

BioRA Preparation Meeting PART I  
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# Fish and Fisheries

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[www.mrcmekong.org](http://www.mrcmekong.org)

## Overview of Fisheries of BioRA



- ⇒ Status of the fisheries
- ⇒ Pressures acting on fisheries and other aquatic organisms



- ⇒ Indicators
- ⇒ Status and trends
- ⇒ Response curves



## Fisheries of the lower Mekong Basin



- ⇒ Fish diversity: 800-1200 species
- ⇒ 200+ species; 30+ of high commercial importance
- ⇒ More than 50% of total fish catch in the lower Mekong basin (about 1.3 million tonnes worth US\$2.5 billion) dependent on migratory fish
- ⇒ Fish migrate all seasons of year
- ⇒ Total first-sale value is **US\$17.0 billion** per year
- ⇒ Per capita consumption average is about **46 kg/person/year**

## Fish species diversity in the 6 main zones of the Mekong River

**HIGH MOUNTAINS**



151 species  
(12% endemics)

**PLATEAU**

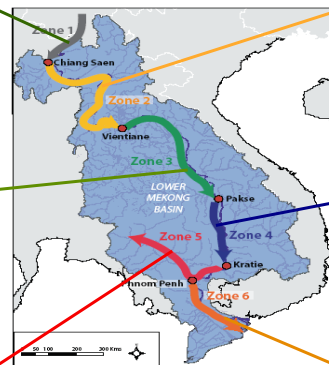


191 species  
(14% endemics)


**FLOODPLAINS**



328 species  
(11% endemics)




**LOW MOUNTAINS**




140 species  
(18% endemics)

**ISLANDS, WETLANDS**



267 species  
(16% endemics)

**DELTA**



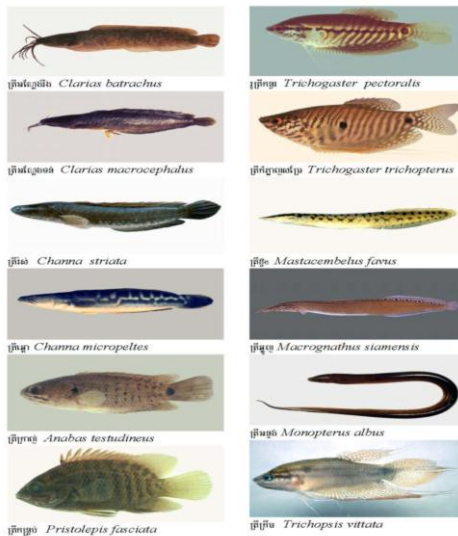
484 species  
(6% endemics)

*Mekong River mainstream is characterized by a gradient of increasing species richness from the headwaters to the sea*

## Characteristics of the main fish groups

**Black fish**- Floodplain resident fish, with limited lateral migrations from the river onto floodplains and no longitudinal migrations upstream and downstream.

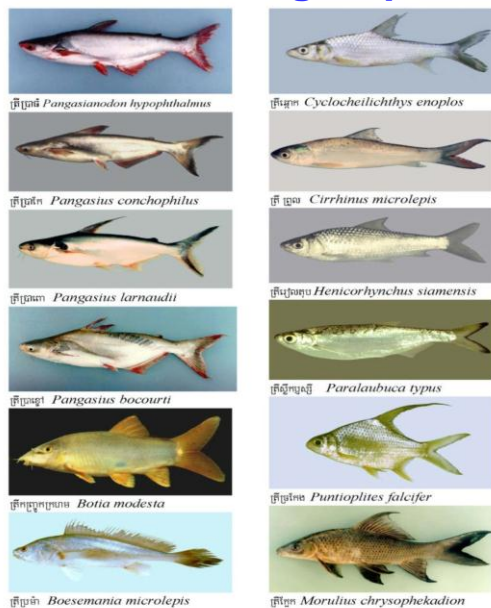
**13% of species richness**  
**50% of capture**



## Characteristics of the main fish groups

**White fish**, undertaking long distance migrations, in particularly between lower floodplains and the Mekong mainstream and its major tributaries.

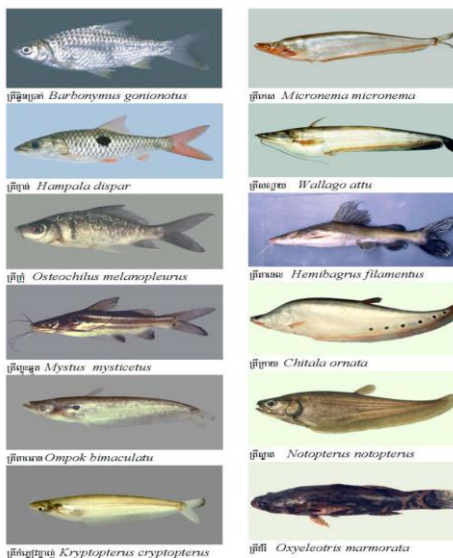
**37% of species richness**  
**36% of capture**



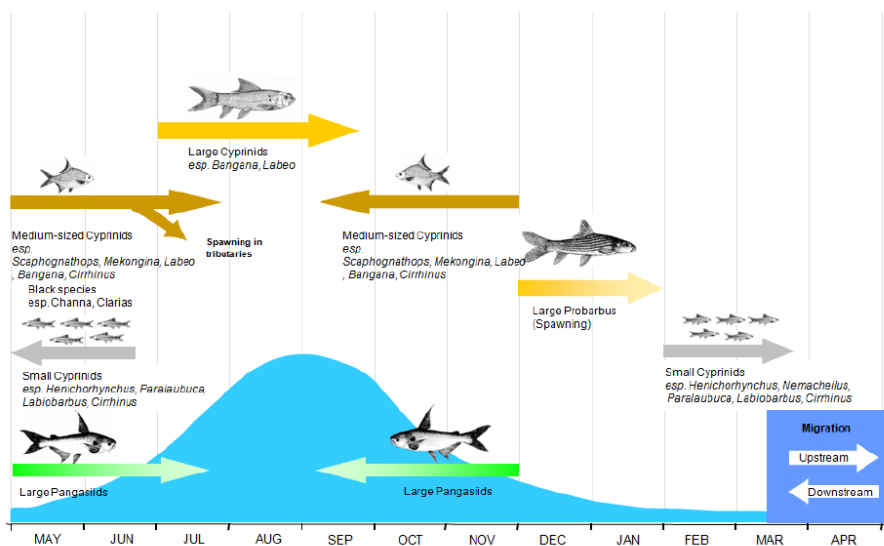
## Characteristics of the main fish groups

**Grey fish:**  
ecologically intermediate between two previous groups, corresponds to fishes that do not spend the dry season in floodplain ponds, but do not undertake long distance migrations either.

**50% of species richness**  
**14% capture**



## Spawning migrations all year round



Baird and Shoemaker 2007

## Pressures on Mekong fish and fisheries



### Pressures on fisheries

- Fisheries harvesting pressure
- Aquaculture linked to invasive species
- Land use changes
- In-channel barriers
- Impoundments
- Run-of-river abstractions
- Irrigation
- Urbanisation
- Industrial and urban pollution
- Agricultural pollution
- Mining pollution
- Sediment mining
- Climate change

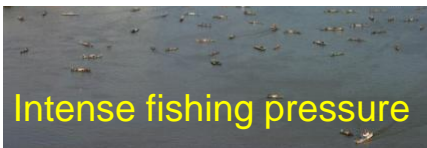
## Pressures on fisheries in LMB



Ricefields replacing flooded forest near the Great Lake

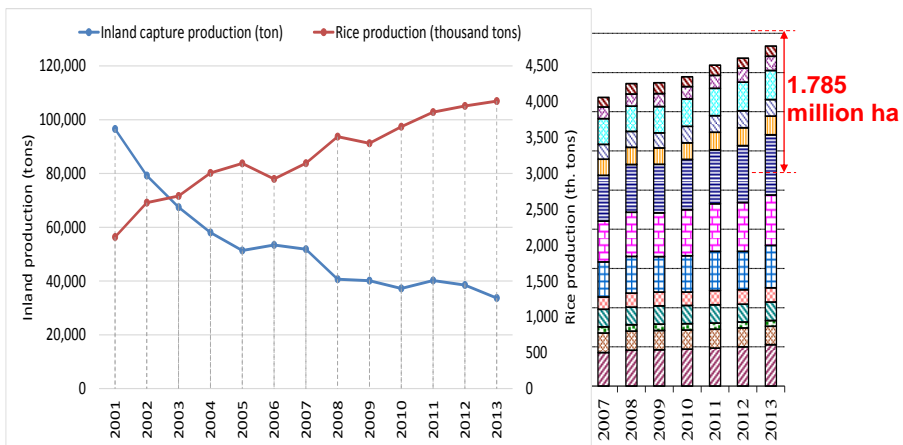


The red-bellied pacu, *Piaractus brachipomus*, a member of the piranha family from South America

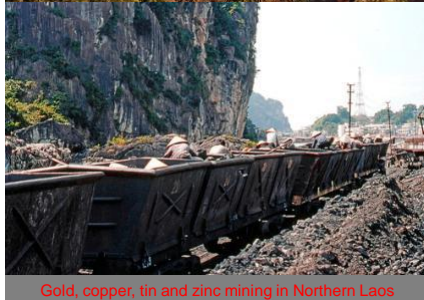


## Mekong Delta

Rice farming areas (more crops): --> habitat degradation



## Pressures continue....



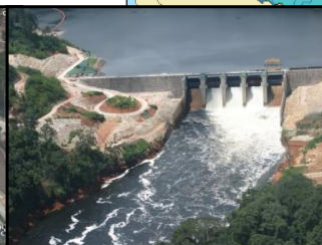
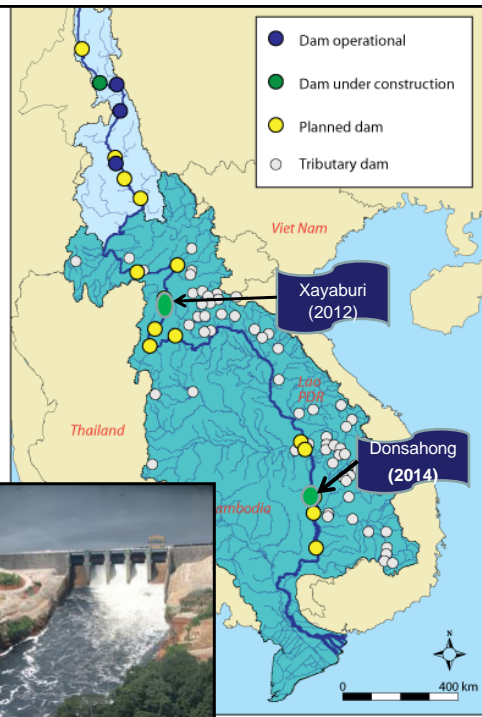
Gold, copper, tin and zinc mining in Northern Laos



A rapid expansions of rubber cultivation in Laos

## Biggest potential threat is considered hydropower dams


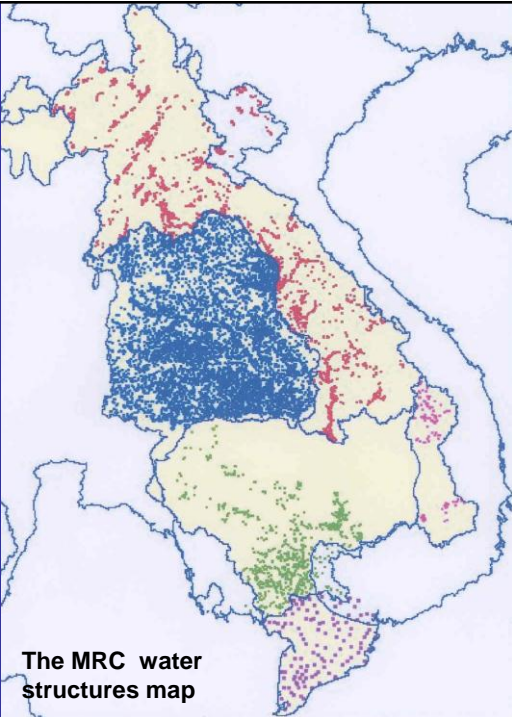
- ❖ 9 planned dams on LMB (mainstream) – two under construction.
- ❖ 23 existed dams (> 20 MW) on tributaries
- ❖ Many more tributary dams are projected or under construction



**It isn't just about damming rivers.....!**

**Floodplain & basin connectivity**

- Every dot is a registered water control structure
- Loss of connectivity = loss of productivity in floodplain/riverine fisheries

The MRC water structures map

### Pressures on fisheries in Laos

	1900 (115)	1950 (65)	1970 (45)	2000 (15)	2015 (0)
1. Intense fishing pressure					
2. Agriculture development					
3. Flood mitigation					
4. Deforestation					
5. Rubber plantation					
5. Mining					
6. Hydro power					
7. Alien species					

- Little development during 1900-1950.
- First tributary dam Nam Ngum 1 constructed in 1968 and commissioned 1971
- Theun-Hiboun dam commissioned 1998
- More dam built during 2000-2012 (Nam Ngum 2, Xeset 2, Nam Lik 2, Nam Theun 2)



### Pressure on Fisheries Mekong-Thailand

	1900 (115)	1950 (65)	1970 (45)	2000 (15)	2015 (0)
1. Agriculture - monoculture					
2. Aquaculture					
3. Fisheries exploitation					
4. Deforestation					
5. Irrigation network					

#### Remarks:

1. Northeastern part of Thailand is the major area of the Mekong-Thailand, growth rate population fast since 1970 resulting in development.
2. High rate of deforestation starting around 1950
3. Monocrop plantation (rice, sugar cane, cassava, fruit and rubber tree)

### Pressures on fisheries in Cambodia

	1900 (115)	1950 (65)	1970 (45)	2000 (15)	2015 (0)
1. Intense fishing pressure					
2. Agriculture development					
3. Deforestation					
4. Hydropower					
5. Mining					
6. Climate change					
7. Exotic species					

## Pressures on fisheries in Vietnam

	1900 (115)	1950 (65)	1970 (45)	2000 (15)	2015 (0)
1. Fishing pressure + illegal gears					
2. Agricultural development					
3. Aquaculture development					
4. Deforestation					
5. Urbanization + pollution					
6. Climate change					
7. Exotic species					

## Indicators



## Indicators

- Need to account for diversity of species – 800+ species
- Need to account for spatial and temporal distribution
- Need groupings that are responsive to pressures
- Adopted fisheries guild structure commonly used in in this type of analysis

## Indicators

#	Indicator	Code
1	Rithron resident species	Rithron
2	Main channel resident (long distant white) species	CRes
3	Main channel spawner (short distance white) species	CSpawn
4	Floodplain spawner (grey) species	FSpawn
5	Eurytopic (generalist) species	Gen
6	Floodplain resident (black fish)	FRes
7	Estuarine resident species	ERes
8	Anadromous species	Anad
9	Catadromous species	Catad
10	Marine visitor species	Marine
11	Non-native species	NonN

# Indicators

Indicator selection / Site indicators

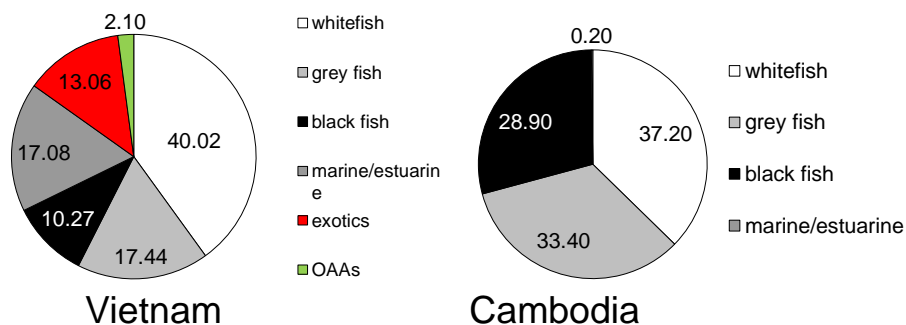
Legend:

- Used
- To be added, (A)dd
- To be deleted, (D)elete / (U)ndelete

		Sites							
		FA1-Pak Beng	FA2-Vientiane	FA3-Se Bang Fai	FA4-Stung Treng	FA5-Kampong Cha	FA6-Tonle Sap Riv	FA7-Tonle Sap Lak	FA8-Delta
Birds									
Fish									
Rhithron resident	%Base	Used	Used	Used	Used	Used			
Main channel resident (long distance)	%Base	Used	Used	Used	Used	Used	Used	Used	Used
Main channel spawner (short distance)	%Base	Used	Used	Used	Used	Used	Used	Used	Used
Floodplain spawner (grey)	%Base	Used	Used	Used	Used	Used	Used	Used	Used
Eurytopic (generalist)	%Base	Used	Used	Used	Used	Used	Used	Used	Used
Floodplain resident (black)	%Base			Used	Used	Used	Used	Used	Used
Estuarine resident	%Base				Used	Used	Used	Used	Used
Anadromous	%Base			Used	Used	Used	Used	Used	Used
Catadromous	%Base				Used	Used	Used	Used	Used
Marine visitor	%Base								Used

## Impact of disruption to longitudinal connectivity

### Contribution of fish species guilds to catches



40 % whitefish [33 species] in Vietnam and 37% [37 species] highly vulnerable/at risk

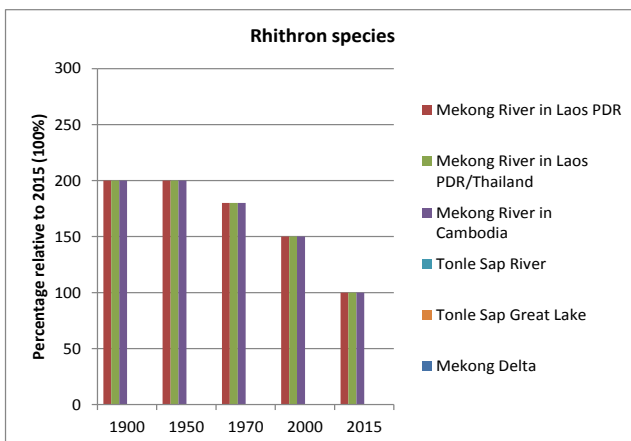


Estimated 2015 ecological status for each of the fish indicators

Table 9.14

Area	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
Mekong River in Lao PDR	C	C	C	N/A	B	N/A	N/A	D	D	N/A	E
Mekong River in Lao PDR/ Thailand	C	C	C	D	D	C	N/A	D	D	N/A	D
Mekong River in Cambodia	C	B	N/A	B	N/A	B	N/A	C	C	N/A	C
Tonle Sap River	N/A	B	N/A	B	N/A	B	N/A	C	C	N/A	C
Tonle Sap Great Lake	N/A	B	N/A	C	C	B	N/A	B	B	N/A	D
Mekong Delta	N/A	B	N/A	C	C	B	N/A	B	B	B	E

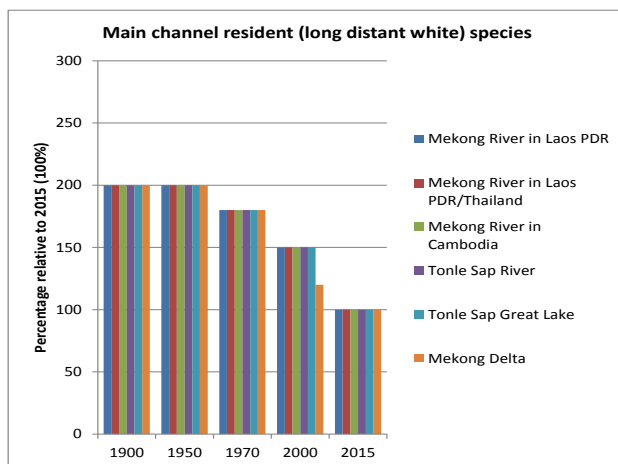
## Historic abundance estimates as % relative to 2015



Main drivers include:

- fishing pressure;
- sand & gravel mining;
- sedimentation;
- flow regulation.

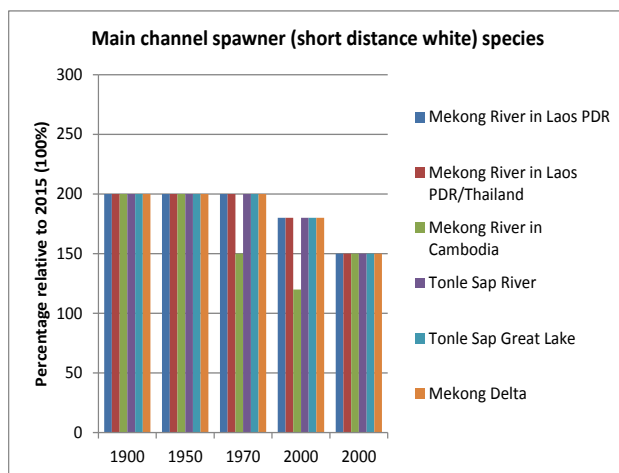
## Historic abundance estimates as % relative to 2015



Main drivers include:

- fishing pressure;
- Dam development;
- flow regulation.

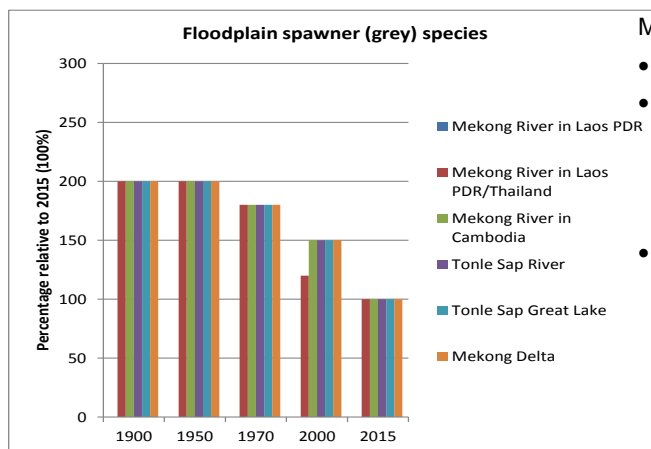
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- fishing pressure;
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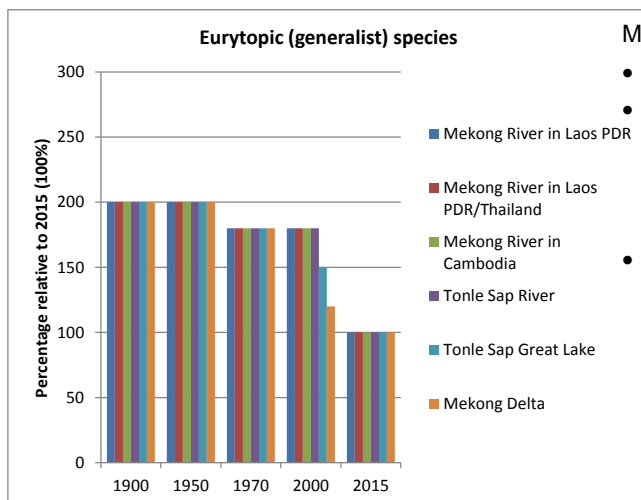
## Historic abundance estimates as % relative to 2015



Main drivers include:

- fishing pressure;
- agricultural development, especially for rice production
- isolation of the floodplain by urbanization & flood control.

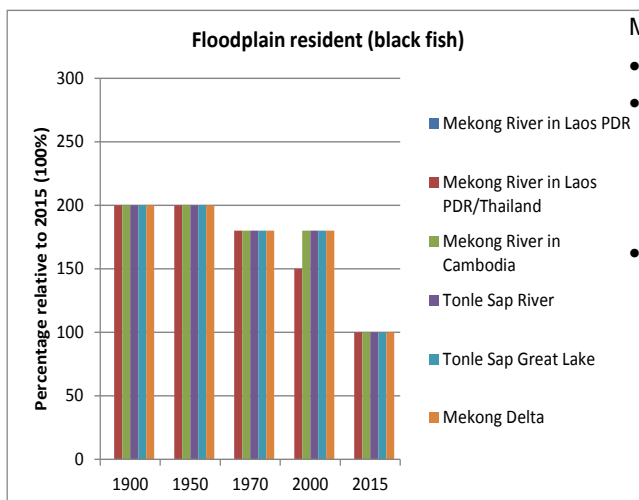
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- fishing pressure;
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## Historic abundance estimates as % relative to 2015



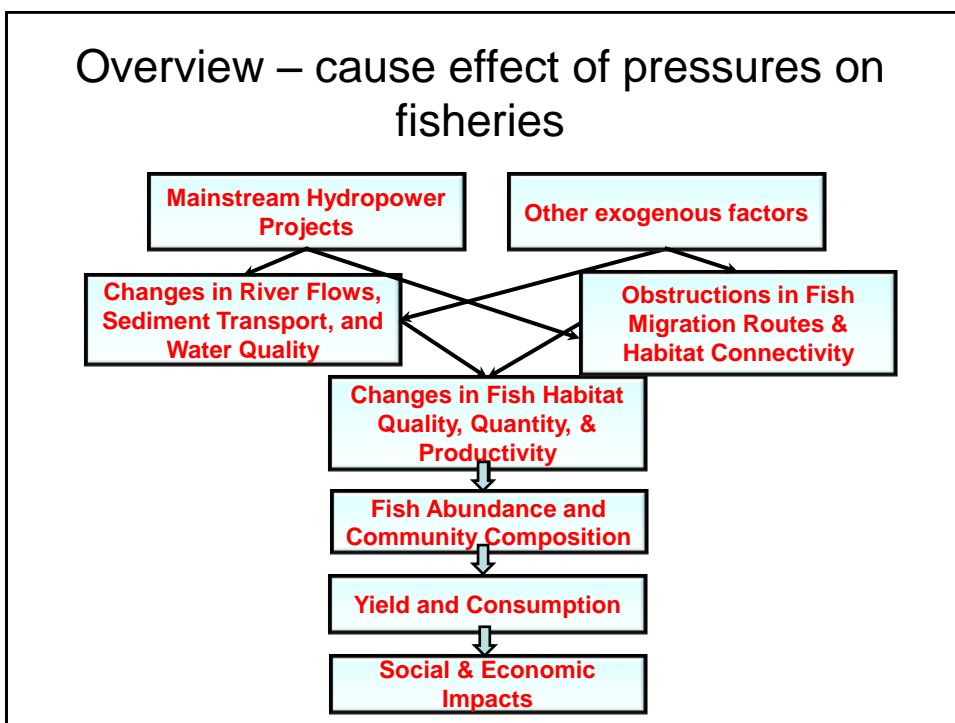
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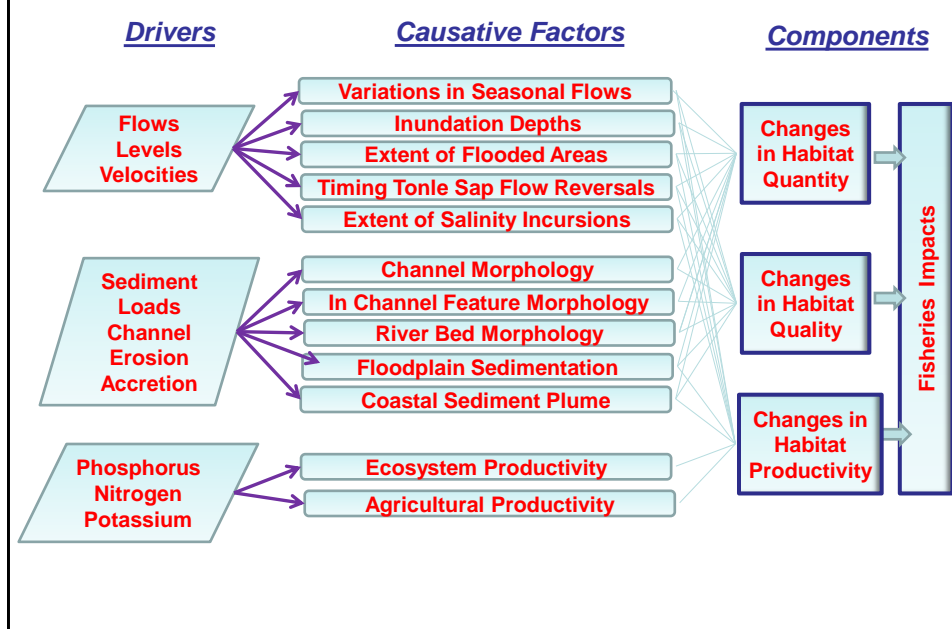




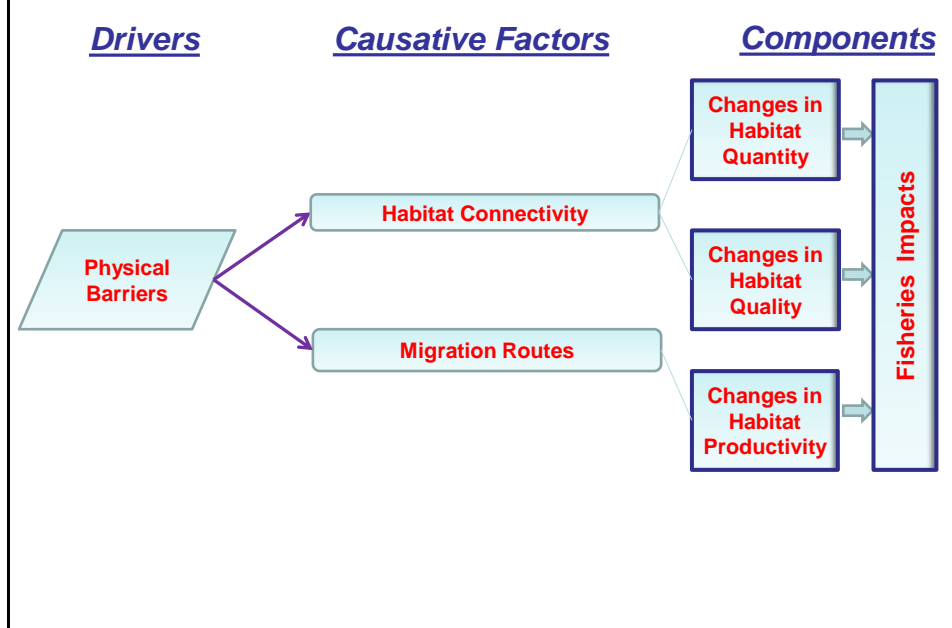
## Response curves



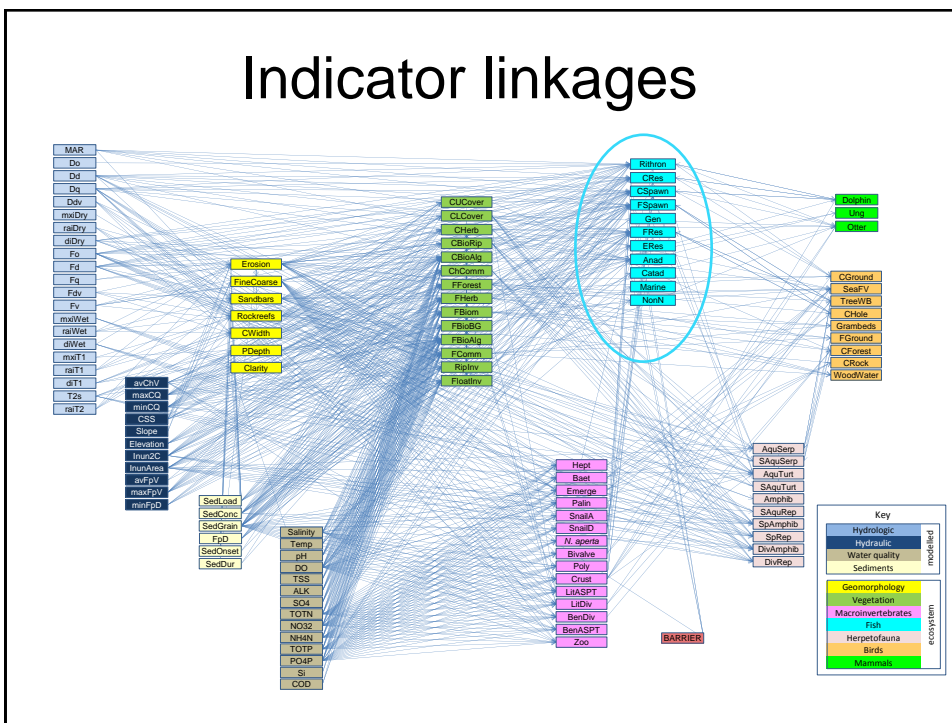
## Linkage Between Drivers and Impacts



## Linkage Between Drivers and Impacts

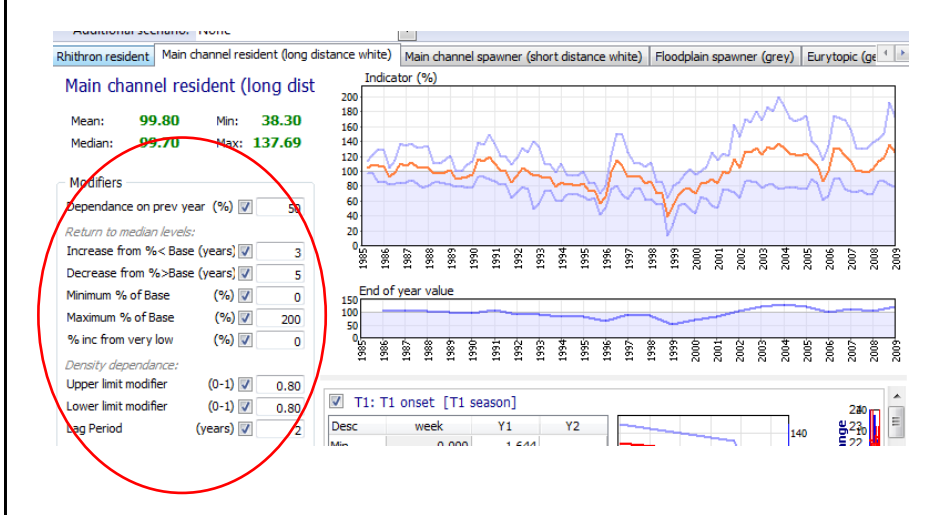


# Indicator linkages



## Response curves: Modifiers

Modifiers based on life history of species, age at maturity and time complete life cycle

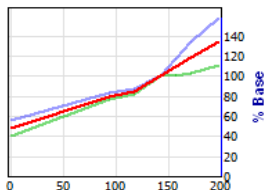


## Response curves: Main channel resident (long distant white) species

### Hydrological linkages

Wet duration [F season]

Desc	days	Y1	Y2
Min	0.000	-3.000	
Min Base	93.000	-1.158	
	117.750	-0.868	
Median	142.500	0.000	
	157.250	0.624	
Max Base	172.000	1.268	
Max	197.800	1.787	

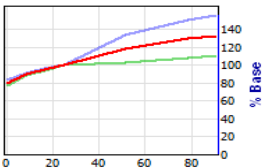


### Logic

Longer duration of the flood pulse and the amplitude of the flood the greater the opportunities to spawn and grow

Dry max rate of change [D season]

Desc	m3/s/min	Y1	Y2
Min	0.000	-1.158	
Min Base	8.343	-0.579	
	16.393	-0.289	
Median	24.443	0.000	
	51.569	1.268	
Max Base	78.695	1.644	
Max	90.500	1.744	



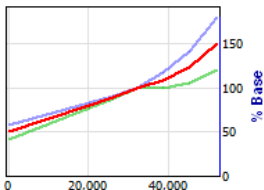
Rapid increases in flows can strand fish on floodplains or flush fish downstream

## Response curves: Main channel resident (long distant white) species

### Hydrological linkages

Wet: ave FloodVolumeFA6 [F season, Site=FA6]

Desc	m/km	Y1	Y2
Min	0.000	-2.895	
Min Base	20194.460	-1.158	
	26142.756	-0.579	
Median	32091.053	0.000	
	38752.174	0.628	
Max Base	45413.296	1.475	
Max	52225.290	2.110	



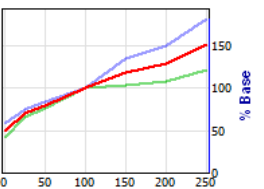
### Logic

Flood volume product of duration and amplitude of the flood pulse and the greater the flood volume the greater the opportunities to spawn and grow

### Foodbase linkages

Zooplankton abundance [F season]

Desc	%Base	Y1	Y2
Min	0.000	-2.895	
Min Base	25.000	-1.737	
	50.000	-1.158	
Median	100.000	0.000	
	150.000	1.268	
Max Base	200.000	1.644	
Max	250.000	2.119	



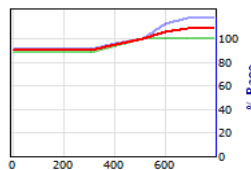
Zooplankton major source of food for fish, especially juvenile life stages

## Response curves: Main channel resident (long distant white) species

### Geomorphology linkages

Wet: ave Sediment conc [F season]

Desc	ppm	Y1	Y2
Min	0.000	-0.579	
Min Base	302.062	-0.579	
	405.580	-0.289	
Median	509.098	0.000	
	596.768	0.300	
Max Base	684.438	0.624	
Max	787.104	0.624	

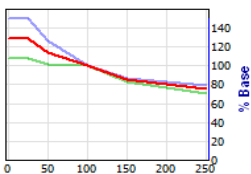


### Logic

Sediment concentration used as a surrogate of nutrients [N and P] which underpin the food chain, as well as habitat quality

Erosion (bank / bed incision) [F season]

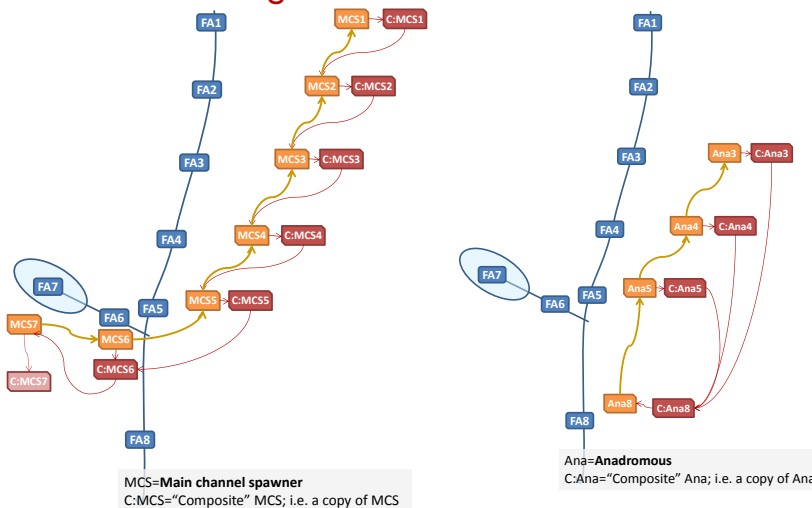
Desc	%Base	Y1	Y2
Min	0.000	1.644	
Min Base	25.000	1.644	
	50.000	1.001	
Median	100.000	0.000	
	150.000	-0.868	
Max Base	200.000	-1.158	
Max	250.000	-1.447	



Impact on white fish recruitment because of deposition on spawning and nursery habitat in the main channel

## Response curves: Main channel resident (long distant white) species

### Connectivity linkages: Accounting for upstream and downstream migration

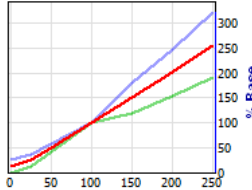


## Response curves: Main channel resident (long distant white) species

### Connectivity linkages

Main channel resident (long distance white) [F season, Site=FA4, Step= -1]

Desc	%Base	Y1	Y2
Min	0.000	-5.000	
Min Base	25.000	-4.300	
	50.000	-2.900	
Median	100.000	0.000	
	150.000	2.100	
Max Base	200.000	2.700	
	250.000	3.100	

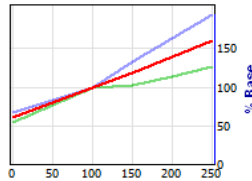


### Logic

Connectivity: u/s or d/s or into tribs important component of life cycle of any migratory species

Conn: Fish from tributaries [F season]

Desc	%Base	Y1	Y2
Min	0.000	-2.258	
Min Base	25.000	-1.693	
	50.000	-1.129	
Median	100.000	0.000	
	150.000	1.245	
Max Base	200.000	1.888	
	250.000	2.264	



Blockages can cause disruption to life cycles and loss of species

