Finding the best 'ways' with fish passes around dams

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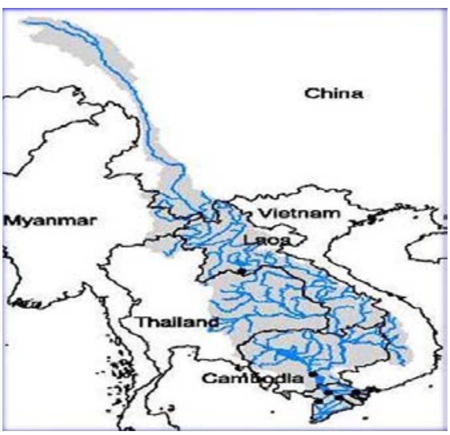
Abstract

The Lower Mekong Basin provides habitat for more than 480 species and 40 families of fish, many of which are endemic. The catchment provides 2% of the worlds commercial fish catch, with 2.2 million tonnes per annum extracted. Movement of fish through the Basin is vital to maintain fish populations, especially for migratory species. However, thousands of barriers have been installed throughout the Lower Mekong Basin hindering fish passage. Work is being undertaken to establish the best responses to the increasing number of barriers throughout the Lower Mekong Basin. Engineered structures are being designed to account for specific ecological objectives, hydrology and fish species within a site. This endeavour is not without challenges, and one size does not fit all. The Pak Peung Wetland Research site is located about 100 km to the north-east of Vientiane, the capital of Laos. The ACIAR-supported project started in 2008 and a fully commissioned cone fishway was installed in 2014. Monitoring has been an essential part of the project; to learn about the success of the fishway so similar projects can be successfully rolled out across the Basin. This talk discusses an example of an engineered fishway at Pak Peung, Laos, and some of the successes and challenges of fish passage design.

Our project is about how to find the best type of fishway for the Lower Mekong River. Fishways in other countries show they have the potential to solve the problem of how fish can have access upstream and downstream along a river. However, the Mekong offers a number of challenges for fishways, compared to other countries, with the numerous hydropower dams now along its course as the Lancang River in China and Myanmar, and the Mekong River through Laos, Thailand, Cambodia and Vietnam (see map, *left*).



Freshwater fish in the Mekong are very biodiverse: there are more than 480 different species in 40 different families (Figure 1). Only the Amazon Basin has more species of freshwater fish. Many of the species in the Mekong are endemic, and they have commercial value. Annually, 2.2 million tonnes of fish –

This paper has been prepared from a transcript and the illustrative slides of the presentation.

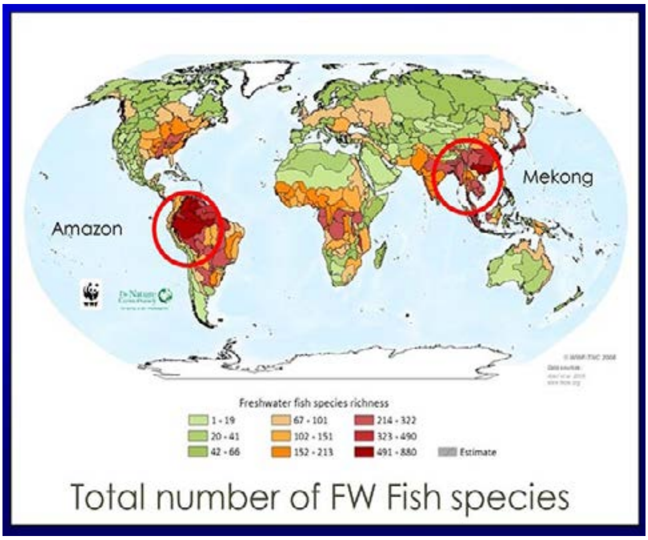


Figure 1. Total numbers of freshwater fish species. The Mekong region (orangey-red) has around 480 species in 40 families.

Source: WWF and The Nature Conservancy, 2008.

2% of the world’s total commercial fish catch – are taken from the Mekong. Fish is important to diets here; for example it provides 48% of animal protein intake in Lao PDR and 79% in Cambodia.

The Lower Mekong also has four different agro-ecological zones (Figure 2): the plateau (upland) which is used to grow rice or other vegetables; the lowland areas; the riverine habitats of island-dominated areas such as in Cambodia where there are 4000 islands, and the seasonally flooded wetlands on the floodplain. The livelihoods of people living along the river are based on fishing (Figure 3). The fish themselves depend on being able to migrate between these zones, to areas specific for reproduction, and to maximise genetic diversity and therefore maintain the fish populations.

Figure 2. Four different agro-ecological zones.

Figure 3. Fishing is important for people's food and livelihood.

Figure 4. Floodplain wetlands are important feeding and breeding sites for fish, and the richer the resource the more the fish.

Floodplain wetland habitats can be rich sources of food, and important breeding sites (Figure 4), supporting large populations of species vital for human food.

But people have built thousands of barriers (Figures 5, 6, 7) that hinder fish passage and prevent fish migration throughout the Mekong and its tributaries and associated waterbodies. Dams, weirs, levee banks and wetland regulators support the very large irrigation systems that have been established so that rice production could expand, but they restrict fish access to most of the 200,000 km^2 of wetland areas in the Lower Mekong Basin. The result is that 70% of Mekong fisheries are now endangered.

At Pak Peung village in Paksan District in Lao PDR, after the irrigation system was established about 15 years ago, fish species declined in the area. Fishermen complained that the irrigation water could reach the rice fields, but fish could not, and fish production was suffering.

Figure 5. Types of barriers across the Mekong Basin: planned, commissioned, under construction, cancelled, unknown (see legend). *Source*: CGIAR.

Figure 6. Numbers of dams in the Mekong Basin, October 13, 2016.
Source: Kim Gehab, CGIAR.

Figure 7. Wetland regulators restrict fish access to the 200,000 km² of wetlands in the Lower Mekong Basin.
Source: Marsden et al. 2014

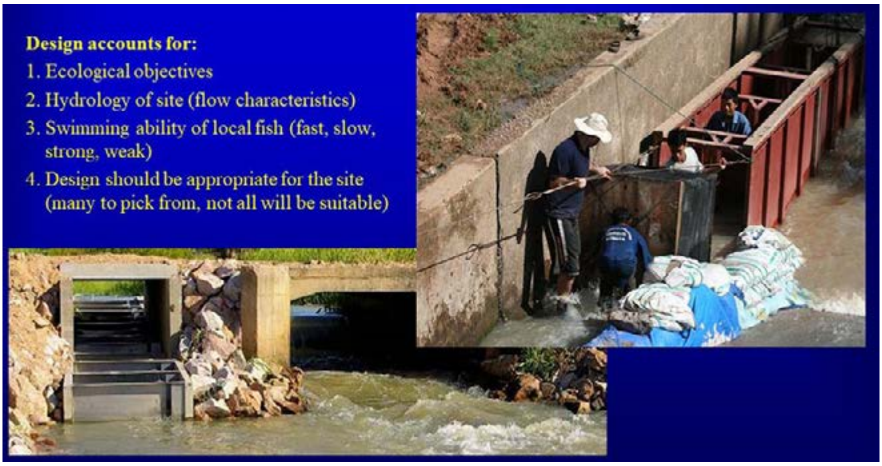


Figure 8. The solution: engineered structures that enable fish to overcome the various physical and flow barriers challenging fish passage.

So, around five years ago we collaborated with Australia's Charles Sturt University to see if we could design a suitable fishway so that fish can swim around the various barriers (Figures 8 – 12).

The project has involved observation and experimentation, and design of permanent fishways appropriate for the types of barriers and the riverine species involved.

Design challenges

1. **Target species**. The Mekong fish populations include a range of species of different shapes and sizes. Some are large, including dolphin and stingray. There are also catfish and many species of smaller size, all with different swimming abilities (Figure 9). It is difficult to design fish passes that function for the whole range of species.

Figure 9.

Figure 10. Some areas experience distinct wet and dry seasons, with large differences in the amount of water present at the same spot in the two seasons.

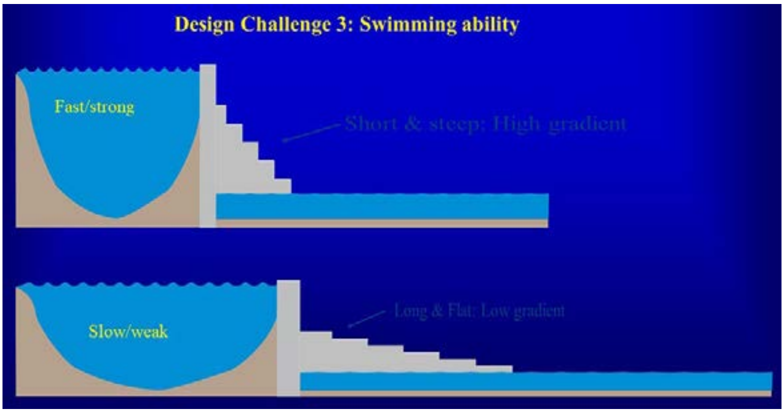


Figure 11. Differing swimming abilities need to be accommodated.

Figure 12. The form of fishway to use is another design challenge: whether a rock ramp fishway (left), a vertical slot fishway (centre) or a cone fishway (right).

2. **Hydrology**. The floodplain is flooded in in the rainy season and dry in the dry season (Figure 10).

3. **Various swimming abilities**. (Figure 11). Fast-flowing water with strong currents tire fish before they can fully negotiate a barrier. For larger fish, shallow

water can be a problem, being difficult to swim in, and not supporting them when they need to jump.

4. **Form.** Rock ramp? Vertical slot? Cone fishway? (Figure 12).

Our trial fishway

We set up our first fishway, or fish ladder, at the Pak Peung Wetland Research Site (Figures 13 and following), beside the Mekong River, and started collecting data on the fish movements upstream and downstream.

From similar work in Australia we learnt, for example, that fish (in both countries) survive passage over overshot weirs better than across undershot weirs (Figure 14), and that led to a new idea: a fish-friendly floodgate to improve survival for undershot weirs. We plan to upgrade existing gates and compare the effects on fish injury and/or mortality.

The project has led to collaboration with Thailand and other countries in the Mekong Basin where fish have been declining, and also overseas. From our

Figures 13 (above), and following. Pak Peung Wetland Research Site

Figure 14. More fish survive overshot weirs (lower diagram & photo) compared to undershot weirs (upper diagram & photo).

experimentation here in Lao, at Pak Peung, we now have an Asian country inviting many other countries to come to see and learn about the problems of fish passage and some appropriate solutions.

References

Marsden T. et al. 2014. *Prioritising barriers to upstream fish passage for remediation works. Xe Champhone Catchment, Lao P.D.R*. Australian Fish Passage Services. 49p.

Dr Oudom Phonekampeng is a Laos National who has worked across the globe from Oceania, Australasia, Europe to the Americas. He has over 22 years experience both in teaching and practising animal and agricultural science. He completed his Bachelors in Russia, Masters in Thailand and his Doctorate in Sweden. His expertise is in aquatic ecology and fisheries, working specifically on hydropower and agricultural projects. He previously held the position of Dean of the Faculty of Agriculture for a period of more than ten years, and now holds the position of Vice-President of the National University of Laos.