Nam, the seed quality has been degraded resulting in slow growth, high mortality and disease.

New strain of red tilapia in Cai Be

Photo: Lem Chamnap

Red tilapia hybrid strain

In 2008, RIA 2 teamed up with Norwegian company Akvaforsk Genetics Center AS (AFGC), owned by Norway’s National Center for Veterinary Contract Research and Commercial Services (VESO), to develop a new strain of red tilapia. The aim was not only to improve the quality of red tilapia seed in Viet Nam but also to develop a strain for brackish water in the Mekong Delta. “Since they live in brackish water, they can be used in empty fish ponds,” Mr Trong said. “They can also be used to diversify the species farmed in brackish water. The red fish tolerate brackish water well, 25 ppt and higher, while the Nile tilapia cannot, making the red a preferred choice for brackish and sea water areas.”

The base population was formed from 100 full-pedigree families from the second-generation of a breeding programme in Ecuador. These red tilapia were developed from seven different strains including two second-generation strains from Colombia, a second-generation strain from Jamaica and another strain from Israel. To breed the first generation, the team selected 500 females and 250 males from 92 families along with another 200 females and 100 males for backup. Selection criteria included the largest individuals in each family and red or pink body colour.

The programme had produced 140 full and half-sib families by July this year and was planning to supply the same My Tho hatchery with 10,000 broodstock by the end of October. From 2010 onwards, the

programme hopes to disseminate 100,000 broodstock to hatcheries in the delta.

Mr Trong noted that red was a naturally-occurring mutant colour sometimes found in the skin and scales of red-throat tilapia. The pure red variety is particularly favoured in Viet Nam and elsewhere in Southeast Asia as well as other markets ranging from Fiji to Mexico where premium fish are often marketed whole. Other variations in body colour are pink, orange and albino. Since the red fish is believed to be slower growing than the others, Mr Trong said the current plan was to develop two lines of the new strain. The first strain would contain only the pure red variety for the whole-fish market. The second strain would contain all varieties of "red tilapia" and would be developed for growth performance only, mainly for export as fillets with the skin and scales removed.

[1] The design highlights the importance of avoiding the mating of closely-related individuals (sibs, half-sibs and cousins). It also stresses the need to avoid feeding females about to spawn, since this might cause them to swallow the eggs. If males are much larger than the females, they need to have their upper lips removed with a "mouth clipping" to reduce their aggressive behaviour.

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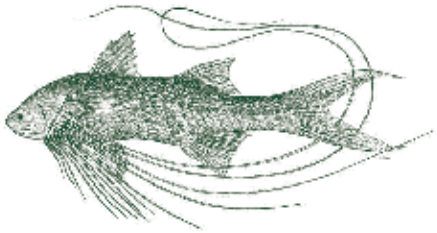

New projects at Research Institute for Aquaculture No. 2

Approved by Ministry of Agriculture and Rural Development to start in 2010

No.	Project Title	(VND mln)	Duration
1	Evaluation of effect of the realised breeding selection response for growth and fillet yield of sutchi river catfish (*Pangasianodon hypophthalmus*) and explorative study on selection for disease resistance	3,000	3 years
2	Establishment of a base population and estimation of the genetic parameters of red tilapia (*Oreochromis* spp)	2,970	3 years
3	Improvement of effectiveness of inactivated vaccines by heating shock of protein in vaccines	1,660	2 years
4	Study on procedures for diagnosis of infectious myonecrosis virus (IMNV) in white shrimp (*Liptopenaeus vannamei*) and Laem-Singh virus (LSNV) in black tiger shrimp (*Penaeus monodon*) and producing their test kits	1,200	2 years
5	Research on probiotics antagonistic to bacteria *Ewardsiella ictaluri* for prevention of white spot disease in catfish (*Pangasianodon hypophthalmus*)	1,200	2 years
6	Research on enzyme technologies on production of collagens from skin of catfish (*Pangasianodon hypophthalmus*)	1,200	2.5 years
7	Research on recirculation technologies in intensive culture of catfish (*Pangasianodon hypophthalmus)* for ensuring bio-security and environmental protection	3,000	3 years
8	Application of bio-technology in improvement of fecundity of black tiger broodstock (*Penaeus monodon*) in captivity	2,000	3 years
9	Breeding selection of giant prawn (*Macrobrachium rosenbergii*) for growth by family selection	2,500	3 years
10	Establishment of disease surveillance systems of shrimp and catfish culture in the Mekong Delta.	1,600	2 years

Viet Nam to **accelerate distribution** of **improved** catfish **broodstock** to delta

By Nguyen Van Sang *

The third phase of Viet Nam's selective breeding programme for one of the world's most widely-traded fish species is now underway. The Research Institute for Aquaculture No. 2 has been tasked with the job of meeting industry requirements for improved stocks in the Mekong Delta within three years.

The Research Institute for Aquaculture No. 2 (RIA 2) started its selective breeding programme for sutchi river catfish *(Pangasianodon hypophthalmus)* with a project funded by the Support to Aquaculture (SUFA) programme of the then Ministry of Fisheries and the Danish aid agency Danida. The aim of the project, which ran from 2001 to 2005, was to improve growth by individual selection and fillet yield by family selection. Three first-generation stocks were established from base populations selected in 2001, 2002 and 2003 (see *Catch and Culture*, Vol 13, No 2).

The breeding programme continued with a three-year project funded by the Ministry of Agriculture and Rural Development from 2006 to 2008. This project produced 162, 208 and 183 second-generation families from the same base populations respectively. Heritability was high for growth rate (0.43-0.54) and low for fillet yield (0.04-0.12). For the first generation, the realised response was about 13% for growth rate. For the second generation, the expected selected response rate is about 21% for growth rate and 2% for fillet yield. Overall, the project disseminated 10,000 improved broodstock from both generations to several hatcheries in the Mekong Delta.

To estimate the realised response rates for the second generation, the Ministry of Agriculture and Rural Development has approved a further project to be carried out from 2010. The three-year project also aims to further improve and stabilise the selection response for growth on the third generation while selecting and supplying 10,000 broodstock from this generation to the industry. To speed up the distribution of broodstock to producers in the Mekong Delta, the ministry has asked RIA 2 to propose a dissemination program for 2009-2011 with the aim of supplying 30,000 pairs of broodstock a year which would satisfy industry requirements within three years.

Stripping catfish eggs

Photo: Nguyen Van Sang

In addition to growth rate and fillet yield, RIA 2 aims to include disease resistance into its breeding goals. In 2008 and 2009, work was carried with 81 families from the second generation to estimate the genetic variation of resistance to white spot disease. To confirm the genetic variation of the trait, this work must be repeated on a large number of families in the coming years

** Mr Sang is a deputy director of the National Breeding Center for Southern Freshwater Aquaculture in Cai Be*

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Selective **breeding** programme for **giant freshwater prawns** extended to **2012**

The Vietnamese Ministry of Agriculture and Rural Development has approved $120,000 in additional funding for a promising new research programme started in collaboration with the WorldFish Center in 2007. The funding for 2010 to 2012 is almost four times the amount invested over the first three years.

Common names for crustaceans can sometimes be as misleading as those for fish. Take the giant freshwater prawn *(Macrobrachium rosenbergii)*, also known as the giant river prawn or giant freshwater shrimp. Distributed across a wide range from India to the Philippines and northern Australia, the species has been known to science since 1705 and was given its scientific name by a Dutch biologist in 1879. With male individuals reaching up to 32 cm from tail to claw, this freshwater prawn is indeed a giant. But since females migrate downstream to estuaries where their eggs hatch as free-swimming larvae, it's not a pure freshwater species. The larvae also require brackish water to survive as they pass through a number of stages over several weeks before metamorphosing into post-larval juveniles, also known as postlarvae (PL). A week or two after metamorphosis, the juvenile prawns start migrating upstream to freshwater conditions in rivers, lakes, canals and ponds.

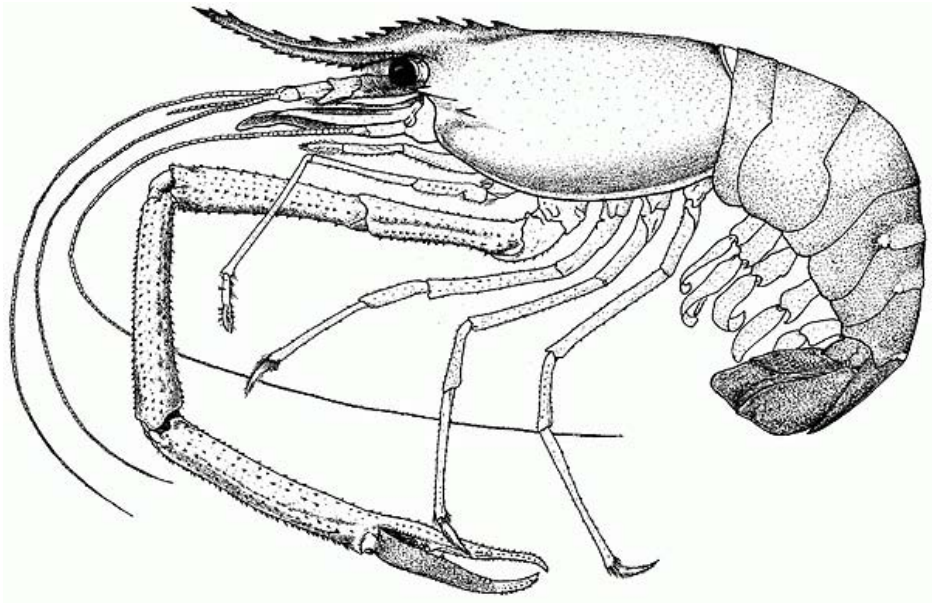
Early pioneers

According to the Food and Agricultural Organization of the United Nations (FAO), it was this discovery in Malaysia that led to modern farming of the species in the early 1960s and the first commercial giant freshwater prawn farms in Hawaii and elsewhere in the 1970s. While Thailand and Taiwan were among the early pioneers, commercial farming has since spread to about 40 countries with significant increases in global production, especially since the mid-1990s. According to the FAO, major producers of more than 200 tonnes a year included Bangladesh, Brazil, China, Ecuador, India, Malaysia, Taiwan and Thailand in 2002. The FAO considers Viet Nam a "significant" producer,

'The FAO considers Viet Nam a "significant" producer'

Two species

In 2007, the Raffles Bulletin of Zoology of the National University of Singapore published the results of a study confirming that what has been called *Macrobrachium rosenbergii* actually belongs to two separate species. In the strictest sense, the authors said, *M. rosenbergii* occurs in Australia, Papua New Guinea, eastern Indonesia and the Philippines. The paper identified the second species, occurring in South Asia and other parts of Southeast Asia including the Lower Mekong Basin, as *M. dacqueti*. This is the widely-cultured species.



Giant freshwater prawn

Illustration: FAO

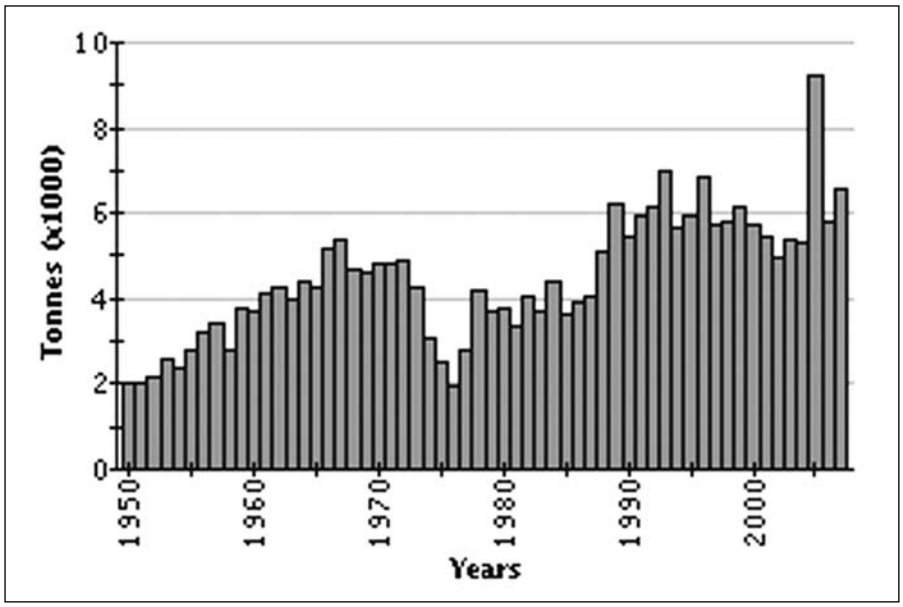
although production is masked in a broader category of statistics reported to the UN agency. Researchers from Vietnamese and Japanese universities have, however, estimated that Viet Nam's production grew from about 2,500 tonnes a year in the 1990s to more than 10,000 tonnes in 2002, with more than 90 hatcheries in the Mekong Delta producing 76.5 million post-larval juveniles in 2003.

To appreciate the scale of commercial farming of this species, the FAO estimates the global catch of giant freshwater prawns from capture fisheries to have fluctuated between about 2,000 tonnes and 9,000 tonnes since 1950 (see Figure 1 on opposite page). Production from aquaculture surpassed capture production in the mid-1980s, exceeding 20,000 tonnes in 1990 and 100,000 tonnes in 2000. By 2007, the global harvest from aquaculture excluding Vietnam was more than 200,000 tonnes (see Figure 2 below). The value of production was estimated at close to $1 billion the same year.

'Two of the strains were from Viet Nam—from the Mekong and Dong Nai Rivers—while the third came from Malaysia'

Figure 1 **Global catch**

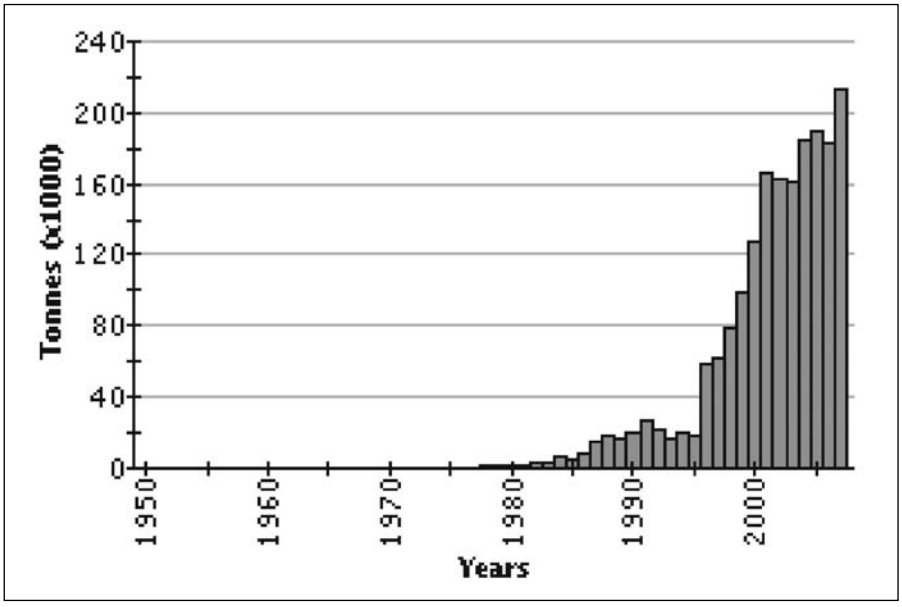
World capture production of giant freshwater prawns



SOURCE: FAO

Figure 2 **Global culture**

World aquaculture production of giant freshwater prawns excluding Viet Nam



SOURCE: FAO

Three strains

Such was the status of the global giant freshwater prawn industry in 2007 when the Research Institute for Aquaculture No. 2 (RIA 2) in Ho Chi Minh City launched a selective breeding programme to improve growth performance of the species on Vietnamese farms. Working in collaboration with the WorldFish Center, which provided modest funding of $7,500 for the first year, scientists selected three strains of the prawns to prepare broodstock for breeding the following year. Two of the strains were from Viet Nam—from the Mekong and Dong Nai Rivers— while the third came from Malaysia, the country where experimental larval rearing first took place four decades ago.

With additional funding of $7,500 from the WorldFish Center and VND 100 million ($5,500) from the government in Hanoi, RIA 2 produced 80 families of giant freshwater prawns in 2008. The families were produced in a complete diallel cross, a mating design commonly used by plant and

Visible **implant** elastomer **tags**

By Dinh Hung, David Hurwood, Nguyen Thanh Vu and Peter Mather *

Research on high-value cultured aquatic species shows that family selection is one of the most efficient approaches for achieving sustainable genetic gains over time. A basic prerequisite for family selection is the ability of tags to identify individuals by the family to which they belong. This will depend on developing efficient tagging methods. Various physical tags have been applied successfully to fish and some molluscs. Since tags should be applied at the earliest possible stage, many are inappropriate for crustaceans because juveniles are generally much smaller than fish when they need to be tagged. Tags can also be lost when crustaceans moult.

The RIA 2 breeding programme for giant freshwater prawns requires a large number of families to be tagged. Under a trial conducted by the programme, juveniles of 2 to 4 grams were tagged at four potentially suitable positions on the left and right sides of the first and sixth abdominal segments. Five different elastomer colours were used and each juvenile was given two tags with different colour combinations or tag codes. Following tagging, individuals were kept in fibreglass tanks with aeration and survival monitored over three days. Tagged prawns were reared for 16 weeks in hapas followed by six weeks of culture in earthen ponds.

Tag retention and readability

The 1,870 prawns harvested were checked for tag retention and readability. In addition, a blind test was applied to 310 prawns where five assessors independently scored each prawn's tag code. A sixth person recovered the tags by dissection to record the correct code. Survival after tagging was as high as 100% and the tag retention ratio was 99.1%. Out of 1,550 assessments recorded in the blind test with 310 prawns, 89 individuals scored incorrectly (see Table 1). The most common mistake made was scoring pink tags as orange, contributing to 50% of all errors. Most of the errors due to scoring tags in incorrect positions occurred with prawns tagged in the sixth abdominal segment (see Table 2).

Table 1 **Errors by assessor**

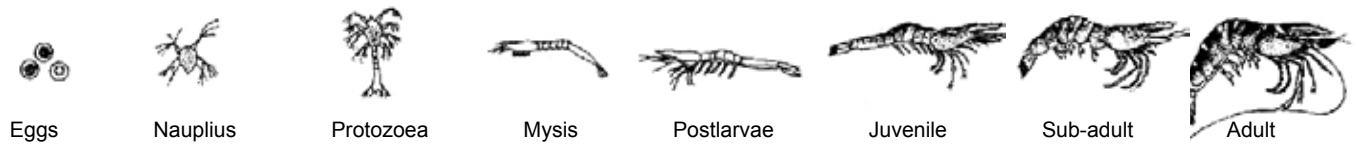
Assessor	1	2	3	4	5
Errors	9	16	29	15	20

Table 2 **Errors by tag position**

Tag position	6 L	6 R	1 L	1 R
Errors	44	22	12	15

The error rate of 6% could be reduced considerably by replacing one of the colours used (removing the pink tags or using another colour, for example). This should reduce the error rate by about 50%. Similarly, reducing the number of tag positions in the sixth body segment from two to one may also significantly reduce the error rate. Relying on only four colours would cut the number of families with unique codes for the breeding programme to 96. Four colours with only three tag positions would further reduce the number to 48.

** Mr Hung and Mr Vu are researchers at the Research Institute for Aquaculture No. 2 in Ho Chi Minh City. Dr Hurwood is an associate lecturer and Dr Mather an associate professor at the School of Natural Resource Science at Queensland University of Technology in Brisbane. The article is based on a poster presentation to an international symposium on genetics in aquaculture in Bangkok in June.*



Life cycle of a giant river prawn

animal breeders to evaluate founder populations and establish synthetic populations for selection. In this case, nine crosses were conducted to ensure that all possible combinations of maternal and paternal parents from the three strains were used. When the first-generation juveniles reached 1-2 grams, they were tagged using visible implant elastomer (VIE) tags (see box on previous page) and transferred to 10 hapas, small net enclosures in shallow ponds that are used to nurse young aquatic animals. Five hapas were used for each sex and all families were represented in each hapa. The juvenile prawns were later transferred to two 2,000m² ponds which were aerated daily with the water changed once a week.

Second generation

By the time the prawns reached maturity at the beginning of 2009, the tagging retention rate was more than 95%. Based on their estimated breeding value, RIA 2 scientists then selected individuals from each family for broodstock to develop a second generation of 105 families this year with additional funding of VND 150 million ($8,300) and $5,500 from the WorldFish Center. The mating scheme for the second generation was to mate between genetically-unrelated broodstock to produce full-sib and half-sib families. The post-larval juveniles from this second generation were being nursed in August when the Ministry of Agriculture and Rural Development approved an additional VND 2.15 billion ($120,000) in funding for the programme between 2010 and 2012. RIA 2 scientists have since tagged 104 families from this second generation for communal stocking in ponds The process is to be repeated in 2010 and further refined in the following two years. RIA 2 also plans to carry out genotype by environment interaction (GEI) tests in pond and rice field culture, the two main culture systems in Viet Nam. When the genetic parameters of the species are well documented and estimated, RIA 2 plans to disseminate the genetically-improved strain of giant freshwater prawn to farmers, especially in the Mekong Delta.

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Viet Nam begins **commercial production** of **all-male** giant freshwater **prawns**

By Nguyen Van Sang *

With monthly production of 'neo-female' broodstock targeted to reach 6,000 in December, the Research Institute for Aquaculture No. 2 expects to meet a quarter of the delta's demand for post-larval giant freshwater prawns from 2010

Using technology transferred from Israel's Ben Gurion University, the Research Institute for Aquaculture No. 2 (RIA 2) in Ho Chi Minh City developed surgical procedures to reverse the sex of male freshwater prawns (*Macrobrachium rosenbergii)* to "neo-females" between 2002 and 2004. Neo-female prawns can mate with normal males to produce all-male offspring, which are favoured by farmers for their superior growth rate (see *Catch and Culture*, Vol 13, No 1). Between 2006 and 2008, RIA 2 undertook trials of all-male mass production funded by the Ministry of Agriculture and Rural Development. The trials produced 25,000 neo-females and five million all-male post-larval prawns, confirming that production on a commercial scale could be profitable.

RIA 2 has now started commercial production of the neo-female prawns at the National Breeding Center for Freshwater Aquaculture in Cai Be in Tien Giang province. Since March this year, neo-females have been transferred to a commercial hatchery in Dong Thap province which produces all-male post larvae for farmers. If the National Breeding Center's production targets are met, more commercial hatcheries in the Mekong Delta are likely to start receiving neo-females in 2010.

During the first half of 2009, the National Breeding Center successfully trained ten new technicians from vocational schools in Vinh Long and Tra Vinh provinces. With more staff able to perform the delicate surgical procedures, our target is to reach monthly production of 6,000 neo-females in December, up from 1,000 in March with only two technicians. At such a rate, annual production of neo-females for commercial hatcheries will double from an estimated 36,000 in 2009 to 72,000 in 2010, covering about 25% of the Mekong Delta's annual requirements for post-larval giant freshwater prawns.

** Mr Sang is a deputy director of the National Breeding Center for Southern Freshwater Aquaculture in Cai Be*

A technician performing the surgical procedure on a male giant freshwater prawn

Photo: Lem Chamnap

Farmers of the delta, **unite!**

By Peter Starr *

To improve their bargaining power with catfish feed companies, processors and buyers, small farmers in the Mekong Delta are being encouraged to unite as they adopt better management practices which are now being tested by ten producers. After trials in An Giang, Dong Thap and Vinh Long provinces and Can Tho City, the guidelines are expected to be formally adopted at a national conference on better farming practices in mid-2010.

When the United States imposed anti-dumping duties on imports of Vietnamese catfish in 2003, farm-gate prices in the Mekong Delta crashed. For many farmers, margins that were already razor thin suddenly evaporated, prompting widespread bankruptcies (see *Catch and Culture*, Vol 9, No 2). The industry soon rebounded, however, as processors found new markets beyond America, notably Europe but also other Asian countries, the Middle East, Latin America and Australia. Five years later, both farmers and producers were squeezed by hikes in interest rates as the State Bank of Vietnam moved to rein in galloping inflation resulting from an overheated economy. That led to another downturn in catfish prices accompanied by a slump in the share prices of processing companies (see *Catch and Culture*, Vol 14, No 2). With prices under additional downward pressure with much of the world in recession and a temporary import ban by Russia, the United Nations Food and Agriculture Organisation (FAO) reported that 90% of catfish farmers suffered losses in 2008, leaving up to 50% of grow-out ponds lying empty. Yet the FAO publication Globefish noted that the industry was "still in a bonanza phase" with exports increasing 48% from a year earlier to almost $1.5 billion in 2008 and prices rising in the first few months of 2009. In May, Globefish said that demand for Vietnamese catfish "should be good in these times of economic crisis, where consumers are looking for inexpensive products." For careful consumers, catfish fillets were "ideal products" for the America and Western European markets.

Unwanted competition

Despite the positive outlook, Vietnamese catfish prices resumed falling in the second half of the year, reportedly depressed by declining prices for competing species such as Nile perch from Lake Victoria in eastern Africa. "All over the world, local fishermen are complaining that the fish from Viet Nam is creating unwanted competition by undercutting prices substantially," Globefish reported in July, adding that Vietnamese catfish fillets were probably the only fillets available in Europe at less than 10 euros per kilogram. By September, the Vietnamese newspaper *Lao Dong* reported that as much as 80% of farmers were still suffering losses in An Giang province, the country's top catfish producer. Phan Van Danh, chairman of the An Giang Fisheries Association, was quoted as saying that banks were still reluctant to lend to catfish farmers because of the high risks involved. "With high commercial prices and low selling prices, farmers cannot get any benefits," Mr Danh reportedly said. In Ben Tre province, most catfish farmers had lost interest and many farm sites had been rented out or sold to processors. "In Tien Giang, the situation is the same," the newspaper said.

Has the extraordinarily rapid growth in production, up fifty-fold over ten years, reached its limit and for how much longer can Vietnamese catfish compete on price alone? At workshops to discuss better management practices in Cao Lanh and Can Tho in October, participants indicated that the industry was still in deep turmoil and not sustainable at such low prices. Philippe Serene, managing director of leading Vietnamese feed supplier Proconco, said his company received only 8% of the catfish retail price of about $10 a kilogram in Europe whereas processors got 31% of the final price. "This is completely unacceptable," he told the first workshop in Cao Lanh, the capital of Dong Thap province. Other estimates show that processors get only 20% of the retail price (see table on page 22). "The catfish production system is not developing, it's just growing year by year," the manager of one cooperative told the second workshop in Can Tho. "A lot of people have lost a lot of money and are getting killed by lower prices," he said. "It's not just the farmers, it's also the processors." Can Tho Import-

Snapshot of an **industry under pressure**

A survey of almost a hundred sites in the Mekong Delta shows why catfish farming practices need to be improved

The catfish industry supports more than 220,000 people in the Mekong Delta. Farming alone employs the equivalent of more than 105,000 people full time. Processing provides another 116,000 jobs, mostly to rural women. By 2015, farming and processing are projected to employ more than 250,000 people. If other manufacturing and services such as feed production, transport, packaging and freezing are included, activities subsidiary to farming are estimated to provide 10% of jobs in a region with more than 17 million people. On a global basis, Vietnamese exports of sutchi river catfish (*Pangasianodon hypophthalmus*) are today sold in more than 100 countries and annual production of more than 1 million tonnes now rivals that of farmed salmon and shrimp.

Vertical integration rare

But what does the average catfish farm look like and how is it run? As part of a project to improve management practices, the Research Institute for Aquaculture No. 2 in Ho Chi Minh City did a survey last year with colleagues from the College of Aquaculture and Fisheries at Can Tho University, the Network or Aquaculture Centres in Asia-Pacific in Bangkok and the Department of Primary Industries in the Australian state of Victoria. The project is part of the Collaboration for Agricultural Research and Development programme of the Vietnamese and Australian governments. Conducted between May and July in 2008, the survey covered 89 farms and 98 farm sites in the four main administrative areas for catfish production. Published in *Aquaculture**, the findings show that the average size of farms surveyed was about 4 ha with a water surface area of 2.7 ha. Each farm had an average of 4 ponds, with the average size being 0.6 ha. Overall, 72% of the farms were smaller than 5 ha and only 9% were 10 ha or more. In other words, catfish was farmed intensively but most farms are small and owned, operated and managed by farmers themselves. Farming was rarely vertically integrated; grow-out farms, nurseries and hatcheries operated separately and were even somewhat specialised in some areas.

Of the 98 sites surveyed, 80% got their water from the main branches of the Mekong. But only 6% screened inflows and only 3% used sedimentation ponds before supplying water to fish-rearing ponds. To treat the bottoms of ponds before filling them with water, 96% of farms used liming, 82% removed sludge, 71% applied salt and 57% used chlorine. Products used to treat pond water before stocking included chlorine (29% of farms surveyed), lime (27%), benzalkonium chloride (15%) and salt (11%). The average size of fingerlings stocked in ponds was 7.8 cm while stocking density averaged 48 fish/m^2 (equivalent to 12 fish/m^3). Before stocking, more than 90% of the farms tested fish for uniformity in size, disease and general activity. Three quarters of the farms stocked their ponds on a staggered basis over short periods and treated fingerlings before stocking. Treatments included salt (78%) and antibiotics (32%).

Selected delta catfish producers, 2008

Operating farms (& farms surveyed) in main catfish farming areas

Province	Grow out	Nurseries	Hatcheries
An Giang	2,891 (24)	1,041	—
Can Tho*	1,569 (15)	100	83
Dong Thap	636 (30)	4,300	—
Vinh Long	346 (20)	94	4

* Acreage of grow-out farms (ha)

Commercial vs farm-made feed

While 97% of farms were found to use commercial feed bought from feed mills or merchants, 37% also used farm-made feed of which almost half was produced on site. The use of farm-made feeds occurred at more than half the farms surveyed in An Giang and Can Tho but less than a fifth of the farms in Dong Thap and none in Vinh Long. The survey found that the quality of both commercial and farm-made feed was highly variable in terms of protein content. Main ingredients in farm-made feed were trash marine fish, fishmeal and powdered or crushed dried fish from fresh and brackish waters of delta floodplain areas as well as soybean meal, broken rice and rice bran. Farm-made feeds also included vitamins, probiotics, prebiotics and premixes. Feeding rates ranged from 1 to 18% of fish body weight a day for commercial feeds and 1 to 10% for farm-made feeds. Feeding rates for farm-made feeds were generally greater than those for commercial feeds. Fish

were typically fed twice a day but sometimes as often as six times a day. The food conversion ratio—the amount of feed used divided by the increase in biomass of the fish—averaged 1.7 for commercial pellets and 2.3 for farm-made feed.

Although three quarters of the farms monitored pond water quality for parameters such as acidity and alkalinity, dissolved oxygen and ammonia, frequency of monitoring ranged from daily to once a month. Frequency of water exchanges ranged from as little as once a week during the first two months after stocking, increasing to as much as twice a day, especially close to harvest time. Replenishments ranged from 30% to 100%. More than 80% of the farms discharged water directly into the main branches of the river or primary canals and 11% discharged the water to rice fields or gardens. Only 8% screened water before discharging and 11% usually treated discharge water with chlorine or lime.

High yields

Crop yields ranged from 70 to 850 tonnes a hectare, averaging a bit more than 400 tonnes a hectare (equivalent to about 2 to 23 tonnes for each 1,000 m^3 of water, an average of more than 10 tonnes). Three quarters of the farms yielded more than 300 tonnes a hectare. Up to 30% of fish died within a week of stocking, with an average mortality rate of 7%. Mortality rates were typically as high as 30% during the early to middle months of the 6-7 month production cycle, dropping to less than 10% in later months. The main reasons were disease and poor weather, especially in June and July. Health management practices mainly involved chemical treatment, often with antibiotics, along with feed additives such as Vitamin C and regularly changing pond water. Dead fish were mainly buried or sold and—disturbingly— 30% of farms sold dead fish to other fish farmers. Harvesting was done by draining up to 80% of the water from the pond and generally completed in four days. The catfish weighed between 0.6 to 1.5 kg at harvest, averaging 1 kg.

Most farm owners and managers were less than 50 years old, although ages ranged from 23 to 65. The average farm had 11 workers of whom about one in five were family members. Females averaged 10% of the workforce and were involved in a wide range of activities. Two thirds of the farmers said their standard of living had increased since taking up catfish farming but only 11% planned to expand their farms, largely due to unstable or low fish prices. In An Giang province alone, the amount of land devoted to catfish farming fell by almost 20% in the year to May, 2009, amounting to more than 270 ha. Fixed costs of running farms varied from as little as VND 7 million to more than VND 15 billion (about $440 to $940,000 at the time of the survey), largely reflecting pond construction and land purchases. Next came storage and facility costs. Operating costs ranged from VND 84 million to VND 47 billion ($5,300 to $3 million) with feed averaging 75% of total costs and seed averaging 12%. For each kilogram of fish, production costs ranged from VND 11,000 to VND 17,000 ($0.69 to $1.07) and averaged VND 14,200 ($0.89).

Further expansion likely to be small

While Viet Nam has targeted catfish production to reach as much as 1.5 million tonnes with an export value of $1.5 billion in 2009, the study concluded that the industry's growth has probably peaked. Given the high prices for riverfront land and growing competition with other sectors such as tourism and upmarket real-estate development, any further expansion is likely to be small. But the authors argued that catfish farmers could improve production by adopting better management practices as shrimp farmers already had in the Indian state of Andra Pradesh. Among immediate management measures, they stressed the importance of introducing a planned and well-managed system of water intake and discharge farms clustered into groups according to location. At the same time, improving feed quality was "urgently warranted" given that commercial feed was not performing significantly better than farm-made feeds. Further improvements in the way effluent is discharged are also needed, possibly through the introduction of sediment ponds before discharge.
To ensure that catfish farming can be sustained, the authors also highlighted the need for adaptive measures to deal with climate change over the next decade or so. Moreover, developing salinity-tolerant strains of catfish and making associated changes in hatchery production should be done "sooner rather than later."

* Phan, L.T., Bui, T.M., Nguyen, T.T.T., Gooley, G.J., Ingram, B.A., Nguyen, H.V., Nguyen, P.T., De Silva, S.S. (2009). Current status of farming practices of striped catfish, *Pangasianodon hypophthalmus,* in the Mekong Delta, Vietnam. *Aquaculture* 296: 227-236.

Export Seafood Joint Stock Company (Caseamex) is a prime example. With annual sales of $40 million, the company's catfish processing plant in the city's O Mon district employs 1,600 workers who process 60,000 tonnes of raw material a year. Nguyen Chi Thao, the company's deputy managing director, said Caseamex was barely breaking even buying catfish from farmers at between VND 14,800 and VND 15,200 ($0.82 and $0.84) and processing them into frozen fillets for export to markets as diverse as Europe, India and Latin America. Moreover, Mr Thao said that selling catfish by-products to feed companies to process into fishmeal or fish oil was more profitable, fetching between VND 2,500 and VND 4,500 ($0.14 and $0.25) per kilogram. With a little negotiating clout, however, it is the small farms have been among the hardest hit by low prices. "There are about 60 processing plants in the delta and plants face competition to offer low prices to buyers," one farmer told the Cao Lanh workshop. "Importers want quality and prices are going lower and lower. Farmers feel like they're fish on a chopping board." Another complained about "how cheaply we sell our labour and knowledge."

Challenge to small farmers

Who gets what

Based on final catfish fillet sales price of $7/kg

Link in value chain	%
Farmer	10
Collector	10
Processor	20
Trader	20
Retailer	40

Source: Globefish

In such a difficult climate, small farmers as well as hatcheries and nurseries are being urged to adopt the better management practices unveiled to producers at the two workshops in October. To increase their negotiating power with feed companies, processors and buyers, they are also being encouraged to cluster together in groups based on location. Developed under an Australian-funded project, the 28 practices proposed were drafted by a project team from the Department of Primary Industries in Melbourne and the Network of Aquaculture Centres in Asia-Pacific (NACA) in Bangkok in collaboration with the Research Institute for Aquaculture No 2 (RIA 2) in Ho Chi Minh City and the College of Aquaculture and Fisheries at

Caseamex workers packing frozen catfish for export in October

Photo: Lem Chamnap

Can Tho University. As part of the process, the project team undertook an extensive survey of almost 100 farms in the delta in 2008 (see pages 20 and 21). And to get a first-hand look at how Indian shrimp farmers had adopted better management practices based on groups of farms, NACA facilitated a visit to the southeastern states of Andra Pradesh and Tamil Nadu by Vietnamese catfish farmers in mid-2009. "Normally, farmers go to other countries to learn new techniques," NACA Director-General Sena De Silva said. "In this case, we thought it would be good to get some Vietnamese farmers to see some of the social aspects of how Indian farms are organised and how they could be implemented in this country."

Despite negative publicity about quality in some markets such as Australia, France, Germany and Russia, Dr De Silva reassured farmers that they should be proud of their industry whose production is now equivalent to 70% of the total output of European fish farms. "Catfish farming in the Mekong Delta is very unique. It has the highest productivity per hectare in the world. But as with any biological system, you begin to see problems cropping up as productivity increases. Globalization, markets, consumer demand and other physical factors come into play. To face these global challenges, you need to be proactive if you're going to survive in the long term," he told the Cao Lanh workshop. Dr De Silva also stressed the importance of not confusing better management practices with standards required by international certification bodies.

"Better management practices are what you do. They are practices that are being improved all the time," he said. "Standards are something that external forces impose upon you. But if you end up with proper management practices as individuals and groups, you can satisfy all the standards in the world. It's been proven with shrimp farmers in India where the farms are much smaller and the farmers are less rich and less educated. In a nutshell, better management practices are a gateway to meeting all standards."

'Farmers feel like they're fish on a chopping board'

Helga Josupeit, the Rome-based Globefish correspondent for freshwater species, agrees on the need for better practices. She reckons that the Vietnamese catfish sector is "moving from a booming industry into a more mature phase" and that European importers are the driving force. "Producers have to improve their quality and their business practices, in order to maintain their markets in Europe." Quality problems such as those reported by a German consumer journal in late 2008 "will lead to more consumer resistance," Ms Josupeit warned in early 2009. "The low price alone will not be able to maintain the EU market." Indeed, the Globefish correspondent argued that price cuts were at the expense of quality. Intense competition was resulting in the excessive use of additives and glazing, the process of applying cold water after freezing to form a protective layer of ice to prevent fish from drying in cold storage. It's feared that such practices will erode the quality of catfish fillets, ultimately resulting in consumer dissatisfaction. "As for all other major seafood items, importers will start to control more the quality being offered, and establish good working relationships with trustworthy companies in Viet Nam," she said, adding that an industry shakeout was imminent.

Indian model

Will the parlous state of the catfish industry serve as the catalyst for change as disease outbreaks did for Indian shrimp farmers in the early part of the decade? Under a programme dating back to in 2001, NACA worked with the Marine Products Export Development Authority of India's Ministry of Commerce and Industry to develop better management practices and organise farmers into self-help groups. After conducting trials with five farmers with seven hectares of ponds in 2002, the first group was established in Andra Pradesh in 2003. It had 58 small farmers with 108 ponds yielding 22 tonnes of black tiger shrimp a year. By 2006, the programme had been extended to the states of Gujarath, Karnataka, Tamil Nadu and Orissa with 28 groups representing 750 farmers with 1,370 ponds producing almost 900 tonnes a year. To provide technical support and help the farmers produce quality shrimp in a sustainable manner, the export development authority set up the National Centre for Sustainable Aquaculture (NaCSA) in 2007. Today, the four southern Indian states have no fewer than 400 groups of shrimp farmers with 350 in Andra Pradesh alone. Eight years on, the effort to get groups of small farmers to adopt better management practices seems to be paying off. In October, the Indian export development authority signed a $2.3 million deal to promote Indian shrimp in North America through a co-branding agreement in New Delhi with leading food distributor Sysco Corp. With sales approaching $38 billion in 2008, the Houston-based company reportedly has the capacity to absorb almost 10,000 tonnes of shrimp from India each year.

To share India's experience with Vietnamese farmers, NaCSA Regional Coordinator AB Chandra Mohan attended the two workshops in Cao Lanh and Can Tho to explain how better management practices had evolved with shrimp farmers clustered into groups known as "Aqua Farmer Welfare Societies" in India. In presentations, he noted similarities between Viet Nam and India where 90% of shrimp farmers are small producers. In addressing food safety and quality issues, they were largely disorganised and lacked communications with other stakeholders. Like the Vietnamese farmers, the main constraints to Indian farmers included a lack of credit, rising production costs and poor access to markets. Unlike the Vietnamese, however, disease was also a major constraint. Under the cluster approach, groups of 20 on 75 farmers now place advance bulk seed orders with government-registered hatcheries 45 days before stocking their ponds. Broodstock and seed are screened for white spot syndrome virus (WSSV) and monodon baculovirus (MBV). To minimise stress and further reduce the risk of disease, groups of farmers adopted uniform stocking densities. By working together, farmers are now able to reduce costs by

hiring machinery as a group and sharing the costs of cleaning common intake channels and outlets. NaCSA hopes to quadruple the number of farmer groups to 1,400 societies with 75,000 farmers before its current mandate expires in 2012. "Cooperation between farmers is the key to success," Mr Mohan said. In India's experience with shrimp farmers, "better management practices provide strong incentives for positive change. There's a way to address all issues involved in farming".

Government roles

After abandoning its approach to collective farming two decades ago, is the Vietnamese government ready to support such a cluster approach for catfish farmers in the Mekong Delta? What's clear is that the Indian government's export development authority, established in 1972, has been much more pro-active than the Vietnam Association of Seafood Exporters (VASEP), a non-governmental organisation set up in 1998 which effectively acts as an export cartel. Tran Anh Dung, director of the Fisheries Sub-Department in An Giang province said the two organisations were "similar" but that the Indian agency "takes care of farmers which is not the same as VASEP in Viet Nam." Mr Dung, who accompanied Vietnamese farmers on their visit to Andra Pradesh and Tamil Nadu earlier this year, also noted other differences from Viet Nam. "My feeling from these two states was that the farmers were much poorer than Vietnamese farmers. The scale of farms was very small at around 1,000 to 2,000 square metres. There were hardly any farms of more than one hectare," he told the Can Tho workshop.

"Because of the disease problem, most farms collapsed and didn't have the capacity to revive themselves. The government supported these shrimp farmers by providing funds and working in conjunction with all service providers to revive their farming system to resume their livelihoods," Mr Dung said. "During the earlier period of low catfish prices in Viet Nam, the government also supported catfish farmers. But the support was indirect and went to the processors, not the farmers. In India, the National Centre for Sustainable Aquaculture Development has responsibility for providing support directly to farmers including marketing issues and many other factors to improve their farming practices. It's very different from Viet Nam. We have associations here and there but they are not structured and support to farmers is ineffective. In India, NaCSA influences the government and the international market by helping farmers take good quality products to the market and get premium prices. NaCSA is a key player in helping farmers to market products developed with better management practices." Mr Dung also noted that buyers now came directly to the Indian shrimp farmers. "The buyers then contract the processors to process the product according to their requirements," he said. "How we move forward in Viet Nam is important. We need to involve many players including the government. But how to support farmers effectively is another problem and I hope we can improve our system so farmers have a say in negotiating the prices of the products they offer."

What did the farmers themselves think? "While certification standards are very difficult for farmers to implement, better management practices don't look so difficult to apply," one farmer told the Cao Lanh workshop. "From the Indian experience, we've learned that the farmers have the power to negotiate prices. Vietnamese catfish farmers should be able

Ms Ro, head of a breeding federation, at the Cao Lanh workshop
Photo: Lem Chamnap

to achieve the same level of success as Indian farmers." Others expressed doubts, or voiced the need for strict regulations and even new laws. "I hope recommendations will be made to the Vietnamese government for legislation to cover the legal aspects of the value chain of catfish production," another farmer said.

Pilot producers

To test the feasibility of the better management practices discussed at the Cao Lanh and Can Tho workshops, ten producers volunteered to test the practices on their grow-out farms, hatcheries and nurseries. Tran Van Hung, managing director of Dong Thap processing company Hung Ca Ltd, offered to test the practices on farms covering 100 hectares, amounting to 40% of the company's farm area. Nguyen Thi Ro, head of the Fish Breeding Federation of Dong Thap Province, volunteered to do likewise with 50 hectares of hatcheries and nurseries. Grow-out farmer Le Van Hai, also from Dong Thap, allocated 5 hectares of catfish farming land while the Fisheries Cooperatives Association of Mang Thit District in Vinh Long province offered to test the practices on a pilot area of 2 hectares. In Can Tho, volunteers comprised grow-out farmers Nguyen Ngoc Hai (6 hectares) and Vo Van De (7 hectares) as well as nursery and grow-out company Song Hau and grow-out and processing company Thuan Hung (5 hectares each). In An Giang province, Tran Van Hoang from a hatchery and fish-breeding group agreed to trials on 10 hectares and grow-out farmer Bui Ho Ngoc offered to test the practices of five hectares.

Mr Hai, a grow-out farmer, at the Can Tho workshop

Photo: Lem Chamnap

Scope of better practices

The 28 better management practices proposed by the Vietnamese-Australian project team comprise 14 farm practices, 9 hatchery and nursery practices and 5 practices related to more general aspects of catfish farming. Practices for grow-out farms include various aspects of preparing ponds such as removing sludge, liming and filling. They also cover stocking practices related to choosing and transporting the seed, acclimatisation, stocking density and time of day. Aspects of day-to-day management include managing sludge, keeping records, managing, procuring and storing feed as well as feeding the fish, managing their health and harvesting them. Hatchery practices are related to ponds, conditioning and managing the broodstock as well as spawning, hatching and maintaining genetic biodiversity. In addition to preparing and liming nursery ponds, the nursery practices specify requirements for the larvae to fry stage and the fry to fingerling stage. The better practices also address the use of chemicals, community responsibility and the environment along with food safety and traceability. Following feedback from farmers, the draft practices (see http://library.enaca.org/inland/projects/draft-catfish-bmps-09.pdf) were revised after the workshops and are scheduled to be adopted at a national conference expected to be held in Long Xuyen, the An Giang provincial capital, during the second quarter of 2010.

During the two workshops, many farmers said they were already implementing some of the better management practices. Others expressed fears that adopting fancy new techniques would lead to higher production costs. Dr De Silva, the NACA director general, was quick to address such concerns. "Better management practices are not rocket science. It's

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What's **the market** doing?

For one European catfish importer, Ho Chi Minh City is a key part of its global network spanning four continents

Established in 1994, Dutch company Anova Food BV is a leading supplier of fresh and frozen fish to Europe and the United States. Based in 's-Hertogenbosch, about 80 km south of Amsterdam, it sources most of its fish through two representative offices in Viet Nam and Indonesia as well as a subsidiary in Kenya. Customers range from retail and wholesale buyers to institutional caterers and food-processing companies.

The office in Ho Chi Minh City is responsible for outsourcing and shipping frozen sutchi river catfish (*Pangasianodon hypophthalmus*) and managing Anova's certification programme for farming and feed production in the Mekong Delta (see *Catch and Culture*, Vol 15, No 1). The office also sources frozen Nile tilapia (*Oreochromis niloticus)* from China. The Bali office sources frozen tuna and other kinds of wild caught fish while the Nairobi subsidiary buys Nile perch (*Lates niloticus*) fresh from Lake Victoria. International sales are carried out from the head office in the Netherlands and a subsidiary in Tampa, Florida, which also sources fresh and frozen albacore tuna (*Thunnus alalunga*).

With European consumers increasingly choosy about their food, Anova's marketing strategy emphasises sustainability and quality assurance. For catfish from Viet Nam, quality control is of paramount importance since the fish only appeared in Europe in recent years. "For many European consumers, pangasius is a mystery fish," says Hoang Thi Kim Tuyet, manager of the Viet Nam office. "That's why we think it's very good to have it with high quality and traceability in order to create a better image for our fish."

Anova ships dozens of containers of frozen catfish each month. Ms Kim Tuyet says about 60% of the shipments from Ho Chi Minh City are to Rotterdam. From there, catfish is transported to various markets including Eastern Europe and Mediterranean countries. By mid-2009, business seemed to have recovered, at least tentatively, from the global economic downturn. Average monthly shipments of full container loads fell by half between the second quarter of 2008 and the first quarter of 2009 but rebounded from their lows in the second and third quarters. As a former sales manager with Vinh Hoan Corp, one of Viet Nam's leading processors, Ms Kim Tuyet is no stranger to the industry. Based in Dong Thap province, Vinh Hoan received approval to export to the European Union in 2000. Today, it is among 10 processors that supply Anova, up from three in 2005 and only one in 2004. "To develop our suppliers, we organise visits by our quality team," Ms Kim Tuyet says. "We need to know if the quality is good enough to meet Anova's quality standards."

Among the 11 staff in Ho Chi Minh City, seven are dedicated to quality and food safety. Of these, four are involved in supervising and auditing processors as well as quality controls on the final product before shipment. The other three implement the "Anova Trace Panga" quality farming system created in 2005, although two also work in quality control and auditing. "The Trace programme is supported by strict controls and is today the best assurance for food safety and traceability for the most demanding customers," says Technical Manager Nicolas Privet. "Every year, the supply chain is audited and certified by a third-party European certification body, ISACert." The quality team is also working to update existing farms to meet other international standards set by the Global Partnership for Good Agriculture Practice (GLOBALGAP) and the new Aquaculture Stewardship Council (ASC). "Certification is planned for early 2010," Mr Privet said.

With its presence in all three of the world's major time zones, Anova operates virtually 24 hours a day. And as with any other commodity trader, the trading week starts every Monday morning in Asia while Europe and America are still asleep. For Anova and other buyers, one of the biggest challenges is to find the latest level of catfish prices in the Mekong Delta before any deals are done. Since foreign buyers don't have access to the computerised price quotation system operated by the Vietnam Association of Seafood Exporters (VASEP), this is easier said than done. But as can be seen in the special insert over the following four pages, determining the market's level is just one of many tasks faced by the Viet Nam office each Monday.

Continued from page 25

something you do to improve production as much as possible without incurring extra costs," he said. "Experience in other countries shows that when groups of farms cluster together to improve management practices, productivity increases, there's less disease and quality improves so the markets come to you." But what about the widespread practice of farms discharging untreated effluent from their ponds to public water systems in the Mekong Delta? RIA 2 Director Nguyen Van Hao noted that managing effluent was a "hot issue" in the Mekong Delta. "Farmers can apply all the better management practices except those related to effluent," Dr Hao said. "This is a big issue for implementing better management practices." A company official from leading processor Vinh Hoan Corp agreed. While addressing problems related to effluent was not an issue for newer farms, "old farms will need to be modified to comply with the requirements which is very difficult," she said. "The only way will be for small-scale farmers to come together as a group as most of them don't have sediment ponds."

Dr De Silva indicated that dealing with effluent discharge was in any case more of a longer term goal. "Not all of the better management practices have to be adopted lock, stock and barrel at once," he said. Besides, the argument voiced by some environmental lobbyists that catfish farms pollute the Mekong is overly simplistic. "We've calculated the amount of nitrogen and phosphorus discharged into the river. Our calculations show that it is insignificant[1] compared with all the other activities that occur in the delta. This is what makes catfish farming in the Mekong Delta so unique. There are not many countries blessed with such a natural resource. And the current thinking is that the amount of nitrogen and phosphorus discharged into the sea is profitable from the point of view of global warming." Dr De Silva also stressed that the amount of nitrogen and phosphorus discharged for each kilogram of catfish produced was no greater than for salmon, trout or any other farmed fish. "You can't have any form of food production without affecting the environment. That's how the world manages to feed 4.6 billion people. What's important is to minimise the effect." At the same time, however, he urged farmers not to be complacent about the impact of negative publicity. "In some markets, people are being asked not to eat Vietnamese catfish. There are invisible forces working against your sector," he warned. "The bottom line is that to take care of the river, you will have to start treating effluent in the foreseeable future. But you need to go step by step. Your catfish farmers are being looked at by magnifying glasses from all over the world. That's why we want to help you remove any bad image so you can market your products at a good price. Better management practices took eight years to be implemented in India. We'd like to see the time frame at least halved in the case of Viet Nam."

[1] According to "An Assessment of Water Quality in the Lower Mekong Basin" published as MRC Technical Paper No. 19 at the end of 2008, the index of water quality for aquatic life in the Mekong Delta was either "high" or "good" along the two main branches of the river between 2000 and 2005. This is where most catfish is produced. Of the 37 stations monitored during the period, Chau Doc on the border with Cambodia in An Giang province, had the highest quality of water for aquatic life. The water quality was also "high" at Tan Chau, another border town in An Giang, and further downstream in My Thuan in Vinh Long province. The quality was "good" at another two mainstream stations, although Can Tho was better than My Tho in Tien Giang province. At the station located furthest downstream in Dai Ngai in Hau Giang province, the water quality index for aquatic life was "moderate." Among the nine primary stations located on canals and distributaries, water quality was "high" or "good" at the three stations closest to the Cambodian border. At another four stations, the water quality was found to be "moderate." At the two southernmost stations, the water quality indexes for aquatic life were found to be "poor", especially in Vinh Tuan in Kien Giang province, which was the furthest of the nine stations from the mainstream. The index comprised six parameters forming a 10-point scale. Four primary parameters—dissolved oxygen, acidity, total ammonia and conductivity—were assigned values of 2 if the water samples met MRC guidelines If samples met MRC guidelines for the other two parameters of nitrogen and total phosphorous, values of 1 were assigned. Water quality for aquatic life was "high" if all four primary parameters met the guidelines with few exceptions, "good" if the four parameters complied most of the time, "moderate" if at least one of the four parameters failed to comply much of the time and "poor" if many of the primary parameters were not compliant most of the time. A separate index of water quality for human impact reflected chemical oxygen demand as well as dissolved oxygen and total ammonia while a third index of water quality for agricultural use was based on FAO salinity guidelines.

* *Mr Starr is the editor of* Catch and Culture

Number of **species found** rises to **166** in **Sekong** drainage, **84** in **Nam Ou** drainage

Recent surveys have discovered several new fish species in two Lao tributaries of the Mekong. Although too early to tell, it's possible that as many as 25 of the 250 species now recorded in these two river drainages may not be found anywhere else.

A recent survey of the Sekong drainage in southern Lao PDR has recorded 137 fishes, bringing the number of known species in the drainage to 166. Originating in Viet Nam, the Sekong is one of the Mekong's largest tributaries and the only one that cuts across three countries of the lower basin. Before flowing into the mainstream in Cambodia, it is joined by the Sesan River which, in turn, is joined further upstream in Cambodia by the Srepok River. Together, these three rivers account for almost 20% of the Mekong's water volume.

Conducted by Swiss ichthyologist Maurice Kottelat in May, the 12-day survey of the Lao part of the Sekong drainage discovered two new species from the carp family (Cyprinidae). While the identity of another four species was not clear as of September, they potentially represent another two new species of carp, a new species of loach (Cobitidae) and a new species of Asiatic glassfish (Ambassidae). The survey recorded four unnamed species—two loaches (Cobitidae), a river loach (Balitoridae) and a carp (Cyprinidae)—although these were already known from earlier records in the Sekong or other drainages. The survey, part of the World Wildlife Fund (WWF) program in Lao PDR to improve the management of capture fisheries and conservation of aquatic biodiversity, also observed a species of sisorid catfish (Sisoridae) that had not been previously recorded in Lao waters (*Glyptothorax filicatus)*.

Twenty endemic Sekong species?

According to Dr Kottelat, 20 species observed are known from no other drainage and may be endemic to the Sekong. These comprise eight loaches (Nemacheilidae and Botiidae) seven carps (Cyprinidae), four river loaches (Balitoridae) and a sisorid catfish (Sisoridae). These fishes were mostly found in rapids and other high-gradient habitats, reflecting the limited distribution range of species that prefer to live in running water and maybe also a sampling bias. Given the lack of data available from adjacent Lao and Cambodian drainages, however, it's not yet clear if the distribution of these species is limited to the Sekong drainage.

A possibly unnamed species from the *Rhinogobius* genus of gobies. It seems to have affinities with *R. albimaculatus,* known only from the Nam San, a tributary of the Nam Ngum in Vientiane province.

Photo: Maurice Kottelat

About 500 species now recorded in Lao waters

In 1996, scientific literature had recorded only about 210 fish species from Lao PDR. Surveys conducted by Dr Kottelat between 1996 and 1999 increased Lao fish fauna to 480 species of which 130 were new to science. The number of named species known from Lao PDR is now about 500.

The 166 species that have now been recorded in the Sekong drainage are mostly carps (Cyprinidae), loaches (Nemacheilidae, Cobitidae and Botiidae) and river loaches (Balitoridae). Other species include bagrid catfishes (Bagridae), sisorid catfishes (Sisoridae), puffers (Tetraodontidae), sheatfishes (Siluridae), spiny eels (Mastacembelidae), gouramies (Osphronemidae), snakeheads (Channidae), shark catfishes (Pangasiidae), stream catfishes (Akysidae), featherbacks (Notopteridae) and gobies (Gobiidae). A Sundaland noodlefish (Sundasalangidae), a herring (Clupeidae), an algae eater (Gyrinocheilidae), a schilbeid catfish (Schilbeidae), a torrent fish

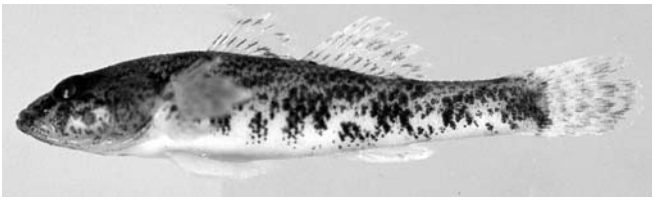
(Amblycipitidae) and a needlefish (Belonidae) have also been recorded along with a pipefish (Syngnathidae), a swamp eel (Synbranchidae), an Asiatic glassfish (Ambassidae), an Asian leaf fish (Pristolepididae), a freshwater triple tail (Datnioididae) and a sole (Soleidae).

A carp that lays eggs in a mussel

One of the species observed in the Upper Nam Ou drainage was the bitterling *Acheilognathus deignani.* Bitterlings are a sub-family of carps (Cyprinidae) that spawn their eggs in mussels where they hatch and stay for several weeks. This particular species of bitterling, native to Lao PDR, Thailand and Viet Nam, was found at several localities in the Upper Nam Ou together with an unidentified mussel species. Bitterlings depend entirely on mussels to survive. And not just any mussel. According to Dr Kottelat, each bitterling species needs a specific mussel of mussels to lay its eggs and will not use other mussels if the required species is not present. The mussel also has a larval stage, known as a glochidium. Glochidia are parasites, attaching themselves to the gills and fins of fishes until metamorphosis when they drop to the bottom. Glochidia are generally species-specific.

In reality, Dr Kottelat reckons that the Sekong drainage has more than 166 species as a number of additional fishes documented by Canadian biologist Ian Baird in 1999 is probably based on records from the Sekong. Moreover, several catfish families were under-represented in samples collected during this year's survey. These were mainly nocturnal species living in deep water that are rarely caught by the sampling gear used in the survey.

A separate survey by Dr Kottelat earlier in the year observed 52 fishes in the Upper Nam Ou drainage in northern Lao PDR, bringing the number of species recorded in the entire drainage to 84. The Nam Ou is the largest tributary of the Mekong in northern Lao PDR and the survey focussed on Phongsali province bordering China and Viet Nam. Carried out in February and March 2009, the 13-day survey found a species of goby (Gobiidae) that is possibly new to science. On its return to Vientiane, the survey team also discovered what appeared to be a new species of freshwater



An apparently unnamed species from the *Terateleotris* genus of freshwater sleepers. It was found along the shore of the Nam Xong in Vientiane province. The genus itself was discovered only in 1996 in the Xe Bangfai river. Another species from the same genus was later found in the Nam Mouan, a tributary of the Nam Kading.
Photo: Maurice Kottelat

sleeper (Odontobutidae). The survey, also part of the WWF programme on fisheries management and aquatic biodiversity conservation, observed another unnamed species of sisorid catfish (Sisoridae) in the Nam Ou drainage, although this species was already known from earlier records.

Five endemic Nam Ou species?

According to Dr Kottelat, five of the species observed are known from no other drainage and may be endemic to the Nam Ou drainage. One of these species was the apparently newly-discovered goby while the other four were loaches (Nemacheilidae). Like the possibly endemic species in the Sekong drainage, the five species were mostly found in rapids and other high-gradient habitats. Given the lack of data available from adjacent Lao and Vietnamese drainages, however, it's also unclear if the distribution of these species is limited to the Nam Ou drainage.

Of the 52 species observed, as many as four cyprinids are not native to the area. Dr Kottelat noted that the Chinese barb *(Puntius semifasciolatus*) and the spotted steed (*Hemibarbus maculatus)* were widely distributed in China and Viet Nam but had been observed only at a few northern Lao sites. "It is not yet clear whether their presence is natural or results from introduction. I suspect that they have been accidentally introduced with fry of other species (most likely carps) from Vietnam," he wrote in the survey report in September. But another two species, the Asian carp (*Cyprinus rubrofuscus)* and the stone moroko *(Pseudorasbora parva)*, were "clearly introduced" and were probably the same species recorded on the Vietnamese stretch of the Nam Noua, a tributary of the Nam Nou originating in Dien Bien province.

Combining the survey findings from the Upper Nam Ou with information from surveys of the Lower Nam Ou in 1997 and 1999, there are now 84 species recorded in the drainage, mostly carps (Cyprinidae) and loaches (Nemacheilidae and Cobitidae). Other families include sisorid catfishes (Sisoridae), river loaches (Balitoridae), gobies (Gobiidae), puffers (Tetraodontidae), bagrid catfishes (Bagridae), airbreathing catfishes (Clariidae), spiny eels (Mastacembelidae) and snakeheads (Channidae). A stingray (Dasyatidae), a schilbeid catfish (Schilbeidae), a needlefish (Belonidae), a swamp eel (Synbranchidae), an Asiatic glass fish (Ambassidae) and a gouramy (Osphronemidae) have also been recorded.

As with the survey of the Sekong drainage, Dr Kottelat noted that several catfish families were under-represented in samples collected in the Upper Nam Ou survey, which covered the area upstream from Meuang Khoa. Given that his previous surveys in 1997 and 1999 were limited to too few localities to be representative, "an educated guess is that the actual number of species present in the drainage could be around 120" compared with the 84 recorded so far.

Further reading

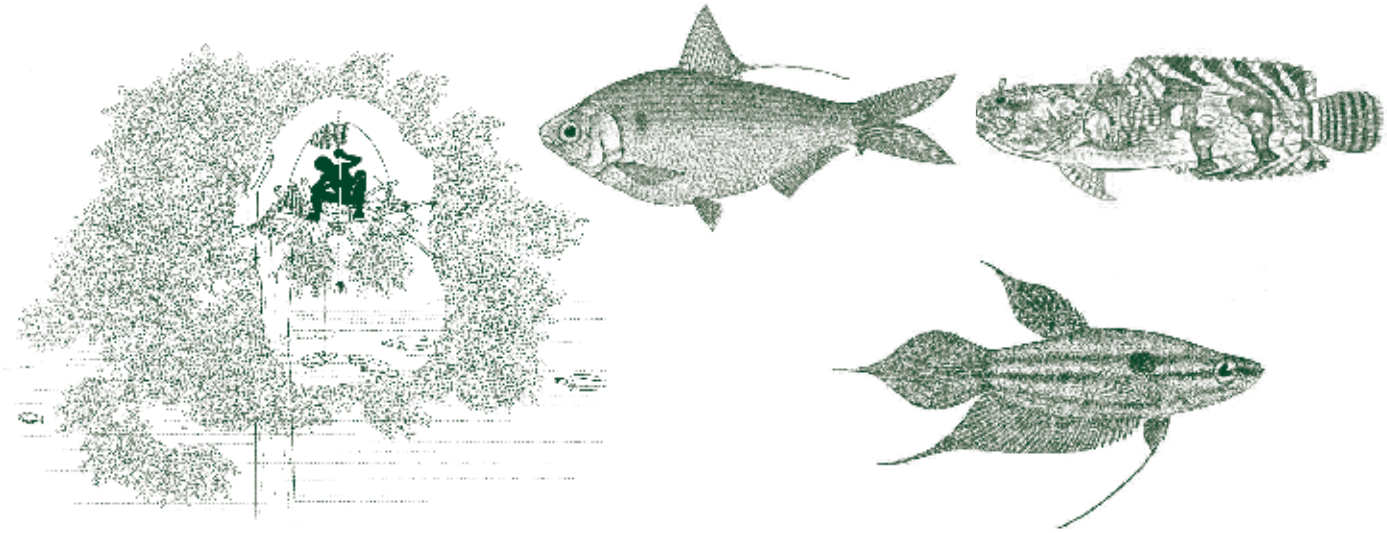
Kottelat, M. (2009) *Fishes of the upper Nam Ou drainage in Laos,* World Wildlife Fund

Kottelat, M. (2009) *Fishes of the Xe Kong drainage in Laos,* World Wildlife Fund

Kottelat, M. (2001) *Fishes of Laos.* WHT Publications (Pte) Ltd, Sri Lanka. 198 pp.

Lao **fisheries output** nears **$200 million**

Lao fisheries production was estimated to be worth LAK 1,555 billion ($183 million) in 2008, up from LAK 1,404 billion ($165 million) a year earlier and accounting for 3.4% of the country's gross domestic product (GDP). The estimates by Lao authorities, published by the International Monetary Fund (IMF) in mid-2009, showed that the fisheries sector was slightly larger than the banking sector in terms of its contribution to GDP. It was also bigger than the leasing and real-estate sector, the electricity and water-supply sector and the food and beverage sector. The estimates indicated that fisheries accounted for 11% of total agricultural production in 2008. Apart from fisheries, this included an estimated LAK 12,335 billion ($1.45 billion) from crops and livestock and an estimated LAK 1,871 billion ($220 million) from forestry activities. The IMF said the official GDP estimates differed from its own staff estimates, although details of the differences were not available. According, to separate statistics published by the Ministry of Agriculture and Forestry, aquaculture produced 64,300 tonnes in 2008 while capture fisheries produced 24,200 tonnes. The figures, however, do not fully capture the production from the large subsistence fisheries sector.



Cambodia identifies **endangered freshwater species** under Fisheries **Law**

Sub-decree covers 29 species of fishes and other aquatic animals found in the Lower Mekong Basin

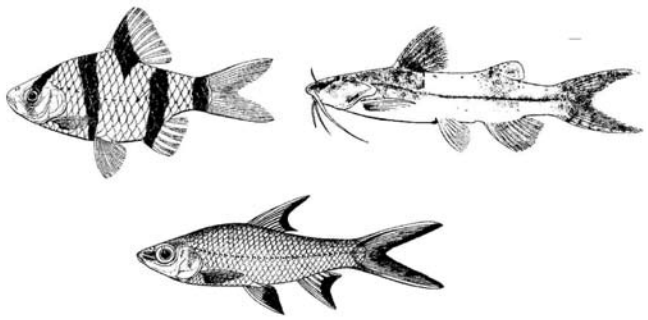
Cambodian Prime Minister Hun Sen has signed a sub-decree under the country's Law on Fisheries that identifies 58 endangered aquatic animals including 29 freshwater fish, reptile and mammal species. Signed on August 12, 2009, the sub-decree spells out which freshwater and marine animals are banned from being transported or traded unless they are being farmed or are in compliance with the domestic fisheries law and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which Cambodia ratified in 1997.

Appendices 1, 2 and 3
Species covered by CITES are listed in three Appendices. Appendix I cover species threatened with extinction. Trade in specimens of these species is permitted only under exceptional circumstances. Appendix II covers species not necessarily threatened with extinction but in which trade must be controlled to avoid use incompatible with their survival. Appendix III contains species that are protected in at least one country which has asked other CITES parties for assistance in controlling the trade.

The endangered freshwater species comprise 19 fish and 7 turtles as well as the Siamese crocodile (*Crocodylus siamensis*) and the Irrawaddy dolphin (*Orcaella brevirostris*). CITES considers 7 of the 29 freshwater species to be threatened with extinction including both the crocodile and the dolphin as well as giant fish species like the Mekong giant catfish (*Pangasianodon gigas*), Giant barb (*Catlocarpio siamensis*) and the Isok barb (*Probarbus jullieni*), also known as Jullien's barb. Other endangered freshwater species threatened with extinction under CITES are two fishes—the Asian bonytongue (*Scleropages formosus)* and the smalltooth sawfish (*Pristis microdon*)—and a turtle known as the mangrove or estuarine terrapin (*Batagur baska)*. Endangered marine species identified by the sub-decree include a dozen marine mammals and half a dozen bivalves and gastropods. Also included are five species of turtles, three fish species, two horseshoe crabs and a crocodile as well as corals and sea anemones.

Article 68 of the Cambodia fisheries law passed in 2006 prohibits exporting, importing, buying, selling, transporting, possessing or stocking endangered fishery products with exceptions for aquaculture. The law also provides for endangered species to be identified by sub-decree. In addition to complying with CITES, authorised trade in such products has to comply with Articles 64, 65, 66 and 67 of the law which require commercial fisheries transport to be licensed and products subject to duty unless they are for family use or research purposes. Exports and imports are also subject to Fisheries Administration licensing and quality control certification as well as a CITES permit in the case of endangered species.

In October 2009, the Fisheries Administration began distributing the first of 6,000 posters featuring the 58 endangered species. The posters were printed in collaboration with the World Wildlife Fund, the Wildlife Conservation Society and Conservation International.



Some of the endangered species now identified by Cambodian law: *Puntius partipentazona (*top left), *Glyptothorax fuscus* (top right) and *Balantiocheilos melanopterus* (bottom)

Endangered Freshwater Species in Cambodia

Under sub-decree signed by Prime Minister Hun Sen in August, 2009

	Khmer common name	Scientific name	English common name	CITES
1	ត្រីតាពត ឬ ត្រីនាគ (trey tapawt, niek)	*Scleropages formosus*	Asian bonytongue	I
2	ត្រីថ្ក (trey thkaw)	*Pristis microdon*	Small-tooth sawfish	I
3	ត្រីបីកំណាត់ ឬ ត្រីខ្លា (trey bai kamnat, kla)	*Puntius partipentazona*	Tiger barb	
4	ត្រីកៀតស្រង់ (trey kiet srawng)	*Balantiocheilos melanopterus*	Bala sharkminnow	
5	ត្រីគជ្រៅ (trey kuchrea)	*Puntioplites bulu*	—	
6	ផ្សោតក្បាលត្រឡោក (phsaut kbal trolaok)	*Orcaella brevirostris*	Irrawaddy dolphin	I
7	ត្រីរាជ (trey reach)	*Pangasianodon gigas*	Mekong giant catfish	I
8	ត្រីគល់រាំង (trey kolreang)	*Catlocarpio siamensis*	Giant barb	
9	ត្រីត្រសក់ក្រហម (trey trawsak krahom)	*Probarbus jullieni*	Isok barb	I
10	ត្រីត្រសក់ (trey trawsak)	*Probarbus labeamajor*	Thicklip barb	
11	ត្រីត្រសក់ស (trey trawsak sor)	*Probarbus labeaminor*	Thinlip barb	
12	អណ្តើកហ្លួង ឬសរសៃ (andeuk luong, sorsai)	*Batagur baska*	Mangrove or estuarine terrapin	I
13	ត្រីត្រចៀកដំរី (trey trochiek damrey)	*Osphronemus exodon*	Elephant ear gourami	
14	ត្រីរមាស (trey romeas)	*Osphronemus goramy*	Giant gourami	
15	ត្រីកន្ត្រៀលខ្លារ (trey kantrawb khlar)	*Datnioides undecimradiatus*	Narrow barred tiger perch	
16	ត្រីក្បូក (trey kbauk)	*Tenualosa thibaudeaui*	Laotian shad	
17	ត្រីកញ្ឆោះក្របី (trey kanchos krawbey)	*Glyptothorax fuscus*	—	
18	ត្រីស្តុក់ (trey stouk)	*Wallago leeri*	—	
19	អណ្តើកសង្កែ (andeuk songkol)	*Hieremys annandalii*	Yellow-headed temple turtle	II
20	អណ្តើកខ្មែក (andeuk kaek)	*Siebenrockiella crassicollis*	Black marsh turtle	II
21	ត្រីក្របី (trey krawbey)	*Bagarius bagarius*	Dwarf goonch	
22	ត្រីក្របី (trey krawbey)	*Bagarius suchus*	Crocodile catfish	
23	ត្រីក្របី (trey krawbey)	*Bagarius yarrelli*	Goonch	
24	ត្រីឆ្មាក្រពើ (trey chmar kror poeu)	*Lycothrissa crocodilus*	Sabertooth thryssa	
25	ក្រពើត្រី (kror poeu trey)	*Crocodylus siamensis*	Siamese crocodile	I
26	អណ្តើកស្រែ (andeuk srer)	*Malayemys subtrijuga*	Rice-field terrapin	II
27	អណ្តើកសោម (andeuk saom)	*Hieremys grandis*	Asian giant terrapin	II
28	កន្ធាយអាស៊ី (konthiey asie)	*Amyda cartilaginea*	Asiatic soft –shell turtle	II
29	កន្ធាយក្បាលកង្កែប (konthiey kbal kongkep, lomech)	*Pelochelys cantorii*	Asian giant soft-shell turtle	II

Maximising the **benefits** of aquaculture in Cambodia's **Svay Rieng** province

Should farmers who raise fish from the wild convert their ponds to farm domesticated species instead? No, say researchers from Cambodia's Royal University of Agriculture, arguing that more research is needed to identify techniques that benefit both forms of aquaculture.

As Cambodia expands the use of modern aquaculture techniques, policymakers face a dilemma. Seeing the potential to boost incomes, improve their livelihoods and increase food security, traditional farmers who raise fish recruited from the wild may sometimes be tempted to switch to domesticated species. But without technical support, production levels may be low—in which case the farmers may get discouraged and simply move back to their traditional practice of raising fish recruited from the wild, putting renewed pressure on wild stocks.

In an attempt to introduce simple and affordable semi-artificial fish breeding techniques to farmers, the Faculty of Science at the Royal University of Agriculture recently completed a 21-month project in Svay Rieng province in eastern Cambodia. The project, in collaboration with the Cambodia Agricultural Research Fund (CARF) and the Cambodian Fisheries Administration, found that the lack of technical expertise was the main constraint to expanding aquaculture. For example, a survey of Chantrey commune in Romeas Heak district found that while 30% of households had ponds, only 20% of these were stocking them with domesticated species. These included both indigenous species, such as catfish from the *Pangasius* genus and silver barb (*Barbonymus gonionotus),* and introduced species such as the Indian carp *(Labeo rohita)*, the common carp *(Cyprinus carpio)* and Nile tilapia (*Oreochromis niloticus*).

On other hand, about half the households with ponds were still raising fish recruited from the wild such as snakehead (*Channa* spp.*)*, walking catfish (*Clarias batrachus*) and climbing perch (*Anabas testudineus*). The remaining 20% were stocking their ponds with both, starting with domesticated species and then adding wild species as the wet season progressed. But the domesticated species suffered high mortality rates—by the time the fish were ready to harvest, only the wild species and *Pangasius* had survived. While *Pangasius* seed was easily accessible through Vietnamese retailers and could also be stocked with other domesticated species, most farmers complained about the absence of a hatchery in the local commune. Supplies were often inadequate, expensive and faced high rates of mortality when transported along poor roads.

So in the next phase of the project, two small-scale hatcheries were developed for the two communes in

Preparing small net enclosures as part of the Svay Rieng project

Photo: Touch Dara

Table 1 **Small-scale hatchery results in Chantrey Commune, Romeas Heak District**

Species	Broodstock	Average size	Fertilisation (%)	Hatching (%)	Survival (%)
Silver barb *(Barbonymus gonionotus)*	7 males, 4 females	296 g	81	73	47
Indian carp *(Labeo rohita)*	4 males, 2 females	1240 g	49	68	59
Common carp *(Cyprinus carpio)*	3 males, 2 females	840 g	85	75	68
Tilapia *(Oreochromis niloticus)*	3 males, 6 females	320 g	83	82	71

Table 2 **Small-scale hatchery results in Chheu Teal Commune, Svay Chrum District**

Species	Broodstock	Average size	Fertilisation (%)	Hatching (%)	Survival (%)
Silver barb *(Barbonymus gonionotus)*	6 males, 3 females	276 g	76	45	21
Indian carp *(Labeo rohita)*	4 males, 2 females	1120 g	46	38	12
Common carp *(Cyprinus carpio)*	3 males, 2 females	820 g	73	56	42
Tilapia *(Oreochromis niloticus)*	3 males, 6 females	310 g	75	52	46

the target area. Jointly operated by two households in each commune, each hatchery comprised a 3m³ cylindrical plastic tank, a 2m³ tank as an incubator and a small tank filled with gravel and sand for treating water discharged into the pond. After a failed attempt to breed silver barb and Indian carp in 2007, a second trial was conducted with four species at the two hatcheries between May and August in 2008 (see Tables 1 and 2 above). The poor results for silver barb and Indian carp were attributed to the use of well water which tends to have lower dissolved oxygen, high amounts of arsenic and an elevated iron content (Svay Rieng is a relatively dry province and both species require large amounts of water during incubation).

At a workshop to disseminate the results to farmers, three quarters indicated they were interested in using the technique, although about 15% said wanted to keep recruiting fish from the wild (the rest weren't interested due to limited household labour). Thirty local households with ponds were then selected to stock the fingerlings of all four species in equal ratios. Costs were shared between the project and each household. Six months after stocking at a rate of four fingerlings per square metre (the average size of the ponds was 150 m²), fish sizes averaged 187 g for the silver barbs, 425 g for the Indian carp, 365 g for the common carp and 330 g for the tilapia. About half of these households were able to harvest fish frequently for their own consumption and some were able to sell as much as 50kg. Six of the 30 households, however, failed to harvest anything due to floods caused by heavy rains.

While the final report of the project highlights the need for improving fish culture techniques among farmers, it also concedes that regular and continuous support is often constrained by limited capacities and budgets of fisheries extension officers or non-governmental organisations. To fill the gap, it stressed the importance of farmer networks playing a greater role in promoting aquaculture in villages and communes given that technical transfers between farmers themselves are more effective in influencing their behaviour. In addition to the 30 farmers selected for distributing fingerlings, the report noted that other farmers also became interested in small-scale aquaculture as more and more visited the hatcheries and the model farmers. This had helped to change community attitudes to addressing environmental change, reducing their dependency on natural resources and improving livelihoods and food security.

Yet the research team did not recommend converting wild fish ponds to stocking with domesticated species. Ponds with fish recruited from the wild were found to be a good source of nutrients and incomes for several households. Despite the perception that wild fish production was declining, the authors noted that projects to set up broodstock refuge areas in better rain-fed provinces such as Takeo and Kampot showed evidence of increased production from such ponds. As such, the report concluded that more research was needed to identify techniques to benefit from both types of aquaculture.

Further reading

"Small scale hatchery and development in Svay Rieng province", project final report by Khov Kuong (team leader), Phan Ra and Men Sokha, lecturers at Faculty of Fisheries, Royal University of Agriculture, Phnom Penh

How can Cambodia **promote** fish **farming** when **natural resources** are so abundant?

By Peter Starr *

A high-level Cambodian fisheries delegation visits Viet Nam in an attempt to find out how to solve an emerging policy dilemma

To reduce the country's dependence on natural fish resources, Prime Minister Hun Sen and Agriculture, Forestry and Fisheries Minister Chan Sarun have been exhorting Cambodians to farm fish at highly-publicised National Fish Day events since 2003. With farmers encouraged to dig small ponds for family fish farms and with villages and communes urged to establish community fish ponds, the fisheries sector is now a priority in the government's reform programme. As a result of these and other efforts, fish farming has skyrocketed in recent years. Between 2004 and 2006, Cambodia was ranked seventh worldwide in terms of growth, according to the World Review Of Fisheries and Aquaculture published by the United Nations Food and Agriculture Organisation (FAO) earlier this year (see table opposite). But aquaculture production still remains tiny compared with Viet Nam or Thailand and represents less than 10% of the country's entire fish production

While Cambodia produced almost 500,000 tonnes of fish in 2008, only 40,000 tonnes came from farms. That compares with about 2.3 million tonnes in Viet Nam, where aquaculture is now a major export sector. One of the most popular farmed species in both countries is catfish. In 2008, Cambodian fish farms produced about 20,000 tonnes of catfish, equivalent to what Viet Nam was producing 10 years ago. Today, Vietnamese farmers in the Mekong Delta produce more than one million tonnes of catfish a year, bringing in annual export earnings of more than $1 billion. Moreover, the average catfish farm yields 400 tonnes a hectare in Viet Nam compared to 50 tonnes or less in Cambodia.

Fastest Growing Aquaculture Producers

Average annual growth between 2004 and 2006 in countries producing more than 1,000 tonnes in 2006

Country	%
Uganda	142.8
Guatemala	82.2
Mozambique	62.2
Malawi	43.1
Togo	40.7
Nigeria	38.7
Cambodia	**28.6**
Pakistan	26.1
Singapore	25.9
Mexico	23.3

Source: Food and Agriculture Organization (FAO)

Few incentives

To be sure, Cambodian fish farmers face constraints not shared by their Vietnamese counterparts. Access to credit is difficult due to high interest rates and commercial fish feed is expensive as it has to be imported. And being located close to the sea, many Vietnamese farms in the Mekong Delta don't have to use diesel pumps to change pond water as they can rely on the natural tidal flushing of ponds each day. One of the biggest constraints, however, is that Cambodia is much richer in wild freshwater fishery resources than neighbouring countries thanks to the Tonle Sap Lake, the most productive inland fishery in the world. In terms of total inland capture fisheries production, Cambodia was ranked fifth worldwide in 2006 behind China, Bangladesh, India and Myanmar, all countries with significantly higher populations (see table on next page). In such an environment, there is little incentive to farm fish when they are freely available in rivers and lakes. Since these resources are clearly limited and also under pressure from various human activities across the Mekong River Basin, Cambodia has no option but to promote fish farming or to find other sources of protein to feed its rapidly growing population.

Dr Nao Thuok visiting a small-scale snakehead farm in Tan Phuoc district in Tien Giang province. Since snakeheads are carnivorous fishes that consume large quantities of small fish, snakehead farming is currently banned in Cambodia.

Photo: Lem Chamnap

Top Inland Capture Fisheries Producers

Thousands of tonnes, 2006

Country	Quantity
China	2,544
Bangladesh	957
India	858
Myanmar	631
Cambodia	**422**
Uganda	367
Indonesia	301
Tanzania	293
Egypt	256
Brazil	251

Source: Food and Agriculture Organization (FAO)

It was with this is mind that a nine-member delegation from the Cambodian Fisheries Administration visited southern Viet Nam from October 20 to 24. Led by Director-General Nao Thuok, who is also fisheries adviser to Samdech Hun Sen, the high-level visit was the first since the former Fisheries Department was re-established in 1979. Sponsored by the Fisheries Programme of the Mekong River Commission (MRC), the visit took place as part of regional cooperation activities under the MRC's Technical Advisory Body on Fisheries Management (TAB). Such activities under the TAB have previously included high-level visits to Cambodia by Lao and Thai fisheries agencies.

In Tien Giang province, which lies on the main branch of the Mekong River, the delegation visited the government-run My Tho Fish Landing for marine species such as tuna and mackerel, one of two fish landing sites in the province. It also visited catfish ponds in Cho Gao district, tilapia net pens and cages in My Tho City and a small-scale snakehead cage farm and hatchery in Tan Phuoc district. In Ben Tre province, where the Mekong enters the South China Sea, the delegates visited a clam field and shrimp farm in Binh Dai district and a catfish processing plant in Chau Thanh district which also processes shrimp and clams for export. In Vung Tau, a coastal port north of Ho Chi Minh City, the Cambodian fisheries

officials visited pomfret, grouper and cobia cages on the Cha Va River and the National Breeding Centre for Southern Marine Aquaculture. The centre focuses on marine species and is operated by the Research Institute for Aquaculture No 2 (RIA 2) in Ho Chi Minh City which has another breeding centre for freshwater species in Tien Giang province focussing on catfish, tilapia and giant freshwater prawns.

Mutual concerns

Before returning to Phnom Penh, the delegation paid a courtesy call on the Ho Chi Minh City regional office of the Vietnam National Mekong Committee (VNMC), the agency responsible for assisting the Vietnamese prime minister in all matters related to the Mekong Basin which extends to 13 provinces in southern Viet Nam. Tan Duc Cuong, the VNMC deputy secretary general who is also one of the 12 members of the TAB, told the delegation that proposals for mainstream dam development in the upper stretches of the Mekong were of "mutual concern" for both Viet Nam and Cambodia. Among other areas of mutual concern, Mr Cuong mentioned climate change and variations in Mekong water levels, the degradation of water quality and aquatic resources, and the recent occurrence of smaller floods during the wet season and increased drought during the dry season.

Cambodian delegation visiting red tilapia net pen in My Tho

Photo: Lem Chamnap

Dr Nao Thuok said the two countries have natural resources that "we should manage together." Mr Cuong agreed on the need for bilateral fisheries cooperation, proposing that future exchanges could be combined under a memorandum of understanding between the Vietnam National Mekong Committee and the Cambodia National Mekong Committee. Signed

Cambodian delegation visits catfish farm in Cho Gau district, Tien Giang province

Photo: Lem Chamnap

by Vietnamese Agriculture and Rural Development Minister Cao Duc Phat and Cambodian Water Resources and Meteorology Minister Lim Kean Hour in 2005, the memorandum provides for maximising the mutual benefits and minimising the possible negative impacts of water resource development and management in border areas of the Mekong Basin.

Management lessons

During the meeting, Dr Nao Thuok said the Cambodian delegation was particularly impressed by the visit to the government-run fish landing in Tien Giang province. The director general of the Fisheries Administration said he was also impressed by the community-managed clam field in Ben Tre province. "I've never seen clam culture before so it was the first time for me." Asked why Tonle Sap fishermen were still poor despite the abundance of fish in the lake, Dr Nao Thuok explained that it was due to increased numbers of people competing for the same resource. As a result, the average annual fish catch for each fisherman has declined drastically. "It is hard to increase our natural production so we have to rely on aquaculture. That's why we came here," he told Mr Cuong. "It doesn't mean we want to compete with you. We want to learn from you."

** Mr Starr accompanied the Cambodian delegation to Viet Nam in his capacity as editor of* Catch and Culture

Strategic planning in Cambodia

By Perry Jago *

Ricefield fisheries provide a simple answer to the complex problem of feeding a growing population

More than 30% of Cambodia is covered by wetlands on either a permanent or seasonal basis. Not only does the Mekong run right through the heart of Cambodia, but the Tonle Sap Lake is the largest freshwater body in the region. From these wetlands, Cambodia has one of the largest and most diverse freshwater fisheries in the world and the availability of fish is crucial to the health and wellbeing of the Cambodian people. Not surprisingly, Cambodians eat a lot of fish. A recent MRC study estimated annual consumption to be 52.4 kg per person per year, and fish represents more than 80% of the animal protein intake in the Cambodian diet (see *MRC Technical Paper No 16*). Fish is everywhere in Cambodia; in the culture, in the history, and in the language. Cambodians have a saying: *mean teuk, mean trey* (where there is water, there is fish).

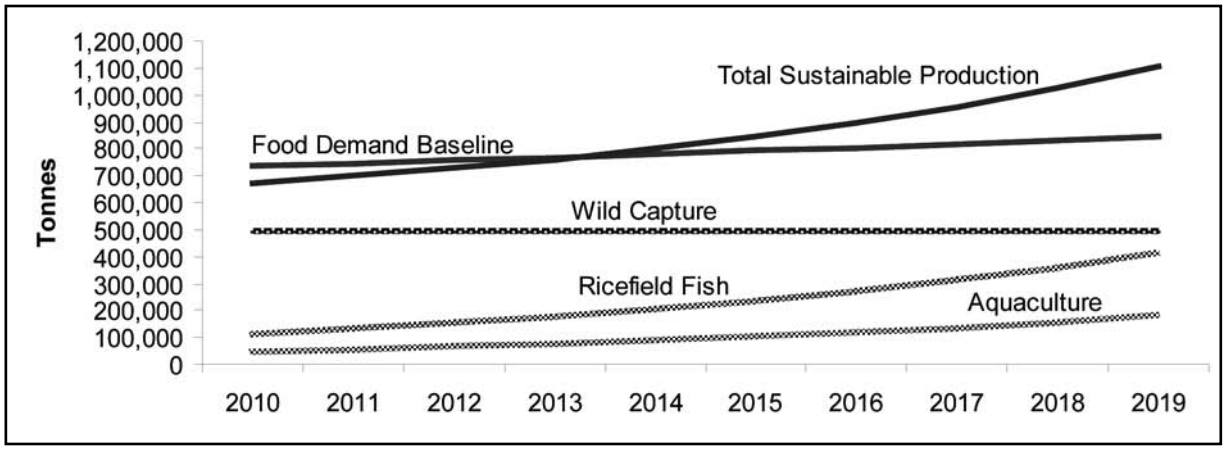
But there are problems. Despite this abundance of fish, Cambodia continues to face the challenges of fighting against undernourishment and malnutrition, especially among poor people. And the population is growing—at more than 1.5% per annum, according to the 2008 national census. At the same time, the wetlands environment, like all such environments around the world, faces threats. The natural water flow, which drives the flood patterns, which in turn drive the ability of the fish to breed, is likely to be affected—perhaps dramatically—by climate change, but also by the development of hydropower dams on both the upper and the lower reaches of the Mekong. And the growing population not only needs the fish that this threatened environment produces. It also needs land for agricultural use and for economic development, and these changes also have an effect on the ecosystem. On top of all this, there are strong indications that the inland capture fisheries, which make up some 70% of total production, are already over-exploited.

Strategic Planning Framework

It was in this context that the Cambodian Fisheries Administration took on the task of creating a Strategic Planning Framework to guide the development—and maintenance—of the fisheries sector for the next decade. This task took a number of stages: analysis of the need and the setting of goals; analysis of the current situation; analysis of alternatives; and decisions on the courses of action to be followed. From the need analysis, it was clear that more fish was

Meeting food security needs

Ricefield fisheries are projected to reach 400,000 tonnes a year in 2019



In some parts of south-east Cambodia fish ponds are common in ricefields. They are usually covered with brush and sticks to shelter the fish and to prevent theft.

Photo: Kent Hortle

required: at least an additional 150,000 tonnes per year by the end of the decade, just to keep food and nutrition security at the status quo. From the situation and options analyses, it was also perfectly clear that this growth could not come from the wild capture fisheries, which were already under stress and facing threats. This left as the only option an increase in production from human-managed sources.

'Aquaculture on its own cannot fill the gap'

Some of Cambodia's neighbours, particularly Thailand and Viet Nam, have well-established and very large aquaculture industries, capable of producing in the region of a million tonnes per year. Cambodia is not in this situation. Most aquaculture is on a family scale and current total annual production is in the region of 50,000 tonnes. Growth is certainly both possible and highly desirable, but it will require considerable investment, not least in infrastructure. Nonetheless, ambitious targets have been set for growth. But even with the most aggressive development that might be feasible, aquaculture on its own can not fill the gap. This left only one option remaining: the capture of fish from ricefields. In a number of countries, ricefields form part of an integrated "polyculture" system, where fish are farmed alongside the rice crop. Both benefit from this arrangement: the fish eat the pests that feed on the rice plants and then help fertilise the rice as a result. However, in Cambodia, neither polyculture nor the use of ricefields for aquaculture is widespread. Nevertheless, there is a sizeable catch of wild fish from ricefields. In 2008, this was estimated to be at least 100,000 tonnes although MRC Technical Paper No 18 has estimated the harvest as high as 340,000 tonnes.

Rice relies on the presence of water. While water supplies to ricefields face the same general threats from climate change as "wild" water bodies, water supplies in ricefields are generally far more amenable to human intervention to ensure their maintenance

than rivers and lakes. So production from ricefields already offers some small degree of resilience to future threats. The question was, could the amount of fish produced be increased?

The fish caught in Cambodian ricefields are "self-recruiting" as they breed naturally and move into the fields as they flood. But this process relies on the level and timing of the natural flood and is therefore still vulnerable to changes in the water flow. While most fish in ricefields are either caught, return to the rivers or die as fields dry out, some survive the dry season in ponds—both natural and human-made. When the following year's rains arrive, these fish are the first to exploit the newly-created wetlands in their vicinity and therefore get a "head start" with breeding. This gave us our way forward.

Community fish refuge ponds

A programme to help local districts create fish refuge ponds was already underway, with a target of creating a pond in all 175 districts in the country. Some had already been created and data on their effectiveness was starting to become available. The results were striking: in a pilot study, the increase in fish productivity after the creation of the pond was found to be sixfold. While there was not enough data to show how valid this result might be on a wider basis, it clearly suggested that the results were likely to be highly beneficial. An extension of this programme to reach further into the community could therefore yield dramatic results.

'The process requires neither large amounts of capital nor high technologies'

So, instead of 175 ponds, could we create more? The answer was simple: yes, especially now that we knew just how important this intervention could be. The process requires neither large amounts of capital nor high technologies, just training in how to create and manage a suitable and sustainable pond and a fair deal of physical labour. These can easily be provided, and our target is now the creation of at least 1,200 ponds in the next 10 years—one in every commune in the entire country that has suitable basic water resources. By 2019, these "community fish refuge ponds" should allow the catch from the ricefields to increase to over 400,000 tonnes per year; more than enough to meet the needs for food security.

Significantly more fish

If the growth targets that have been set for ricefield fisheries and aquaculture can be met, Cambodians will have significantly more fish by the end of the next decade. But as well as providing food, increased use of the ricefields has other benefits. It gives the farmers an extra crop— fish—that they can potentially sell in order to improve their livelihoods. In due course, this can help to bring about economic growth. And in the meantime, it helps reduce the pressure on the wild natural resources that the poorest people rely upon, thereby potentially reducing competition for those resources and helping to improve the livelihoods of these people. And last but not least, it helps to reduce the vulnerability of all of Cambodia's people to the shocks and stresses that might be caused by changes to the natural water resource in the future.

Of course, the Strategic Planning Framework covers a lot more than just the setting up of community fish refuge ponds. Not only will there come a time when the creation of ponds will have an ever decreasing effect as the production potential of the ricefields reaches its limit, but many other interventions are needed to meet the four key priorities of ensuring food security, improving people's livelihoods, supporting economic growth and ensuring sustainability. Consequently, there are some 60 targets for development, spread across seven major goal areas. All are important to achieving the Royal Government of Cambodia's vision for the sector: management, conservation, and development of sustainable fisheries resources to contribute to ensuring people's food security and to socioeconomic development in order to enhance people's livelihoods and the nation's prosperity. But perhaps none is more important or more effective than the comparatively simple task of helping people to create ponds.

** Mr Jago is a business and management consultant who is working as a management advisor to the Cambodian Fisheries Administration as part of a two-year contract with Volunteer Service Overseas (VSO), a British non-governmental organisation. This article solely reflects the views of the author and does not represent the official position of any government body or other organisation.*

Mixed fortunes among listed **processors**

Faquimex workers sort frozen catfish fillets for export at the company's plant in Ben Tre in October

PHOTO: LEM CHAMNAP

How are Mekong Delta catfish, shrimp and clam exporters faring in the worst global economic downturn since the Great Depression?

Nam Viet Corp (Navico) has lost its position as Vietnam's top catfish exporter falling to third place behind Vinh Hoan Corp and Hung Vuong Corp, Saigon Securities Inc. (SSI) said in its outlook for the country's fisheries sector in 2010. SSI, an affiliate of Australia and New Zealand Banking Group Ltd (ANZ), said the listed Long Xuyen-based company's export revenues fell 30% from a year earlier to $28 million in the four months to April. That compared with about $36 million for both Vinh Hoan, an unlisted company based in Cao Lanh, and Hung Vuong, which is based in My Tho and also unlisted. SSI said Navico's export revenues were expected to decline by as much as 60% in the second quarter.

Among other stockmarket-listed processors in the Mekong Delta, SSI noted that the export revenues of shrimp processor Minh Phu Seafood Corp in Ca Mau province came to $44 million in the first four months of 2009. Although earnings looked impressive in the same period, the main profit driver was financial investments. According to SSI, the star performer was Bentre Aquaproduct Import and Export Joint Stock Co (Aquatex Bentre) with net earnings of VND 25 billion ($1.4 million) in the four months to April, almost 70% of its target for 2009. Sales reached VND 200 billion ($11 million) in the same period, about 50% of the target for the year. SSI research analyst Pham Luu Hung said he expected Aquatex Bentre to beat its 2009 earnings target as fundamentals were "good" while growth prospects looked "more stable than its peers". Mr Hung also noted that provisions for losses on the company's financial investments had been done "properly" while the level of debt at Aquatex Bentre was low.

Outlook brighter for 2010

Sales and earnings of publicly-listed southern Vietnamese fish processors

First quarter 2009 compared with first quarter 2008

Company name **Trading name (stock code)**	Location	Products	Q1 sales	Q1 profit
Bentre Aquaproduct Import and Export Joint Stock Co **Aquatex Bentre (ABT)**	Ben Tre	Catfish Clams	+ 6 %	- 19 %
CLFish Co **Cuu Long Fish (ACL)**	An Giang	Catfish	- 18 %	- 86 %
An Giang Fisheries Import Export Joint Stock Co **Agifish (AGF)**	An Giang	Catfish	- 41 %	- 14 %
Nam Viet Corp **Navico (ANV)**	An Giang	Catfish	- 44 %	†
Basa JSC **Basaco (BAS)**	Can Tho	Catfish Sea bass	NA	‡
Bac Lieu Fisheries JSC Joint Stock Co **Baclieufis (BLF)**	Bac Lieu	Shrimp	+ 61 %	+ 189 %
Cai Doi Vam Seafood Import-Export and Processing Joint Stock Co **Cadovimex (CAD)**	Ca Mau	Catfish	+ 30 %	+ 184 %
Ben Tre Forestry and Aquaproduct Import-Export Joint Stock Co **Faquimex (FBT)**	Ben Tre	Shrimp Catfish	+ 10 %	- 80 %
Sao Ta Foods Joint Stock Co **Fimex (FMC)**	Soc Trang	Shrimp	- 19 %	- 70 %
Investment Commerce Fisheries Corp **Incomfish (ICF)**	HCMC	Fish* Shrimp	+ 7 %	- 46 %
Minh Phu Seafood Corp **Minh Phu (MPC)**	Ca Mau	Shrimp	+ 23 %	+ 163 %
Ngo Quyen Export Seafood Processing Joint Stock Co **Ngoprexco (NGC)**	Kien Giang	Shrimp Seafood	- 11 %	+ 1612 %
Seafood Joint Stock Co No. 1 **Seajoco (SJ1)**	HCMC	Shrimp Fish*	+ 102 %	+ 47 %
Seafood Joint Stock Co No. 4 **Seapriexco (TS4)**	HCMC	Fish* Squid	+ 7 %	- 64 %

† Loss of VND62 billion ($3.4 million) ‡ Loss of VND1.8 billion ($100,000) * Fish means mainly marine but also freshwater species

Source: Saigon Securities Inc, company websites

Mr Hung said negative external pressures remained on catfish exporters such as expectations that the United States would classify Vietnamese catfish as catfish after all in order to apply stricter quality assurance measures. In 2003, the administration ruled that sutchi river catfish (*Pangasianodon hypophthalmus*) and Bocourt's catfish (*Pangasius bocourti*) could not be marketed as "catfish" in the United States as they came from a different family from the American domestic species. Since then, Vietnamese processors have diversified their exports to more than 100 countries and the product is now widely known as "pangasius" even though most exports are of the former species which is from a different genus. In addition to external pressures, Mr Hung noted that intense competition among catfish exporters had driven down prices and damaged the reputation of the country's fisheries sector which could be negatively affected in the longer term.

While the performance of the overall fisheries sector was worse than expected in the first half and while the export target of $4 billion may not be met in 2009, Mr Hung said the outlook was "brighter" for 2010 as consumption in developed countries was expected to recover. With exporters establishing their own farms to control inputs, the SSI research analyst predicted that the issue of raw material shortages would be gradually resolved. However, he warned, the risks of tariff and non-tariff barriers from countries such as the United States and Russia still remained.

Mobile hatcheries help **mitigate** impact of **declining catches** in northern Thailand

By Suphap Kaewla-aid, Naruepon Sukumasavin, Napaporn Sriputinibondh and Malasri Khumsri *

An effective tool in fisheries co-management also highlights the importance of conserving fishery resources

When the MRC Technical Advisory Body on Fisheries Management (TAB) held a series of learning events on regional fisheries management issues in 2008, fisheries communities in Chiang Rai in northern Thailand raised the problem of fishery resources declining. Such declines are believed to be the result of unusual variations in water levels caused by upstream dams.

In 2002, the Aquaculture of Indigenous Mekong Fish Species (AIMS) component of the MRC Fisheries Programme developed mobile hatcheries to produce fish seed in remote areas. They proved to be an effective tool to promote fisheries co-management. It was anticipated that mobile hatcheries could also raise local people's knowledge and awareness of conserving fisheries resources. The Fisheries Management and Governance (FMG) component of the Fisheries Programme therefore identified the use of mobile hatcheries in fisheries co-management as a priority activity in 2009. Both components of the MRC programme have since collaborated with Chiang Rai Fisheries Station and local fisheries communities in using mobile hatcheries to produce fish to stock in the Mekong River at Pak Ing village in Chiang Rai.

'Tambon Administration Organisations are now committed to using the mobile hatchery to mitigate the impact of declining fishery resources'

Local people were encouraged to participate actively. During an inception meeting, 15 local representatives in a work team helped identify target indigenous fish species and develop a work plan. The work team and several additional interested community members were then trained in mobile hatchery breeding techniques for the tinfoil barb (*Barbonymus schwanenfeldii*). After the hatchery was set up in the village, the fish-producing programme took place over four days between September 16 and 19. About 600,000 fry were produced. Local people, government staff, community organisations and the district governor stocked about 500,000 into the Mekong River. The remaining 100,000 fry were distributed to 17 community member ponds for nursing with the survival rate monitored. More than 200 community members took part in the activity and Tambon Administration Organisations are now committed to using the mobile hatchery to mitigate the impact of declining fishery resources.

A mobile hatchery in the northeastern province of Nakon Phanom

** Mr Suphap is head master and professional-level fisheries biologist at the Chiang Rai Fisheries Station. Dr Naruepon is director of the Information Technology Centre and Mrs Napaporn is senior expert in fish genetics at the Department of Fisheries in Bangkok. Miss Malasri is a fisheries biologist at the Amnat Charoen Fisheries Station. The article is based on a poster presentation at the Tenth Technical Symposium on Mekong Fisheries in Pakse in November.*

Vietnamese **clam** fishery awarded **first certification** from MSC in **Southeast Asia**

Viet Nam wins international praise for taking a pioneering role in advancing sustainable fisheries management in the region

The Marine Stewardship Council (MSC) announced in November that the Ben Tre clam fishery in the Mekong Delta had become the first fishery in Southeast Asia to meet the organisation's sustainability and management standards. The clams (*Meretrix lyrata)* are picked by hand and sold to the domestic Vietnamese market and exported to Europe, the United States, Japan, China and Taiwan (see *Catch and Culture,* Vol 15, No 1). Noting the "vital economic role" of the clam fishery, an MSC statement said local cooperatives provided close management and surveillance of the broodstock and harvestable clams within their area.

"Although our clams are largely familiar to the EU market, we are still thinking of ways to better promote our business overseas," said Tran Thi Thu Nga, vice director of the Department of Agriculture and Rural Development in Ben Tre province, which co-sponsored the MSC certification with the World Wildlife Fund (WWF). "MSC certification gives us the right to promote our products with the credible MSC eco-label to customers worldwide."

MSC Chief Executive Rupert Howes described the certification as is an "historic occasion" given that the Ben Tre clam fishery was the first small-scale, community-based fishery in Southeast Asia to achieve MSC certification. "I am also delighted to hear that certification is already bringing benefits to the communities who depend upon this sustainable resource and very much hope other Vietnamese fisheries will soon come forward into the third-party assessment process," he said. "Viet Nam was the first nation-state to publicly commit to using MSC certification to promote sustainable fishing," Howes continued. "With the certification of the Viet Nam Ben Tre clam fishery, we are celebrating the first successful MSC certification in Southeast Asia. This confirms Viet Nam's pioneering role in advancing sustainable fisheries management in the region."

The Ben Tre clam fishery was visited by a high-level fisheries delegation from Cambodia in November

Photo: Lem Chamnap

While the Ben Tre clam fishery was one of the pilot fisheries involved in testing a recently-announced Risk Based Framework added to the MSC Fisheries Assessment Methodology, the statement said the fishery was ultimately assessed using the conventional methodology in use at the time.

Based in Britain, the MSC runs the only certification and eco-labelling programme for wild-capture fisheries consistent with the ISEAL Code of Good Practice for Setting Social and Environmental Standards and the United Nations Food and Agriculture Organisation guidelines for fisheries certification. More than 150 fisheries are engaged in the MSC programme with 59 certified and over 100 under full assessment. Another 40 to 50 fisheries are in confidential pre-assessment. Together, fisheries already engaged in the MSC programme record annual catches of close to 7 million tonnes, representing over 12% of global capture production for direct human consumption. The fisheries already certified catch close to four million tonnes.

Pakse hosts **Tenth Technical Symposium** on Mekong Fisheries

Symposium includes workshop on climate change

More than 120 delegates from the four countries of the Lower Mekong Basin as well as several regional and international agencies attended the Tenth Technical Symposium on Mekong Fisheries in the southern Lao city of Pakse in November. Organised by the MRC Fisheries Programme, the two-day symposium was followed by a field trip to the Siphandone area in southern Champasak province, which contains key migration channels allowing fish to move between various habitats on Lao and Cambodian stretches of the Mekong.

The first day of the symposium featured presentations on fisheries ecology, valuation and mitigation which focussed on fish and larval abundance, fisheries monitoring and deep pools. There was also a presentation on the impact of dams on fisheries in large rivers by Professor Ian Cowx of Hull International Fisheries Institute in Britain. This was followed by presentations on fisheries management and governance which addressed the problems of illegal fishing and aspects of participatory appraisal and monitoring as well as community awareness of the trans-boundary character of fisheries management. The day concluded with a presentation on the 10-year experience of the Regional Network for the Promotion of Gender and Women in Fisheries. On the second

From left, Mr. Soulivanthong Kingkeo, Deputy Director General, National Agriculture and Forestry Research Institute (NAFRI), Mr. Niphone Viengplaseuth, Acting Governor, Champasak Province, Mr. Xaypladeth Choulamany, Programme Coordinator, MRC Fisheries Programme

Symposium delegates pose at the Lao-Cambodia border as the Cambodians prepare to return by road to Phnom Penh

Photo: Lem Chamnap

day, a session on aquaculture of indigenous Mekong fish species focused on propagation and broodstock-management techniques. It also discussed the significance of indigenous species for aquaculture and the importance of economic analysis to ensure that propagation techniques are cost effective to make these species more competitive.

At the request of the MRC's Technical Advisory Body on Fisheries Management (TAB), the symposium held a workshop on climate change, considered one of the two main pressing issues affecting Mekong fisheries (the other being mainstream hydropower development). The session included a presentation by Kittipong Jirayoot, a modelling specialist and consultant to the MRC Environment Programme, on the impacts of climate change on Mekong flow regimes and possible implications for fisheries. According to one climate scenario presented, the Mekong Basin will experience average annual increases of 0.7 degrees in temperature and 5.3% in precipitation between 2010 and 2050, resulting in greater wet-season variability in Tonle Sap waters over the next 40 years (see table below). The Wetlands Alliance also gave a presentation on how climate change was being addressed at the local level. The workshop identified common grounds and suitable entry points for climate change-related activities which may be taken up in the upcoming Third Phase of Fisheries Programme scheduled to start in 2011.

In addition to the Wetlands Alliance, international agencies attending the symposium were the Network of Aquaculture Centres in Asia and Pacific (NACA), the WorldFish Center and the World Wildlife Fund (WWF).

Greater extremes?

One climate scenario for Tonle Sap Lake water variability in the wet season (2010-50)

Water	Past variations between extreme wet and dry years (2000 and 1998)	Future variations between extreme wet and dry years (2048 and 2045)
Level	2.4 m	5.3 m
Area	2,875 km²	5,975 km²
Volume	28,285 million m³	65,060 million m³

Source: MRC-CSIRO Project on Climate Change Vulnerability in the Mekong River Basin

Kent Hortle

Kent Hortle has been appointed chief technical advisor to the MRC Fisheries Programme, succeeding Chris Barlow who has returned to Australia (see *Catch and Culture*, Vol 15, No 2). Mr Hortle was based in Phnom Penh as coordinator of the Assessment of Mekong Capture Fisheries Component of the Fisheries Programme between 2001 and 2005. Since 2005, he has been working as a consultant in fisheries on projects for the MRC, for the WorldFish Center and on community fisheries development in Papua New Guinea. Prior to working for the MRC, Mr Hortle was employed as environmental monitoring superintendent for PT Freeport Indonesia for about five years, monitoring coastal and riverine fisheries. His earlier experience included a wide range of fisheries and environmental projects in Indonesia, Papua New Guinea, Thailand, India, New Zealand, East Timor and Australia. He has completed or contributed to more than 100 reports or publications including several in the MRC Technical Paper series and in Catch and Culture. He has presented at numerous conferences and workshops on fish biology, environmental assessment and limnology. Mr Hortle holds the position of Honorary Research Fellow at the Water Studies Centre of Monash University in Melbourne where he graduated with a BSc Honours (1st Class) in 1979 in zoology and chemistry.

Mr Hortle

Photo: Siew Yeen Liew

Soukkanya Philavong

Soukkanya Philavong has been appointed as secretary to the MRC Fisheries Programme. Ms Soukkanya was previously office manager at the S Sanguan Tyre Recycling Factory in Vientiane. Before that, she worked as assistant to the permanent secretary of the Lao Ministry of Finance for almost five years. Ms Soukkanya graduated with honours from the Graduate Institute for Development Studies in Geneva in 2005. She also has a bachelor of business administration degree from the University of the Thai Chamber of Commerce in Bangkok and an English language diploma from the Pedagocical University of Vientiane.

Ms Soukkanya

Photo; Phousavanh Fongkhamdeng

Mekong **Fisheries Index**

Process of creating global catfish standards enters final stage

WWF Press Release - 20 November, 2009

The final step in the process of creating global standards for farming two shark catfish species began on November 20 when the Pangasius Aquaculture Dialogue (PAD) kicked off its last public comment period. According the World Wildlife Fund (WWF), which has been coordinating the dialogue since 2007, feedback received during the 60-day comment period will be used the finalise standards for farming sutchi river catfish *(Pangasianodon hypophthalmus*) and Bocourt's catfish (*Pangasius bocourti*) during the first quarter of 2010. The process includes more than 400 producers, conservationists, government officials, academics and other interested parties (see Catch and Culture Vol 14, No 1 and Vol 15, No 1). In a statement, WWF said "significant changes" had been made to the draft standards as a result of inputs from 140 people during the first public comment period, discussions at a dialogue meeting in Ho Chi Minh City in August and meetings with small-scale farmers in Vietnam and Bangladesh. Among the changes are prohibiting the conversion of natural resources for farming, banning all antibiotics listed by the World Health Organization as critical antibiotics for human health, and assessing the quality of receiving waters (not just what water comes into and comes out of the farm). "Tapping into the experiences and expertise of a broad and diverse group of people will make the standards more robust," said Dr Flavio Corsin, the WWF senior aquaculture adviser in Hanoi ."I am confident that, because of the open and transparent process we use, the final standards will help transform the pangasius farming industry."

Gruesome fish stabbing follows love rejection

An ornamental pet Mekong fish is just the latest in a long line of innocent fish victims to have been stabbed to death, following an Oregon domestic violence incident.

Oregon court documents say that Donald Earl Fite III wanted to reunite with his girlfriend in July, but she wasn't willing. After Fite acted aggressively, the woman fled. Unfortunately, she didn't think to take the fish with her, or remove it from harm's way.

When she returned to her abode, she found that the 27-year old Fite had stabbed the fish and left it on the floor with a knife through it.

Fite told a police officer, "If she can't have me, then she can't have the fish." He pleaded guilty to animal abuse and domestic-violence assault and was sentenced to two years probation and a psychological evaluation.

His attorney, Tom Macnair, said stabbing the fish was "a very low point" in his client's life. The stabbed fish's specific species wasn't named.

Source: The Oregonian

New species discovered in the Greater Mekong at risk of extinction

A bird-eating frog, a gecko that looks like it's from another planet and a bird which would rather walk than fly, are among the 163 new species discovered in the Greater Mekong region last year that are now at risk of extinction due to climate change.

During 2008, scientists identified these new rare species within the jungles and rivers of the Greater Mekong, including a bird eating fanged frog that lies in streams waiting for prey, one of only four new species of musk shrew to be described in recent times, and a leopard gecko whose "other world" appearance – orange eyes, spindly limbs and Technicolour skin – inspired the report's title Close Encounters, according to a report released in October by the World Wildlife Fund.

The newly identified Mekong species identified in 2008 include 100 plants, 28 fish, 18 reptiles, 14 amphibians, two mammals and a bird, all discovered in Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam and the south-western Chinese province of Yunnan.
"After millennia in hiding these species are now finally in the spotlight, and there are clearly more waiting to be discovered," said Stuart Chapman, Director of the WWF Greater Mekong Programme.

But no sooner are these new species discovered than their survival is threatened by the devastating impacts of climate change, warns the WWF.

Recent studies show the climate of the Greater Mekong region is already changing. According to the report, models suggest continued warming, increased variability and more frequent and damaging extreme climate events.

Rising seas and saltwater intrusion will cause major coastal impacts especially in the Mekong River delta, which is one of the three most vulnerable deltas on Earth, according to the most recent International Panel on Climate Change report. “Some species will be able to adapt to climate change, many will not, potentially resulting in massive extinctions,” said Chapman.

Source: WWF

Latest catfish wars news:

Catch and Culture brings you the latest developments in the long-running attempt to keep Vietnamese catfish out of European and North American markets.

A Scottish MEP has warned the European Parliament that cheap panga from Viet Nam, also known as Vietnamese River Cobbler, could destroy the Scottish fishing industry because it is a substitute to cod and haddock.

“A price slump could affect fresh-caught cod and haddock, and even farmed salmon and trout, as shoppers turn to panga and chips,” said Struan Stevenson, the senior vice-president of the European Parliament’s Fisheries Committee.

Marketed at about £2 a pound, panga has already proved so popular in France and Spain that fishermen there complain sales of their own catches are in grave decline.

Source: The Scotsman

Meanwhile, another official body gave its voice to a proposal by the US catfish farmers lobby to have Vietnamese catfish reclassified as well, catfish, so that imports can be inspected as part of the US Department of Agriculture’s food safety inspection program.

The Delta Council, a regional group of agriculture and business interests in the Mississippi Delta

“We want the USDA to treat catfish just like it does beef, pork and poultry,” said John Phillips, chairman of the Delta Council executive committee.

The proposal has the backing of the Catfish Farmers of America, who want the Obama administration to sign off on a strategy to have Vietnamese imports considered catfish so that they will be covered by a new inspections regime that they pushed through Congress in 2008.

The USDA currently regulates all meat products, but it does not inspect seafood. The inspection of imported seafood is now administered by the Food and Drug Administration.

The reason that Vietnamese catfish is currently not sold as “catfish” in the US is that previously the Catfish Farmers of America organisation successfully lobbied congress to pass legislation to prohibit it being sold under the catfish title.

The inspections feud is the latest in a long-running battle between a $400 million domestic farm sector that raises catfish in ponds across Mississippi, Alabama and Arkansas and a burgeoning industry in Vietnam, where fish are raised in ponds and cages along the Mekong River.

Source: Clarion Ledger.

Viet Nam starts pilot scheme to track Mekong seafood

A pilot programme to monitor origins and quality of seafood processed in the Cuu Long (Mekong) Delta provinces has been undertaken in response to an EU regulation requiring Vietnamese seafood imports to certify the location of the catch, according to the Ministry of Agriculture and Rural Development.

Under the programme, the ministry, in collaboration with the Danish Ministry of Foreign Affairs, has begun monitoring seafood processed in the city of Can Tho and in Dong Thap Province from input to output, with both breeding units and suppliers being given their own identification numbers and barcodes to identify

product origins in the event of a claim of substandard quality.

Thirteen types of information are now being tracked, from where and when products are bought and sold, to what and when the fish have been fed, including pharmaceuticals.

Source: Business in Asia Today

Govt panel takes new look at dam

The Thai government has agreed to set up a committee to investigate claims by villagers that they are suffering problems from the Pak Moon dam in Khong Chiam district in Ubon Ratchathani.

The decision was made after a meeting yesterday of government officials, led by the PM's Office Minister Sathit Wongnongtoey, and representatives from the Assembly of the Poor, a non-governmental organisation.

Mr Sathit said he would head the committee and call the first round of talks tentatively planned for two weeks in Ubon Ratchathani.

The committee will review a dam impact study conducted by Ubon Ratchathani University under the Thaksin Shinawatra government. It would be expected to come up with fresh recommendations on solutions to the people's problems, Mr Sathit said.

The study suggests the dam's sluice gates should be opened year-round to allow fish from the Mekong River to migrate to the Moon River, but the government has refused. It decided to open the gates for just four months a year, claiming the dam needed to accumulate water to produce electricity.

Mr Sathit said villagers claimed they were still unable to catch many fish in the Moon River because the dam affected stocks and breeding.

Source: Bangkok Post

Lao Fishway project helps river species to breed

A project to increase fish populations and boost reproduction is expected to expand to the northern provinces of Lao PDR.

The fishway pilot project was implemented in Pakpung village, Pakxan district, in Borikhamxay province from 2008-2009 with the aim of stimulating fish reproduction.

Fishways can boost fish populations by providing a access to suitable habitat for feeding and reproduction. They can create links between floodplains and rivers, allowing fish to bypass barriers such as dykes and weirs that have blocked the connections between habitats.

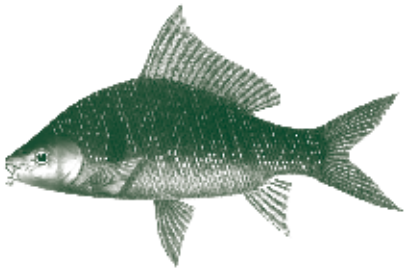
Under the project, more than 100 species have been shown to be able to move upstream through an experimental fishway.

Project organisers say that because the technique is new for many people, it was initially hard to enlist local support and get riverside communities involved.

"We are working on low barriers that are less than six metres high. In the future, if possible, we will encourage dyke and weir builders to construct fishways to provide access for fish", Project Leader, Mr Douangkham said.

According to a report from the project, many streams feeding the Mekong River have been diverted to provide water for agriculture. This has blocked some streams altogether, making it difficult for fish to find their way up or downstream. This has affected fish breeding cycles, and growth, diversity and size of fish stocks.

Disclaimer: these stories are for general information only and are not meant as a statement of official endorsement by the Mekong River Commission.



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