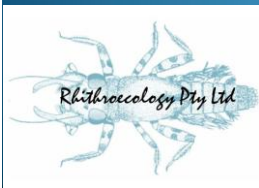


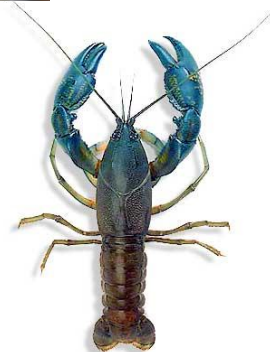
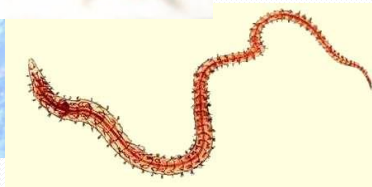
Aquatic Invertebrate Indicator Status, Trends and Update

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Invertebrates include insects, crustaceans, snails, mussels and worms.



Why are invertebrates important?

Biodiversity

Ecological processes

Ecological indicators (especially for rivers)

Food for fish

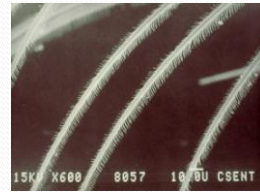
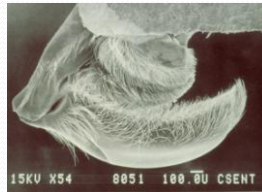
Food for people

Hosts for parasites (Schistosomiasis)



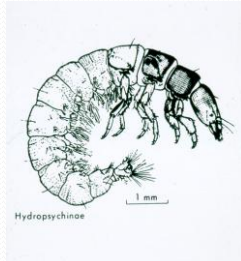
How are invertebrates influenced by flows?

Many invertebrates living in rivers require moving water to feed



How are invertebrates influenced by flows?

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How are invertebrates influenced by flows?

All invertebrates are habitat specific

The flow regime is a major factor in controlling habitat:
e.g. stones, sand, silt, bedrock, accumulations of detritus



How were invertebrates indicators selected?

Identified from taxa identified from the MRC bioassessment studies (2003-8), taxa selected because of :

- specificity to habitats likely to be influenced by changes in flow regime,
- importance to people,
- conservation significance,
- existing data and known indicator value.

Who selected them?

Dr Bounnam Pathoumthong (NUL) who conducted the early littoral invertebrate surveys suggested many of the indicators.

Ian Campbell added to, and revised the list.



Nominated Invertebrate Indicators?

- Abundance of Insects on stones (stony habitat)
- Abundance of Insects on sand (sandy habitat)
- Abundance of burrowing mayflies (silty habitat)
- Abundance of dry season emergence (fish food)
- Abundance of snails (food for people)
- Diversity of snails
- *Neotricula aperta* (schistosomiasis host)
- Abundance of bivalves (food for people)
- Abundance of polychaet worms (salinity indicator)
- Abundance of shrimps and crabs (food for people)
- Diversity of littoral invertebrates
- Diversity of benthic invertebrates
- Abundance of zooplankton

Two key historical events will have affected
Mekong invertebrates since 1950

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The Korean War – 1950-1953

China cleared very large areas of primary forest around Jinhong to grow rubber



Two key historical events will have affected Mekong invertebrates since 1950

The American-Vietnam War (1960-75)

Defoliation using Agent Orange from
~ 1965-70



Abundance of insects on stones (stony habitat)

Many insects, such as heptageniid mayflies, live only on stone surfaces.

Insects on Stones: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	B	125	80	90	90
Mekong River in Laos PDR/Thailand	B	125	80	90	90
Mekong River in Cambodia	B	125	80	90	90
Tonle Sap River		NA	NA	NA	NA
Tonle Sap Great Lake		NA	NA	NA	NA
Mekong Delta		NA	NA	NA	NA



Abundance of insects on sand (sandy habitat)

Many insects, such as some baetid mayflies, live only on sand.

Insects Living on Sand: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	B	100	80	90	90
Mekong River in Laos PDR/Thailand	B	100	80	90	90
Mekong River in Cambodia	C	120	80	90	90
Tonle Sap River	C	120	120	90	90
Tonle Sap Great Lake	NA	NA	NA	NA	NA
Mekong Delta	D	200	200	150	120



Abundance of burrowing mayflies (soft and fine sediment habitat)

There are a number of species of burrowing mayflies in the Mekong – Pallingeniidae, Ephemeridae, Potamanthidae etc.

Burrowing Mayflies: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015				
	2015	1900	1950	1970	2000	
Mekong River in Laos PDR	C	120	80	120	120	
Mekong River in Laos PDR/Thailand	C	120	80	120	120	
Mekong River in Cambodia	C	120	80	120	120	
Tonle Sap River	C	120	80	120	120	
Tonle Sap Great Lake	NA	NA	NA	NA	NA	
Mekong Delta	NA	NA	NA	NA	NA	



Abundance of dry season emergence

Large numbers of aquatic insects emerge in the dry season

Dry Season Emergence: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015				
	2015	1900	1950	1970	2000	
Mekong River in Laos PDR	C	120	120	80	110	
Mekong River in Laos PDR/Thailand	C	120	120	80	110	
Mekong River in Cambodia	C	120	120	90	110	
Tonle Sap River	C	120	120	120	110	
Tonle Sap Great Lake	C	120	120	120	110	
Mekong Delta	C	120	120	70	110	



Abundance of snails (food for people)



Abundance of snails (food for people)

Snail Abundance: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	80	60	80	90
Mekong River in Laos PDR/Thailand	C	80	70	80	90
Mekong River in Cambodia	C	80	80	90	95
Tonle Sap River	C	120	120	120	110
Tonle Sap Great Lake	C	120	120	120	110
Mekong Delta	D	120	120	60	110

Diversity of snails

Snail Diversity: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	120	120	80	90
Mekong River in Laos PDR/Thailand	C	120	120	80	90
Mekong River in Cambodia	C	120	120	90	110
Tonle Sap River	C	120	120	110	105
Tonle Sap Great Lake	C	120	120	110	105
Mekong Delta	D	120	120	80	90

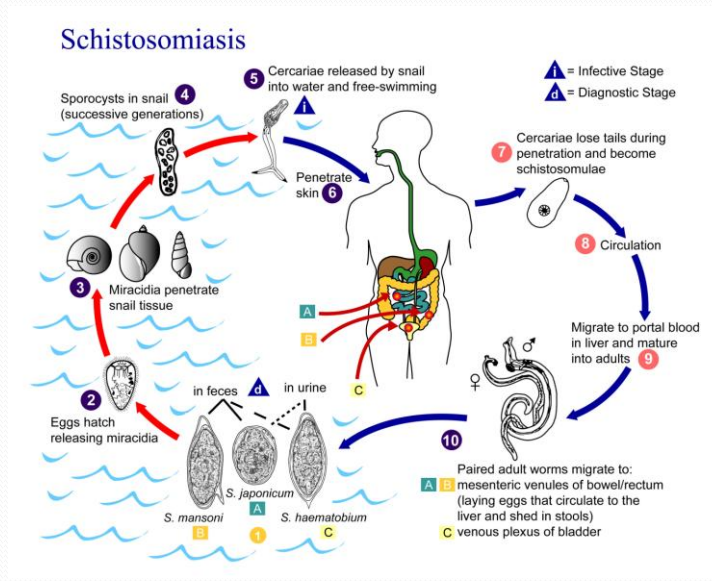
Neotricula aperta (schistosomaisis host)

Host of *Schistosomaisis mekongi*.

***Neotricula aperta*: Historic abundance estimates as % relative to 2015 (100%)**

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	-	-	-	-	-
Mekong River in Laos PDR/Thailand	B	90	90	80	90
Mekong River in Cambodia	B	90	90	80	90
Tonle Sap River	-	-	-	-	-
Tonle Sap Great Lake	-	-	-	-	-
Mekong Delta	-	-	-	-	-

Parasite hosts: Schistosomiasis,



Abundance of bivalves (food for people)

Bivalve abundance: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
		2015	1900	1950	1970
Mekong River in Laos PDR	B	120	80	110	110
Mekong River in Laos PDR/Thailand	B	120	80	110	110
Mekong River in Cambodia	B	120	90	110	110
Tonle Sap River	B	120	115	115	110
Tonle Sap Great Lake	B	120	120	115	110
Mekong Delta	C	150	150	50	110

Abundance of polychaet worms (salinity indicator)

Polychaets: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	-	-	-	-	-
Mekong River in Laos PDR/Thailand	-	-	-	-	-
Mekong River in Cambodia	-	-	-	-	-
Tonle Sap River	-	-	-	-	-
Tonle Sap Great Lake	-	-	-	-	-
Mekong Delta	D	120	120	70	105

Abundance of shrimps and crabs (food for people)

Shrimps and crabs: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	120	90	95	105
Mekong River in Laos PDR/Thailand	C	120	90	95	105
Mekong River in Cambodia	C	120	100	110	110
Tonle Sap River	C	120	120	120	110
Tonle Sap Great Lake	C	120	120	120	110
Mekong Delta	C	150	150	80	120

Diversity of littoral invertebrates

Littoral Invertebrate Diversity: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	110	80	90	105
Mekong River in Laos PDR/Thailand	C	110	90	95	105
Mekong River in Cambodia	C	120	120	120	110
Tonle Sap River	C	130	130	120	110
Tonle Sap Great Lake	C	150	150	130	110
Mekong Delta	C	150	150	80	120

Diversity of benthic invertebrates

Benthic Diversity: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	120	120	120	110
Mekong River in Laos PDR/Thailand	C	120	120	120	110
Mekong River in Cambodia	C	120	120	120	110
Tonle Sap River	C	130	130	120	110
Tonle Sap Great Lake	C	150	150	130	110
Mekong Delta	C	150	150	80	130

Abundance of zooplankton

Zooplankton Abundance: Historic abundance estimates as % relative to 2015 (100%)

Area	Status	Abundance as % of 2015			
	2015	1900	1950	1970	2000
Mekong River in Laos PDR	C	100	80	90	90
Mekong River in Laos PDR/Thailand	C	100	90	95	90
Mekong River in Cambodia	C	120	120	120	110
Tonle Sap River	C	130	130	120	110
Tonle Sap Great Lake	C	150	140	130	110
Mekong Delta	C	150	140	80	130

