Environmental Monitoring

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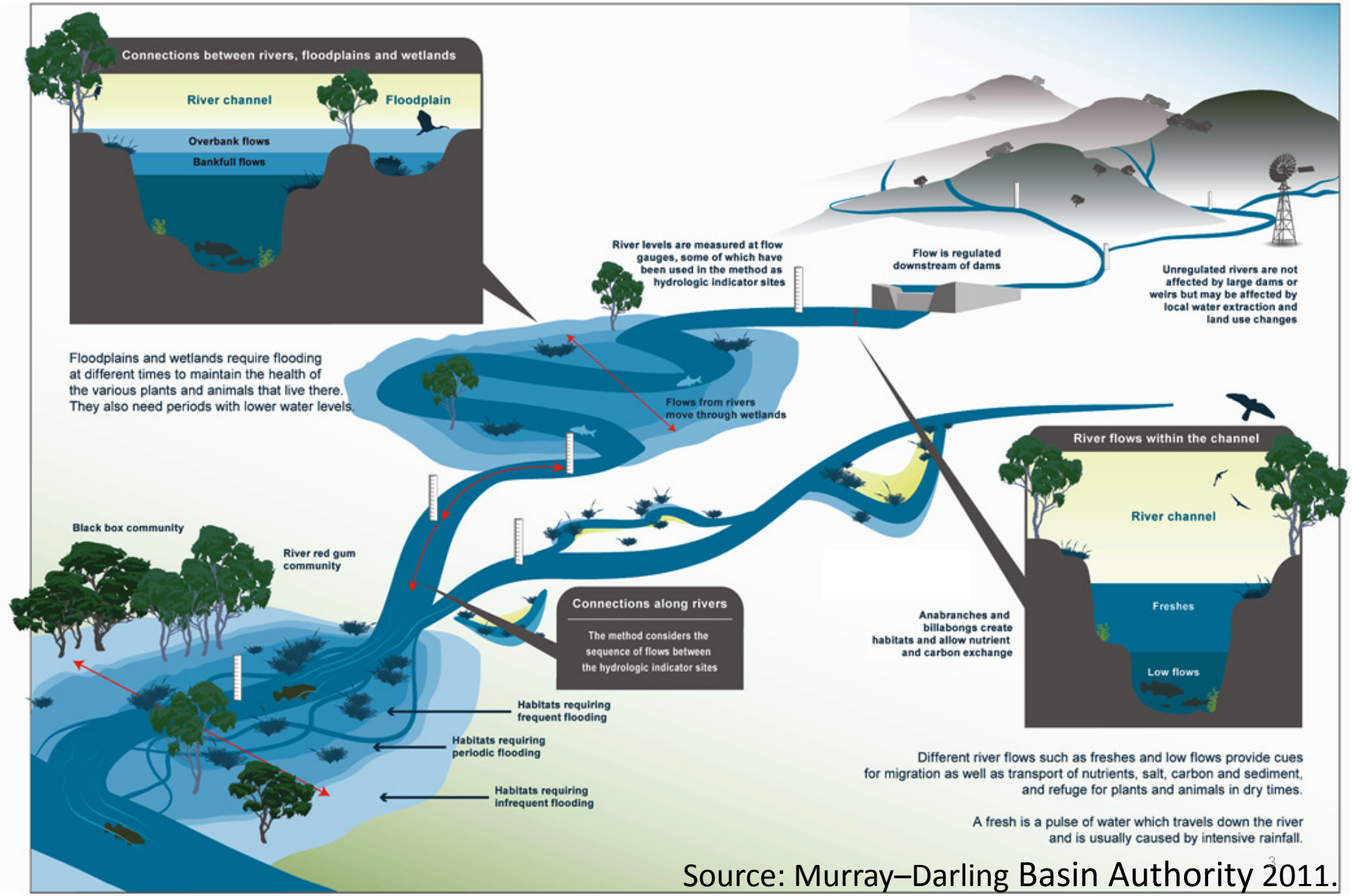
outline

Environment = Riverine Ecosystem

Water Quality Monitoring in LMB

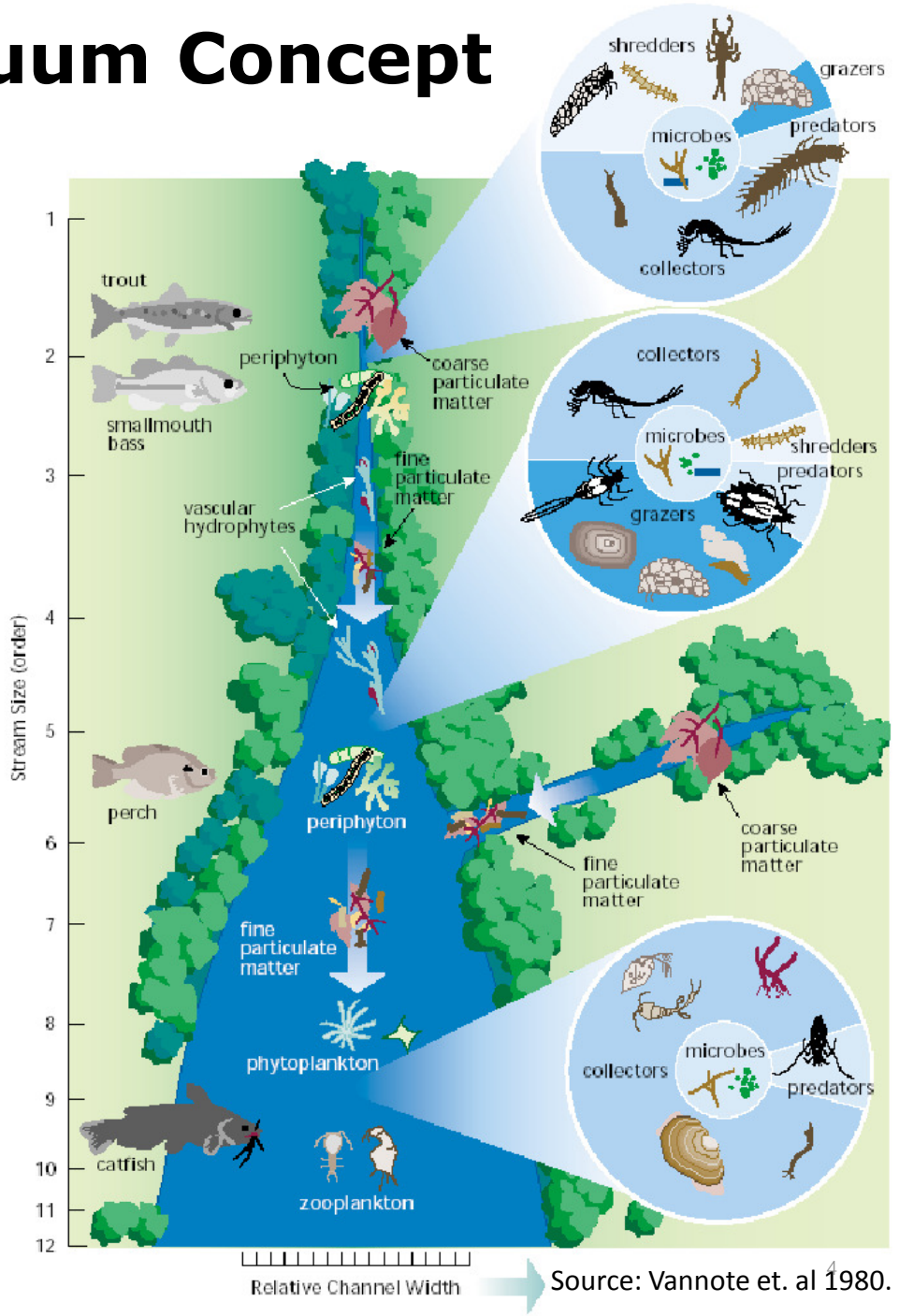
Connections between Basin ecosystems



Source: Murray–Darling Basin Authority 2011.

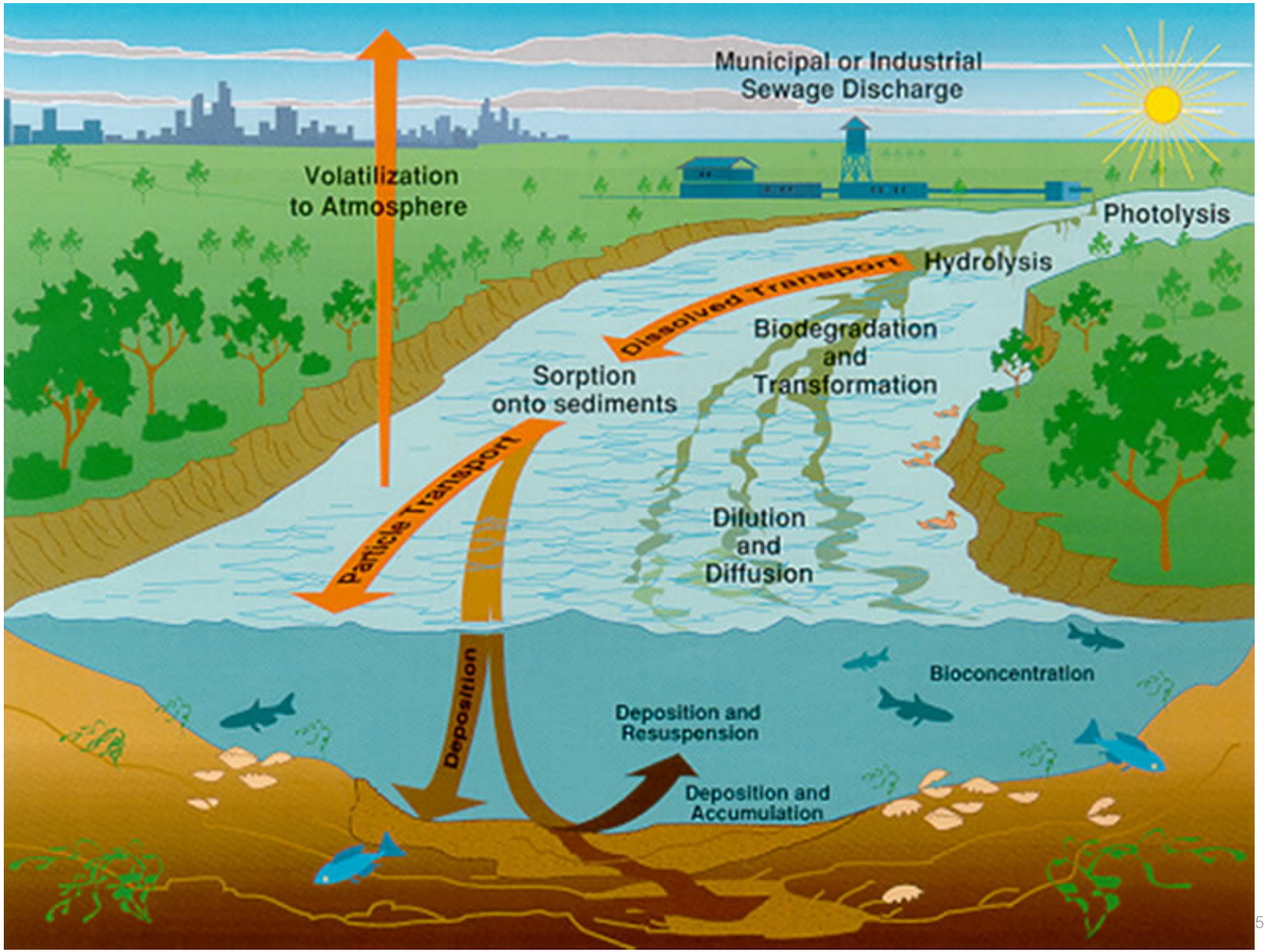
River Continuum Concept

Connections from upstream to downstream habitats control flow of energy and carbon → Primary production/Respiration → species of aquatic organism in riverine ecosystems



Source: Vannote et. al 1980.

hydrological processes in a river



Environmental Monitoring

Physical	Chemical	Biological
• Flow • Water level • X-section • Dept • Sediment • Conductivity	• Salinity • Nutrients • Dissolved Oxygen • Biological Oxygen Demand • Heavy Metals • Pesticide	• Plankton • Algae • Macro-invertibrates • Fish • Others organism • Bacteria

Environmental Monitoring in LMB

Water Quality Monitoring

Ecological Health Monitoring

Water Quality Monitoring

Countries	# of Stations (# in main stream)
Lao PDR	11 (5)
Thailand	8 (3)
Cambodia	19 (6)
Vietnam	10 (3)
Total	48 (17)

- Frequency: Monthly
- 3 stations on mainstream in Thailand:
  1. Chiang Saen
  2. Nakhon Phanom
  3. Khong Chiam

Water Quality Monitoring

7 Parameters :

- pH
- Electrical Conductivity (EC)
- Total Suspended Solids (TSS)
- Nitrogen
- Phosphorus
- Dissolved Oxygen (DO)
- Chemical Oxygen Demand (COD)

Assessment: Water Quality Index (WQI)

1. For Protection of Aquatic Life
2. For Protection of Human Health
3. For Agricultural Uses

Water Quality Index

1. For Protection of Aquatic Life

$$WQI = \frac{\sum_{i=1}^{n} p_i}{M} \times 10$$

where,

p_i = points scored on sample day i

n = number of samples from the station in the year

M = maximum possible score

Parameters	Target Values
pH	6 – 9
EC (mS/m)	< 150
NH3 (mg/L)	0.1
DO (mg/L)	> 5
NO2-3 – N (mg/L)	0.5
T-P (mg/L)	0.13

Rating Score	Class
9.5 ≤ WQI ≤10	A: High Quality
8 ≤ WQI < 9.5	B: Good Quality
6.5 ≤ WQI < 8	C: Moderate Quality
4.5 ≤ WQI < 6.5	D: Poor Quality
WQI < 4.5	E: Very Poor Quality

Water Quality Index

2. For Protection of Human Health

$$WQI = 100 - \left(\frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732} \right)$$

where,

F_1 = % of parameters exceed guideline

F_2 = % of individual test each parameters exceed guideline

F_3 = extent of exceed values

Parameters	Target Values
pH	6 – 9
EC (mS/m)	< 150
NH_3 (mg/L)	0.5
DO (mg/L)	4
NO_{2-3} – N (mg/L)	5
COD (mg/L)	5
BOD (mg/L)*2	4

Rating Score	Class	Description
95 ≤ WQI ≤100	A: Excellent Quality	All measurements are within objectives virtually all of the time
80 ≤ WQI < 95	B: Good Quality	Conditions rarely depart from desirable levels
65 ≤ WQI < 80	C: Moderate Quality	Conditions sometimes depart from desirable levels
45 ≤ WQI < 65	D: Poor Quality	Conditions often depart from desirable levels
WQI < 45	E: Very Poor Quality	Conditions usually depart from desirable levels

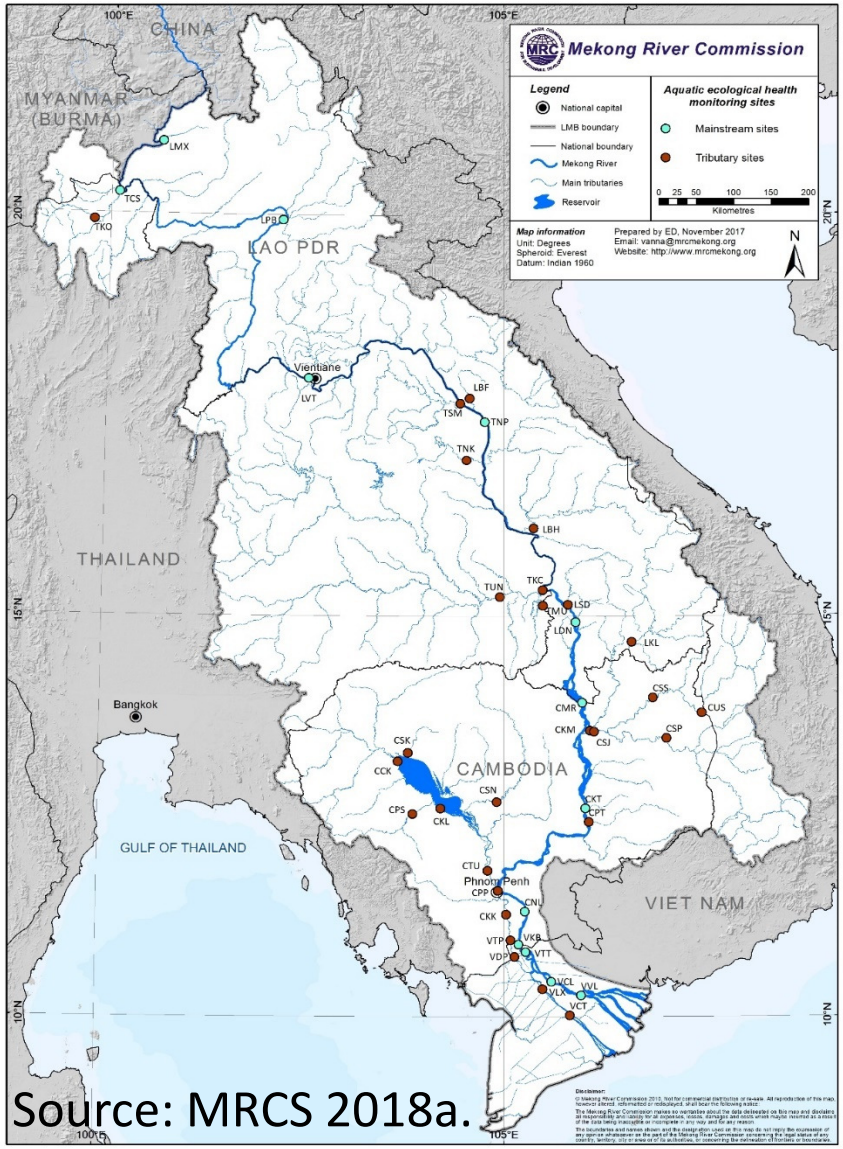
Water Quality Index

3. For Agricultural Uses

Irrigation Raw Water	Unit	Degree of Consequence[1]		
		None (Good)	Some (Fair)	Severe (Poor)
Electrical Conductivity				
General Irrigation	mS/m	<70	70-300	>300
Paddy Rice	mS/m	<200	200-480	>480

Degree of Consequence:
None = 100% yield
Some = 50 - 90% yield
Severe = <50% yield

Ecological Health Monitoring



Source: MRCS 2018a.

Countries	# of Stations (# in main stream)
Lao PDR	11 (5)
Thailand	8 (3)
Cambodia	19 (6)
Vietnam	10 (3)
Total	48 (17)

- Frequency: Once every 2 years, Mar – Apr (Dry Season)
- 4 stations on main stream in Thailand:

1. Chiang Saen
2. Songkram River Junction at Nakhon Phanom
3. Nakhon Phanom City
4. Khong Chiam

Ecological Health Monitoring

Sampling and Data Collection

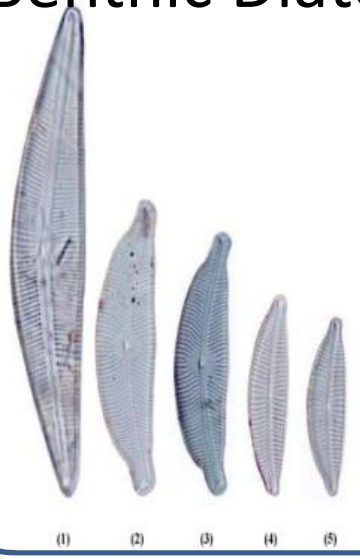
General physical condition

On site Water quality

- ➢ Disturbance Score (SDS)
- • Benthic Diatom
- • Zooplankton
- • Litoral macroinvertebrates
- • Benthic macroinvertebrates
- ➢ Abundance (*mean no. of individual per sample)*
- ➢ Average richness (*mean no. of taxa per sample)*
- ➢ Average Tolerance Score per Taxon (ATSPT)

Ecological Health Monitoring

Benthic Diatom



Benthic Macroinvertebrates

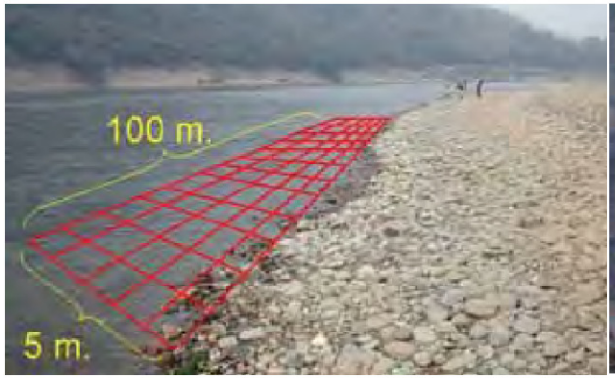


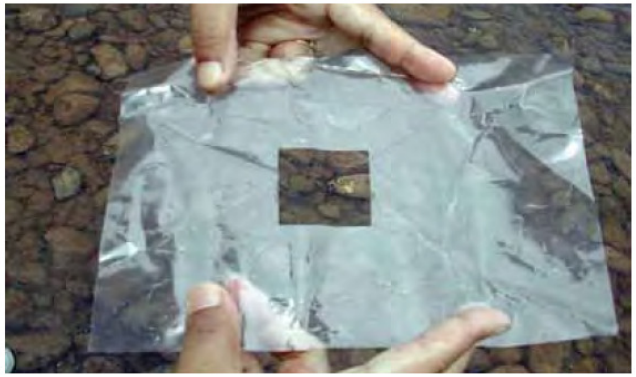
Zooplankton


Litoral Macroinvertebrates


Sample Collection

Benthic Diatom Collection





Source: MRCS 2010.

Sample Collection

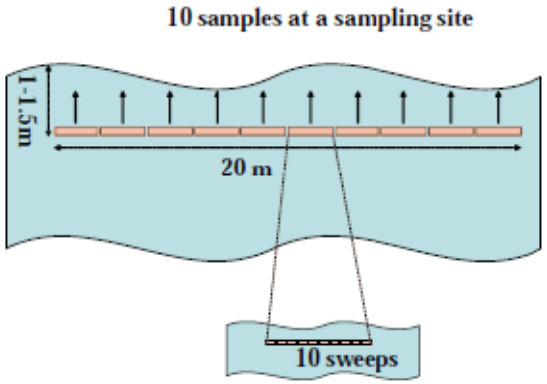
Zooplankton Collection

Source: MRCS 2010.

Collect 10L of water and filter through plankton net and transfer to 250mL jar

Sample Collection

Litroal Macroinvertibrate Collection



D-Frame and transfer to Tray for sorting.

Source: MRCS 2010.

Sample Collection

Benthic Macroinvertibrate Collection

Peterson Grab

Source: MRCS 2010.

Example of Species Identification

Table 7 The benthic diatom distribution for 2017 EHM Thailand.(Cell/ 1cm^2)

Species	TNP	TSM	TNK	TMU	TKC	TUN	TCH	TKO
Achnanthes exigua	0	0	0	0	0	0	0	34
Achnanthes crenulata	0	0	0	0	0	0	0	2
Achnanthes exigua var constricta	0	0	0	0	0	2	0	0
Achnanthes minutissima	216	73	28	108	8	422	8	0
Achnanthes oblongella	0	6	0	6	0	42	2	0
Amphora libyca	0	0	0	0	4	0	0	0
Amphora montana	0	10	0	2	0	2	0	0
Amphora sp.1	0	0	0	0	0	0	0	8
Amphora pediculus	0	0	0	0	0	2	0	0
Aulacoseira distans	12	16	0	18	0	0	0	0
Aulacoseira granulata	0	2	0	84	0	2	0	2
Brachysira neoexilis	0	0	0	4	0	0	0	0
Bacillaria paradoxa	2	6	2	0	2	0	4	6
Capartograma crucicula	0	0	0	52	0	6	0	0
Cocconeis placentula	54	64	0	54	16	816	20	178
Cyclotella pseudostelligera	0	0	0	52	0	4	2	0
Cyclotella meneghiniana	44	4	0	0	36	4	2	10
Cymbella minuta	0	0	0	10	0	0	0	32

Source: PCD 2018

Example of Species Identification

Table 8 The zooplankton distribution for 2017 EHM Thailand.

Species	TNP	TSM	TNK	TMU	TKC	TUN	TCH	TKO
Alona verrucosa	0	0	5	0	0	0	0	0
Alonella excisa	0	0	2	0	0	0	0	0
Anuraeopsis coelata	0	1	0	2	0	1	0	0
Anuraeopsis fissa	0	0	1	1	0	62	0	0
Arcella sp.	0	0	0	0	0	1	0	0
Asplanchna sp.	0	0	2	0	0	0	0	0
Bosmina meridionalis	0	0	1	58	1	0	0	0
Bosminopsis deitersi	0	0	63	25	0	4	0	0
Brachionus angularis	0	0	0	0	0	255	0	0
Brachionus calyciflorus cf *calyciflorus*	0	0	0	0	0	1	0	0
Brachionus caudatus	0	0	0	3	0	1	0	0
Brachionus donneri	0	0	0	6	0	0	0	0
Brachionus falcatus	0	0	2	10	0	69	0	0
Brachionus forficula	0	0	0	7	0	11	0	0
Brachionus quadridentatus var. *quadridentatus*	0	0	0	1	0	0	0	0

Source: PCD 2018

Example of Species Identification

Table 10 The benthic macroinvertebrate distribution for 2017 EHM Thailand.

Family and Genus	TNP	TSK	TNK	TMU	TKC	TUN	TCH	TKO
Afromera	0	2	0	0	0	0	0	0
Agapetus	0	0	0	0	0	0	0	2
Amphipsyche	2	0	0	0	0	0	0	0
Anulotaia forcarti	0	0	0	0	0	2	0	0
Aphelocheirus (nymph)	0	0	0	0	0	0	0	7
Baetis	0	0	0	0	0	0	0	12
Bezzia	0	0	15	5	1	6	0	3
Burmagomphus	0	0	1	0	0	0	0	0
Caenis	2	0	0	0	0	6	1	4
Caridina	0	0	8	2	0	34	0	0
Cercion	0	0	1	0	0	1	0	0
Cerobrachys	2	0	0	0	0	0	0	0
Cheumatopsyche	4	0	0	0	0	0	0	34
Chlorotepides	1	0	0	0	0	0	0	0
Clea (*Anentome*)	0	0	1	2	0	2	0	0
Clypeocaenis	2	0	0	0	0	0	0	0
Coenagrionidae (genus unknown)	0	0	1	0	0	1	0	0

Source: PCD 2018

Ecological Health Assessment

Class (compare to reference site)

A: Excellent B: Good C: Moderate D: Poor

Site code	Sampling date	Diatom			Zooplankton			Littoral sweep			Benthos			No. meeting guideline	Class
		Abundance	Average richness	ATSPT	Abundance	Average richness	ATSPT	Abundance	Average richness	ATSPT	Abundance	Average richness	ATSPT		
TNP	05-Mar-2008	Y	N	N	Y	N	Y	N	N	Y	Y	Y	Y	7	B
TNP	31-Mar-2011	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	8	B
TNP	15-Jun-2013	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	10	A
TNP	1-Apr-2015	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	9	B
TNP	**2-May-2017**	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**	**4**	**C**

Source: PCD 2018

References

- F. Richard Hauer et. al 2016. *Gravel-bed river floodplains are the ecological nexus of glaciated mountain landscapes. Science Advances: 2 (6).* retrieved from http://advances.sciencemag.org/content/2/6/e1600026.full
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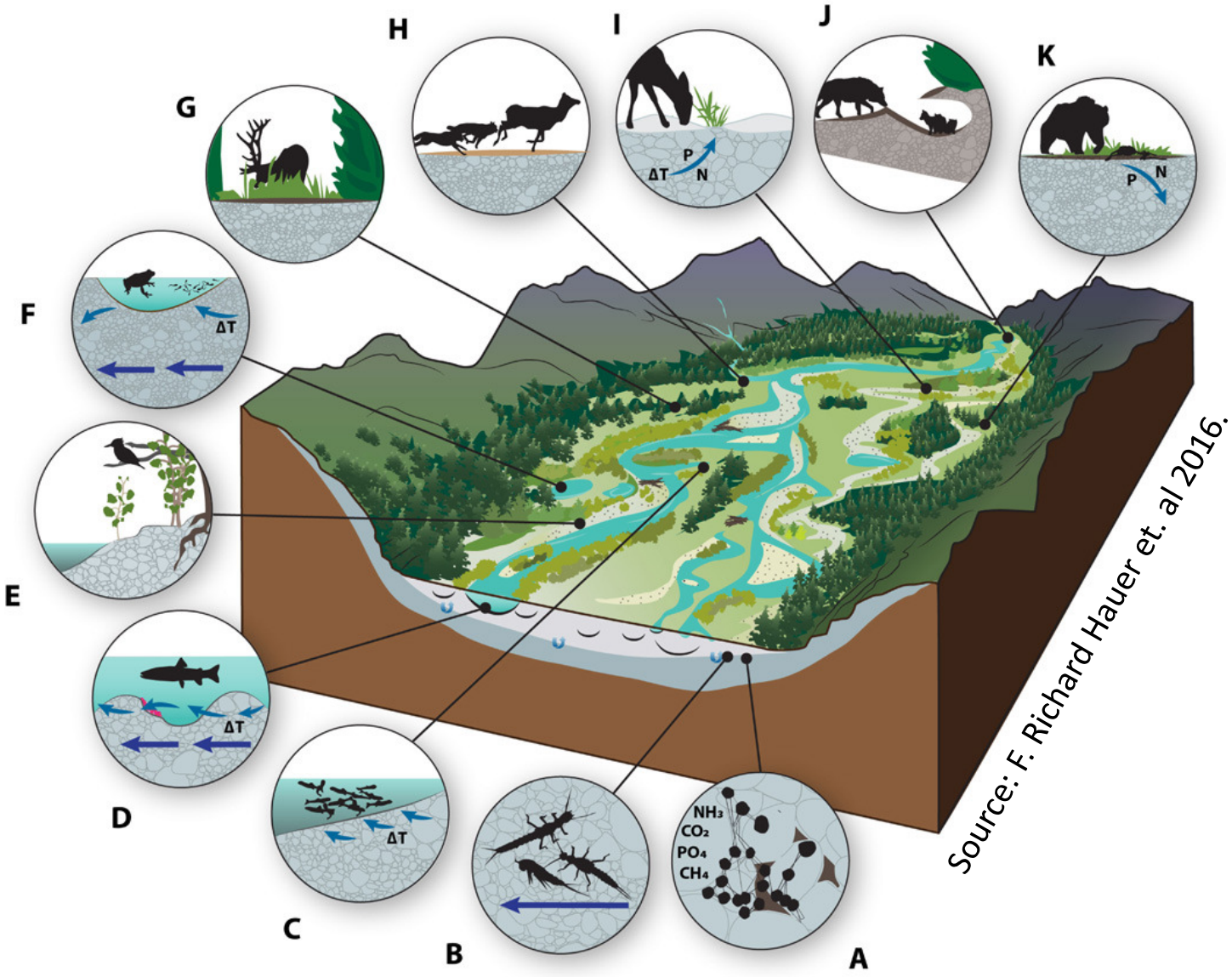

Source: F. Richard Hauer et. al 2016.

Thank You For Your Attention