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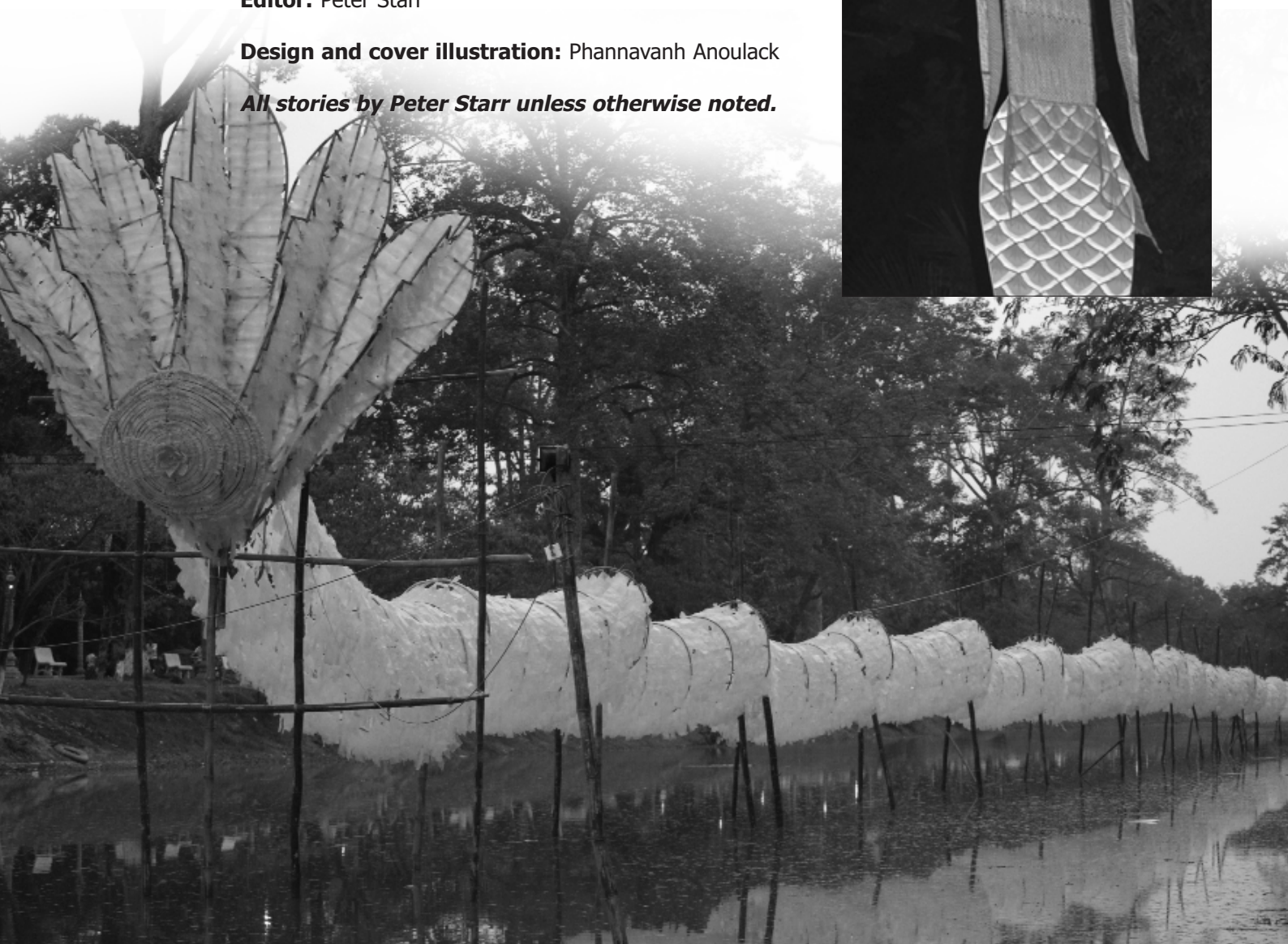
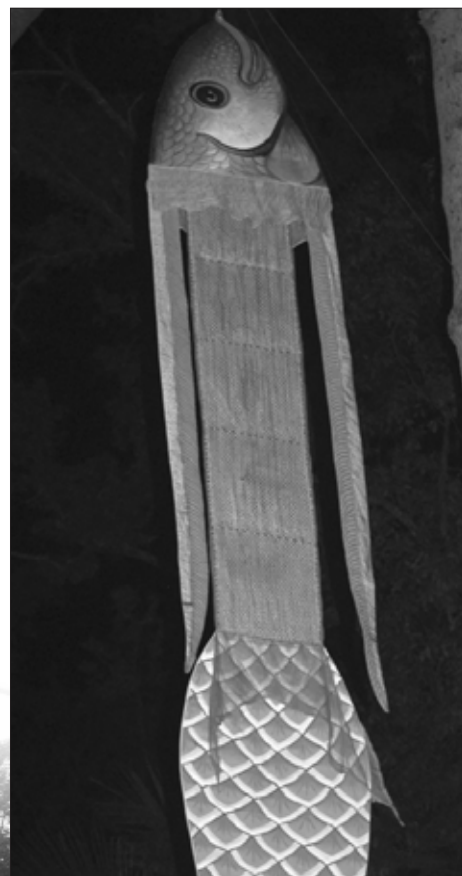
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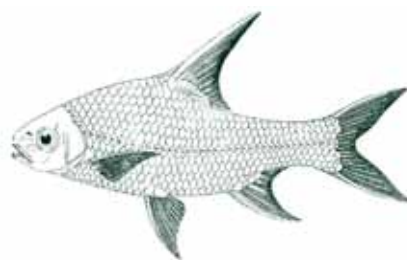
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# Editorial

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In this issue of *Catch and Culture*, we interview Jeremy Bird, the new Chief Executive Officer of the MRC Secretariat. Mr Bird, who took up his position in March, highlights the challenge of developing infrastructure in the Lower Mekong Basin while maintaining the fishing industry that supports so many people. He also sees a growing role for fisheries management in the region, as food prices soar and land pressure increases

Regarding capture fisheries and management, we examine recent ecological insights into the stationary bagnet fishery in Cambodia and also feature a description of a traditional Lao hunt for the endangered Mekong giant catfish. This involved elaborate rituals that seem to have died out half a century ago. This first issue of *Catch and Culture* in 2008 also looks at the aquaculture industry's recent efforts to develop certification standards for *Pangasius* exports from Viet Nam.

As for the big picture, we take a special look at the impacts of climate change on fisheries with extracts from a background paper circulated ahead of the global food crisis summit in Rome in June.

This issue also features an enormous art installation near the Angkor temples to mark World Water Day in March. Created by Cambodian artist Leang Sekhon, sponsored in part by the MRC, and assembled with the help of fishermen from the Tonle Sap Lake, the rattan and plastic structure illuminated the banks of the Siem Reap River for almost three weeks.

*The Editors*

# Interview: Jeremy Bird, CEO of the MRC Secretariat

***Jeremy Bird, a British specialist in water resources management, assumed the position of Chief Executive Officer of the MRC Secretariat in March. A chartered engineer with postgraduate qualifications in water law and policy, Mr Bird has over 25 years of international experience in the water sector. Here he speaks to Catch and Culture about fisheries-related developments across the basin.***

**What do you see as the major challenges for the MRCS over the next few years?**

At this time of rapid development in the basin, there are several areas on which we have to focus. Many people do not realise just how much effort has been put into developing the procedures and guidelines for implementing the 1995 Mekong Agreement.

Among the significant achievements already gained are the procedures on notification and prior consultation of new water resources infrastructure, and for maintenance of water quality and mainstream flows. Now is the time to test these procedures and to ensure that they are implemented effectively in support of the overall goals of sustainable development.

As I pointed out in my inaugural speech on joining the Secretariat, one of the key challenges for us is to demonstrate our relevance in the planning and management of water resources in the basin. The procedures are one important part of that, but we also need to ensure that the unique assets of the MRC are properly used.

The considerable knowledge and analytical capability that has been built up over the past years must be made available to decision-makers in governments, to private sector developers, and to society more



Mr Bird delivering the opening address at the Sixth Annual Mekong Flood Forum in Phnom Penh in May

PHOTO: AIDEN GLENDINNING

generally. There is much new data collection, modelling and research work to be done, but we already have a vast array of information available. Perhaps in the past we have not been successful in getting this data out into the public domain in a form that is readily accessible. That needs to change.

Turning towards challenges for the future of the Secretariat itself, we have embarked on a transition from an organisation managed by international specialists, to one where in three years time, all senior management and corporate service functions

will be staffed by people from the four member countries. I have no doubt that eminently qualified people will come forward to take on these roles and further increase regional ownership.

As an organisation representing the joint interests of four member countries, we have to ensure that procedures are in place which not only stimulate cooperation, but also are perceived as fostering independence and neutrality in management decisions.

The long-term sustainability of our financing is also important if we are to carry out the core management functions of the MRC over the next decade and beyond. To continue to grow we will need financial commitment from our member countries. In the transition period, we hope to retain the confidence and invaluable support of our development partners.

#### **What are the big issues for development in the basin?**

Asia is still home to huge numbers of poor people struggling to attain minimum levels of food security. Fortunately, in the basin the proportion is less than in Asia as a whole, but nonetheless, poverty alleviation must remain a key focus. Rapid economic growth will certainly help basin states in their efforts to reduce poverty, but it can also bring with it increased inequity if not carefully planned.

Targeted measures to protect and build on current poverty alleviation initiatives will be important. Key questions when considering new investments would be who gains, who loses and who pays? Answering these questions and addressing their consequences will inevitably encourage a balanced approach. The region's impressive growth rate provides new opportunities as urban areas expand. But again, this raises questions of maintaining a sustainable resource base and providing opportunities for rural communities in parallel.

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### ***'Key questions when considering new investments would be who gains, who loses and who pays?'***

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Pressure on resources will only continue to grow, and this may well be exacerbated by the effects of climate change. We need to better understand these effects and work not only on emission reductions, but also adaptation strategies.

#### **Based on your experience, what approaches would you like to see for water developments in the Mekong Basin?**

Some people describe the Mekong Basin as having limited development when compared to other basins in the world. This may well be true in terms of infrastructure to exploit irrigation and hydropower potential, but should not be equated to a lack of development more generally. The basin's natural resource base, particularly fisheries, is already intensively exploited by the population through industry worth over \$2 billion per year. To me the underlying challenge is to develop these other sectors proactively, while maintaining the fishing industry that supports so many people. An integrated approach is essential – in the assessment of development options and the consideration of who benefits and who is at risk of losing out.

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### ***'Fisheries management will need to play an increasing role in the basin's development'***

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Such integration does not mean we have to wait until new institutions are established. We already have the necessary tools at our disposal, whether they be strategic environmental assessment, multi-objective planning processes or distributional analysis. Such approaches are not designed to delay or stall development, but rather to ensure that there is a fair distribution of benefits, and that the value of existing socio-economic development is fully recognised.

#### **How do you see the importance of fisheries in the context of the development of the Basin's aquatic resources?**

The readers of *Catch and Culture* probably know the answer to this better than me! The scale and diversity of natural fisheries in this basin is almost unique. Not only does it sustain millions of people and contribute significantly to the economy, but it has social and cultural implications that are difficult to appreciate unless you are familiar with the area.

We should recognise that new infrastructure developments are not the only threat. Already, increasing pressures of population growth and exploitation are causing problems. To some extent this can be compensated by an increased emphasis on culture fisheries, and this will be important in relation to mitigating some of the impacts of new hydropower developments in the tributaries.

**Given the current world food crisis, do you see an important role for fisheries management?**

Absolutely. There is no question that fisheries management will need to play an increasing role in the basin's development. What are the alternatives? Increasing protein intake from other sources requires massive quantities of animal feed – a commodity that is not only already under significant pressure, with grain prices at historic levels, but also requires huge quantities of water for irrigation. Some additional water will be available in the dry season once reservoir projects in the upper basin and in the tributaries are operational, but suitable land for irrigation is also constrained.

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***'Increasing protein intake from other sources requires massive quantities of animal feed – a commodity that is not only already under significant pressure, with grain prices at historic levels, but also requires huge quantities of water for irrigation'***

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**How can fisheries adapt to or co-exist with large scale hydropower development? What are the prospects for mitigating some of the impacts of development?**

Experience from this region has not so far been very encouraging, but that is partly due to a lack of well directed applied research, and partly to a belief that mitigation measures can be transplanted here from other places such as Europe and North America. For example, fish ladders are a technology that we now know does not work in the context of the Mekong. It is not only about fish passage upstream, but also ensuring a safe passage downstream for juvenile and adult fish.

As far back as 1994, before the Mekong Agreement was signed, the then Mekong Committee Secretariat advised that more research was needed on fish migration and on the mitigation measures for hydropower projects. At that stage, and in fact until very recently, there was a general feeling that mainstream dams were unlikely to proceed. The research was unfortunately not initiated as planned, but even so, through other work, our understanding in this area has gradually improved. The context for hydropower development in the basin has significantly changed in recent years with the entry of private sector concession arrangements and an extensive array of proposals on both tributaries and the mainstream.



New infrastructure developments are not the only threat

Although our understanding of the migratory patterns of fish is not complete, the MRC can constructively enter this discussion. Certainly, we want to avoid a situation like that in North America, where billions of dollars are being spent on retro-fitting measures to help fish migration long after the dams were built. We have an opportunity here to get it right first time – to put information on the table for decision-makers on the potential for mitigation measures and on the consequences for communities downstream and upstream. If decisions are taken to proceed with mainstream dams, the MRC can assist in ensuring that an effective, integrated and consistent approach to mitigation is followed throughout the basin.

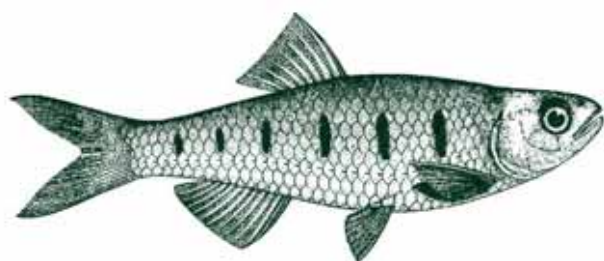
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***‘We want to avoid a situation like that in North America, where billions of dollars are being spent on retro-fitting measures to help fish migration long after the dams were built’***

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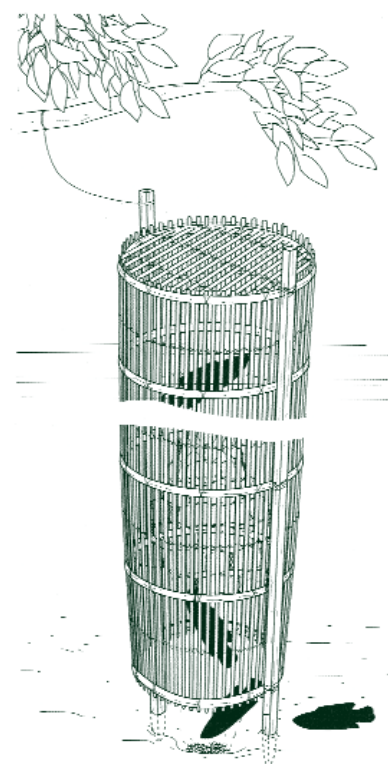
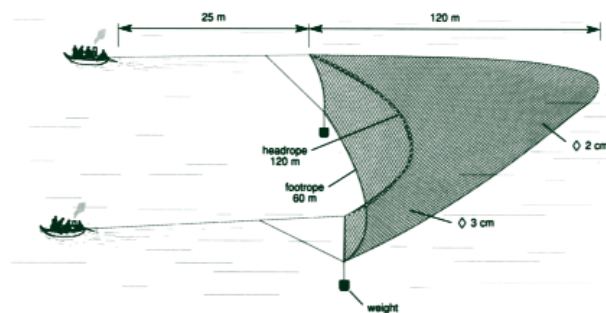
**How will the MRC be responding to the increased emphasis on hydropower in the basin, particularly the dams on the mainstream?**

We have a number of entry points. First, there are the formal procedures, under the 1995 Mekong Agreement, on notification, prior consultation and agreement as I mentioned earlier. Here there is a requirement for countries to enter into a process of prior consultation for mainstream projects with a view to reaching agreement at the MRC Joint Committee. The Secretariat will facilitate that process and, if needed, provide supplementary analysis. As directed by our Strategic Plan 2006-2010, the Basin Development Plan will undertake cumulative impact assessments of a number of development scenarios, including for mainstream dams.



Our new Hydropower Programme is proposing a number of dialogues among different groups, including an initial regional multi-stakeholder consultation and a meeting of specialists to look into options for mitigation measures. We have other plans too, which we are discussing with the Joint Committee.

The MRC supports sustainable hydropower development as a general principle. We do not have a position on mainstream dam proposals, other than to ensure that the procedures set out in the 1995 Agreement, and the information and knowledge we have made available for decision-makers to use, are followed in the spirit of Mekong cooperation.



# New research reveals ecological insights into *dai* fishery

By Ashley S. HALLS, LIENG Sopha, NGOR Pengby and TUN Phalla \*

*Catch and Culture* has been regularly reporting the landings of the important stationary trawl or *dai* fishery on the Tonle Sap River, Cambodia since 2004 [Volumes 10(1), 11(1), 12(1) and 13(1)]. Landings from the fishery have declined for a second consecutive season from the record of 28,600 tonnes in 2005-06 to 11,081 tonnes this season—a figure below the average of 14,300 tonnes (Figure 1a).

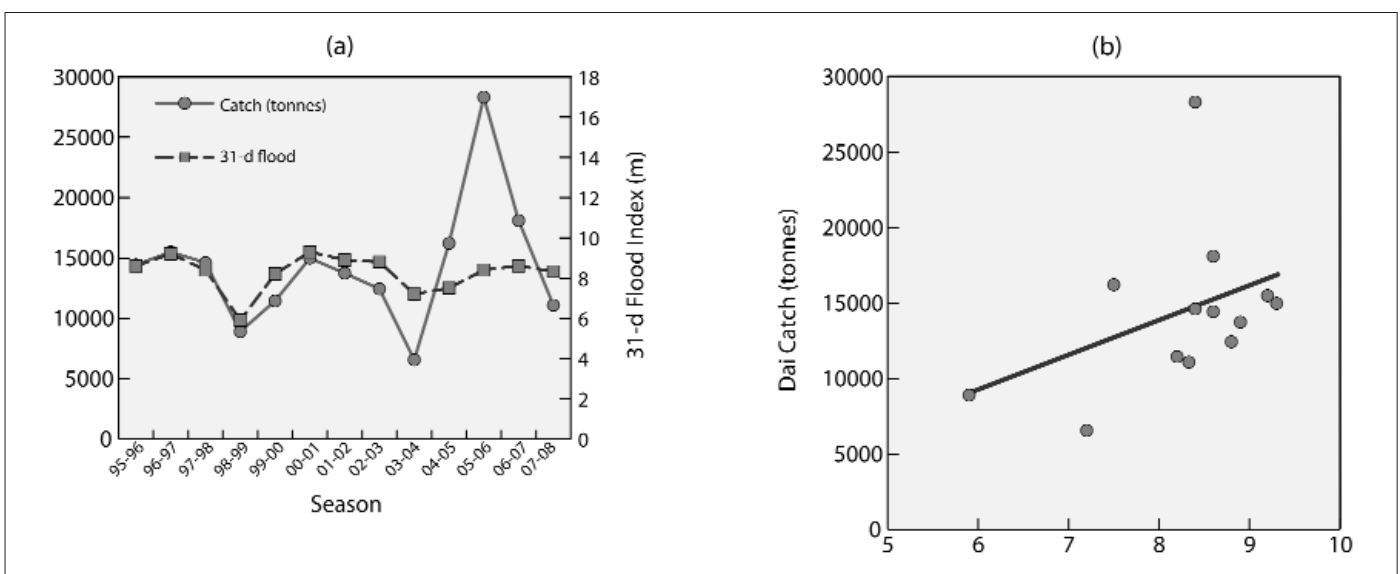
Hydrological conditions within the Tonle Sap-Great Lake System described using a simple flood index—the mean water level over a 31-day period recorded 15 days each side of (and including) the maximum recorded water level at Phnom Penh Port, as well as a range of alternative flood indices—have been employed to explain these large inter-annual variations in landings (e.g. Ngor and Hom 2000; Baran *et al.* 2001). However the '31-day Flood Index' now appears to be a poor predictor of catches (Figure 1b).

Halls *et al.* (2007) raised concern over the use of landings or catch (C) as a proxy of fish biomass (B) to monitor the 'health of fishery resources of the Great

Lake-Tonle Sap' because this approach assumes that both fishing effort (E) and gear efficiency or catchability (q) remain constant each year or season:  $C = BEq$ .

Halls *et al.* (2007) illustrated significant inter-annual variation in fishing effort since formal monitoring began and postulated that gear catchability is also likely to vary with the prevailing hydrological conditions each season. They argued that monitoring fish biomass—which accounts for any changes in fishing effort and catchability—would provide a more meaningful approach to monitoring the health of fish resources in the system and for describing the response of fish stocks to changes in the hydrology arising from development activities. They also highlighted that the selected flood index, used to explain environmental effects on rates of fish growth, mortality and reproduction, may also need to be revised since it takes no account of hydrological conditions outside the 31-day 'window' upon which it is based.

Using a De Lury depletion model (De Lury 1947),



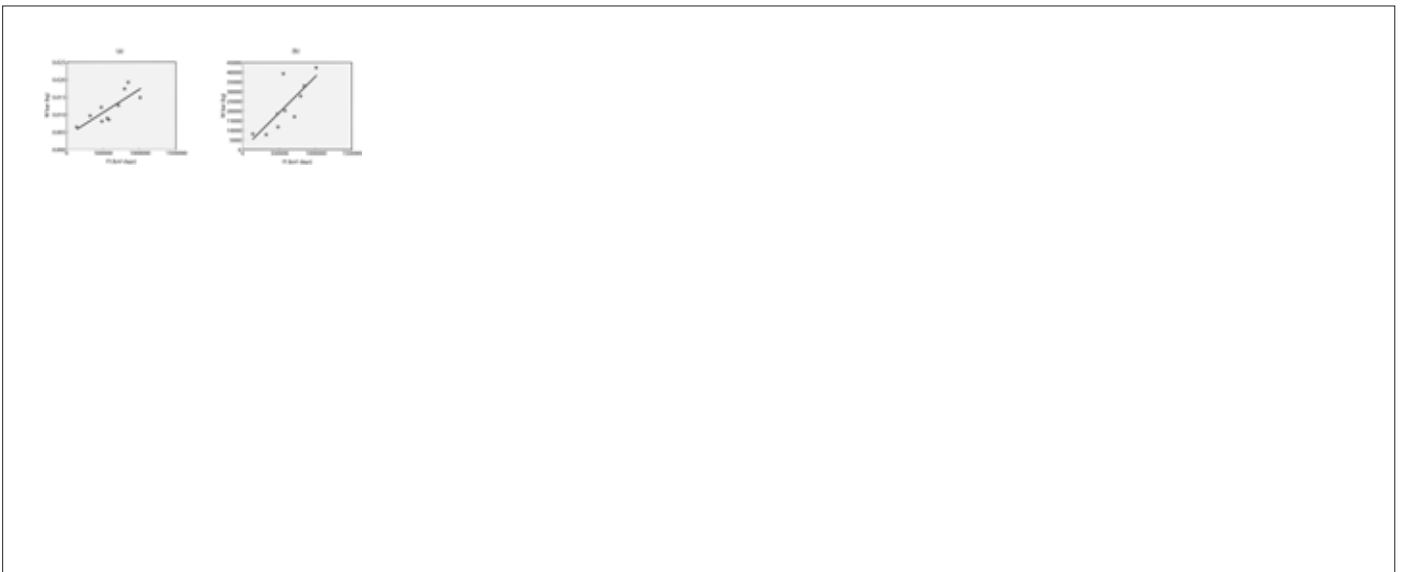
**Figure 1** (a) Estimated annual dai landings (solid line) and the 31-day flood index (broken line) from 1995/06 to 2007/08 and (b) Estimated annual dai landings plotted as a function of the 31-day Flood Index ( $R^2 = 0.16$ ,  $p = 0.18$ ).

mean *dai* catchability ( $q$ ) was estimated this year for each season from the rate of change in catch rates (mean numbers of fish caught per *dai* per day) between successive *dai* rows. Combining these estimates with monthly estimates of catch, effort and mean fish weight enabled estimates of fish biomass arriving at the *dai* fishery each season to be derived. A new flood index was also proposed that accounts for the extent and duration of flooding during the entire flood period—not just during the peak flood period. This was estimated by summing the wetted area estimates of the TS-GL system during the flood defined as the period when the wetted area exceeds

FI but not significantly at the 5% level.

Whilst this work is still in progress, these results suggest that variation in mean fish size is the main factor affecting inter-seasonal (annual) variation in fish biomass arriving at the *dai* fishery. These results indicate that the mean fish size (weight) caught can vary by a factor of up to 3 or 4 depending upon the extent and duration of flooding (flood index).

Three types of nets varying according to maximum and minimum mesh size are used by *dai* operators during the course of the fishing season according to



**Figure 2** (a) Mean fish weight for all species combined ( $R^2 = 0.64$ ,  $p < 0.01$ ) and (b) estimates of fish biomass ( $R^2 = 0.63$ ,  $p < 0.01$ ) arriving at the *dai* fishery each season plotted as functions of the new FI.

the long term daily average (approx. 7000 km<sup>2</sup>).

Estimates of *dai* catchability were found to vary significantly ( $P < 0.05$ ) between years (seasons) and inversely with the flood index ( $R = 0.70$ ), implying that the *dai* gear is less efficient at catching fish when water levels (and volumes) are high and potentially lowering fish density. The same catchability response to changes in water area or volume has been reported in a numbers of African lakes and reservoirs by several authors (see Bernacsek 1984).

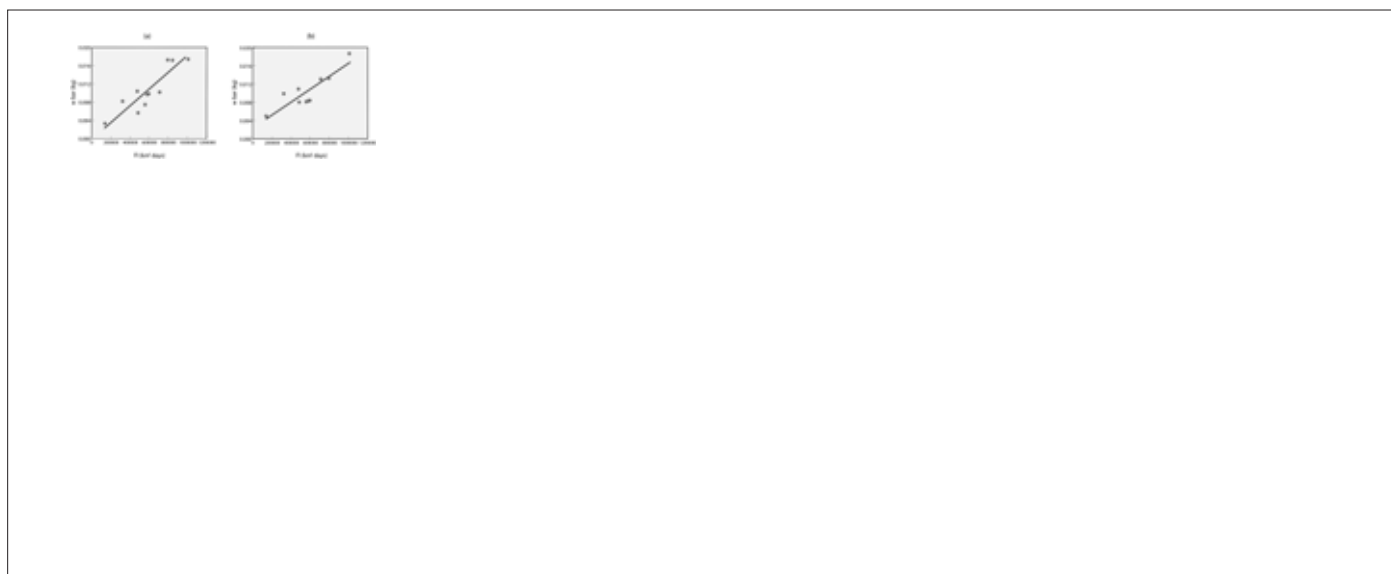
Estimates of mean fish weight (all species combined) in each season were found to increase significantly ( $p < 0.01$ ) with the new flood index (Figure 2a). Employing a simple linear (regression) model to describe the variation in catchability,  $q$  with the FI described above, estimates of fish biomass arriving at the *dai* fishery each year were also found to increase significantly with the FI (Figure 2b). Fish abundance (numbers of fish) was also found to increase with the

the prevailing hydrological conditions and the mean size of migrating fish - *dai chieu*, *nheuk* and *yor*. All three nets are conical in shape but the *yor* net has a much smaller top-panel and longer U-shaped top-rope to maintain net buoyancy during low flow conditions towards the end of the season (Jan–March) when lift forces exerted on the net generated by the flow are much lower (Halls *et al.* in prep). This raises the question: do these changes in the mean fish size caught reflect greater fish growth during longer and more extensive flooding or simply the use of larger mesh nets by *dai* operators during years when the flood index is high? Examination of the mean weight of fish landed for fixed mesh sizes suggests that the observed inter-annual variation in mean fish weight landed is likely to be driven by changes in the flood index rather than by changes in mesh size (Figure 3a & b). Indeed, the slope of the regressions shown in Figures 2a and 3b are almost identical differing by only 3%. Significant or highly significant correlations between mean fish weight and the FI were also



obtained for individual species including *Henichorhynchus lobatus*, *Henichorhynchus siamensis*, *Paralabuca typus*, *Labiobarbus lineatus* and *Labeo chrysophekadion* that contributed to more than 50% of the catch by weight this year. Positive correlations were also found for another 5 less abundant and therefore less well sampled species that make up a further 30% of the catch by weight. The remaining species were not examined owing to small sample sizes.

opportunities. At the same time, fish density and therefore competition for resources is likely to decline making it difficult to separate the effects of the two factors. Other confounding factors linked to flooding include temperature and dissolved oxygen. A negative correlation between mean fish weight and numerical density was found for the *dai* fishery this year supporting the hypothesis that growth is density-dependent.



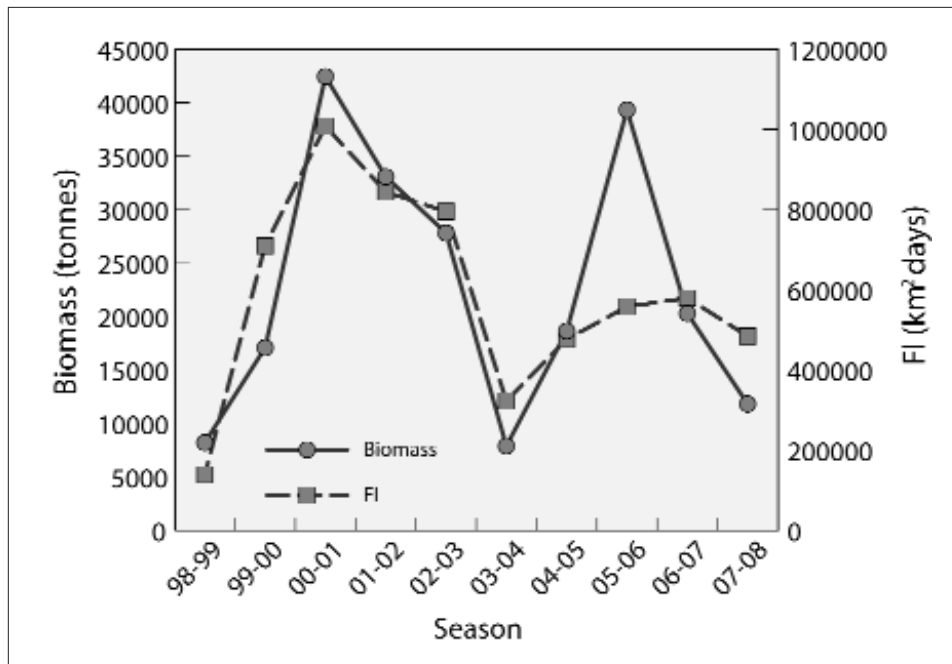
**Figure 3** Mean fish weight (all species combined) plotted as a function of the FI for (a) nets with a reported mesh range of 200 - 15 mm ( $R^2 = 0.80$ ,  $p < 0.001$ ) and (b) nets with a reported mesh range of 100 - 15 mm ( $R^2 = 0.75$ ,  $p = 0.001$ ).

Positive but not significant ( $p = 0.32 - 0.28$ ) correlations between both minimum and maximum net mesh size and the FI were also found. These inter-annual variations in mesh size may therefore be driven by the mean weight (size) of fish available for capture which in turn appears to be driven by variation in the FI.

Correlations between indices of flood extent and duration and fish growth have been reported in other systems although the underlying mechanisms responsible for the response are largely uncertain. Dudley (1972) and Kapestsky (1974) found significant correlations between the annual growth increments of several cichlid species and a flood index in the Kafue River, Zambia. Welcomme (1985) cites several other examples of this correlation including the Senegal River system where *Citharinus citharinus* failed to reach sexual maturity achieving less than 50% of its normal size resulting in recruitment failure. More extensive flooding is likely to promote greater primary and secondary production upon the floodplain and bring greater quantities of allochthonous food inputs into the system thereby improving feeding

Regardless of the mechanisms responsible, these results imply that long-term or permanent reductions in the FI arising from planned basin development could not only threaten the livelihoods of fishers dependent upon the resource by reducing exploitable biomass, but reductions in the FI could also threaten the long-term sustainability of the stocks inhabiting the system by reducing their reproductive potential (mean size/weight) and by making fish more vulnerable to capture.

During the last decade, estimated fish biomass has varied almost by a factor of 5 in response to variation in flooding extent and duration (FI) but with no discernable trend through time (Figures 2b and 4). The below average catch reported this season is therefore likely to reflect the below average flooding conditions in the system rather than the effects of overexploitation. Sustaining the *dai* monitoring programme will be necessary to confirm this interpretation. Importantly, these findings suggest that fisheries management efforts might be most effectively geared towards maintaining natural flooding conditions in the system.



**Figure 4** Estimates of fish biomass (solid line) arriving at the *dai* fishery and the FI (broken line) from 98-99 to 07-08.

These results also urge caution when monitoring mean fish size as a proxy for rates of exploitation. Whilst rates of exploitation may indeed have increased during this period as fish become more vulnerable to capture in drier years, a downward trend in the FI and corresponding mean fish size over several years as observed in this dataset since 2001-

02 (Figure 5) could lead to erroneous or overzealous conclusions regarding the rate of increase in exploitation rates over the period. This interpretation would be further complicated if the relationship between fish abundance and the FI described above was indeed significant.

### Key Findings:

- A new 'flood index (FI)' to describe the extent and duration of flooding in the system for the entire (not just the peak) flood period has been developed.
- Fish were found to be less vulnerable to the capture during more extensive and longer floods (high FI) as is typically found in African lakes and reservoirs.
- Mean fish size (weight) can vary by a factor of 3 to 4 depending upon the extent and duration of flooding. Fish size (weight) was found to increase linearly with the FI.
- The effect of the FI on fish growth appears to be the main factor affecting inter-seasonal (annual) variation in fish biomass arriving at the *dai* fishery although there is some evidence that numbers of fish also increase with the FI. Exploitable fish biomass was also found to increase with the FI.
- The below average catch reported in 2007-08 is probably a result of below average flooding conditions rather than the effects of overexploitation. Sustaining the *dai* monitoring programme will be necessary to confirm this interpretation.
- Long-term or permanent reductions in the FI arising from planned basin development could not only threaten the livelihoods of fishers dependent upon the resource by reducing exploitable biomass, but could also threaten the long-term sustainability of the fish populations by reducing their reproductive potential (mean size) and by making fish more vulnerable to capture.
- Fisheries management efforts might therefore be most effectively geared towards maintaining natural flooding conditions in the system.
- These results urge caution when monitoring mean fish size as a proxy for rates of exploitation since whilst rates of exploitation may increase during drier years as fish become more vulnerable to capture, fish size is also expected to decline irrespective of rates of exploitation.

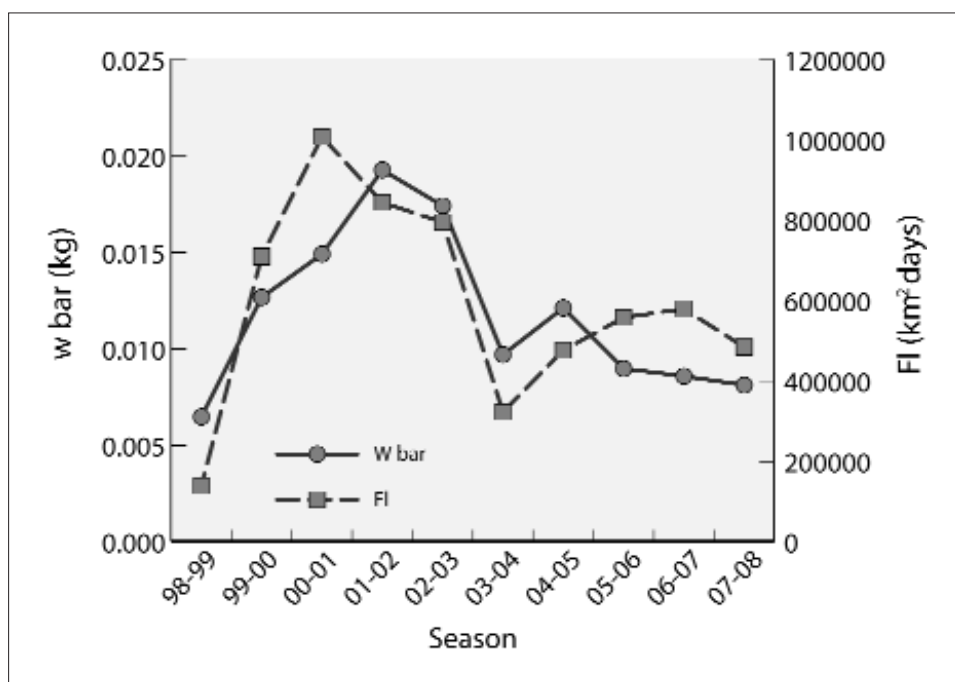


Figure 5 Inter-annual (season) variation in mean fish weight, W bar (solid line) and the flood index, FI (broken line) from 98-99 to 07-08.

During the next two years, the Fisheries Ecology, Valuation and Mitigation Component of the MRC's Fisheries Programme will seek further insights into the dynamics of the dai fishery with the technical assistance of Murdoch University and financial support from the Australian Centre for International Agricultural Research (ACIAR). This research will include further development, testing and validation of the types of models described above to aid basin planning. The project will also seek to determine if any significant changes in fish diversity have occurred since formal monitoring began.

\* Dr Halls is the Coordinator of the Fisheries, Ecology, Valuation and Mitigation component of the MRC Fisheries Programme. Mr Sopha is National Component Director for Cambodia and also the Deputy Director of Inland Fisheries Research and Development Institute in Phnom Penh. Mr Pengby is the component's Database Manager and Ms Phalla is the Data Entry Officer .

**Further reading:**

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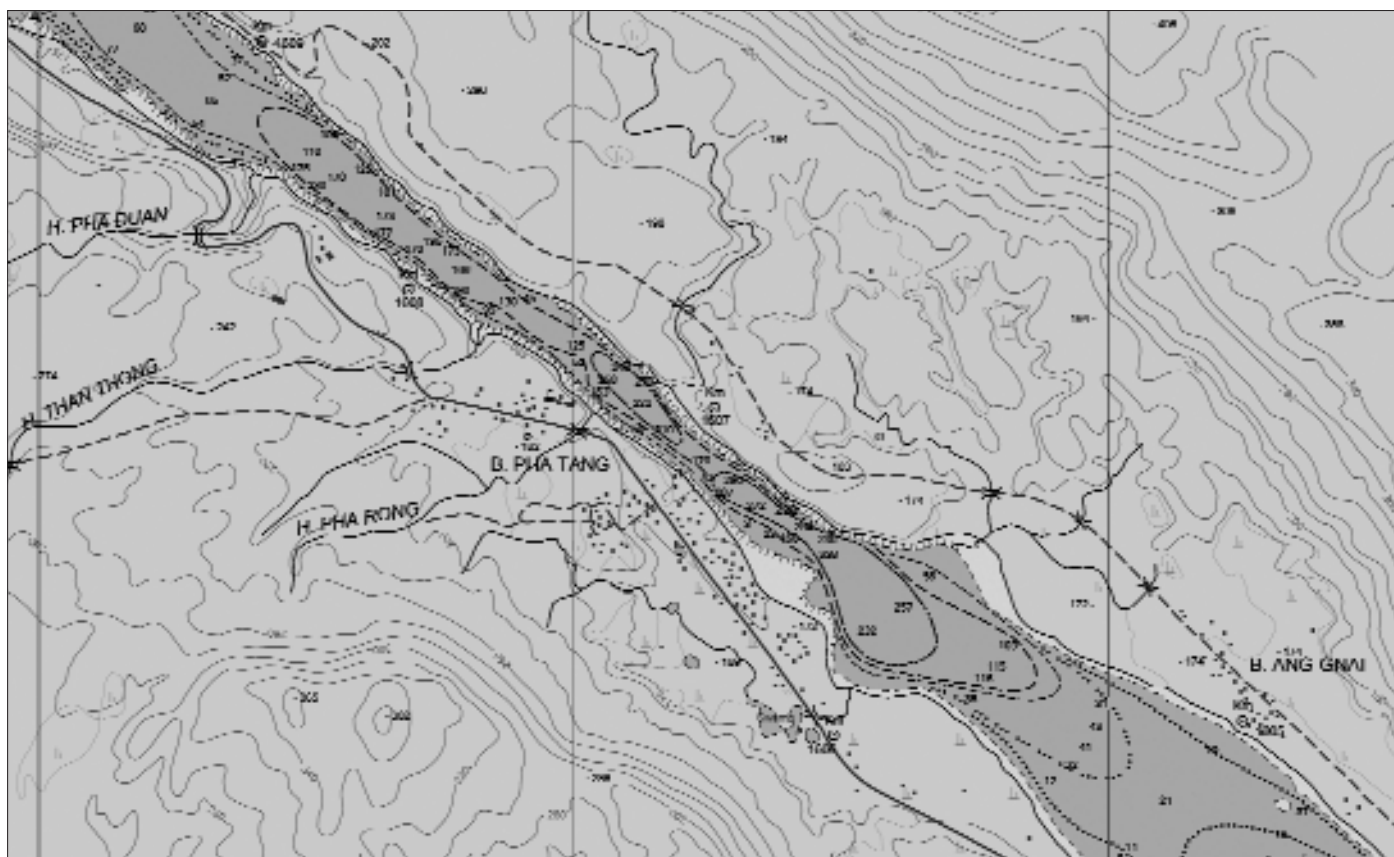


# Historic Lao fishery for Mekong giant catfish sheds light on traditional management

By Wolf HARTMANN \*

***Underwater caves in an enormous deep pool near Vientiane are a legendary home of the Mekong giant catfish. Early accounts of rituals accompanying an annual three-day fishing season indicate that several villages successfully managed the local fishery until about 70 years ago. Whether the caves are today being used as a refuge habitat for the endangered species is not clear. But at least one shaman thinks so.***

In the strict sense of the term, fisheries management is about deciding how fishing should be conducted and applying those decisions in practice. In the Lower Mekong Basin, systems for managing fisheries have been passed on from generation to generation, often over long periods of time. We know about some rules and activities which evolved under these traditional systems. Such knowledge can be similar to modern management regulations like permanently or seasonally-closed areas, prohibitions on certain types of fishing and protection of important species. But what were the decision-making mechanisms behind such rules, and on what management principles were they based?



The Golden Basin at Ban Ang lies just 25 km northwest of Vientiane. It opens up after the Mekong rushes through one of its narrowest points in Lao territory.

Reports from French and English explorers and scientists who travelled through the region in the late 19th and early 20th centuries are good sources to learn about traditional fisheries. In Laos, fishing for giant species at several locations along the Mekong from Khone Falls in the south to Houayxay in the north impressed all travellers, and so is particularly well described. At the time, the most important centre for fishing giant species—particularly the Mekong giant catfish (*Pangasianodon gigas* or *pa beuk* in Lao), one of the world's largest freshwater fishes—was an enormous deep pool at Ban Ang, just 25 km north of Vientiane. Roughly 750 metres in diameter, the pool was called Ang Tong Nong Chao, the Golden Basin. It was also known as the 'house of the catfish', 'the abyss' and 'the Lord's Lake.' Here, only once a year—and during just three days and nights before the full moon of the third Buddhist month, which normally falls in February—the great fishery for *pa beuk* and the giant catfish (*Pangasius sanitwongsei* or *pa leum*) took place. The Golden Basin is just downstream from a narrow stretch of the river less than 100 metres wide where the Mekong runs between huge sandstone cliffs. According to local legend it is here, in large underwater caves, that the

*pa beuk* lives and only comes out during this period of full moon. Over the first half of the last century, five foreign explorers described the fishery at the Ang (Raquez 1902; Duke 1925; Karpelès 1931; Giles 1935; and Serène 1939, 1951, 1956). Although varying in detail, their accounts provide unique insights into some features of traditional fisheries management along the Mekong. They also make fascinating reading about spiritual beliefs and rituals around Ban Ang—which is just downstream from the site selected for the proposed Pa Mong Dam.

### The fishery at Ang Tong Nong Chao

The fishing, which occurred from dawn to midday during the three days leading to the full moon, was preceded by four days of ceremonies. The observances and rites linked to this fishery were of animist (that is, pre-Buddhist and pre-Lao) Kha origin, and probably thousands of years old. They obtained the necessary help and favour for the fishery from important guardian spirits (*phi*). Associated with particular places, they were considered the real owners, protectors and managers of the water and all its animals. The spirits were from various parts of the river along a stretch of about 40 km. To win the favour



'Just above Wieng Chan, the hills disappear. The last of them are a flat-bedded red sandstone, passing into a conglomerate, the huge slabs lying in rows beside the water. The river opens out between them into a beautiful wide lake, known as the Hong Pla Buk, from the numbers of those big fish caught here.' (H. Warington Smyth 1895).

of the guardians, a procession of fishers and officials travelled in boats carrying offerings such as swords, water gourds, betel nuts and leaves, pieces of silver and beeswax, green coconuts and sweetmeats, and candles. There were also incense tapers, sandalwood flowers, a gong and two flutes. All were offered to the spirits with suitable music and chants.

The procession involved 13 villages with four major and ten smaller shrines. A spirit attendant (*mor cham*) would ask each spirit through a shaman (*nang thiem*) how to guarantee the fishery's success and how many fish would be caught. On each occasion, the spirit's inevitable reply would be: 'if the fishers act in the right and proper way, the catch will be plentiful; but if their behaviour falls below the proper manner, there will be few or no fish.' Asked by the attendant what constituted the right way, the spirit would reply: 'act in accordance with the best traditions of the ceremony.' On the fourth day, the procession would arrive at the deep pool. By then, hundreds of fishers would have congregated and would be cleansing, purifying and 'feeding' their canoes and nets, which were considered living spirits as well. The fishery started in the early hours of the 12th day of the third month, at the very moment the moon disappeared behind the mountain.

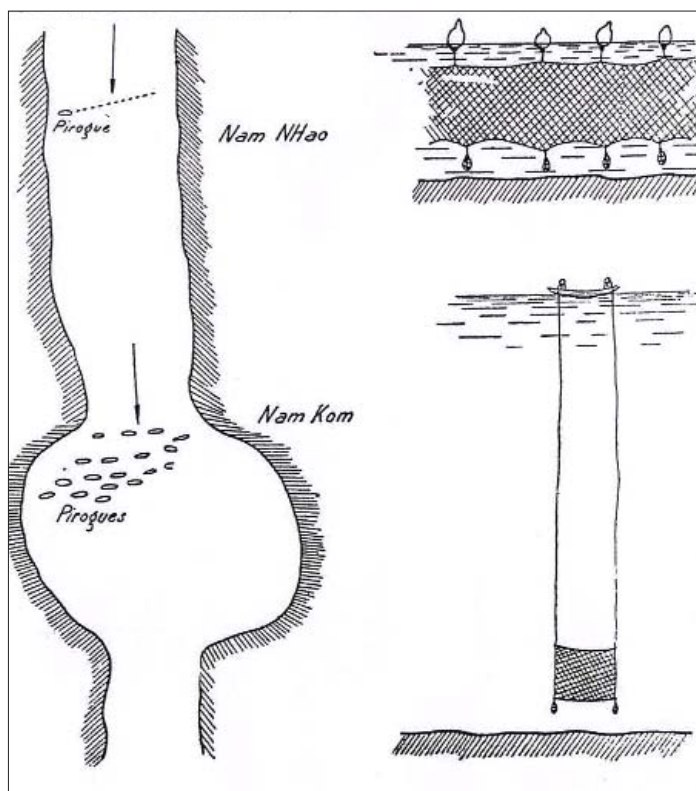
## Sacred chants

**'O Spirit of the Golden Basin, Lake of the Lord. Please open all the cavern doors that the fish many come out ... Please give us our reward ...**

**'O friends, O dogs, O bald-headed fools, O ancients in thy dotage. A dog shall lay with thy mother. I will lay with thy mother. As though art here, I will go and be in thy place, lay with thy wife. Do not return home till dawn ...**

**'Little one, please come up. Thou of lucky omen, please come up. Present thy tail before thy head. Now I let down the creeper noose. Now thou art caught.'**

Source: Giles, 1935



Short and long nets used in the *pa beuk* fishery at Ban Ang (from R. Serène 1939, *Les Engins de Pêche des Laotiens*).

Sacred invocations were chanted, first to make the spirit open the doors to the *pa beuk*'s underwater caves. The chanting, it was said, could be heard as far as Vientiane. Then men in hundreds of canoes would rush into the pool, setting short *nam khom* nets at depths of 30-40 metres, slightly off the riverbed. Giles (1931) was surprised what happened next. 'From the moment the fishery started, all present, men, women, children and old, fishermen and onlookers engage in a competition of abusive language in which sexual relationships take a prominent place, but no offence is taken. It is said that this form of abuse is music in the ears of the Spirit, gives pleasure to him and they thus gain his favour. People hold that if they don't abuse each other in the coarsest language, the fish would not enter their nets.'

The moment a fish was netted, more formulas were chanted to make the fish surrender. In shallow waters upstream and downstream from the pool, other fishers waited with long nets, *nam nhao*, set across the Mekong to stop any escaping fish. Once secure, a caught fish would be tethered to a stake with a ritual cord made from a certain liana (*sen phanh*). The cord was passed through its mouth and out again by the gills, tying the head tight to the tail so that the fish could not make the slightest movement until killed and



A *pa beuk* fishery in 1897 showing about 150 boats. At Ban Ang, between 300 and 700 boats were involved at any one time during the early days. PHOTO: BELL-COUSIN

sold. Other fishers would let their canoes be pulled home by the live *pa beuk*, to be killed later with a bamboo pole thrust between its eyes. All fish and the names of those who caught them were registered in a ledger. The first two would be killed with the heads and tails presented to the Spirit of the Golden Basin. The third one would be offered to the Spirit of the Caves. For each subsequent fish, money would be paid to the 'mandarin' overseeing the fishery. For fish caught by those from the Siamese bank and landed there, money would have to be paid to the Lao official as, in general, all ceremonies linked to the fishery occurred on the Mekong's left bank (the Lao side). Raul Serène was the first scientist to systematically describe aspects of Lao fisheries and was at Ban Ang on more than one occasion in the late 1930s. 'When the *pa beuk* fishing is in progress, the frontier disappears and the Laotians from both sides join forces. The larger group, however, is that from the Laotian shore' (1951).

Though collected by the state, the fishing fee was only destined for ceremonial purposes. Despite the fact that the fish was finally cut up and sold in the

market for local consumption, the fishery was clearly more a ritual activity than a commercial one. Indeed, *pa beuk* was a special and most prestigious product. Its roe was part of the tribute paid to the governor of Yunnan by the Royal Court of Luang Prabang (in addition to rhinoceros horns and ivory). It is the only reference found of fish being sold in old-time Laos. The main benefits of the fishery were the happiness it brought to the fisher and his family, luck in trading, and good fortune for the country.

Undoubtedly, fishing for *pa beuk* was always a minor fishery in terms of numbers of fish caught in Laos and Siam. During the first half of the last century, the annual catch at eight locations was about 180 fish. As Serène (1951) wrote: 'The quality of its flesh, its rarity, the size of the fish, as well as the mysteries surrounding its life, the legends and rituals accompanying its fishery, haven't they, above all, given the fish its mythic value, while its practical interest was much less than that of numerous other species?'

While other early travelers mentioned deep pools as

important fishing spots, his observations at Ban Ang prompted Serène (1951) to be the first to think about their ecological function: 'If the migration takes place in May-June, how come the deep pool fishery takes place in February? It is because some *pa beuk* stay all year long in the Mekong, and instead of descending to the Tonle Sap [or the sea, as some thought], are happy to remain in deep pools between their spawning migrations in June-July.' He describes two distinct types of *pa beuk* fishing. One was the fishery carried out at the time of the lowest water level in Mekong deep pools such as the Golden Basin. Another was in river shallows, when waters were rising and the *pa beuk* had left the deep pools and was migrating upriver (as in Luang Prabang and Houayxay). The latter was the main fishery in the past, when *pa beuk* were mostly fished outside deep pools and all along the Mekong. It had all but vanished, and people counted their age by being born before or after the disappearance of the *pa beuk*.

### The Decline at the Golden Basin

One might ask whether deep pools have become more important as refuge habitats since Serène's time. The writing was clearly on the wall seven decades ago. Giles complained in 1935: 'The French authorities permit the people to indulge in every form of gambling. Opium addicts are allowed to smoke opium without molestation. Booths for the sale of food, drink, and other things are scattered along the river bank. The people are showing signs of losing their belief in the necessity for the observance of these rites, and as it is probable that this ceremonial festival will disappear in a few years, I have thought it wise to make a permanent record of it, before decadence has set in, and the festival disappeared.'

Not only would decadence set in but worse was to come and the fishery declined rapidly from the late 1930s. In the early 1920s and 1930s, between 300 and 700 boats were catching between 50 and 100 *pa beuk* each season. By the late 1930s, the number of boats had decreased to less than 50 and there were years when not a single fish was caught. Serène (1951, 1956) mentions three possible causes for this decline, all linked to the disintegration of traditional fisheries management: overuse of the resource; non-compliance with ancient rules; and disturbance of the water and fish. He was present when the shaman called the fishery off one year because the proper rites had not been followed.

Among the many rules preceding the fishery was the

closure of the pool for navigation ten days before the fishing started. A *taleo*, a traditional bamboo stop sign, was planted into the river, warning boatmen from all directions that they must not travel further. In the old days, this prohibition was strictly observed: no one crossed and navigation along the Mekong was held up. Unfortunately, the captains of French postal boats insisted on passing, and little by little everybody else would follow. Many therefore believe that the decline of the fish was caused by increasing disturbances at the pool. But were the fish disturbed or the spirits? Charles Archaimbault (1956) mentions the *pa leum* fishery in Luang Prabang, where fishers gave up an important fishing area between the Royal Palace and Public Works. This was owned and managed by a spirit named Nang Dam, who apparently didn't like noise and locked the *pa leum* in the underwater caves.

More unrest came to the Golden Basin during the



Ms. Yen, the shaman in Kao Liao, at a spirit ceremony in June 2007.



American war when aircraft returning from raids in Vietnam would release unused bombs over the Mekong. Possibly the last great season was in 1960. After that, as Vientiane was divided between rival forces during the civil war, the yearly procession could no longer be held. No ritual, no *pa beuk*. Or were there no rituals because the *pa beuk* had gone? One elderly Lao fisherman questioned in February, 2008, was convinced that there were no fish because the rituals had stopped.

Despite the end to the processions, popular belief persists in the magic nature of the fish, sometimes called *pa phi*, meaning spirit or devil fish. And the office of *nang thiem* continues until today. I visited a shaman at a ceremony in a makeshift temple next to her house in Kao Liao in June 2007. Ms Yen, 53 years old, was the wife of a veterinarian and mother of an employee of the Justice Department. On that occasion, she was leading a ceremony of 32 other spirit mediums, dancing, smoking, and frequently changing dresses in accordance with the preferences of the spirit which possessed her at any one moment. I met her again a few weeks later, this time to talk about *pa beuk*. With the help of a raw egg standing upright in a heap of rice grains for better divination, she conveyed my questions and passed on the answers: *'The knowledge to make the pa beuk come out from his cave has been lost, and electricity and traffic on the river have further contributed to its disappearance. However, there are still 30-40 pa beuk in the pool and, with the country on the road to progress, no doubt the pa beuk will be back again.'*

### Traditional fisheries management?

Was the fishery at the Golden Basin an exception, or an example of more widely applied 'management' which may have survived into our days? Seven out of ten *pa beuk* fisheries described by early travellers had similar ceremonies to those at Ban Ang. Until today, spirit ceremonies are known from all parts of Lao PDR and neighbouring Mekong countries. Nattaya Tubtim (2005) gives an example from Champassak where people believe female guardian spirits, which they deeply respect, watch over Nong Bua back swamp. The management of the area by 17 surrounding communities is based on nothing else than a shared belief in the spirits. Bruce Shoemaker (2000) presents a separate case from Khammouane. According to local people, loss of respect for the spirit led to a decline in catches.

The belief that working tools such as boats and gear are living things is not limited to the historic Golden Basin fishery. Archambault describes in great detail feeding the 'young girl boat' in the *pa leum* fishery of Luang Prabang. Damrong Tayanin (1991) vividly

writes about sacred formulas among the Khmu of the Nam Tha in northern Lao PDR, which may be as important as physical tools and gear. And in his study of Kha Punong fisheries in Mondulkiri in Cambodia, Peter Degen (2005) points out that practices to appease spirits are indeed management measures as they directly regulate access to the resources and so influence their sustainability.

Several of the fascinating features described at the Golden Basin can be found in other fisheries of the Mekong Basin. Chief among them is the belief that spirits are the real owners and managers of natural resources. Man doesn't dominate nature; he is not the only actor. Indeed, as important as the fishing gear and craft are, they are partners possessed of individual powers and with a life of their own. The animals to be caught are brothers hidden in different bodies, which have to be appeased and, if they agree, sacrifice themselves. Unlike other management systems which focus on single villages, management at the Golden Basin involved several villages over a longer stretch of river and several spirits inhabiting important habitats along that stretch. It was a kind of ecosystem (or 'spirit system?') management with the importance of respect as a principle and major condition for resource sustainability.

Observations made by various scholars at the Golden Basin many years ago are typical for management practices based on traditional ecological knowledge in many parts of the world. Berkes *et al.* (2000) define traditional ecological knowledge as a 'cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment.' Not a bad summary for what used to go on at Ban Ang.

### Postscript

In the early hours of the 12th day of the third month of the year 2550 in the Buddhist calendar (19 February, 2008), I returned to the Golden Basin. It was a cold night, and I had come much too early. I should have believed Giles who wrote in 1935 that fishing started between four and five o'clock in the morning. As the moon set in a large orange disc behind two flashing mobile phone transmission masts, shots rang out from a bar brawl on the Thai shore. There was no other sound, no creaking noise of opening doors. It was as I was told by the shaman lady: *for now, the cave of the pa beuk remains shut.*

*\* Mr Hartmann is the coordinator of the Fisheries Management and Governance Component of the MRC Fisheries Programme*

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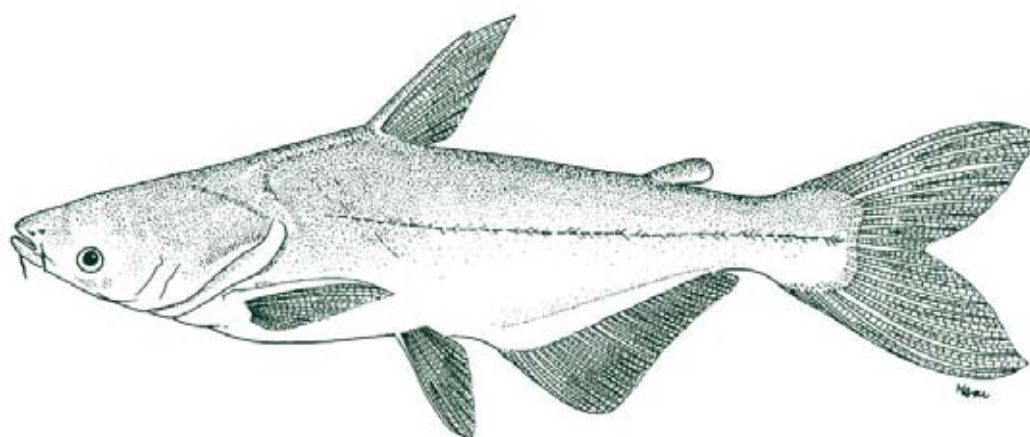
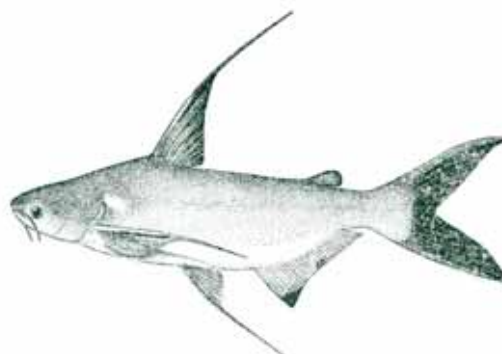
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# Floods and the Mekong River system (Part 2)

By Tim BURNHILL and Peter ADAMSON \*

***This article, the second in a three-part series, examines the characteristics of the flood as illustrated by its hydrograph, and the criteria that can be used to describe and define the dry and wet seasons.***

For everybody who lives close to the river the Mekong's annual rise and fall is part and parcel of the rhythm of the year, no more exceptional than any other of nature's cycles, such as the changing phase of the moon. So accustomed are we to this flux that it is only in extreme years, such as in 1966 when the flood spilled across the runway at Wattay Airport in Vientiane, that we sit-up and take note of this truly remarkable natural phenomenon.

In the first article in this three-part series on floods and the Mekong River system—published in the last edition of *Catch and Culture* 13(2)—we examined the Mekong's flood in a global context, recognising in particular how a combination of the Southwest Monsoon and the landform of the basin combined to produce floods that are on par with river systems that have much larger catchment areas. In this regard the Mekong could be said to 'punch above its weight'. This second article provides the background to the final article, which will look at the natural variation of the 'flood – recession cycle' and to see if there are any patterns that can be observed from records over the last decades that signal major changes in the character of the river system—particularly the frequency and severity of so-called significant and extreme floods.

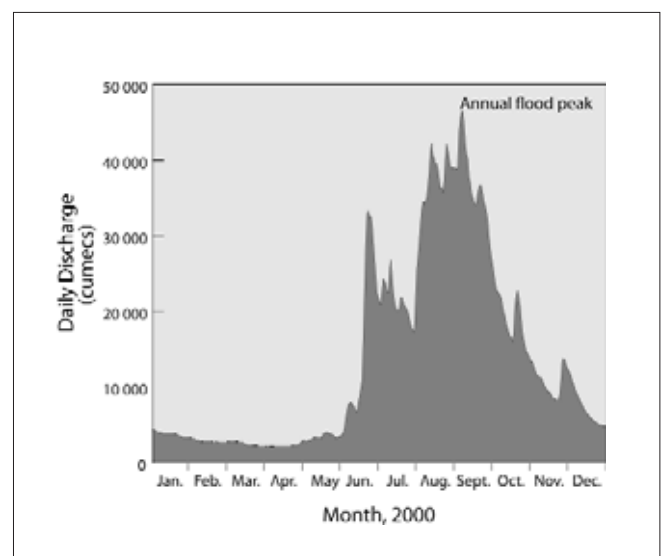
## The hydrograph

Hydrographs provide a very good visual representation of the seasonal variation in the flow of the river. In their simplest form they plot water-level on the vertical axis against time on the horizontal axis. However, water-level is not necessarily a good indicator of flow as the geometry of the river channel also controls absolute water-level (the increase in water-level in a narrow channel will be greater than in a broad channel given the same increase in flow).

Instead, hydrologists prefer to display discharge (usually measured in cubic metres per second, or cumecs), a measure that is independent of the width of the river.

Figure 1, which is the hydrograph recorded at Kratie, Cambodia, in the year 2000, illustrates a hydrograph that is representative of the mainstream of the Mekong. The low, and reasonably uniform, flow during the dry season months from January to May is clear, as is the rapid rise from June through to early September, when the peak discharge for year (the annual flood peak) was reached. This is followed by a rapid recession through October through November and into December. The ten fold increase in flow of the river between the dry and wet seasons is particularly striking.

The shape of the hydrograph also provides interesting information on the climatic controls and nature of the catchment of the river basin. Figure 2 provides a comparison between the hydrograph from Kratie (bottom) and the River Thames in the UK (top) and the Chenab, at tributary of the Indus, in Pakistan (middle).



**Figure 1.** An example of a typical 'Mekong' hydrograph—recorded at Kratie in the year 2000.

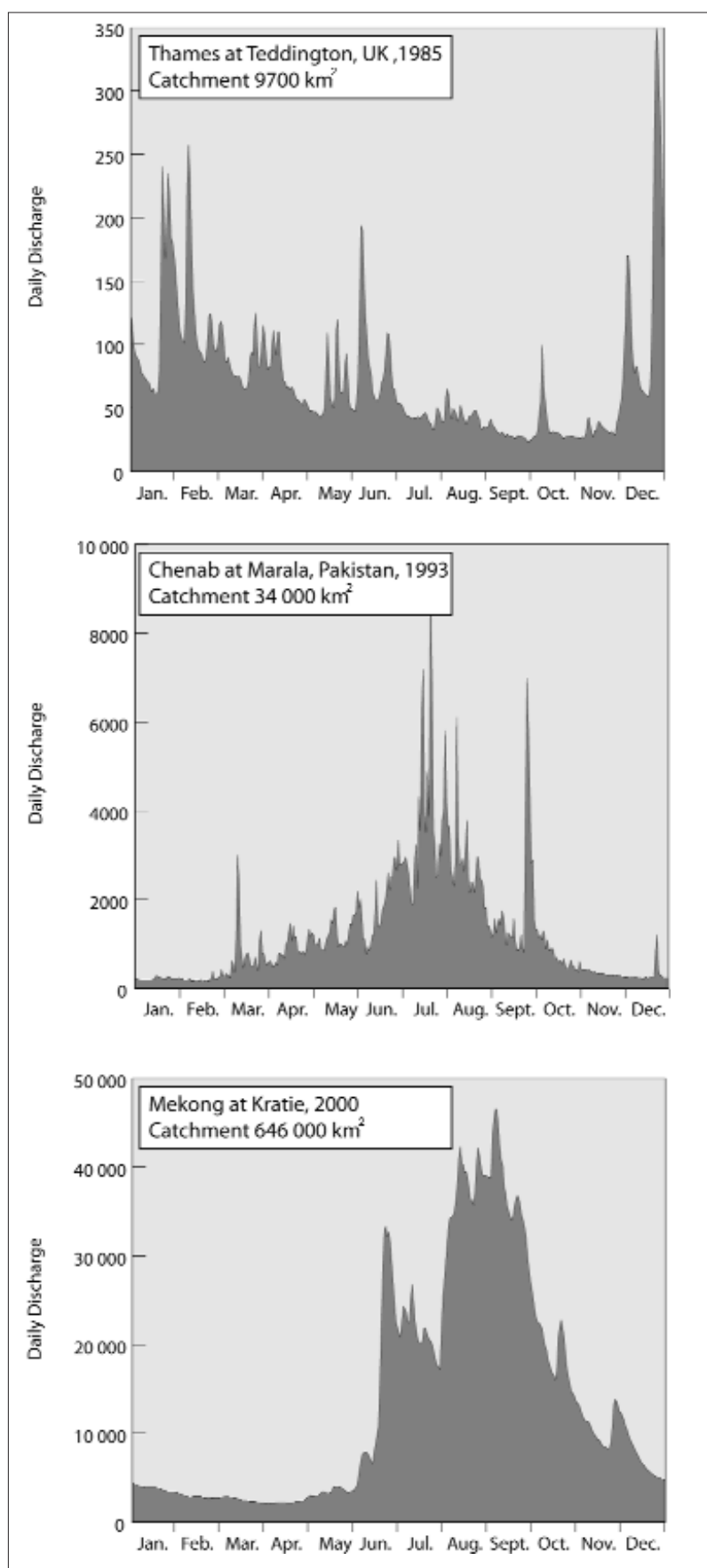
The River Thames is located in a temperate region where the prevailing weather system is dominated by rain-laden depressions sweeping across the UK from the Atlantic Ocean to the west. The major depressions are seen as the sharp peaks in the hydrograph resulting from associated heavy rainfalls. Although there are more, and larger peaks, in the winter months from December through to March, the seasonality is not as strongly developed as it is in Mekong at Kratie (indeed there are impressive spikes in the spring months of April and May and the 'summer' months of June and July).

The hydrograph at Kratie, with a clearly defined annual flood peak, is typical of river-systems in monsoonal regions, particularly those affected by a single monsoon system. The Chenab is also a 'monsoonal river' and its hydrograph exhibits a shape broadly similar to the Mekong, including a well defined flood peak. However, the hydrograph from the Chenab is much more 'spiky' than the Mekong's, which has a smoother overall form. This is not a function of data quality or sampling, but rather an effect of the size of the river's catchment. The Chenab drains a much smaller catchment (34,000 km<sup>2</sup>, compared to that of the Mekong—at Kratie—of 646,000 km<sup>2</sup>) and as a result individual storms have a far greater impact on the flow of the river. In contrast, the effects of localised large storms in the Mekong catchment area tend to be 'masked', or swamped, by the flow coming from other parts of the basin—although, of course, the damage caused by local flooding can be severe. Only in extreme cases, such as tropical storms and typhoons tacking across the basin from the South China Sea, do individual events have a noticeable impact on the hydrograph, particularly at downstream locations.

These two factors, (i) the 'bell shape' with pronounced 'flood peak' (a consequence of the dominance of the Southwest Monsoon), and (ii) the smoothed form (resulting from the large catchment), characterise the hydrograph of the Mekong.

#### Defining the seasons

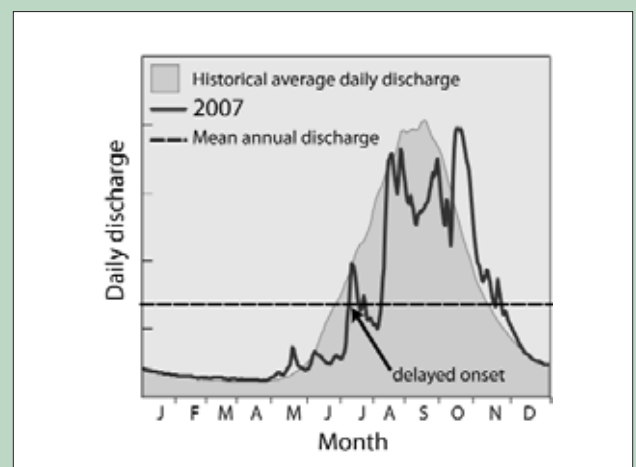
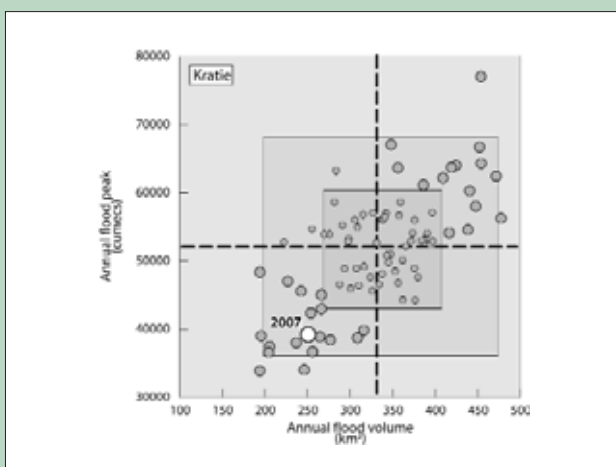
When you are sheltering from a downpour under the leaking roof of a noodle shop in



**Figure 2.** Comparison of the hydrographs from the Mekong (bottom) with those from rivers in temperate (top) and monsoonal (middle) climates.

## The Flood in 2007

The flood in 2007 was below normal, with both the annual flood peak and the annual flood volume less than their long-term average values. However, the degree to which the flood fell below average varied depending on geographical location. Upstream the flood did not plot outside the 1-SD box, but only just. Further downstream, for example at Kratie, the flood was significantly lower than normal (see figure left below). More interestingly the onset of the flood was delayed along the whole course of the river. In Chiang Saen (northern Thailand) the discharge in mid-July was the amongst the lowest since records began in 1960; in Vientiane at the end of July the discharge was also amongst the lowest ever; and in Kratie the discharge at the beginning of August was the lowest on record (see figure right below). Overall, the onset of the flood was delayed between two and four weeks. However, by-and-large the flood recession occurred at the normal time, meaning that the flood season was shorter by up to a month. The implications of the flood extent and duration on the Mekong's fisheries on the *dai* fishery in the Tonle Sap in Cambodia are discussed in a separate article in this issue of *Catch and Culture*.



August, or sitting watching the sunset over the Mekong on a balmy February evening, it is pretty obvious what season you are in. However, things are not so simple for hydrologists, particularly if they are trying to recognise changing climatic patterns resulting from global warming or assess the impact of water-resource developments on the flow of the river. They need quantitative measures that define the natural variability of the river's flow and provide a reference framework against which to measure changes to the natural flow.<sup>1</sup> The hydrograph provides such a quantitative measure, moreover one that is independent of the calendar (there would be little point in defining the onset of the wet season on a particular date on the calendar as this would negate the comparison of the timing onset of the season over years).

The 'long-term mean annual discharge'<sup>2</sup> is the simplest hydrological criterion that can be used to define the start and end of the flood season. While the absolute value of this measure varies from location to location in the basin—increasing downstream—it provides a consistent measure that can be applied basin-wide. In other words, while the long-term mean annual discharge at Luang Prabang is about 3800 cumecs and 13,600 cumecs at Kratie, the measure is valid at both localities given their unique hydrographs. Therefore the onset of the flood season can be defined as the time when the flow of the river first exceeds the long-term mean annual discharge (this event is usually clear-cut in the Mekong because of the smooth form of the river's hydrograph; it would be a less rigorous definition for the Chenab with its spiky hydrograph). Similarly, the end of the wet season can be defined when the hydrograph falls below the long-

<sup>1</sup> This is so important that Article 26 (Rules for Water Utilization and Inter-basin Diversions) of the 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River includes a provision that requires the Joint Committee of the MRC to "[establish] the time frame for the wet and dry seasons" for approval by the MRC Council. This work was delegated to the WUP (Water Utilization Programme) at the MRC Secretariat.

<sup>2</sup> The mean annual discharge is the average discharge (flow) of the river over a given year, and is in effect the average of daily measurements. The period of historical hydrological records varies across the basin. In Vientiane they go back as far as 1913, but this is exceptional. In most cases, records from the monitoring stations on the mainstream of the Mekong are available back to the early 1980s.

term mean annual discharge Figure 3 illustrates this definition of flood season using hydrograph recorded at Luang Prabang in 1988 as an example.

Using this criterion to define the onset and end of flood season hydrologists are able to compare floods both in terms of their flow (annual flood peak—measured in cumecs) and volume (annual flood volume), that is the area under the hydrograph within the limits set by the long-term annual discharge (measured in cubic kilometres, or km<sup>3</sup>).

### What are significant and extreme floods?

Figure 4 presents a plot of the annual flood peak against annual flood volume of the Mekong at Kratie, Cambodia. The period of record extends back to 1924. Interestingly, while there is a broad correlation between the height and volume of the flood there is also a wide scatter of points on either side of the central trend. For example, while in both 1978 and 2000 the annual flood volume was well above average, the annual flood peak in 1978 was the highest on record while that in 2000 was only slightly greater than the norm. Likewise, both 1977 and 2004 were very dry years with similar flood volumes; yet the annual flood peak was far more pronounced in 1977 than in 2004 and almost attained the average height.

Scatter plots such as that illustrated in Figure 4 help to define the 'natural flow envelope' of the river. The darker 'boxes' within the area of the plot indicate one and two standard deviations of the annual flood peak and annual flood volume above and below their respective averages. Events outside the 'one standard deviation box' represent *significant* flood year (both high and low) and those outside the 'two standard deviation box' are classified as *extreme* flood years (MRC, 2007).

The third, and final article, on floods and the Mekong river-system (to be published in the next edition of *Catch and Culture*) will examine the historical and geographical distribution of significant and historical flood years to investigate whether there are any

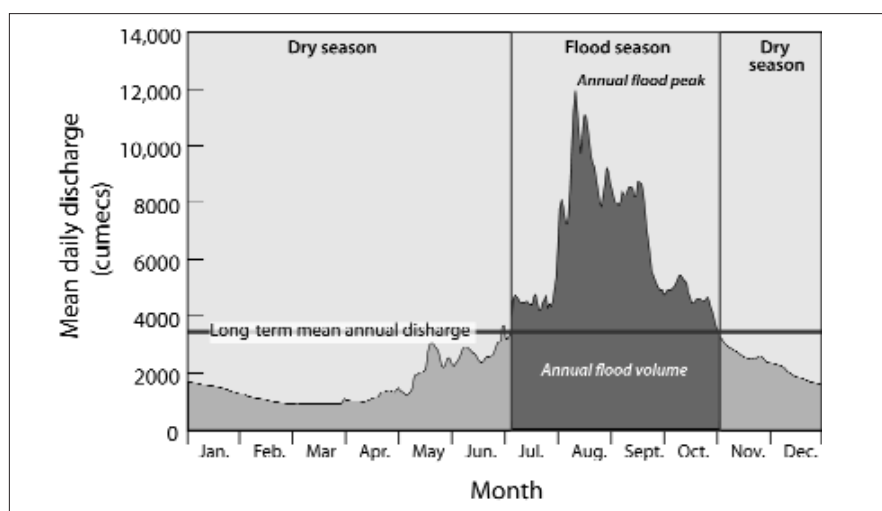


Figure 3. Definitions of the seasons based on hydrology using the hydrograph recorded at Luang Prabang in 1998 as a reference.

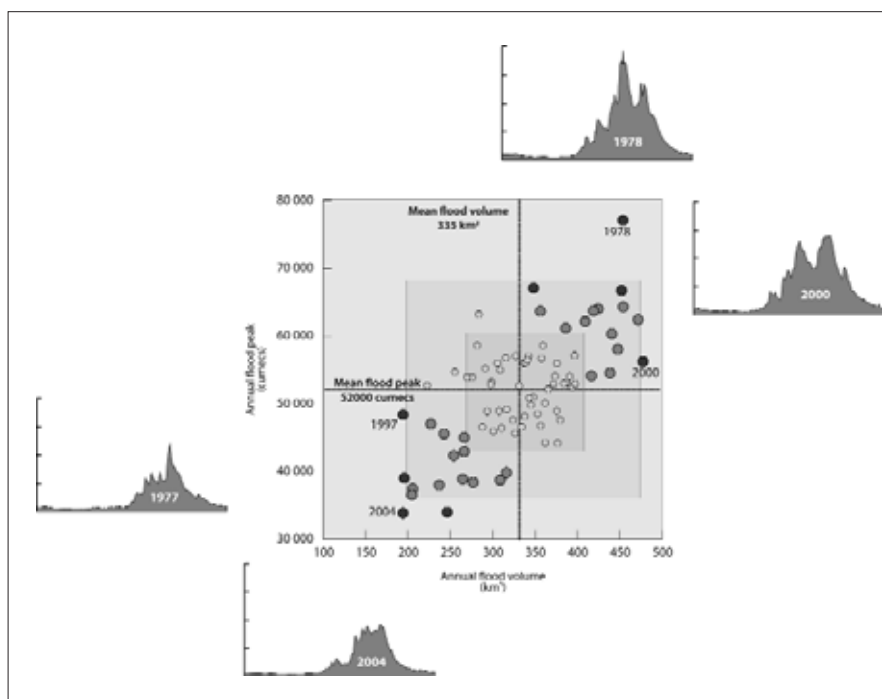


Figure 4. Flood and drought years at Kratie, with example hydrographs. The darker boxes defined the 1- and 2- Standard Deviation (SD) about the mean flood volume and flood peak. Floods outside the 1-SD box are described as significant whilst those outside the 2-SD box are extreme.

trends in the frequency and magnitude of these extraordinary flood years that may be responses to global climate changes and to human activities in the basin.

\* Dr Burnhill is a science writer and Dr Adamson is a hydrologist providing services to the MRC.

### Further Reading:

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# Monitoring fish abundance and diversity in the Mekong Basin

## Four research institutions to share data

The Mekong River Commission has launched a new programme to monitor fish abundance and diversity at more than 20 sites across the Lower Mekong Basin. Initiated by the Fisheries Ecology, Valuation and Mitigation Component of the MRC Fisheries Programme, the routine monitoring covers mainstream, floodplain, tributary and estuary habitats in Cambodia, Lao PDR, Thailand and Viet Nam. The decision to launch a new programme followed a review of research activities and outcomes since 2006 and funding proposals for 2007 which highlighted the need for more coordinated and harmonised research.

Designed during a three and a half day workshop in Phnom Penh in 2007, the programme builds on catch assessment surveys carried out with MRC funding in Cambodia, Lao PDR, Thailand and Viet Nam between 2002 and 2005. These surveys, which were extended on a reduced scale in 2006, employed small numbers of fishermen to record details of species caught and the type of fishing gear used at selected sites. The revised design allows data to be shared and compared among the four MRC countries. 'This is particularly useful for monitoring transboundary stock abundance and assessing any impact of basin developments,' Component Coordinator Ashley Halls said. 'The full participation of the riparian fisheries research institutions in the design, implementation and evaluation stages aims to build capacity in monitoring and evaluation and foster a sense of ownership of the monitoring programme.'

'These outcomes will help to sustain the programme in the long term,' Dr Halls said. 'I was particularly encouraged by the commitment and enthusiasm shown by the participating fishers during visits I made to a number of monitoring sites in Cambodia (Stung Treng province) and the Vietnamese delta (Vinh Long and An Giang provinces). It was clear that fishers had been well trained, understood the significance of their work and welcomed the opportunity to participate in meetings planned for next year to feedback to the participating fishers the results of their monitoring activities. These meetings together with our routine quarterly site visits are vital to maintain fisher motivation and thereby the quality of the data.'

In addition to the main channel of the Mekong River, the workshop in 2007 identified deep pools as important mainstream sub-habitats. It also identified back swamps, flooded forests, lakes, reservoirs and rice paddies as important sub-habitats on the floodplain. To monitor annual monthly catch per unit of effort (CPUE) data as an indicator of fish abundance, the workshop selected gillnets as the standard gear. Based on previous monitoring activities, gillnets were found to be the most common type of gear used within all the habitat types during most months in all four countries. In Cambodia alone, for example, about 53 percent of the catch is landed with gillnets. In a compromise between the need for precision and survey costs, the workshop decided that each of the sites would have at least three fishermen to monitor their daily landings and fishing effort.

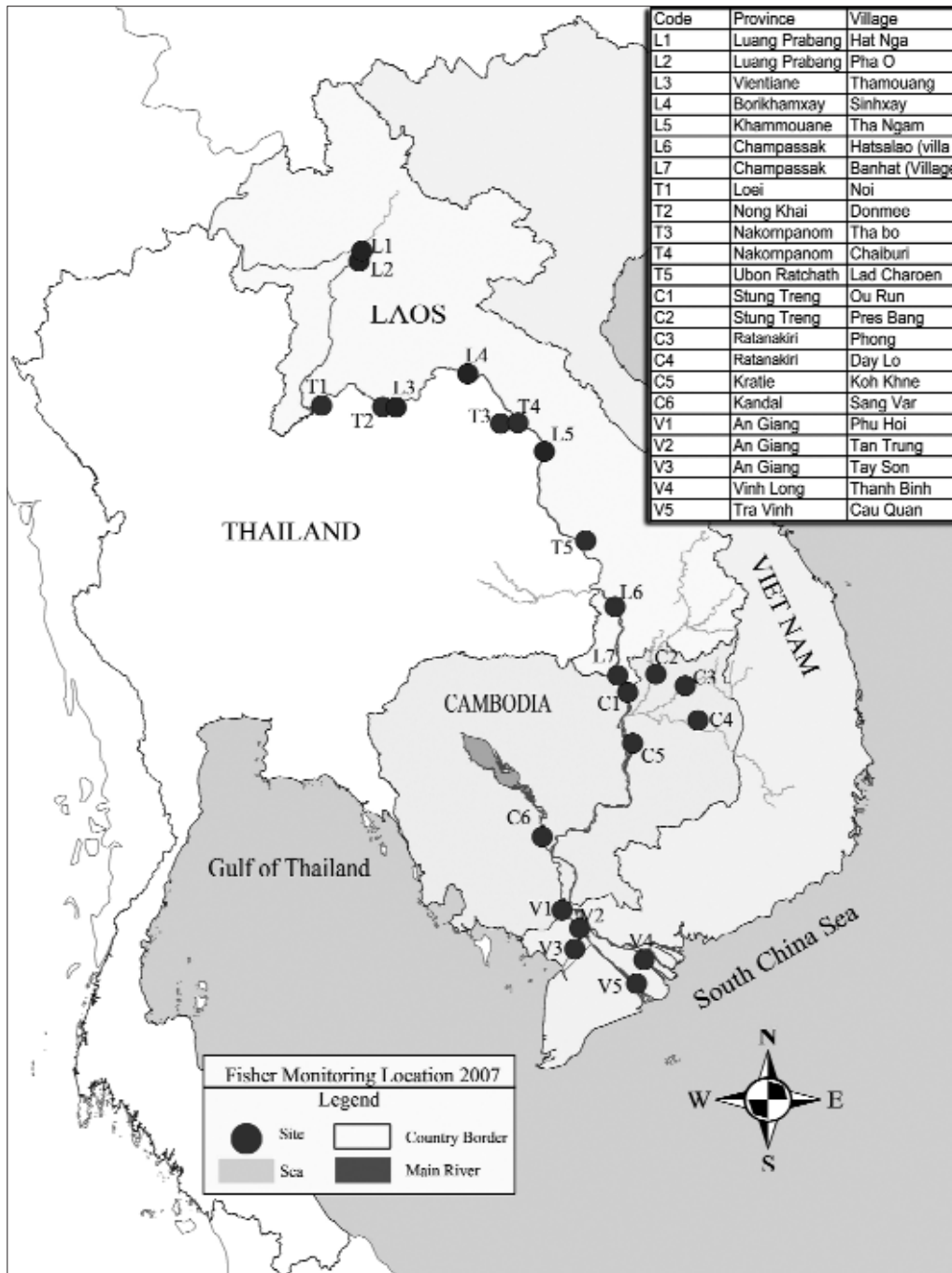
The Cambodian sites include deep pools and flooded forest along the Mekong mainstream, lake and paddy habitats on the floodplain. They also include deep pools along three tributaries. The Lao sites include three across the mainstream as well as a tributary site and a floodplain site. The sites in Thailand include two mainstream deep-pool habitats as well as a flooded forest, back swamp and tributary habitat on the floodplain and a back swamp on a tributary. The Vietnamese sites include a canal and paddy habitat on the floodplain as well as a canal and deepwater pool on a tributary. The monitoring programme also includes a brackish water habitat in estuarine waters in Viet Nam.

Monitoring of both blackfish and whitefish populations is expected to take place in at least one site in each of the four main types of habitat. If resources are available, monitoring of both populations will be extended to all sub-habitats as well. Blackfishes are fishes like snakeheads that stay on the flood plain in water darkened by chemicals from decaying vegetation. Fishes that spend most of their lives in white turbid water of running rivers are known as whitefishes. These include catfishes, sheatfishes and barbs.

Under the programme, the four research institutions taking part will visit the sites every three months to collect data and interview fishermen about any factors

they believe are affecting catch rates and diversity. The first annual report on fish abundance and diversity is scheduled for the end of 2008. The Fisheries Ecology, Valuation and Mitigation component expects to publish guidelines for monitoring and evaluating status and trends in early 2009. Institutions taking part in the programme are the

Inland Fisheries Research and Development Institute (IFReDI) in Phnom Penh, the Living Aquatic Resources Research Centre (LARReC) in Vientiane, the Inland Fisheries Research and Development Centre (IFRDC) in Udon Thani and the Research Institute for Aquaculture No.2 (RIA2) in Ho Chi Minh City.





# Naga appears in Siem Reap

By Darryl COLLINS \*



The naga illuminated the Siem Reap River for almost three weeks PHOTO: LEANG SEKHON

***With the help of some Tonle Sap fishermen and a few sponsors (including the MRC), a Cambodian artist draws attention to water issues with a massive installation near the Angkor temples***

The legendary naga has a common ancestry in countries of the Lower Mekong Basin. In Cambodia, the mythical water creature appears in many forms. The serpents may have special names such as *Ananta*, the mythical 'sleeping couch' for the reclining god Vishnu, or *Mucilinda*, the multi-headed coiled serpent that shelters the Buddha. The naga that appeared along the Siem Reap River in early 2008, however, was fashioned from rattan, recycled plastic, nylon fishing line and fitted with electric lighting. Supported on bamboo poles anchored in the sandy riverbed, the giant white serpent appeared from a distance to be rearing out of the water.

The 225-metre naga was the brainchild of Cambodian artist Leang Seckon as a tribute to World Water Day

The naga comprised about **300,000** staples, **100,000** pieces of hand-cut plastic, **600** lights, **150** kilograms of recycled plastic and **10** kilometres of fishing line.

on March 22. King Norodom Sihamoni was patron to this master installation which took more than one hundred people two weeks to assemble and put into place. Among those who assisted were a dozen fishermen from the Tonle Sap Lake who used their skills in building bamboo fishing gear to anchor the structure to the bed of what scientists now believe is a man-made river (see *Catch and Culture*, Volume 11, No. 2). The installation was inaugurated by Siem Reap Deputy Governor Kim Chay Hieng in a riverfront

ceremony followed by a fashion parade of recycled clothing by the Rubbish Project, which has been seeking to draw attention to environmental issues in Cambodia. The naga was last seen in its entirety on April 10 before it was dismantled ahead of the Khmer New Year.

In Khmer representations, this multi-headed serpent (with three, five, seven or nine heads) has long been associated with water and its benefits. As such, the naga is symbolically the guardian of prosperity and treasures. It is a common motif in many temples, where it decorates the entrance balustrades, bridges, moats and reservoirs. The naga is not only associated with creation myths of Cambodia but is also the serpent that shielded the Buddha while he meditated, raising him from floodwaters by using the coils of its body. This serpent also operates in local folk beliefs as a protector of buildings (usually from fire), due to its association with water, and is frequently found in a stylised form as finials at the ridge ends of roofs.

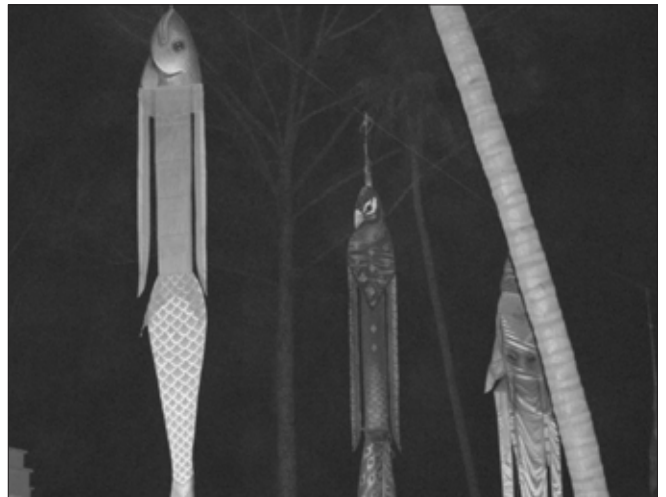
The Siem Reap River rises from a plateau where thousands of stone linga are carved into the sandstone riverbed at both Phnom Kulen and Kbal Spean. There the river waters are sanctified, cascading onto the plain below to flow to the ancient city of Angkor and onward to the great Tonle Sap lake. An ancient inscription from the Bat Chum temple at Angkor ascribes a certain sanctity to the waters of the river by stating that 'with the exception of the sacrificial priest, no-one may bathe in the waters ... born at the summit of the holy mountain of Mahendra.' An 11th century inscription at Kbal Spean describes the river as the 'torrent of Rudra, river of Siva, this Ganga.' In another reference, the legendary ruler Preah Thong is cured of leprosy by the holy waters of the Siem Reap River. It identifies him with the equally legendary Khmer Leper King (Sdach Kanlong).

More recently, the ecological habitats associated with the Tonle Sap Lake have drawn naturalists and scientists to study its wildlife. The lake draws water from the overflow of the Mekong as well as its own tributary system; when the Mekong subsides at the end of the wet season, the flow of the Tonle Sap River reverses and the lake empties back into the Mekong. The lake itself is an important breeding ground for fish, a major source of protein in the Cambodian diet, while the flooded forest wetlands have become a focus for eco-tourism.

\* Mr Collins has worked as a consultant to the National Museum of Cambodia since 1994. He is also co-author of *Building Cambodia: 'New Khmer Architecture' 1953-1970* (The Key Publisher, Bangkok, 2006)



Fishermen from the Tonle Sap helping with the installation  
PHOTO: LEM CHAMNAP



The inauguration on March 22 featured flags depicting a fish, a bird and an elephant. Other flags depicted a turtle and a crocodile.  
PHOTO: LEM CHAMNAP

#### Further Reading:

<http://therubbishproject.blogspot.com/>

[http://www.sanghanetwork.org/index.php?option=com\\_content&task=view&id=137&Itemid=45](http://www.sanghanetwork.org/index.php?option=com_content&task=view&id=137&Itemid=45)

<http://www.worldwaterday.org/page/1427>

Collins, Darryl, Siem Reap: Then and Now, Udaya, no.7, 2008, pp.73-99

# Draft standards for *Pangasius* expected by end of this year

By Jill SCHWARTZ \*

## ***Pangasius* Aquaculture Dialogue sets up seven working groups after second meeting in Viet Nam**

Aquaculture is the fastest growing food production system in the world. The industry, which is growing at an annual rate of nine percent, supplies almost half of the seafood consumed globally. Aquaculture farms can have a negative impact on the environment. For example, nutrients and chemicals used at fish farms can pollute the water and diseases can spread easily from farmed to wild-caught fish. Because it is a conservation organisation, World Wildlife Fund (WWF) is committed to making sure aquaculture is good for people and nature. When done responsibly, aquaculture's negative impacts on wild fish

populations, marine habitats, water quality and society are minimal. Through its aquaculture dialogues, WWF is working with stakeholders worldwide to create standards for certifying aquaculture farms. Compliance with the standards will minimise the key impacts that cause approximately 80 percent of the environmental and social problems related to aquaculture.

The shark catfish species *Pangasianodon hypophthalmus* and *Pangasius bocourti* are among 12 groups of species that are the focus of the dialogue. Pangasius farming is one of the fastest growing types of aquaculture in the world. Most pangasius is produced at farms in the Mekong Delta. In 1990, pangasius aquaculture was a small industry. But by 2007, approximately one million tonnes of pangasius



Mr Vo Thanh Khon, manager of planning and project development at Binh An Seafood Joint Stock Company (Bianfishco) in Can Tho, briefs dialogue participants ahead of a visit to a farm in March. Mr Khon is a member of the Process Facilitation Group.

PHOTO: WWF

if not more were produced in Viet Nam. Although initiated and coordinated by WWF, the Pangasius Aquaculture Dialogue includes a variety of stakeholders, such as farmers, processors, exporters, traders, retailers, feed and chemical manufacturers, seed suppliers, government agency representatives, non-governmental organisations and researchers. A group of stakeholders, called the Process Facilitation Group, is responsible for managing the process. 'With pangasius farming growing so quickly, there's an urgent need to make the industry sustainable,' said Flavio Corsin, senior aquaculture advisor with the WWF in Hanoi. 'Stakeholders involved in the dialogue are strongly committed to the task.'

At the kick-off meeting for the dialogue in Ho Chi Minh City in September 2007, dialogue participants agreed on the reasons and process for developing standards. They also identified the eight main issues related to pangasius aquaculture, such as water pollution and health management, and principles to address each issue (see boxes). For example, the principle associated with the issue of antibiotics is to ensure food safety and the quality of products while reducing the risk to the ecosystem. At the second dialogue

## Key stakeholders

Members of the Process Facilitation Group are individuals from a wide range of stakeholders with expertise in different areas.

### **Binh An Seafood Joint Stock Company**

Farming and processing sectors

### **Binca**

Processing and marketing sectors

### **BirdsEye/Iglo**

Marketing sector

### **Butler's Choice**

Marketing Sector

### **Monterey Bay Aquarium**

Environment

### **Network of Aquaculture Centres in Asia-Pacific**

Government and farming sectors

### **Research Institute for Aquaculture No. 2**

Government and farming sectors

### **Sustainable Fisheries Partnership**

Environment and farming sectors

### **Van Lang University**

Environment

### **Vietnam Association of Seafood Exporters and Producers**

Farming, processing and marketing sectors

### **World Wildlife Fund**

Environment

Source: WWF

## Main Issues

### **Legal compliance**

Farms are sometimes built or operate outside the legal framework for addressing environmental, social and food safety issues of relevance to the area where farming occurs.

### **Land and water use**

As new farms are established, sensitive habitats can be destroyed and water can be diverted which can affect other water users and the environment.

### **Water pollution**

Excess waste can pollute the water and negatively affect plant and animal habitats.

### **Escapes**

*Pangasius* that escape from aquaculture facilities may compete with wild fish and affect ecosystems, especially in areas where *Pangasius* is not yet established.

### **Feed management**

Use of fishmeal, fish oil and trash-fish as *Pangasius* feed is depleting resources that other fish rely on for food. Also, feeding trash fish to *Pangasius* can cause unsustainable harvesting and water pollution.

### **Health management**

*Pangasius* farms are prone to health problems that can impact farmed and wild stocks.

### **Antibiotics and chemicals**

Inappropriate use of antibiotics and chemicals can have unintended consequences on the environment and human health, such as antibiotic resistance and unsafe products.

### **Social responsibility/user conflicts**

Large numbers of workers are employed on pangasius farms and in processing plants, placing labour practices and worker rights under public scrutiny. Also, conflicts can arise among users of the shared resources.

Source: WWF

meeting, held in Can Tho in March, participants agreed to create several technical working groups that will draft criteria, indicators and measurable standards for certifying pangasius farming. Since then, seven groups have been created – one for each issue except health management and antibiotics/chemical use which will be dealt with by a single group. Each working group has between 7 and 20 members, both from Viet Nam and outside Viet Nam. Members of the technical working groups will seek comments from stakeholders who have not been able to attend the dialogue meetings.

Recommendations from the seven groups will be presented to the third dialogue meeting for final consideration by the end of this year. Once approved by meeting participants, the criteria, indicators and

## Catfish dialogue complements others for shrimp, salmon, molluscs and tilapia

In 1999, WWF partnered with the Food and Agriculture Organisation (FAO) and the Network of Aquaculture Centers of Asia Pacific (NACA) to create the Shrimp Aquaculture and Environment Consortium. The United Nations Environment Programme joined the consortium later. After more than 140 meetings with more 8,000 people and 40 case studies by 120 researchers, the FAO Committee on Fisheries adopted the consortium's International Principles for Responsible Shrimp Farming in 2006. In the intervening period, similar dialogues were set up for salmon and molluscs in 2004 and tilapia in 2005. The Pangasius Aquaculture Dialogue was launched in 2007 with an initial meeting in Ho Chi Minh City in September and a second in Can Tho in March, 2008. With production exceeding one million tonnes in 2007, Vietnam accounts for about 90 percent of the world's pangasius output. The two species most commonly farmed are the Sutchi river catfish (*Pangasianodon hypophthalmus*) and Bocourt's catfish (*Pangasius bocourti*). For the other dialogue species, Norway and Chile are the world's major salmon producers while China accounts for about 80 percent of mollusc production. Major tilapia producers are China, Egypt, Indonesia, Thailand and the Philippines. In early 2008, a separate dialogue was launched for abalone. According to WWF, draft standards for tilapia were scheduled to be posted for public comment during the first half of 2008.

standards will be posted for public comment. Two 60-day public comment periods will be held.

To develop its recommendations, the technical working groups will consider the outcome of discussions at the second dialogue meeting in Can Tho in March. 'Consensus building is always a tough challenge,' said dialogue participant David Graham, head of quality and regulatory affairs at British frozen foods manufacturer BirdsEye/Iglo. 'But the dialogue members have now agreed on an organisational structure that empowers the technical working groups to work towards the development of draft standards before the end of the year. The process is now more efficient, focused on delivery and structured in a way to ensure all stakeholders remain fully represented.'

\* Ms Schwartz is senior communications officer for aquaculture with WWF in Washington.

### Further Reading:

[www.worldwildlife.org/pangasiusdialogue](http://www.worldwildlife.org/pangasiusdialogue)

## Principles

Dialogue participants have identified eight principles for developing the criteria, indicators and standards for responsible pangasius production. The criteria aim to provide direction on how to reduce negative impacts and the indicators address how to measure them.

1. Locate and operate farms within established national and legal frameworks
2. Farms should be located, designed and constructed to minimise negative impacts on other users and the environment
3. Minimise negative impacts on water resources
4. Minimise impacts on local biodiversity and natural habitats
5. Use feed and feed practices that make efficient use of available feed resources and minimise waste
6. Implement health management measures to reduce stress and minimise the risks of disease affecting both cultured and wild stocks
7. Ensure food safety and the quality of products, while reducing the risk to the ecosystem
8. Develop and operate farms in a socially responsible manner that contributes effectively to rural development and poverty alleviation

Source: WWF

# How will climate change affect fisheries and aquaculture?

By Ashley S. HALLS \*

***The Food and Agriculture Organization held an expert consultation on the impact of climate change on fisheries and aquaculture in Rome in April. During the three-day meeting, delegates reviewed and commented upon three background documents summarising global knowledge of the likely physical and ecological impacts of climate change on marine and inland capture fisheries and aquaculture. Delegates then prepared a synthesis of the three background papers representing a technical background document of climate change impacts, mitigation potentials and adaptation strategies. A paper targeted specifically at policy makers entitled 'Options for Policy Makers' was also prepared by the delegates highlighting climate change implications for livelihoods and food security and offering guidance in relation to achievable climate change mitigation measures, adaptation strategies, researchable constraints and implementation strategies at national, regional and international levels. The following are excerpts from the technical background document which was circulated at a global food crisis summit hosted by the FAO in June.***

Aquatic products are among the most widely traded foods. About 40 percent of global production enters international trade. Fishery trade is particularly important as a source of foreign currency for developing nations. At present, their net earnings from aquatic products are greater than the combined earnings from the major agricultural commodities of rice, coffee, bananas, rubber, sugar and tea.

Why separate out climate change implications for fisheries and aquaculture from other food production systems? Wild capture fisheries are fundamentally different from other food production systems in their linkages and responses to climate change and in the food security outcomes. Aquaculture also has strong links to capture fisheries, and both feed into distinct and specialised post-harvest and market chains. Conclusions on food supply and security based on terrestrial contexts usually cannot be applied directly to the sector, indicating that special consideration is needed to ensure policy and management responses are effective.

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***'Net earnings from aquatic products are greater than the combined earnings from the major agricultural commodities of rice, coffee, bananas, rubber, sugar and tea'***

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For example, most fishing depends on wild populations whose variability depends on environmental processes governing the supply of young stock, and feeding and predation conditions through the life cycle. Open water populations cannot be enhanced by simply adding fertilisers as in agriculture, nor can effects of environmental change be quickly observed. Many fish populations migrate over long distances, passing through multiple territorial waters. This creates issues of trans-boundary management, control and utilisation, driven by natural environmental factors. Climate change impacts could change resource access at both community and national level.

Unlike most terrestrial animals, all aquatic animal species for human consumption are poikilothermic, meaning their body temperatures vary with the ambient temperature. Any changes in habitat temperatures will significantly influence metabolism

and, hence, growth rate, total production, reproduction seasonality and possibly reproductive efficacy, and susceptibility to diseases and toxins. Climate change-induced temperature variations will therefore have a much stronger impact on the spatial distribution of fishing and aquaculture activities and on their productivity and yields.

Much fishing is still an open access activity and non-boat-based fisheries, such as collecting clams on a beach, using handlines or simple bamboo traps in rice fields, require little capitalisation. Fishing, therefore, often functions as a last-resort activity, or serves to supplement food supply when other sources are weak, thereby playing an important role in adaptive strategies. However, there are potential mismatches between these important social objectives and the fisheries management concerns of over-exploitation of resources and the need to limit access or restrict fishing to particular species, places or times.

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***'The abundance and species diversity of riverine fishes are predicted to be particularly sensitive to climatic disturbances'***

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Climate change is only one among many environmental and anthropogenic stresses faced by fisheries and aquaculture but is likely to exacerbate the difficulties of achieving sustainable practices. However, the magnitude and direction of climate change-specific stressors will vary from one aquatic system to another, or may play only a small role when compared to other stressors. Climate change may also offer win-win outcomes where adaptation or mitigation measures improve economic efficiency and resilience to climatic and other change vectors. For example, this could include decreasing fishing effort to sustainable levels, decreasing fuel use and hence CO<sub>2</sub> emissions, or reducing aquaculture dependence on fishmeal or oils.

**Impacts of climate change on inland waters**

There has been no global assessment of warming of inland waters but many lakes have shown moderate to strong warming since the 1960s. There are particular concerns for African lakes, as the atmospheric temperature of the continent is predicted to be higher than the global average and rainfall is projected to decrease. Likewise, wetlands and shallow rivers are susceptible to changes in temperature and precipitation and water levels may drop to the point of completely drying out in dry seasons. Increased

temperature may lead to stronger, earlier and longer stratification of lakes and reservoirs and, with limited or no seasonal turnover, greater deoxygenation of bottom layers. River runoff is expected to increase at higher latitudes but decrease in parts of West Africa, southern Europe and southern Latin America. Overall, a global temperature increase of one degree Celsius is associated with a four percent increase in river runoff. Changes in flood areas, timing and duration are also expected.

In general, temperature changes are likely to impact cold-water species negatively, warm-water species positively, and cool-water species positively in their northern ranges and negatively in their southern ranges. Also, there will likely be a general shift of cool- and warm-water species northward in northern hemisphere rivers. The abundance and species diversity of riverine fishes are predicted to be particularly sensitive to climatic disturbances, since lower dry season water levels may reduce the number of individuals able to spawn successfully. The timing of flood events is a critical physiological trigger that induces fish to migrate and spawn at the onset of the flood which enables their eggs and larvae to be transported to nursery areas on flood plains.

**Impacts on fisheries and aquaculture**

The impacts of physical and biological changes on fisheries communities will be as varied as the changes themselves. Both negative and positive impacts could be foreseen, their strength depending on the vulnerability of each community, the combination of potential impacts (sensitivity and exposure) and adaptive capacity. Impacts would be felt through changes in capture, production and marketing costs, changes in sales prices, and possible increases in risks of damage or loss of infrastructure, fishing tools and housing. Fishery-dependent communities may also face increased vulnerability in terms of less stable livelihoods, decreases in availability or quality of fish for food, and safety risks due to fishing in harsher weather conditions and further from their landing sites. Within communities and households, existing gender issues related to differentiated access to resources and occupational change in markets, distribution and processing, where women currently play a significant role, may be heightened under conditions of stress and increased competition for resources and jobs stemming from climate change.

Impacts on aquaculture could be positive or negative, arising from direct and indirect impacts on the natural resources aquaculture requires, namely water, land, seed, feed and energy. As fisheries provide significant

feed and seed inputs, the impacts of climate change on them will also, in turn, affect the productivity and profitability of aquaculture systems. Vulnerability of aquaculture-based communities will stem from their resource dependency and exposure to extreme weather events.

Climatic changes could increase physiological stress on cultured stock. This would not only affect productivity but also increase vulnerability to diseases and, in turn, impose higher risks and reduce returns to farmers. Interactions of fisheries and aquaculture subsectors could create other impacts. For example, extreme weather events could result in escapes of farmed stock and contribute to reductions in genetic diversity of the wild stock, affecting biodiversity more widely.

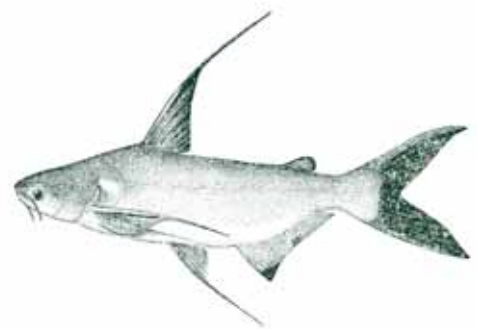
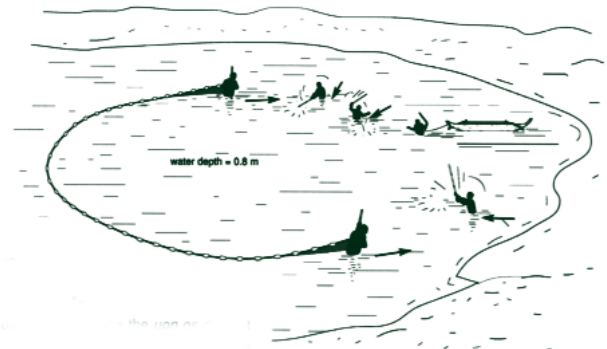
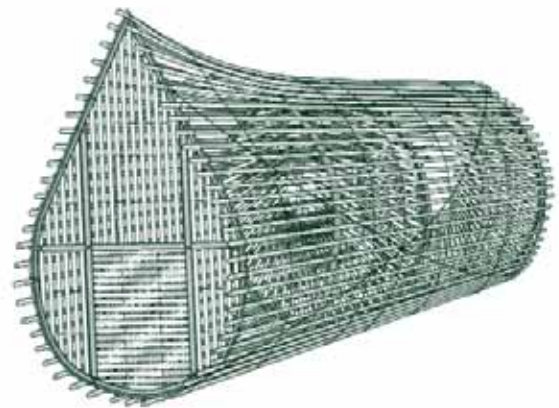
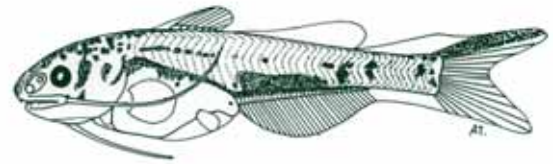
These impacts will be combined with other aspects affecting adaptive capabilities, such as the increased pressure that ever larger coastal populations place on resources; any political, institutional and management rigidity that negatively impacts on communities' adaptive strategies; deficiencies in monitoring and early-warning systems or in emergency and risk planning; as well as other non-climate factors such as poverty, inequality, food insecurity, conflict and disease.

However, new opportunities and positive impacts emerging from such areas as changes in species and new markets also could be part of future changes. So far, these opportunities are not well understood but, nevertheless, are possible. A community's ability to benefit also will depend on its adaptive capacity.

\* Dr Halls, coordinator of the MRC Fisheries Programme's Ecology, Valuation and Mitigation Component, was one of ten international experts invited to the consultation in Rome. His advisory role on climate change impacts on inland fisheries draws on his involvement in related research funded under the British government's DFID Fisheries Management Science Programme (FMSP).

#### Further reading:

<http://www.fao.org/foodclimate/expert/em7.html>





# Dr Sam Nouv

Cambodia's Chamroeun Polytechnic University of Agriculture and Rural Development has awarded a Ph.D. to Cambodian Fisheries Administration Deputy Director Sam Nouv for his thesis on water management for sustainable aquatic resources in the Lower Mekong Basin. Dr Sam Nouv, a former chairman of the MRC's Technical Advisory Body for Fisheries Management (TAB), is one Cambodia's longest-serving fisheries officers. The son of a farmer in Kien Svay district of Kandal province near Phnom Penh, he was in the third year of a degree in veterinary science when his studies were cut short by the Khmer Rouge seizing power in 1975. Six months after liberation in 1979, he joined a Ministry of

Commerce fisheries unit which operated from a former casino on the banks of the Bassac River in Phnom Penh. In 1981, he won a scholarship to study fisheries engineering at the University of Agriculture No. 4 in Ho Chi Minh City. After completing his degree in 1985, he returned to Cambodia for five years and then pursued further studies at the Asian Institute of Technology in Bangkok, completing a master's degree in aquaculture in 1993. Between 1994 and 2000, he worked as a fisheries programme officer for the Interim Mekong Committee in Bangkok and the newly-formed Mekong River Commission, which moved to Phnom Penh in 1998.



Dr Sam Nouv prepares to give a presentation on his thesis at Chamroeun Polytechnic University of Agriculture and Rural Development in Phnom Penh in May PHOTO: LEM CHAMNAP

# Programme, staff and colleagues awarded at regional forum

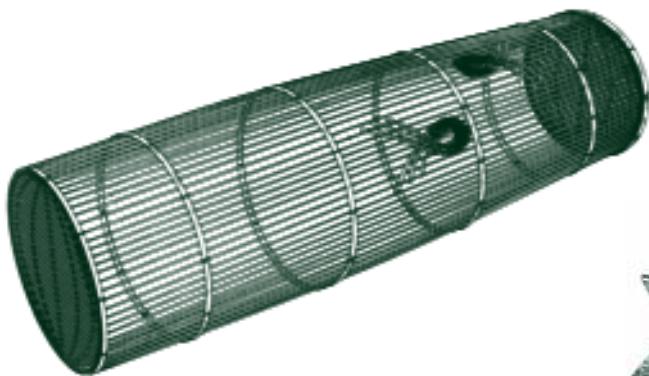
The MRC Fisheries Programme supported 29 staff, counterparts and members of the Technical Advisory of Body on Fisheries Management to attend the Eighth Asian Fisheries Forum in Kochi, India, in November 2007. The forum is held every three years, under the auspices of the Asian Fisheries Society. It is the major fisheries meeting in the Asian region. The aim is to provide a venue for information exchange, networking and cooperation between scientists, technicians and all stakeholders involved in capture fisheries and aquaculture production, research and development in Asia. Approximately 800 people, predominantly from India and Southeast Asia, attended the forum in 2007.

Programme staff and colleagues from the national fisheries agencies delivered 21 presentations, covering a wide range of subject matter including river fisheries ecology, aquaculture, and fisheries management at community through to regional level. One paper delivered by Pham Ba Vu Tung from the Research Institute for Aquaculture No. 2 in Viet Nam won the best paper award in its section (best paper among approximately 50 presentations). Mr Tung's talk was on integrated management of rice and shrimp farming in the Mekong Delta. The information he presented arises from an integrated water resources management project being conducted within the Fisheries Management and Governance component of the Fisheries Programme.



Mr Pham Ba Vu Tung won the best paper award.

The Asian Fisheries Society also takes the opportunity to present awards to individuals and organisations for contributing to its ideals. At the eighth forum, Meritorious Service Awards were presented to the both the MRC Fisheries Programme, in recognition of its contribution to knowledge and management of the fisheries of the Mekong River, and to the Programme Manager, Dr Chris Barlow.



# New Faces

## Steen CHRISTENSEN



The MRC Fisheries Programme has appointed Dr. Steen Christensen as fisheries economics advisor for its Fisheries Ecology, Valuation and Mitigation Component. He has been based at the Research Institute for Aquaculture No 2 in Ho Chi Minh City since October, 2007. Dr Christensen was

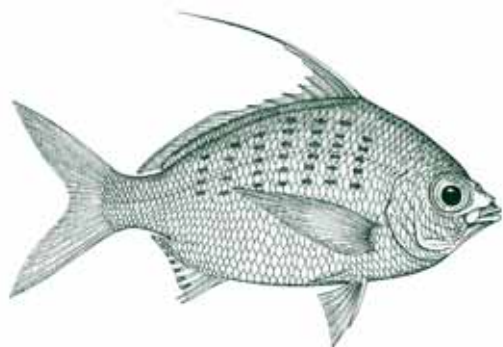
previously senior scientist with the Danish Institute for Fisheries Research (DIFRES). Since 1996, he worked on stock assessment and bio-economic modelling for DIFRES as part of research programmes in the European Union, Viet Nam and Mozambique. On leave from DIFRES, he was based at the Ministry of Fisheries in Hanoi as chief technical advisor for the Danida-supported fisheries sector programme in Viet Nam from 1999 to 2002. The objective of the work was to strengthen marine fisheries management by supporting the collection and assessment of biological and economic statistics. From 1986 to 1997, Dr Christensen was associate professor at the Danish Institute for Fisheries Economics Research at the University of South Denmark. During this period, he completed his Ph.D. evaluating the economic performance of the major fisheries in Greenland under alternative fishery management strategies. The work was based on data he collected as a young biologist from the University of Århus working in Nuuk as fisheries adviser for Greenland home rule.

## BUOY Roitana



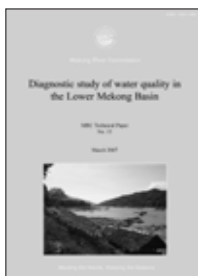
The Fisheries Programme has also appointed Buoy Roitana as a programme officer at the Vientiane secretariat. Mr Roitana, who took up the position in May, was deputy director of the Fishing License Division of the Cambodia Fisheries Administration from 2003 to 2008. During

this period, he also coordinated part of a research project on the role of fish in food and nutrition security in developing countries, focussing on combating micronutrient deficiencies and conducting a survey of fish consumption among Cambodia's rural poor. Before that, he worked for 18 months on regional fisheries policy and programmes at the Southeast Asia Fisheries Development Center (SEAFDEC) in Bangkok. Mr Roitana joined the then Department of Fisheries as a marine fisheries research assistant in 2002 after working as focal point for the Koh Rong Marine Protected Areas and as technical officer for a project collecting information on sustainable pelagic fisheries in the South China Sea. Before that, he coordinated a reservoir fisheries management project and was also involved with a coastal zone management project in Sihanoukville. Mr Roitana received a master's degree in marine fisheries management from Nagasaki University in 2000 after completing a bachelor degree on fisheries science at the Royal University of Agriculture in Phnom Penh in 1990. He authored a report on the Marine Fish Licensing System in Cambodia in 2007 and has co-authored other reports on deep pools in Kratie and Stung Streng, the livelihoods of coastal shrimp and crab peelers, and inland fisheries management in Cambodia.



# New Products

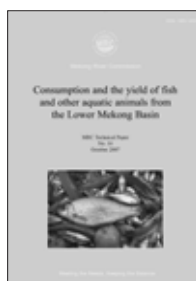
## Diagnostic study of water quality in the Lower Mekong Basin. MRC Technical Paper No. 15



Water quality is one of the key factors that can be used to monitor the ecological health of river systems. The MRC helps to coordinate water quality monitoring at over 100 stations across the Lower Mekong Basin. This paper presents a synthesis of data collected at these stations since the early 1980s, augmented by field

surveys carried out in 2003 and 2004. The surveys recorded a wide range of conventional physical and chemical parameters as well as toxic micro-pollutants. The data are used to establish current baseline conditions for environmental pollutants in the basin.

## Consumption and the yield of fish and other aquatic animals from the Lower Mekong Basin. MRC Technical Paper No. 16



This paper presents a comprehensive assessment of the yield of the capture fisheries in the Lower Mekong Basin (LMB) based on data on the consumption of fish and other aquatic animals (OAAs). The review is based on 20 earlier field surveys from across the basin with supporting analyses of complimentary data. Estimates of

consumption include both fresh and preserved produce which are adjusted to 'fresh whole animal weight equivalents'. Using these data the average per capita consumption in the LMB is 33.7 kg/capita/year, although this value varies across the basin. The yield of fish and OAAs is estimated to be about 2.6 million tonnes of which four-fifths are fish and one-fifth is OAAS. These yields are compared with figures derived by other methods, particularly 'yields per unit of aquatic habitat'. The correspondence between these methods is good, with the values derived from consumption lying in the upper part of the range estimated by habitat yield.

## Socio-economics of the fisheries of the lower Songkhram River basin, northeast Thailand. MRC Technical Paper No. 17

The 'floodplain fisheries' of the Songkhram River Basin (SRB) in northeast Thailand provide good



exemplars of similar fishing habitats elsewhere in the Lower Mekong Basin. This paper presents the results of detailed surveys of the fisheries conducted in the lower SRB during 2000. The scope of the surveys included both a broad coverage provided by a census of village heads, and detailed information provided by 353

households in 27 villages. The results of the survey confirm the socio-economic importance of floodplain fisheries with between 80% and 93% of households involved in part-time fishing and 3% to 6% fishing commercially. While fishing was primarily for household food supply, it was also an important source of income with 28% of households selling wild fish, 3% selling produce from aquaculture, and 13% generating income from other fishing-related activities. The surveys demonstrate the importance of these types of wetlands in terms of fish yield, aquatic biodiversity, and the lives and livelihoods of the people of the Songkhram River basin.

## Lao and Thai fisheries films



These films have been produced by national fisheries agencies and reflect the importance of fisheries in these two countries. The Lao film *Fisheries of Lao* is available in Lao and English. The Thai film *River of Life* is available in Thai and English.



## An Introduction to the Mekong Fisheries of Thailand. Development Series No 5



This report on the fisheries of Thailand is designed for the non-technical reader and features a description of the Thai fishery and its importance to people at all levels of society. Featuring many colour photos and illustrations. This report is available in English and Thai.

# Mekong fisheries index

## **Mekong Delta Fish Processing Factories Boom....** VietNamNet Bridge, 5 March, VNS March 15 and May 16, Prensa Latina, March 7, 2008

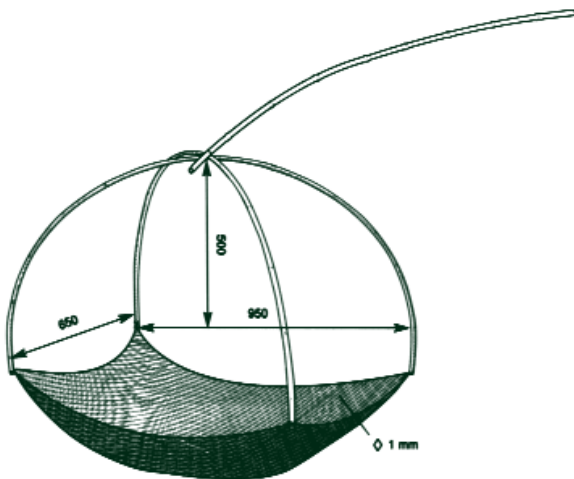
The boom in aquatic product processing factories in the Mekong Delta has triggered a drop in prices and shortages of material input for export processing. An Giang province has 26 factories in operation, producing 220,000 tonnes of tra and basa catfish products per year and another eight factories are planned this year. Neighbouring Dong Thap province is calling for more investment to build five to seven new factories with a total capacity of 100,000 tonnes. In Ca Mau and other neighbouring provinces quite a number of aquatic product processing factories are under construction. Last year Viet Nam's exports of aquatic products grew by 12% to reach US\$3.75 bn. However, a shortage of material input means many factories use only 50-60% of their production capacity. Many aquacultural farmers lost their stock and much money during the February cold snap. Viet Nam exports catfish to many countries including Brazil, Canada, China, France, Hong Kong, Japan, Malaysia, Portugal, Singapore, South Korea, Thailand, and the US. In March it sent its first cargo of 133 tonnes, worth US\$324,000, to Mexico. In the US there have been moves by local catfish producers to lobby against the import of fish from Viet Nam.

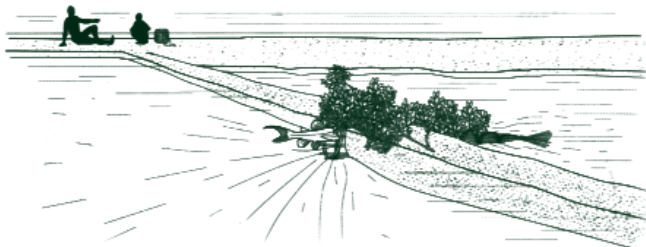
## **....and Bust?** VNS, May 16

Falling *tra* and *basa* prices and rising overheads have cost farmers in the Mekong Delta VND300 bn (US\$18.75 m) since March. The price of tra and basa catfish has dropped by VND1,000–VND1,200/kg to \$0.87–\$0.84. Meanwhile, the price of fishmeal has soared by more than 40% since the beginning of the year. "With the prevailing sale price, farmers are suffering losses of VND2,000/kg," said Bui Huu Tri, chairman of the Can Tho Seafood Association. Despite falling prices, farmers are flocking to seafood processing companies to cut their losses, which puts further downward pressure on the price. In the Mekong Delta, large numbers of fish farms have been forced to close. In An Giang Province alone, about 20 per cent of fish farming families have gone out of business. "The situation has never been as tragic as nowadays," said Tri from the Can Tho Seafood Association. According to the Mekong Delta Seafood Association, 100,000 tonnes of fish are waiting to be sold every day.

## **Renewed Fears for Mekong Dolphins in Cambodia** Reuters, 5 March, 2008

A sharp drop in the number Mekong dolphins born in Cambodia has renewed fears for the survival of the rare mammals according to wildlife experts. Only three baby dolphins, one of them dead, were found during an annual survey conducted in late November 2007, down from six newborns in previous years, said Touch Seang Tana, chairman of the Commission for Mekong Dolphins Conservation. Their weight had also dropped to under 2 kg (4.4 lb) from 5 kg (11 lb) in the 1980s. "A group of ten full-grown dolphins living in the upper Mekong River had no babies at all this year," he said, blaming a shortage of fish and rising water temperatures which might have affected their reproductive systems. There are about 150 dolphins living in the upper Mekong River, up from only 90 before a 2006 ban on net fishing in the eastern provinces of Kratie and Steung Treng. "Global warming may be a possible indirect threat to the dolphin population, particularly if their fitness is reduced," said Teak Seng of the World Wildlife Fund. "Dolphins are very sensitive to changes in their environment such as water temperature and quality. Other factors may be more influential such as diseases and water pollution," he said.





### **New Mekong Herring Less than an Inch Long** Practical Fishkeeping, March 11, 2008

The Mekong River has yielded a new genus and species of miniature river herring to science. Tyson Roberts describes *Minyclupeoides dentibranchialis*, from the Mekong River drainage in Cambodia, in the latest issue of the Raffles Bulletin of Zoology. The new species is a member of the subfamily *Pellonulinae*, and is distinguished from other members of the subfamily in the near total lack of scales, numerous (25-27) teeth on the maxilla, and only a single scale bearing a lateral line pore on the sides of the body at the level of the shoulder. *Minyclupeoides dentibranchialis* is substantially smaller than any of the four pellonuline herring species (*Clupeichthys aesarnensis*, *Clupeichthys goniognathus*, *Clupeoides borneensis* and *Corica laciniata*) found in the Mekong River drainage: mature individuals are no larger than 2.2 cm standard length. The genus is named after its small size (from the Greek *minys*, meaning small and *clupeoides*, a herring genus) and the species after the heavily toothed gill rakers (from the Latin *dent-* meaning teeth and *branchus*, meaning gills). For more information, see the paper: Roberts, TR (2008) "*Minyclupeoides dentibranchialis*, a new genus and species of river herring from the Lower Mekong basin of Cambodia". The Raffles Bulletin of Zoology 56, pp. 125–127. <http://www.practicalfishkeeping.co.uk/pfk/pages/item.php?news=1604>

### **World's Largest Catfish Species Threatened by Dam**

National Geographic News, April 8, 2008

According to conservationists, a planned hydroelectric dam at Don Sahong, Khone Falls, will block the deepest channel on the section of the river that migratory fish pass through when the water level is at

its lowest. One of those migratory fish is the critically endangered Mekong giant catfish, which holds the record as the largest freshwater fish ever caught. The record catch, made in northern Thailand in 2005, tipped the scales at 293 kg. "An impassable dam at the falls could cause the extinction of the Mekong giant catfish species," said Zeb Hogan, a fisheries biologist at the University of Nevada in Reno. Giant catfish were once plentiful throughout the Mekong River basin, but in the last century the population has declined 95-99%, according to Hogan. Although fishing is the biggest immediate threat to the giant catfish in the Mekong, dams and habitat fragmentation could disrupt the animal's ability to reproduce, Hogan said. "There is only one known spawning ground for Mekong giant catfish, and it is in northern Thailand. Until we know better, we have to assume that fish from Cambodia migrate to Thailand to spawn". The construction of the Don Sahong dam, which is slated for completion in 2010, would make that migration impossible. The dam would block Hoo Sahong, the deepest channel and the only one that migratory fish can pass through at the peak of the dry season, in April and May, when the Mekong is at its lowest. Hogan admits that dams provide a number of benefits, including flood control, water for irrigation, and electricity. "But it is also important to consider the costs," he said, "especially in an area where a large part of the population is dependent on fish for food." "From a migratory fish's perspective, there is nothing worse than a dam."

### **Dwindling Fish Stocks Threaten Food Security in Cambodia**

IPS, April 17, 2008

Fish account for 75% of the protein consumed in Cambodia and provide a livelihood for over a million of people. Concerned by falling catches, the Cambodian government is considering the introduction of stringent fishing controls, a move that some believe would only further disadvantage the poor. In early 2008 there were several stories in the Khmer press about the rising price of prahok due to declining fish catches. The cost of small fish, known as *trei riel*, the core ingredient of prahok, has increased nearly 200% in the past 12 months. Nao Thuok, director general of fisheries at the Ministry of Agriculture, Forestry and Fisheries in Phnom Penh, confirmed that the fish catch declined in 2007 to about 12,500 tonnes, down from 28,000 tonnes in 2006, but added that 12,500 tonnes was the average before 2006 and that it was 2007 that was an unusual year. "There is some decrease in big fish but the total amount, especially small fish, is not declining." Eric Baran, research scientist with the WorldFish Center in

Phnom Penh, says "What is clear is that the catch of individual fishers is declining but this has to be balanced by the fact that there are many more people fishing. The increase in population has outstripped the increase in fisheries production resulting in a diminishing catch per fisher. Overall, this trend is set to continue". "Undisputedly the nature of the catch is declining with every year," said Baran. "Importantly, big species that live many years are getting replaced by small, short life species that react instantly to environmental change. The system is becoming more and more variable and less and less predictable." According to Nao Thuok, the situation is prompting the Cambodian government to consider introducing tighter controls on fresh water fisheries. "We are thinking of introducing limits on fishing gear because there are too many people fishing so that fish cannot migrate upstream for the next years' spawning".



### **Giant River Stingrays Found Near Thai City** National Geographic News, April 29, 2008

When anglers called that March afternoon to say they had caught a giant freshwater stingray near the Thai city of Chachoengsao, biologist Zeb Hogan couldn't believe it. He had just spent a week in northern Cambodia, searching for the ray—which could be the world's largest freshwater fish—to no avail. The ray, listed as "vulnerable" on the 2007 World Conservation Union Red List of species, has been overfished in its Mekong River habitat, Hogan said. But when Hogan arrived at the river that afternoon, he found that not only had the anglers reeled in a 4.3-metre-long ray, but that the creature had also just given birth to a dinner plate-size baby. The newborn clung to the rough skin on the back of its mother, which was being held at the riverbank by nine handlers. The giant freshwater stingray, also known as the freshwater whip ray, is found in several rivers in Southeast Asia and northern Australia. There are unverified accounts of individuals growing well over 450 kg in weight and more than 6 metres in length—among the largest of the approximately 200 species of rays. Much is still

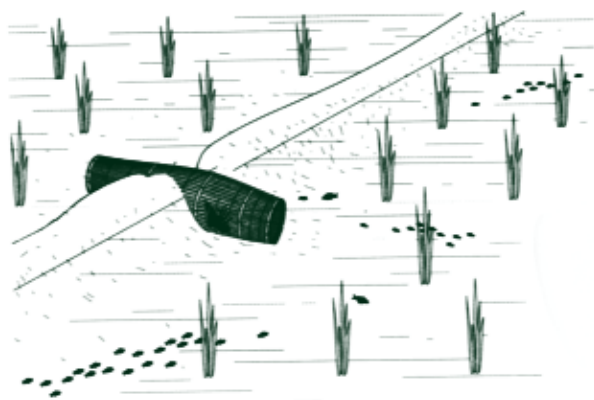
unknown about the mammoth ray, which was only described scientifically in 1989. "We know almost nothing about its abundance and habitat needs, which makes it extremely difficult to manage the species," Hogan said. No one knows whether the species is truly a freshwater fish or if it can also move into the ocean. But the behaviour of the ray can be gleaned just from the way it looks, he pointed out. "It has eyes on top, and the spiracles are modified gill slits that allow the ray to breathe as it's buried in mud." The ray feeds on clams and crabs using jelly-filled pores that are able to detect electrical pulses from its prey, he said. Its barb, or stinger, located at the base of its whip-like tail, can grow 37.5 centimetres long and is the largest of any stingray's. "The tip is sharp like an arrowhead, passes through skin easily, and can even go through bone" Despite fishing pressures in Cambodia, in the Bang Pakong River in eastern Thailand, stingray populations appear to be healthy. It may seem surprising that the giant creatures could thrive in an area densely populated by people, Hogan said. "You wouldn't expect to find tigers or wild elephants or any other large, wild creatures in an urban environment like this," he said. "But it's quite possible that the reason healthy populations of giant freshwater stingray still occur is because they're so difficult to catch".

### **Exotic Fish Threatening Vietnam's Ecosystems** Viet Nam News, April 30, 2008

Several non-native fish species brought into Vietnam in recent years could displace native species and damage ecosystems unless prompt action is taken, scientists have warned. Fishermen on the Saigon River in Ho Chi Minh City have recently been catching large amounts of suckermouth catfish (*Hypostonurus lecostomus*) – an imported fish that used to be bred as pets. Nguyen Van Chuc, a resident in the city's Binh Thanh District, said he could catch up to 100 of the fish daily. "The fish have been reproducing rapidly and I can now catch them everywhere," said Chuc. Nguyen Tuan, an expert from the Research Institute for Aquaculture No. 2, said suckermouth catfish eat indiscriminately and reproduce rapidly. "To compete for food, the fish invade the environments of other



species and damages them," he said. The suckermouth has also appeared in rivers in the Mekong Delta in recent years. Two other carnivorous fish species, the *Colosoma brachpomum* and *Cichla ocellaris*, are threatening the ecology of the Tri An Reservoir in the southeastern province of Dong Nai, according to local scientists. Farmers originally brought in the two fish species, which are native to tropical areas of the Amazon River and reproduce rapidly, and bred them in the reservoir. In addition, the yabby (*Cherax destructor*), a species of crayfish from Australia, was recently imported and bred by local farmers in the central province of Phu Yen. The yabby is threatening irrigation works in the area because of its habit of burrowing into levee banks and dam walls, said Tuan. "If farmers let the yabby get out of captivity, they can cause considerable damage to dams around the river," he warned.



### Lao Official Warns against Hunting Aquatic Species...

Vientiane Times, May 9, 2008

The Lao public has been warned against hunting fish and frogs during the breeding season from May to July. The Living Aquatic Resource Research Centre of the Ministry of Agriculture and Forestry has issued the warning to ensure fish and frog populations are not depleted before they have a chance to reproduce. The centre's Deputy Director, Dr Sinthavong Viravong, said "If possible, hunters should avoid hunting aquatic and amphibian life at this time of the year. If they don't hunt now, they give fish time to breed and there will be many more fish next year." Agriculture and forestry offices at all levels are aware of the regulations banning the public from hunting fish during May, June and July, and these regulations are to be implemented by the district office in each province. "If you follow these regulations, your community will have a sustainable source of fish," Dr Sinthavong said.

### ...But Hunters' Catch Swells in Mating Season

Vientiane Times, May 22, 2008

Despite an official ban by the Living Aquatic Resource Research Centre on fishing and frog hunting in the annual breeding season from May to July, hunters are out in force. The centre's ban goes largely unnoticed because people enjoy a change of diet and like to make the most of nature's seasonal bounty. Fish and frog eggs are popular menu items. At Huakhua market in Vientiane a fish vendor named Ms Kham said "Today is a special day at this market. We have a lot of fish and frogs because it rained hard last night and these conditions stimulate them to mate. This makes it easy to catch them". Mr Tan, 23, from Xiengda village in Xaysettha district often goes out at night to catch frogs. With the onset of the rainy season, Mr Tan charges the battery of the lamp he uses on his night-time hunting expeditions in anticipation of a heavy downpour. "There won't be more than five nights like this, when there are so many frogs around. If you're not ready you'll lose money," he said, adding that the local frog population had noticeably declined in the last few years.

### Youth Conservationists Eye Otters

VNS, May 21, 2008

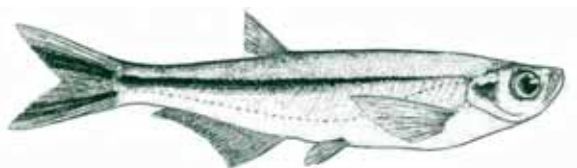
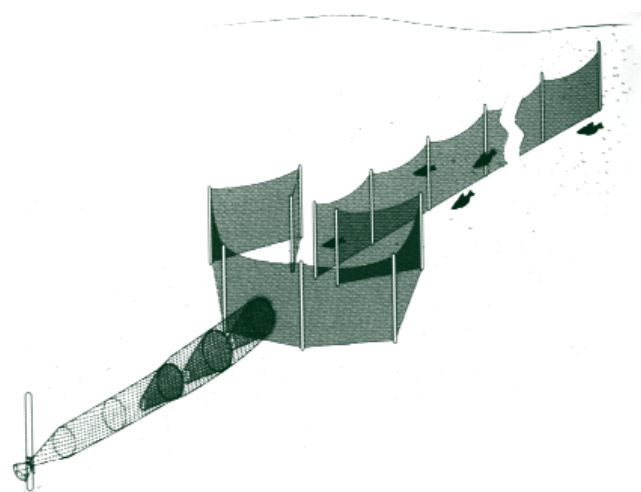
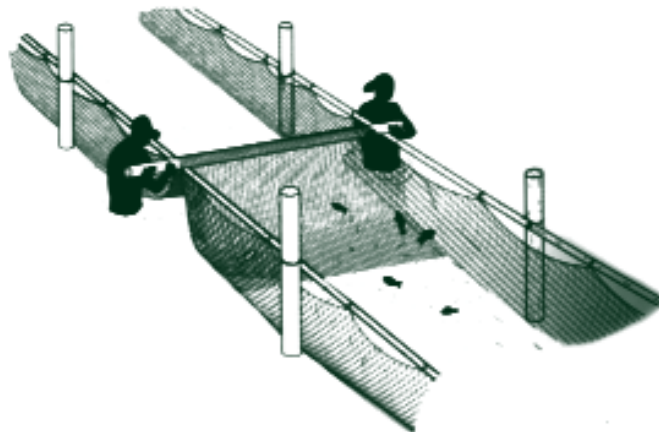
How to ensure the survival of endangered otters was order of the day at a meeting of leading world experts and young conservationists from Viet Nam, Cambodia and Thailand in the southern province of Can Tho in mid-May. The first three days consisted of lectures held in the College of Environment and Natural Resources, Can Tho University where students learnt about the ecology, status and threats to otters as well as techniques to conserve them. Then during a four-day field trip to Song Trem, experts directed students in techniques such as map reading, global position system (GPS), recording scientific data, field detection skills and habitat monitoring (including tracking, scat analysis and plaster casting foot prints). The trainees were also given tips on population monitoring techniques and camera trapping. "Viet Nam is a critical country for otter conservation," IUCN/SSC Otter Specialist Group Asian Co-ordinator Padma K De Silva said. "Four species of otter live in Viet Nam: the hairy-nosed otter (*Lutra sumatrana*); small-clawed otter (*Amblonyx cinereus*); smooth-coated otter (*Lutra perspicillata*) and Eurasian otter (*Lutra lutra*). These four species are critically threatened by the illegal wildlife trade and habitat loss and are considered amongst the most threatened mammals in the region." In particular, the hairy-nosed otter was a species of global and national priority for conservation and if action was not taken it would soon face extinction, she said.



## Research Boost for Fishways Development

LaRREC, 5 February, 2008

A new Australian-funded research project in the Lao PDR is set to allow fisheries experts to find ways of helping fish follow their traditional migration routes, so evading the low-level barriers that modern infrastructure projects are creating along rivers in the Mekong region. Over two years in central Laos, Australian and local researchers will work with local community groups to study how fish can use man-made 'fishways' to move between rivers and floodplains in central Laos. Fishways are channels and other mechanisms that help fish get round obstacles to their movement. Work by the Mekong River Commission and fisheries agencies in Cambodia, the Lao PDR, Thailand and Viet Nam has shown that these movements are crucial to the survival, growth and reproduction of many fish species in the Mekong and its tributary rivers. Barriers to these movements, caused by various projects including hydropower dams, irrigation canals, levees and roads, can block these migratory species and therefore threaten the future supply of fish for subsistence and commercial use. According to project leader Douangkham Singhanouvong of the Living Aquatic Resources Research Centre (LARREC) in Vientiane, the aim is to combine the rich traditional knowledge of Lao people about fish movements with Australian experience on building infrastructure that does not block fish migration. The researchers from LARREC, the National University of Laos, and the Departments of Primary Industries and Fisheries of Queensland and of New South Wales in Australia, are funded by the Australian Centre for International Agricultural Research. The project will design and test fishways that are appropriate for the unique fish species of the Lower Mekong Basin, and that will eventually show engineers how to build new weirs, floodgates, and road crossings that allow fish to continue to breed and grow. Work will commence when the 2008 wet season begins, which is expected to be in May.



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# Catch and Culture

## Fisheries Research and Development in the Mekong Region

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