BioRA DSS Workshop

BioRA zones, focus areas and indicators

BioRA DSS Technical Workshop
Phnom Penh, Cambodia
15-19 February 2016

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Additional detail:
- Progress Report 1_Indicators and Focus Areas
- Interim Technical Report 1 (Vol. 1) _ Specialists' Report

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ZONES AND FOCUS AREAS

BioRA Zones & Focus Areas

- FAs are the focus for the BioRA predictions of ecosystem change:
  - Require hydrology and hydraulics at each FA
  - FAs are representative of whole zone:
    - Same response curves can be used at different points in the zone
- Eight zones for BioRA
- Based on previous analyses (hydro and geomorphological zones), and new analysis as part of BioRA

BioRA Zones
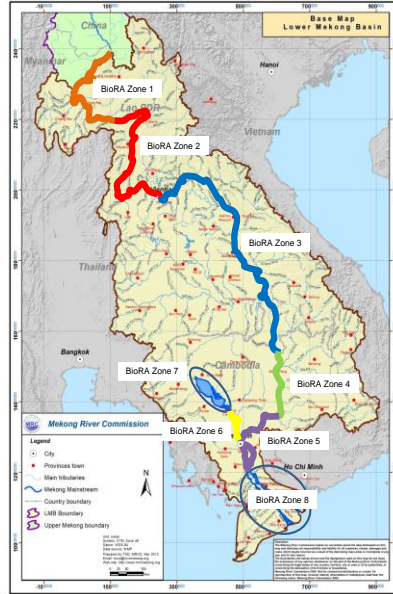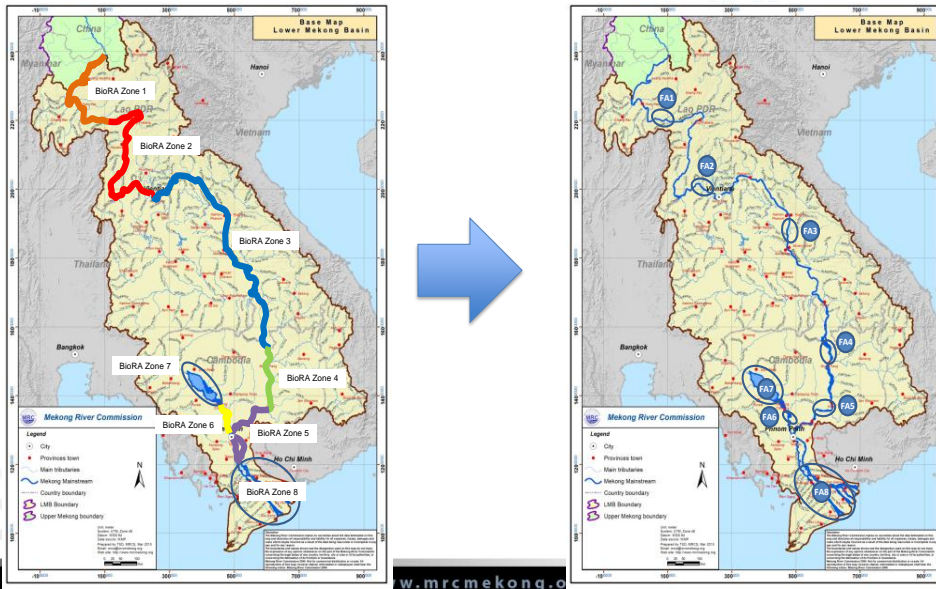
Focus Areas

Focus areas

- 8 Focus areas

Name	Description
BioRA FA1	Mekong River upstream of Pak Beng
BioRA FA2	Mekong River upstream of Vientiane
BioRA FA3	Mekong River upstream of Se Bang Fai
BioRA FA4	Mekong River upstream of Stung Treng
BioRA FA5	Mekong River upstream of Kampong Cham
BioRA FA6	Tonle Sap River at Prek Kdam
BioRA FA7	Tonle Sap Great Lake
BioRA FA8	Mekong Delta

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DISCIPLINES

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Hydrology /
Hydraulics

Water Quality

Sediments

Geomorphology

Vegetation

Macroinvertebrates

Fish

Herpetofauna

Mammals and birds

INDICATORS

2/23/2016

Indicators

- Indicators are building blocks of the BioRA DSS
- Indicators describe (quantify):
  - the flow regime of the river, e.g., duration of the dry season
    - water quality and sediments
    - physical habitat e.g. extent of sandy habitat
    - biota; e.g.; abundance of white fish
- Each habitat and biota indicator has a relationship to the flow or sediment regime
- BioRA will predict how each indicator will change from the selected reference condition

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Indicators

- Three main types:
- From DSF and supporting models
  1. Flow indicators –from the modelled hydrology
  2. "External" indicators-indicators other than flow, also modelled outside of the DSS, and then imported (e.g. hydraulics, water quality)
  3. DRIFT habitat and biota indicators.

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Flow Indicators

All	Mean annual runoff
Dry season	Onset
	Duration
	Minimum 5-day discharge
	Average daily volume
	Within-day range in discharge
Transition season 1	Average daily volume
	Maximum instantaneous discharge
	Maximum rate of change in discharge
	Within-day range in discharge
Wet/flood season	Onset
	Duration
	Maximum 5-day discharge
	Average daily volume
	Flood volume
	Within-day range in discharge
Transition season 2	Average daily volume
	Within-day range in discharge

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Hydraulic Indicators (FA1-FA6)

Area	Indicator	Dry	T1	Wet	T2
Channel	Average velocity	X	X	X	X
	Maximum depth	X	X	X	X
	Minimum depth	X	X	X	X
	Average depth	X	X	X	X
	Shear stress	X	X	X	X
	Wetted Perimeter	X	X	X	X
Floodplain	Onset of inundation				
	Duration of inundation				
	Inundated area				
	Average velocity				
	Maximum velocity				
	Average depth				
	Maximum depth				
	Minimum depth				

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Water Quality Indicators

- Water Quality indicators are modelled externally to the DSS and imported
- Derived from DSF and supporting models:
  - Temperature   - NO_{2+3}
  - pH   - NH_4^+
  - DO   - Si
  - Salinity/EC   -PO_4
  - COD   -TN and TP
- Additional water quality indicators identified as necessary
  - Herbicides
  - Insecticides

Sediment Indicators

- Sediment indicators are external & apply to all Focus Areas
- From DSF:
  - Sediment concentration (mg/L)
  - Sediment Load (t/day)
  - Sediment grain-size (D_{50})
  - Onset of sediment delivery (week number)
  - Duration of sediment delivery (week number)
  - Sediment deposition on the floodplain

Tonle Sap Great Lake indicators

Water level
Water depth
Water area
Total production
Periphyton production
Phytoplankton production
Terrestrial production utilisation in aquatic phase
Sedimentation
Area of oxygen vertical: 0-2 mg/l
Area of oxygen vertical: 2-4 mg/l
Area of oxygen vertical: >4 mg/l
Area of flooded forest
Area of flooded grassland
Area of herbaceous marsh
Area of isolated lakes in dry season

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Geomorphology indicators

Indicators	Focus Areas							
	1	2	3	4	5	6	7	8
Erosion (bank / bed incision)	✓	✓	✓	✓	✓	✓		
Average bed sediment size in the dry season	✓	✓	✓	✓	✓	✓		
Availability exposed sandy habitat in the dry season	✓	✓	✓	✓	✓	✓	✓	
Availability inundated sandy habitat in the dry season	✓	✓	✓	✓	✓	✓	✓	
Availability exposed rocky habitat in the dry season	✓	✓	✓	✓	✓			
Availability inundated rocky habitat in the dry season	✓	✓	✓	✓	✓			
Depth of bedrock pools in the dry season	✓	✓	✓	✓				
Water clarity	✓	✓	✓	✓	✓	✓	✓	✓

Vegetation indicators

Indicator	Focus Areas						
	1	2	3	4	5	6	7
Channel_Riparian trees	✓	✓	✓	✓	✓		
Channel_Extent of upper bank vegetation cover	✓	✓	✓	✓	✓		
Channel_Extent of lower bank vegetation cover	✓	✓	✓	✓	✓		
Channel_Extent of herbaceous marsh vegetation cover	✓	✓	✓	✓	✓		
Channel: Weeds and grasses on sandbanks and sandbars	✓	✓	✓	✓	✓		
Channel_Biomass of riparian vegetation	✓	✓	✓	✓	✓		
Channel_Biomass of algae	✓					✓	✓
Floodplain_Extent of flooded forest			✓			✓	✓
Floodplain_Extent of herbaceous marsh vegetation			✓			✓	✓
Floodplain_Extent of grassland vegetation			✓			✓	✓
Floodplain_Biomass of indigenous riparian/aquatic vegetation			✓			✓	✓
Floodplain_Biomass of algae			✓			✓	✓
Non-native_Extent of invasive riparian cover			✓			✓	✓
Non-native_Extent of invasive floating/submerged plant cover			✓			✓	✓

Macroinvertebrate indicators

Indicator Groups	Focus Areas							
	1	2	3	4	5	6	7	8
Insects on stones	✓	✓	✓	✓	✓			
Insects on sand	✓	✓	✓	✓	✓	✓		✓
Burrowing mayflies	✓	✓	✓	✓	✓	✓		✓
Snail abundance	✓	✓	✓	✓	✓	✓	✓	✓
Diversity of snails	✓	✓	✓	✓	✓	✓	✓	✓
Neotricula aperta abundance			✓					
Bivalve abundance	✓	✓	✓	✓	✓	✓		✓
Polychaete worms								✓
Shrimps and crabs	✓	✓	✓	✓	✓	✓		✓
Littoral invertebrate diversity	✓	✓	✓	✓	✓	✓		✓
Benthic invertebrate diversity	✓	✓	✓	✓	✓	✓		✓
Zooplankton abundance	✓	✓	✓	✓	✓	✓		✓
Zooplankton diversity							✓	
Benthic invertebrate abundance							✓	
Benthic invertebrate biomass	✓	✓	✓	✓	✓	✓		✓

Fish indicators

Indicator Guilds	Focus Areas							
	1	2	3	4	5	6	7	8
Rithron resident species	✓	✓	✓	✓				
Main channel resident (long distant white) species	✓	✓	✓	✓	✓	✓	✓	✓
Main channel spawner (short distance white) species	✓	✓	✓	✓	✓	✓	✓	✓
Floodplain spawner (grey) species	✓	✓	✓	✓	✓	✓	✓	✓
Eurytopic (generalist) species	✓	✓	✓	✓	✓	✓	✓	✓
Floodplain resident (black)	✓	✓	✓	✓	✓	✓	✓	✓
Estuarine resident species								✓
Anadromous species			✓	✓	✓	✓	✓	✓
Catadromous species				✓	✓	✓	✓	✓
Marine visitor species								✓
Non-native species	✓	✓	✓	✓	✓	✓	✓	✓
Fish biomass	✓	✓	✓	✓	✓	✓	✓	✓

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Herpetofauna indicators

Indicator Groups	Indicator species	Focus Areas 1	2	3	4	5	6	7	8
Ranid amphibians	*Rana nigrovittata*	█	█	█	█	█	█	█	
	Hoplobatrachus rugulosus		█	█	█	█	█	█	
Aquatic serpents	*Enhydris bocourti*					█	█	█	
	Cylindrophis ruffus	█	█	█	█	█	█	█	
Aquatic turtles	*Amyda cartilaginea*		█	█					
	Pelochelys cantorii					█	█	█	█
	Malayemys subtrijuga					█	█	█	
Semi-aquatic turtles	*Cuora amboinensis*					█	█	█	
Amphibians for human use	NA				█	█	█	█	
Aquatic/semi-aquatic reptiles for human use	NA				█	█	█	█	
Species richness of riparian/floodplain amphibians	NA		█	█	█	█	█	█	
Species richness of riparian/floodplain reptiles	NA		█	█	█	█	█	█	

Bird indicators

Indicator Groups	Indicator species	Focus Areas 1	2	3	4	5	6	7	8
Medium/large ground-nesting channel species	River lapwing	█	█	█	█	█			
	River tern			█	█				
Tree-nesting large waterbirds	White-shouldered ibis						█	█	
Bank-/hole-nesting species	Pied kingfisher					█	█	█	█
	Blue-tailed bee-eater	█	█	█					
Flocking non-aerial passerine of tall graminoid beds	Baya weaver				█	█	█		
Large ground-nesting species of floodplain wetlands	Sarus crane							█	█
	Bengal florican							█	
Large channel-using species that require bank-side forest	Lesser fish eagle				█				
	Grey-headed fish eagle				█			█	█
Rocky-crevice nester in channels	Wire-tailed swallow			█	█				
Dense woody vegetation / water interface	Masked finfoot				█	█	█		
Small non-flocking land bird of seasonally-flooded vegetation	Jerdon's bushchat		█	█					
	Mekong wagtail				█	█			
	Manchurian reed warbler						█	█	█

Mammal indicators

Indicator species	Focus Areas							
	1	2	3	4	5	6	7	8
Mekong dolphin				▇				
Otter spp.				▇			▇	▇
Hog deer				▇				

LINKS

Links in BioRA

Modelled time-series from the DSF

- Hydrologic
- Hydraulic
- Sediments
- Water quality

- Geomorphology
- Fish
- Vegetation
- Mammals
- Birds
- Macro-invertebrates
- Herpetofauna
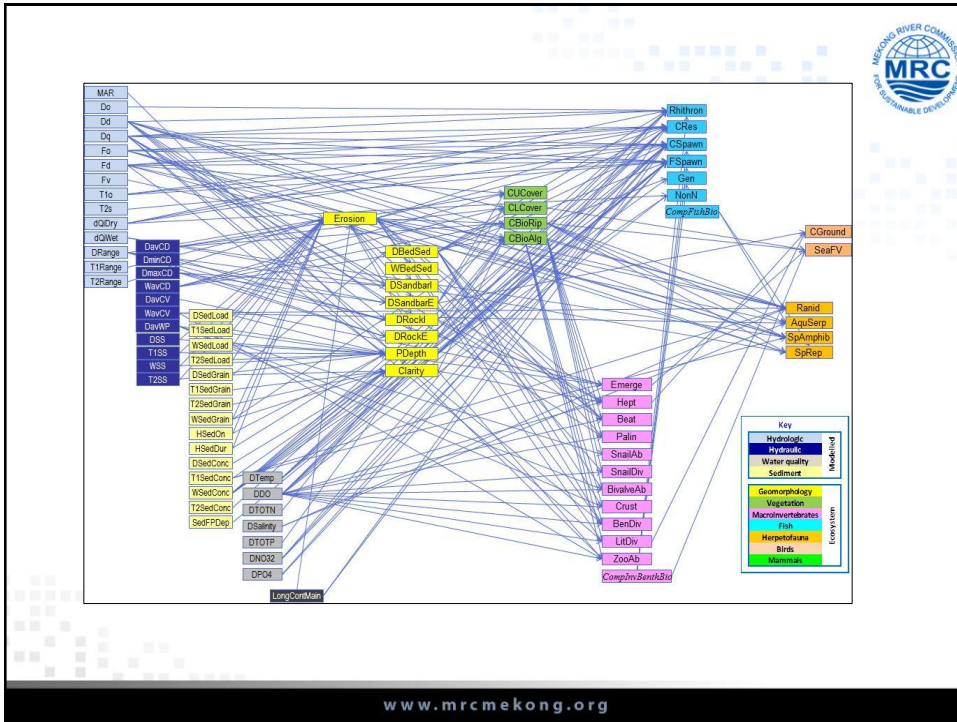- BARRIERS

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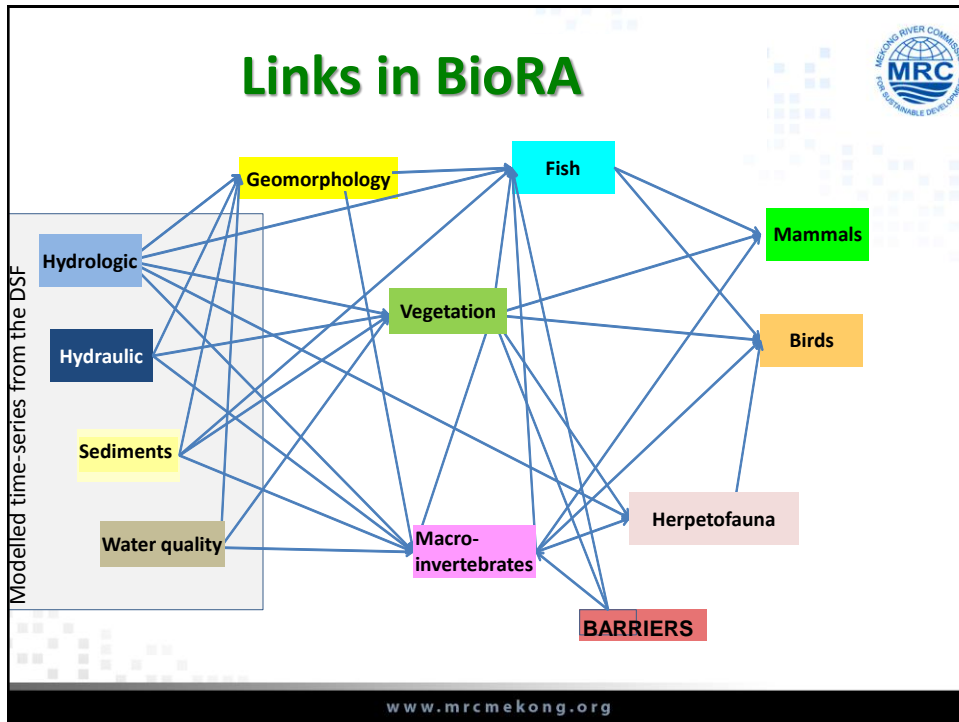
Example of links: Geomorphology - erosion

- Includes changes to banks and river bed
- Negative erosion is deposition
- Linked to:
  - Duration of the wet season
  - Within day range in discharge
  - Shear stress
  - Sediment load
  - Sediment grain size
  - Onset of main sediment delivery
  - Duration of main sediment delivery

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SUMMARY

Summary

- Eight zones with a Focus Area for each;
- Indicators:
  - Flow, hydraulic, water quality and sediment time-series imported in the DSS from DSF and supporting models
  - Biophysical indicators
  - Links between indicators
- … together with the response curves for each link - describe the way the FA / zone will change with changes in flow, sediment.

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Thank You

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