Monitoring fish and fisheries at Khone Falls

MRC MEETING (12 Dec 2014)

DSPC

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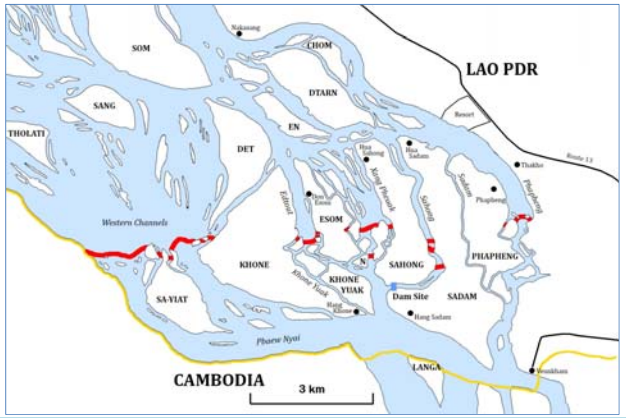
Background Information

The location is unusually complex:

- geography of the falls, many channels;
- seasonal change in flows;
- international border across the southern boundary;
- most data from 1994-1999 studies of fishers downstream of the falls;
- species diversity – 200+ fish species;
- fish migration – many species migrate;
- fisheries at the falls, upstream and downstream;
- many other impacts on fish, up and downstream.

Khone Falls Overview Map



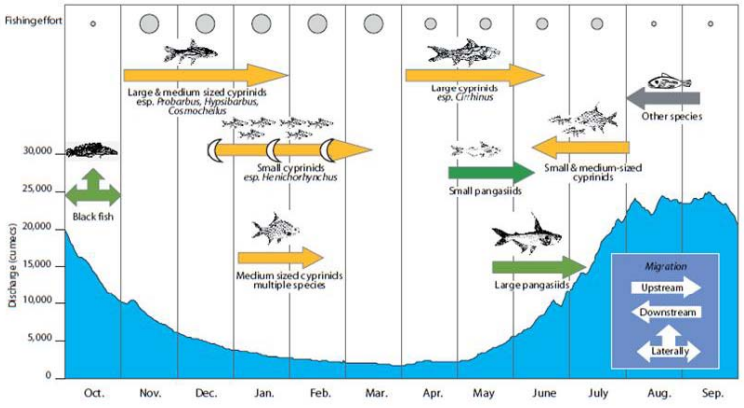
29 Jan 14

17 Aug 14

Large channels

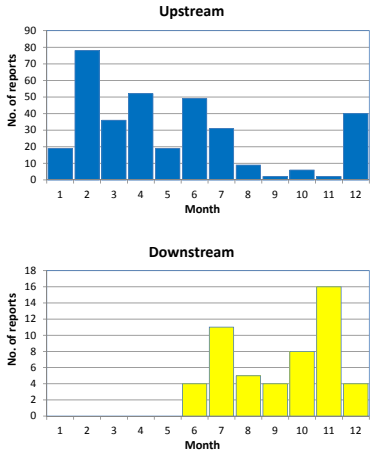
Channel	Approximate width (m)	Natural Discharge ($m^3 s^{-1}$)		
		5 %-ile	Median	95 %-ile
Total Mekong*	1300-5500	29,982	4,691	1,674
Western Channels	600-3500	19,679	1,555	84
Ee Dtout	100-400	1,382	173	12
Xang Pheuak (Khone Lan)	250-850	2,073	260	18
Sahong	90-160	1,387	301	50
Sadam	50-60	291	58	3
Phapheng	250-500	5,170	2,344	1,505

Fish migrations at Khone Falls



Baran (2006) ... Baird et al. (2001)

Migrations from MRC LEK 1999



Champasak Province
34 fishers
218 reports
43 species

The need for data

- Most quantitative information on Khone Falls fisheries is out-of-date (1990s) and tells us only that fish are killed in large quantities while trying to ascend the falls.
- A lot of information is based on old LEK of fishers.
- Many breeding fish are killed while migrating - before they can spawn.
- Some fish do migrate past the falls at certain times.
- But there are no quantitative data on the proportions of fish that get past the falls (in total) or on the proportion that pass each channel at present.
- Nobody can quantify fisheries losses at this stage.

Objectives of Monitoring Fish & Fisheries

1. Fish passage

MRC PDG "The developer should provide effective fish passage upstream and downstream. Effective fish passage is usually defined as "providing safe passage for 95% of the target species under all flow conditions."

- Evaluate the effectiveness of fish passage mitigation measures for upstream-migrating fish and provide information for ongoing fish passage improvement.

- Evaluate risk to downstream-migrating fish and provide information needed to develop downstream fish passage mitigation measures.

2. Socio-economic

Importance and value of the fisheries to the people directly affected by the project.

Fish Passage Monitoring

Monitoring is at two scales:

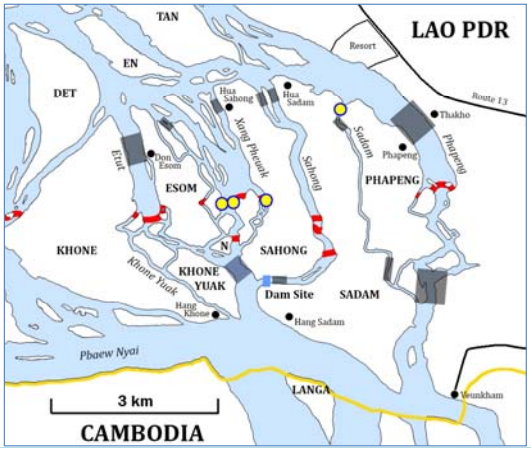
1 Through each of the natural channels – the main work now
2 Through each modified fish pass

- Establish the current rate of successful migration of fish – the baseline - through each channel or fish passage.
- Set up monitoring that is standardised to provide comparable results and can be sustained as the system changes due to construction and operations.
- Develop capacity, purchase and test equipment, set up databases and analyses and adjust monitoring according to results.

General Approach

1. Monitor fish upstream and downstream of the falls and compare abundance by species.
   - Non-capture methods
   - Capture - CPUE sampling
   - Capture - household (fisher) catches (socioeconomic study)
2. Tag or mark fish and recapture or track their movements through the channels.
3. CPUE sampling of downstream-migrating fish.
4. Collect ancillary supporting data.

Khone Falls Monitoring Locations



3 Fish Passage Sites

Non-capture methods

1. **Direct observation – fish can be seen migrating if the water is clear.** Not generally applicable because of scale, turbidity and habitat complexity. However, in the dry season fish are visible at certain places and could provide some information. (Schistosomiasis is a problem).

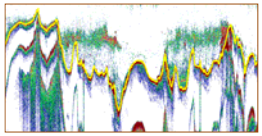
2. **Photographic methods** will be trialled in the fish passages in dry season of 2015 – may be useful for localised information.

Non-capture methods

2. Hydroacoustics – use of sound waves to detect fish.

Standard units are not very effective because of large scale and complexity of habitat, shallow depth in many places, fast turbulent water and likely interferences. Cannot relate to species.

Hi-frequency multi-beam sonar (e.g. Didson) is better in turbid conditions, but has limited range …. 15 m and could not identify most species.



Viravong et al. 2006

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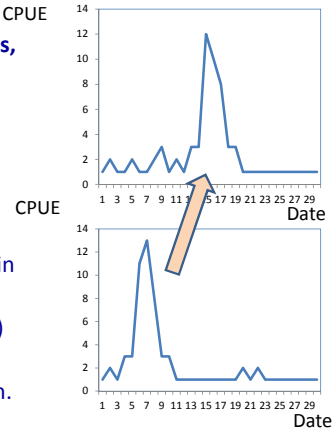
Capture methods - CPUE

Fish are caught using standard methods, CPUE is compared over time and between sites. Migration is inferred based on differences in CPUE.

1. Migration peaks in channels…..example
2. Difference upstream – downstream in CPUE.
3. Difference across channels (laterally) in CPUE.
4. Differences in size distribution of fish.



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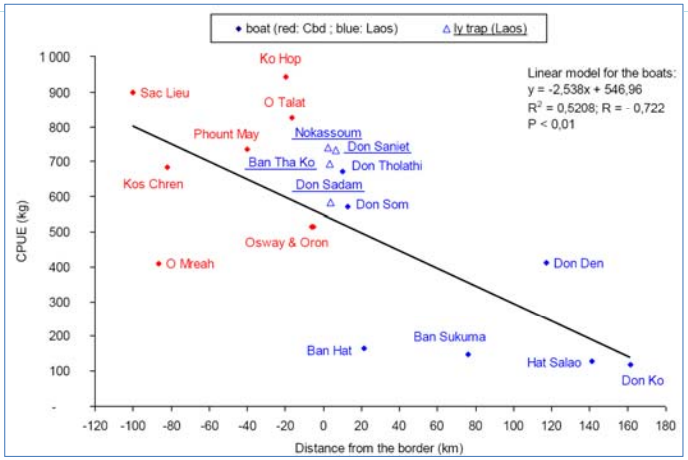
CPUE example (Cacot 2007)



For CPUE comparison to be effective ...

- Requires standardization of gears and methods - this is the basic approach used in many fisheries studies worldwide.
- An assumption is that changes in CPUE (mostly) reflect underlying changes in abundance of fish.
- The efficiency of the gears must be the same at each site (affected by habitat and water quality).
- The catchability of the fish must be the same at each site (affected by behaviour, and also habitat and water quality).

Luang Khang 2013 example of non-standardisability

- Highly variable and site-specific
- Useful for catching fish for tagging.

Gears must suit the habitat

Standard methods of CPUE Monitoring

Various gears have been trialed in 2014.

Now eight methods are used each day at 11 sites.

- Cast net - large (5.5 cm mesh, 3.5 m dia.) - 20 casts
- Cast net - small (2.5 cm mesh, 2.8 m dia.) - 20 casts
- Panel gill net - small (2.5 and 3 cm mesh, 15 m x 0.8)
- Panel gill net - medium (4-11 cm mesh, 16 m x 1.7 m)
- Panel gill net - large (10-16 cm mesh, 16 m x 1.7 m)
- Trap - small cylindrical x 2
- Trap – large cylindrical x 2
- Fyke net x 1

Electrofishing, seining and others cannot be used routinely.

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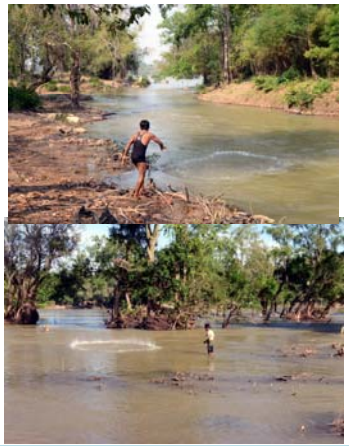
Cast Nets

Advantages

- Can be used in all habitats
- Catch a range of species and sizes.
- Easy replication – no. of casts.
- Easy to standardise.
- Common gear for fishers.
- Fish are alive and generally can be tagged.

Disadvantages

- Not a common standard gear elsewhere.
- Subject to 'operator error'.
- Fish may be damaged by capture.



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Panel gill nets

Advantages

- Common gear worldwide.
- Catch a range of species and sizes.
- Use of multi-meshes allows easy replication.
- Easy to make with local materials.
- Gill nets are familiar to fishers.

Disadvantages

- Cannot use in very fast water.
- Can be torn or damaged, require ongoing maintenance or replacement.
- Fish are dead or damaged, cannot be tagged.

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Traps

Advantages

- Hoop traps or fyke nets are common gear worldwide.
- Catch a range of species and sizes.
- Easy replication.
- Concept is familiar to fishers.
- Fish are alive and can be tagged.

Disadvantages

- Selectivity.
- Bulkiness.
- Sometimes low catches.

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Trap-making and testing on-site

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Trap development

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Fyke nets

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Cast nets

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Other Methods tested

Processing Fish

Standardised the processing

- All samples are brought to one of three places and photographed with a label to eliminate various errors which are common in other studies.
- Qualified staff supervise the fishers and record data.

Fish identification

- A challenge everywhere in the basin; local names vary; even at one site fishers are not consistent with names and lump many species under one name, especially small fish.
- We set up a standard fish table with unambiguous Lao names – added suffixes to clarify species.
- We photograph all catches and all species and are re-printing ID charts.
- Measuring boards good quality.
- Balances are calibrated and digital ±0.1 gram; greatly reduces reading errors.

Processing fish



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Processing fish



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Photo-documentation

Easy to check data showing large or unusual species

Photo-documentation

Easy to check records for exotic species and confirm ID and size

New fish ID chart

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Household Catches

Same principle as CPUE sampling –compare catches between sites and times, but fishers rather than standardised gears; i.e. fisher catches each day using their own gears and methods. Households record their own data in logbooks.

60 HHs from 6 villages record catches daily in logbooks. Purpose was mainly to estimate socioeconomic value of catches.

The results can also support interpretation of migration patterns.

Most fish are caught downstream in each channel.

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Monitoring 'Fish Passages'

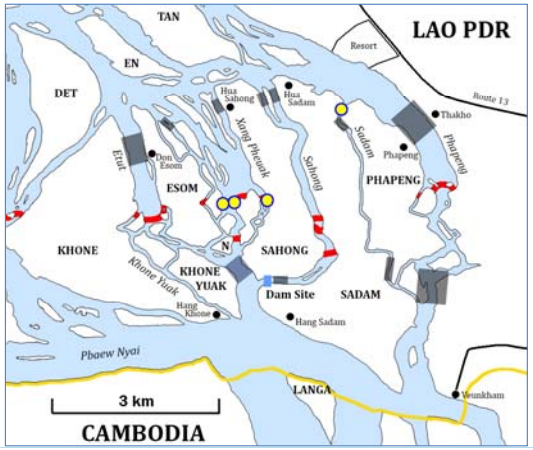
Fish passage has been improved at 4 places: Hou Sadam(1) and Hou Xang Pheuak (3 places)

In the dry season fish can be seen moving upstream through the fish passages and feeding within them.

In May 2014 gears were set downstream and upstream of the 2 main passages in HXP – Luang Pii Teng and Hou Wai every day for one week.

Some traps were also set above the main barriers in Luang Pii Teng fish passage.

Khone Falls Monitoring Locations



3 Fish Passage Sites

Khone Lan waterfall, May 2014

Fish passage at Luang Pii Teng

Trap in Luang Pii Teng fish passage, May 2014

Fish leaped up this waterfall and into the trap on several days.

Luang Pii Teng Fish trapping

Hou Wai Fish Passage, May 2014

Hou Wai fish passage is relatively flat and passes many fish

- Fish caught on one night in directional trap in upper section of Hou Wai

Fish tagging – 'conventional' external tags

Attempt to track fish movement up channels

External tags with unique codes, read visually

- We used common T-bar or dart tags.
- Fish may not be re-captured or tags may not be returned by fishers.
- Pathway of migration not unequivocally proven.

We tagged about 1053 fish in 49 species and 10 families, with 74 returns. Most were near release site. Some moved up the channels

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Downstream fish migration – larval sampling

June 2013 – September 2014

- Determine larval drift density and load over time.
- Model the likely proportion passing downstream through the power plant.
- Estimate proportion affected by passage through the plant.

- Most larvae are very small.
- 2 peaks in drift in July.
- Larvae are well-mixed in river.

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Downstream fish migration

Jib nets were trialled in 2014.

Problems with debris/detritus and dilution during wet season

Existing standard gears also catch downstream migrating fish

Other surveys in 2014

1 Pa soi household catch census

- Calibrate the long-term (60 HHs) dataset to improve the total catch estimate.
- Total catch and species by intensive monitoring

Jan-March 2014, 271 HHs surveyed for 6 weeks.

2 HH catch and consumption study

- Calibrate the long-term (60 HHs) dataset to improve total catch estimate.
- Get more information on changes in fishing and catches over years to decades.

LARREC/DLF team surveyed most (##343 of 524) HHs in six villages in 2014 regarding current and historical catches and consumption.

Field surveys were mainly by GoL staff

LARReC and DLF staff prepare for field survey, Jan 2014

Other surveys in 2014

3 Expert fisher

- Information on catches and migration patterns by species, and changes over time

6 villages x 5 = 30 expert fishers interviewed.

4 Big gear survey

Objectives

Document the numbers and location of big gears (luang khang and lee traps)/

Record catches and cross-check against HH catches.

- ~180 gears recorded in 2014, all are illegal under Lao Law.

Other surveys in 2014

5 Market survey - Nakasang

Main species, rank quantities and prices

Many rare fish species are on sale

Category 1 or 2 in Lao Fisheries Law

Other surveys in 2014

5 Market survey – Veunkham

Main species, rank quantities and prices

Dried Pa Tep from Cambodia

Large Pa Kouang, a protected species

Many fish from Cambodia, are brought up by fishers.

Many large fish, and rare and protected species.

Demand from Lao means fish are caught before they reach Lao and the falls.

Summary

- To monitor fish passage, CPUE sampling at upstream/downstream sites in channels will continue and be refined based on results.
- CPUE sampling will also be applied at fish passage sites in 2015 dry season.
- Photographic monitoring of fish passages planned in 2015.
- HH sampling will continue.
- Fish larvae sampling is completed. Assessment of larval swim bladder development will be done after basic analyses.
- Other studies will be analysed and reported and some will continue.