MRC Council Study

Assessing impacts on the hydrology and environment:

Ecosystems and Bioresources

prepared by BioRA Team
This presentation

• Nature and functioning of river systems
  – Linkages
  – Flow of water and sediment
  – Movement of animals

• BioRA
  – Focal areas
  – Indicators
  – Knowledge base
  – Outputs
Nature and functioning of river systems
Human circulatory system versus river system
Inter-connected and inter-dependent

Modelled time-series from the DSF

Hydrologic
Hydraulic
Sediments
Water quality
Driven by water and sediments

Changes in:

- Volume and timing
  - Depths, velocities and areas inundated
    - Channel shape and sediment dynamics
      - Chemistry and water temperature
        - Carbon cycle
          - Biodiversity and abundance
            - Food web
              - Biodiversity and abundance
                - Food web
                  - Biodiversity and abundance
                    - Food web
                      - Biodiversity and abundance
                        - Food web
                          - Biodiversity and abundance
                            - Affects livelihoods & economies

Overall changes in the nature and functioning of the river ecosystem
Complex and multi-dimensional
Mekong biodiversity
Variability:
- promotes biodiversity
- discourages invasions

Discharge

Connectivity:
- lateral
- longitudinal

Life history patterns:
- migration
- spawning
- emergence

Seasonality predictability

Stable baseflows

Dispersal triggers

Access to floodplains

Reproductive triggers

Flooded habitat

Timing and function of flow regime
Timing and function of sediment regime

Rivers transport sediments and carve landscapes
Migration of fish species: routes, timing and triggers
Biological Resources Discipline (BioRA)
Task of BioRA

CAUSE

• flow regimes
• sediment regimes
• water chemistry and temperature regimes
• barriers

EFFECT

• habitats
• fauna and flora (biodiversity)
• ecosystem services on which people depend.
Overview of cumulative impact assessment

Integrate and synthesize the findings from disciplinary and sector assessments

Solicit stakeholder inputs on design and interpretation

Transparent in communication
BioRA: Focus areas

Eight focus areas:

1. Mekong River: Chiangsean-Pakbeng
2. Mekong River: Pakbeng-Vientiane
3. Mekong River: Vientiane-Pakse (Xebangfai)
4. Mekong River: Pakse-Stung Treng
5. Mekong River: Stung Treng-Kampong Cham
6. Tonle Sap River: Phnom Penh-Prek Kdam
7. Tonle Sap Great Lake
8. Mekong Delta
BioRA: Indicators

Geomorphology:
- Erosion
- Bed sediment size
- Sandy habitat
- Rocky habitat
- Depth of bedrock pools
- Water clarity

Macroinvertebrates:
- Burrowing mayflies
- Snail abundance
- *Neotricula aperta* abundance
- Bivalve abundance
- Polychaete worms
- Shrimps and crabs
- Diversity
- Emergence

Fish
- Rithron residents
- Main channel residents
- Main channel spawner
- Floodplain spawner
- Generalist species
- Floodplain resident (black)
- Estuarine species
- Anadromous species
- Catadromous species
- Marine visitor species
- Non-native species

Mammals and birds
- Medium/large ground-nesting channel species
- Tree-nesting large waterbirds
- Bank-/hole-nesting species
- Flocking non-aerial passerine of graminoid beds
- Large ground-nesting species of floodplains
- Large species using bank-side forest
- Rocky-crevice nester in channels
- Dense woody vegetation / water interface
- Small non-flocking using seasonally-flooded plants
- Mekong dolphin
- Hog Deer
- Otters

Vegetation:
- Riparian trees
- Bank vegetation cover
- Herbaceous marsh
- Weeds and grasses
- Flooded forest
- Grassland vegetation

Herpetofauna
- Ranid amphibians
- Aquatic serpents
- Aquatic turtles
- Semi-aquatic turtles

www.mrcmekong.org
BioRA: Linkages

DRIFT

Key
- Modelled ecosystem
- Hydrologic
- Hydraulic
- Water quality
- Sediments
- Vegetation
- Macroinvertebrates
- Fish
- Herpetofauna
- Birds
- Mammals

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Response curves: Long-distance white fish

The flood duration is important to white fish as they migrate upstream for breeding and growth (Poulsen et al. 2002a, 2004; Baird et al. 2003; Baran 2006). The longer the duration of the flood pulse and the amplitude of the flood the greater the opportunities to spawn and grow (Welcomme 1985; Junk et al. 1989; Holtgrieve et al. 2013; Halls et al. 2015b). The longer the flood the greater the time the inundated vegetation has to decay and nutrients released to stimulate primary and secondary production (Dam et al. 2012; Arias et al. 2013).

The extent of flood inundation is important to all fish occupying the floodplain during all or part of their life cycles. For long-distance migrators this includes the downstream drift of larvae and being flushed on to the floodplains to grow. Flooded area is known to be directly linked to productivity and recruitment in fish (Welcomme 1979; 1985; Lamberts and Koponen 2008; Kummu and Sarkkula 2008; Holtgrieve et al. 2013; Lamberts 2013; Halls et al. 2015b). This is mainly because the greater the area flooded also the greater the area of inundated vegetation that provides nutrients as it decays or land area that also release nutrients to stimulate primary and secondary production (Dam et al. 2012; Arias et al. 2013).
BioRA ...

- For each Focus Area
- Modelled changes in flow, sediment, water quality and barriers
- Predicted change in each indicator relative to baseline
- Reasoning and supporting evidence
- Provides ecosystem data to social to impacts on *livelihoods*
Examples of results

Time series per indicator per site per scenario

Long distance white fish abundance relative to baseline under six scenarios for reference period

End value of indicator abundance

End value of discipline integrity
Triple bottom line

Outcomes for:

• Ecological (BioRA)
• Social
• Economic
Thank you