

MONITORING CLIMATE CHANGE AND ANTHROPIIC PRESSURE AT LAKE TANGANYIKA

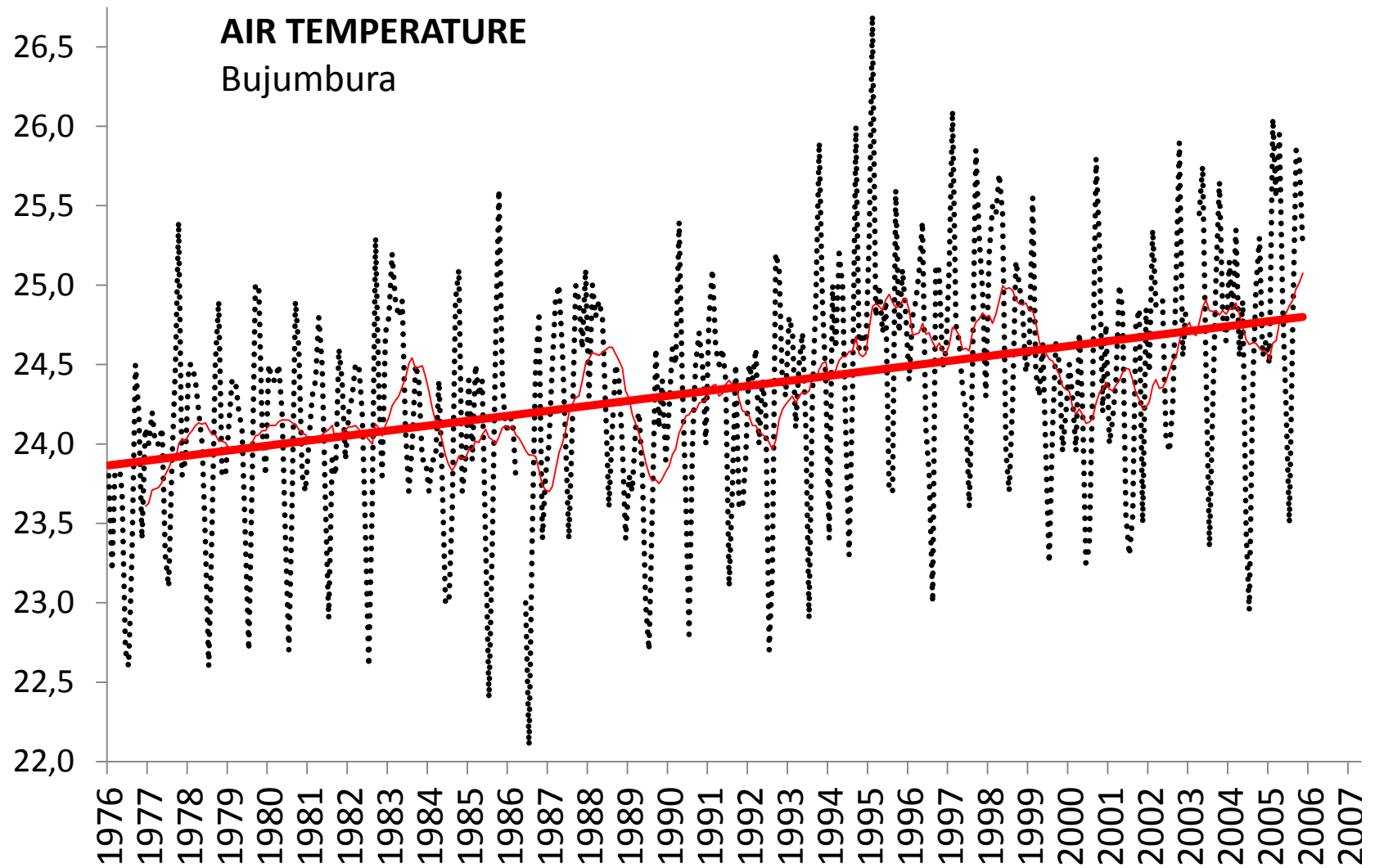
Pierre-Denis Plisnier, Muderhwa Nshombo, Huruma Mgana, & Gaspard Ntakimazi



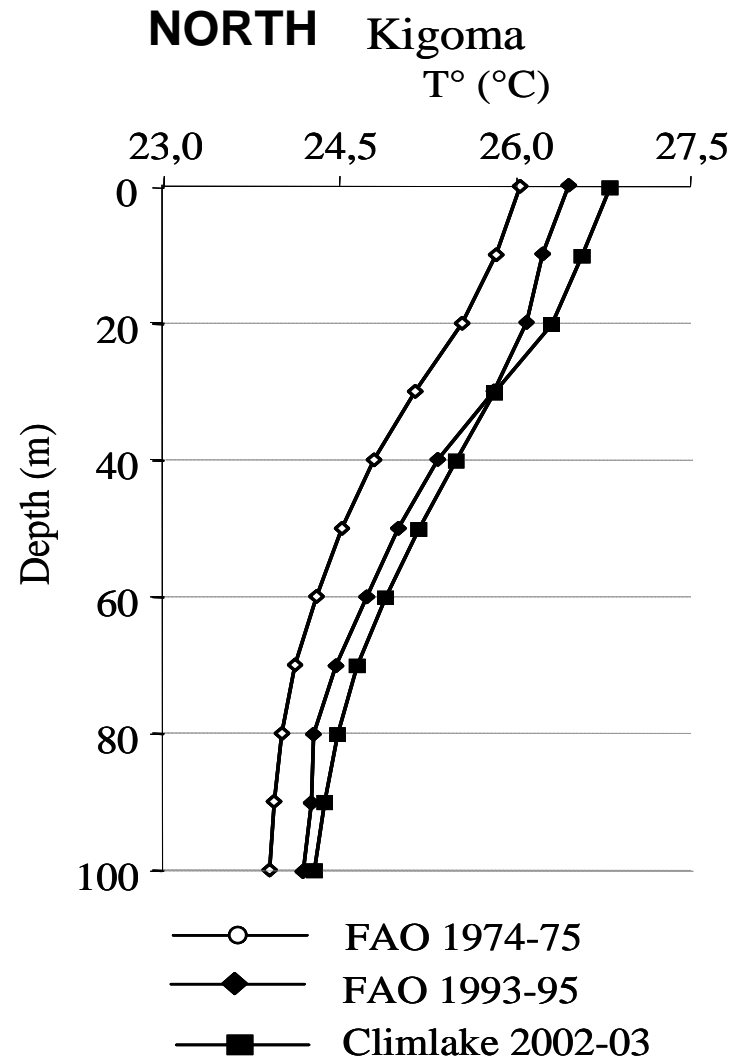
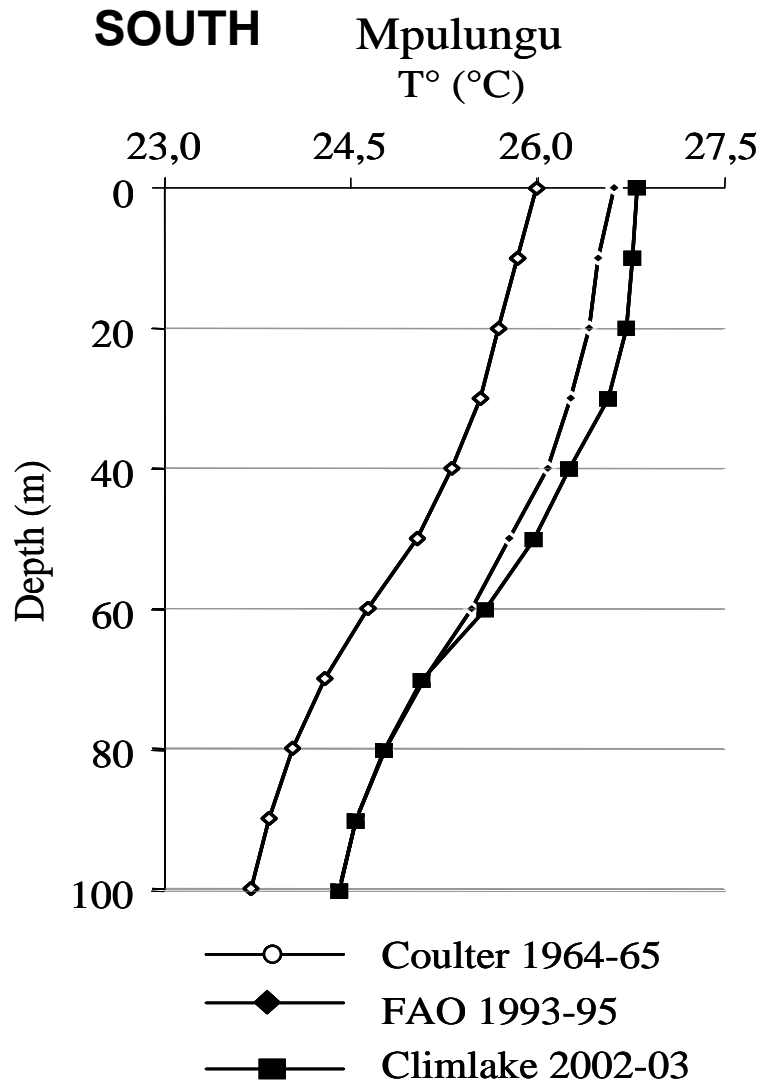
AFRICAN GREAT LAKES INTERNATIONAL CONFERENCE

May 2 to 5th 2017

Air temperature warming



Lake Tanganyika warming

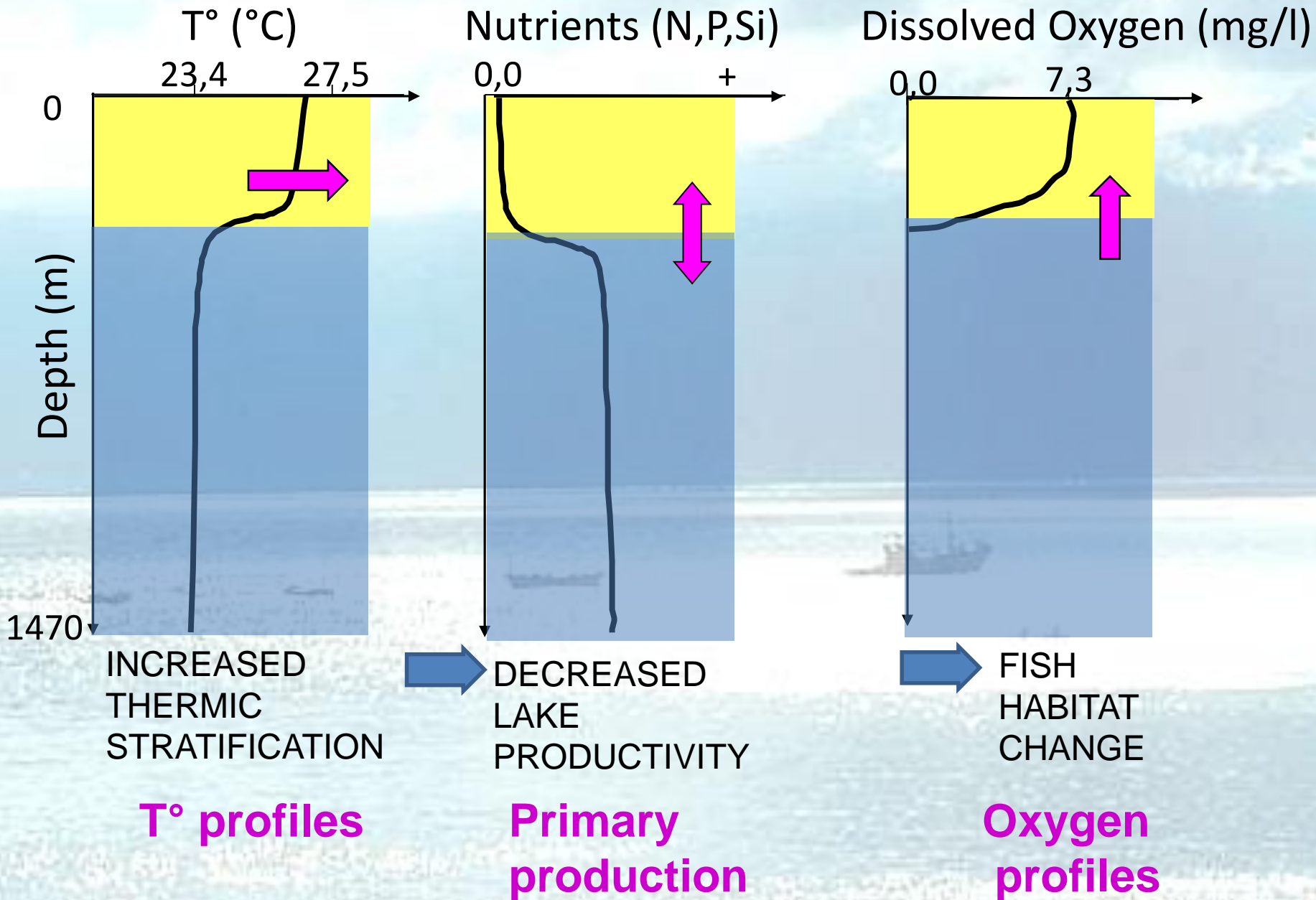


Impact of climate on FISHERIES CHANGES ?

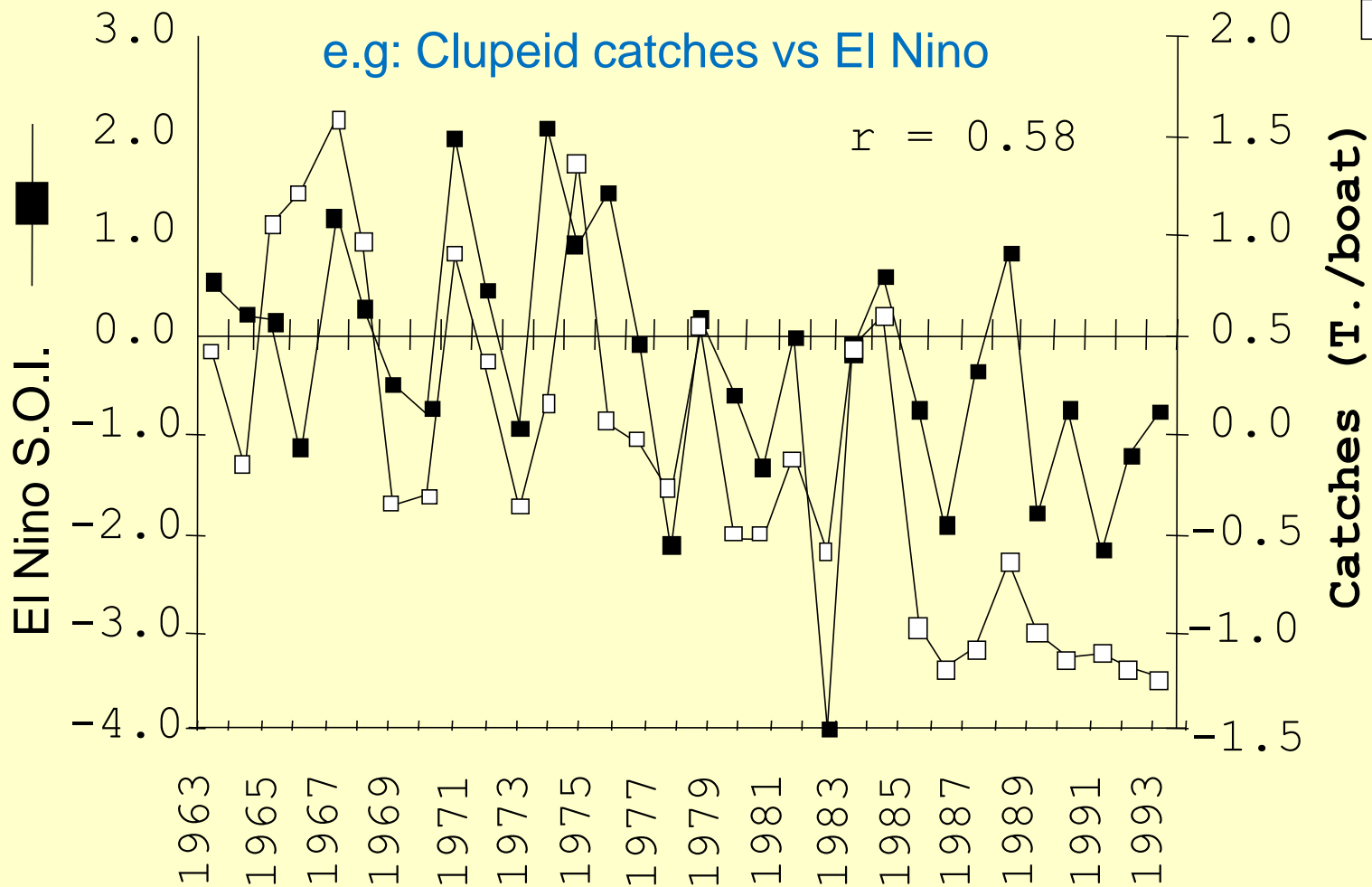
(+ OVERFISHING ?)



MONITORING



FISHERIES MONITORING



(Plisnier, 1997)

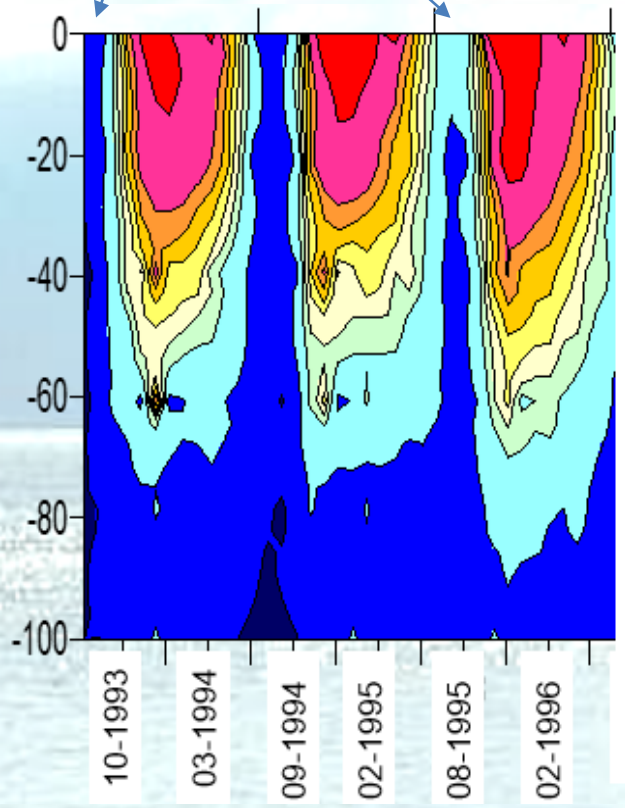
Catches per unit of effort

*Annual
upwelling*

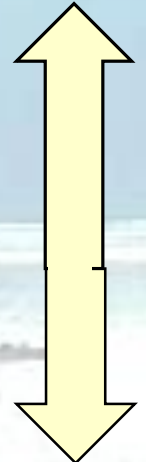
MONITORING GAPS...



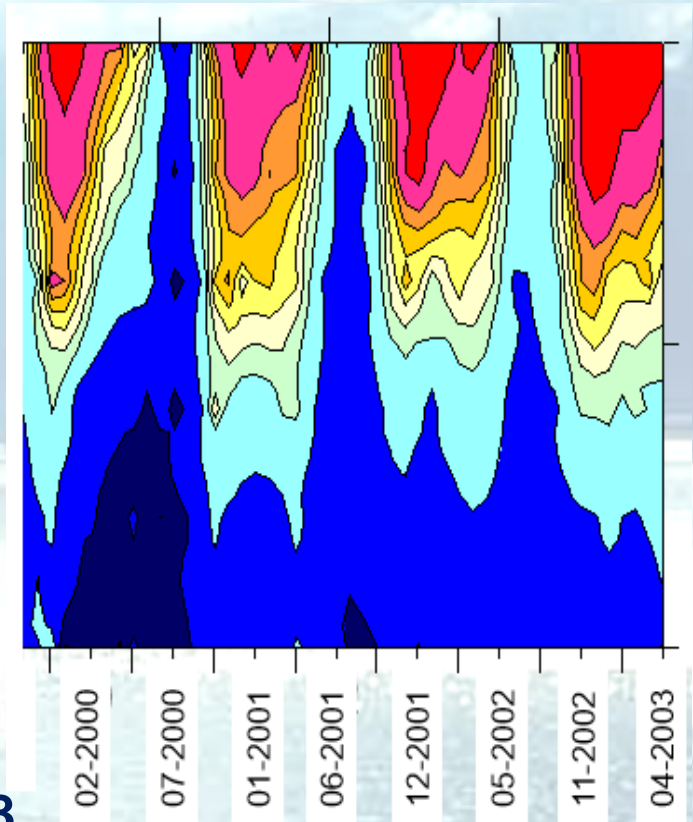
Depth (m)



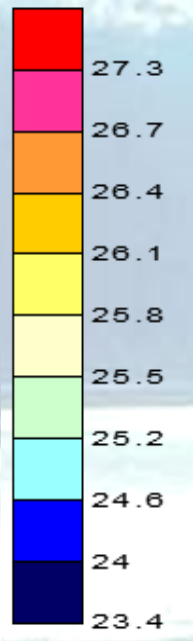
No
Data



**EL NINO
1997-1998**



°C



Long term monitoring

METEOROLOGICAL MONITORING

-TOO FEW OPERATIONAL STATIONS

-WIND DATA ?

-RAINFALL INTENSITY ?

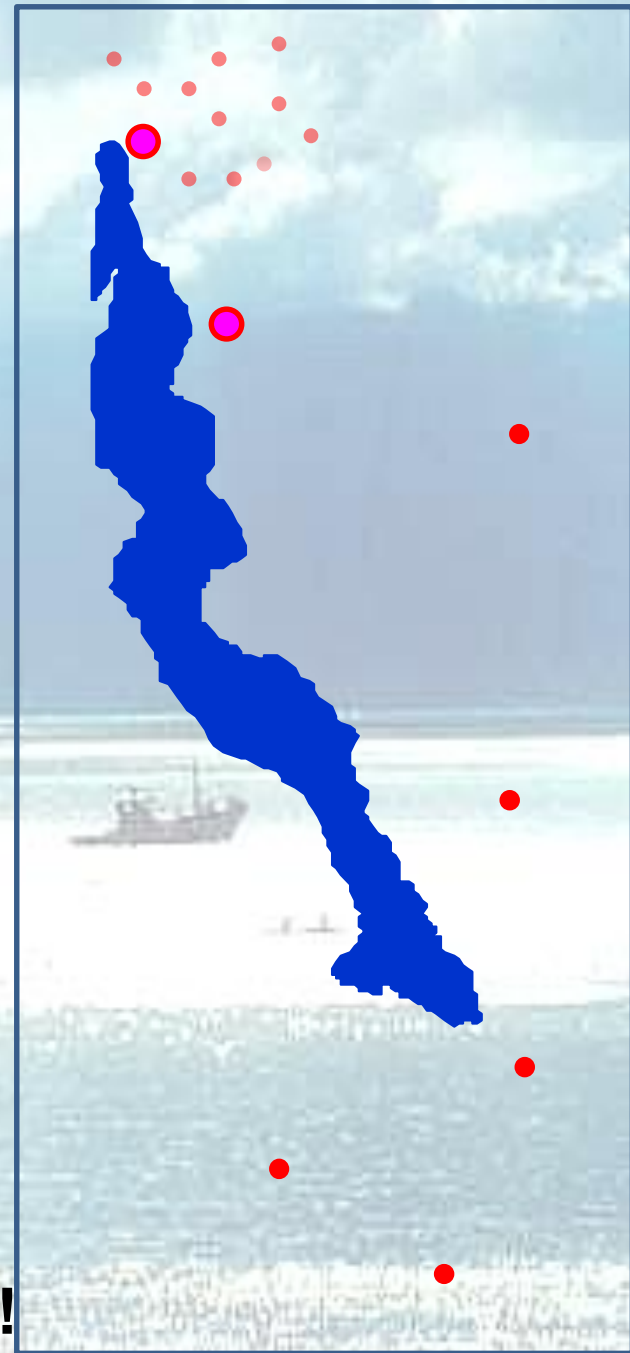
-ACCESS TO DATA ?



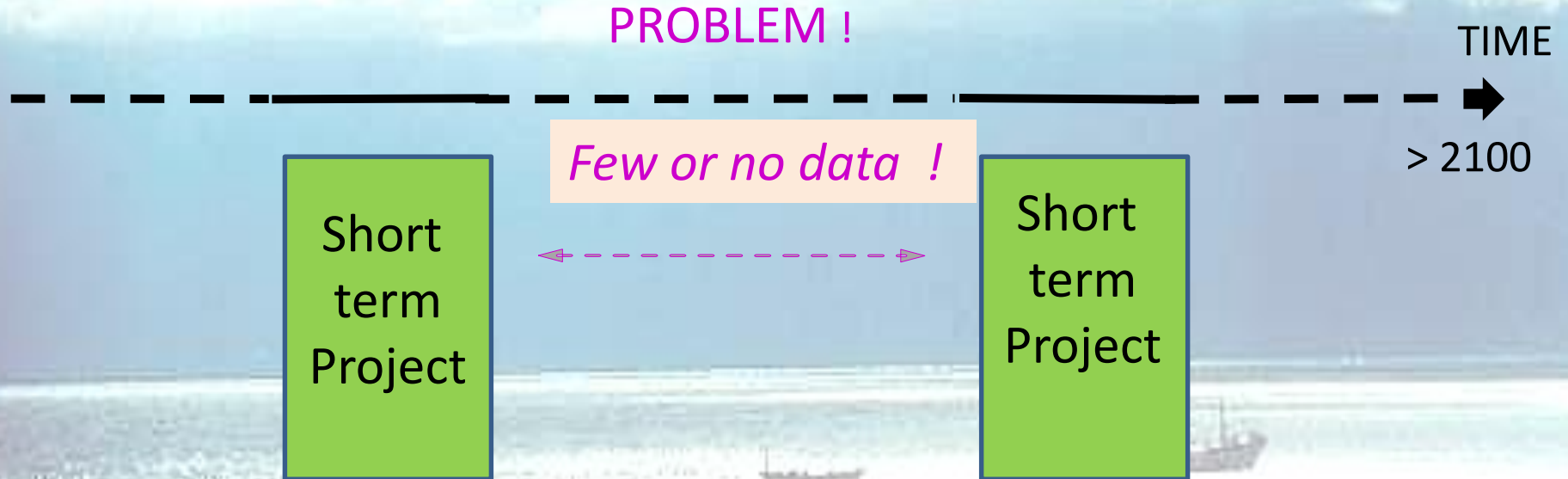
CHALLENGE FOR RESEARCHERS !



LITTLE INFORMATION FOR MANAGERS !

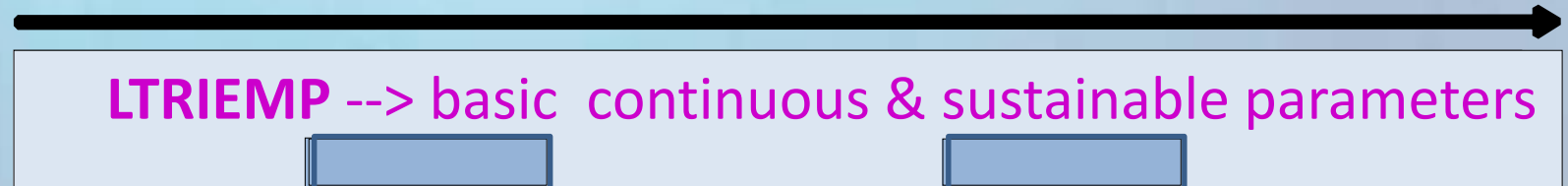


ACTUAL MONITORING at Lake TANGANYIKA



Lake Tanganyika Regional Integrated Environmental Monitoring Programme (LTRIEMP)

Time



Meteorology

Fisheries

Water quality

Land use

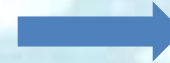
Biodiversity & Invasives species

THREATS !

LTRIEMP MONITORING

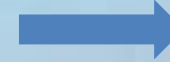


CLIMATE CHANGE



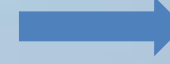
METEOROLOGY

OVERFISHING



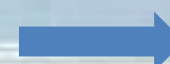
FISHERIES

POLLUTION



WATER QUALITY

EROSION



LAND USE

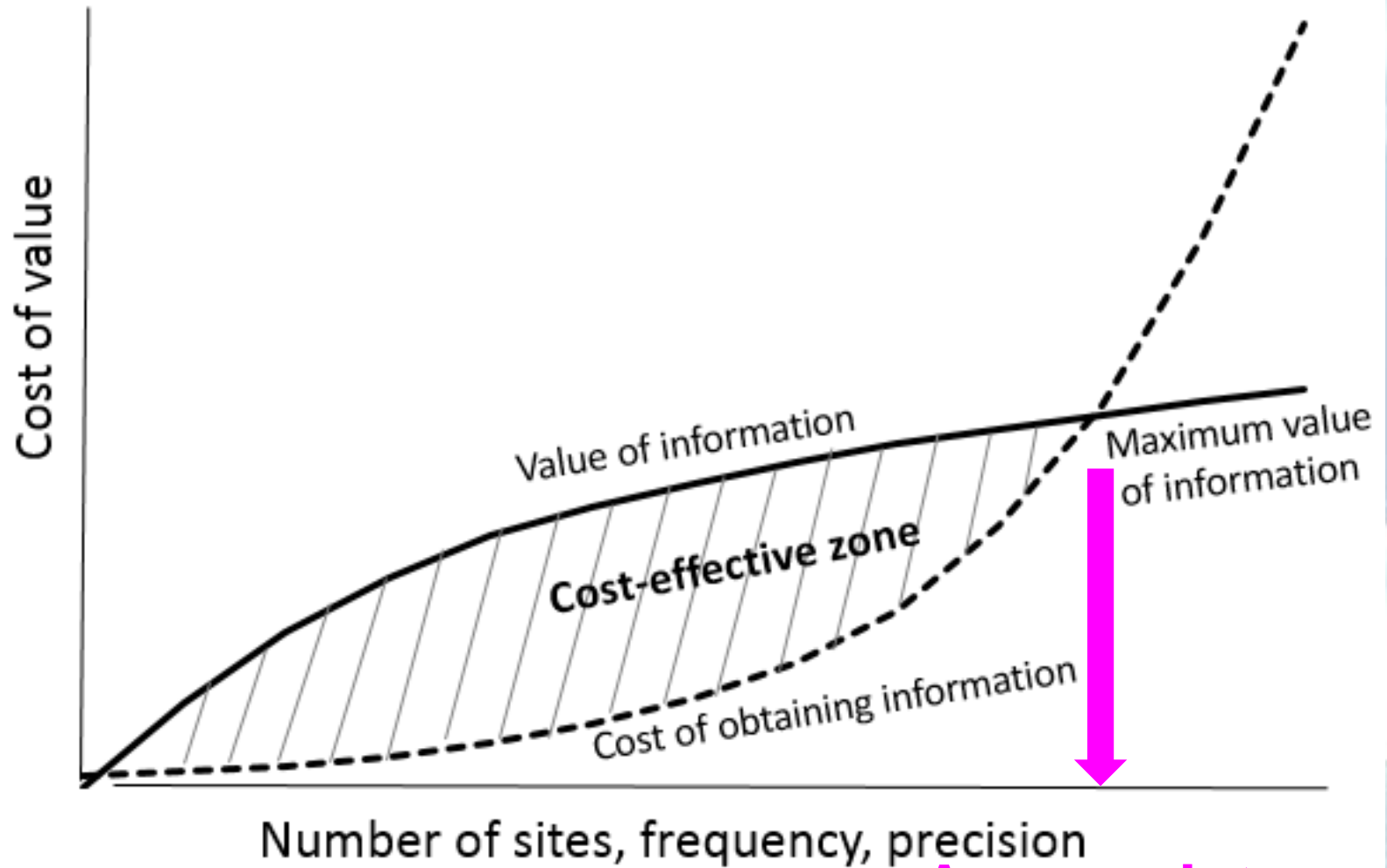
BIODIVERSITY LOST



BIODIVERSITY

“Many important questions in ecosystem science, environmental biology, and earth science can only be addressed with long-term data” (Larson et al. 2007)

Criteria for LTRIEMP sustainability



Appropriate intensity

Exemple

Water parameters

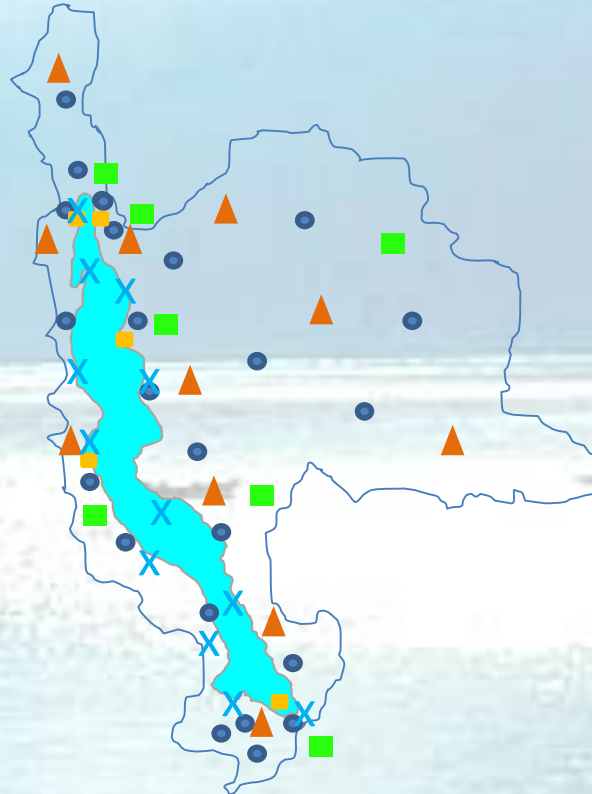
EXEMPLES

	Frequent	Seasonal	Occasional
	<= Monthly	<= Semestrial	
Water T°	X	X	
pH	X	X	
Electrical conductivity	X	X	
Dissolved oxygen	X	X	
Turbidity	X	X	
Transparency	X	X	
Chlorophyll a	X	X	
NO3-, PO4---, TP, TN, SiO2		X	
TDS, TSS	X	X	
Flow measurements	X	X	
coliform, faecal, E.coli	X	X	
BOD, COD		X	
As, Ni, Pb,Cd, CN, Hg, Mn		X	
Cr,Co,Sn,Cu,Zn,Ra,U,Al			X
Ag,Be,Se,Ba,Sr,S,V,Au			X
Pesticides			X
Hydrocarbons			X
Ca++ ,Mg++,Na+,K+			X
Cl-,SO4-- ,F-			X
Fe / H2S			X
Alkalinity/Total hardness			X

MONITORING LTRIEMP PARAMETERS – SITES & FREQUENCY

➔ PROPOSALS
in MS

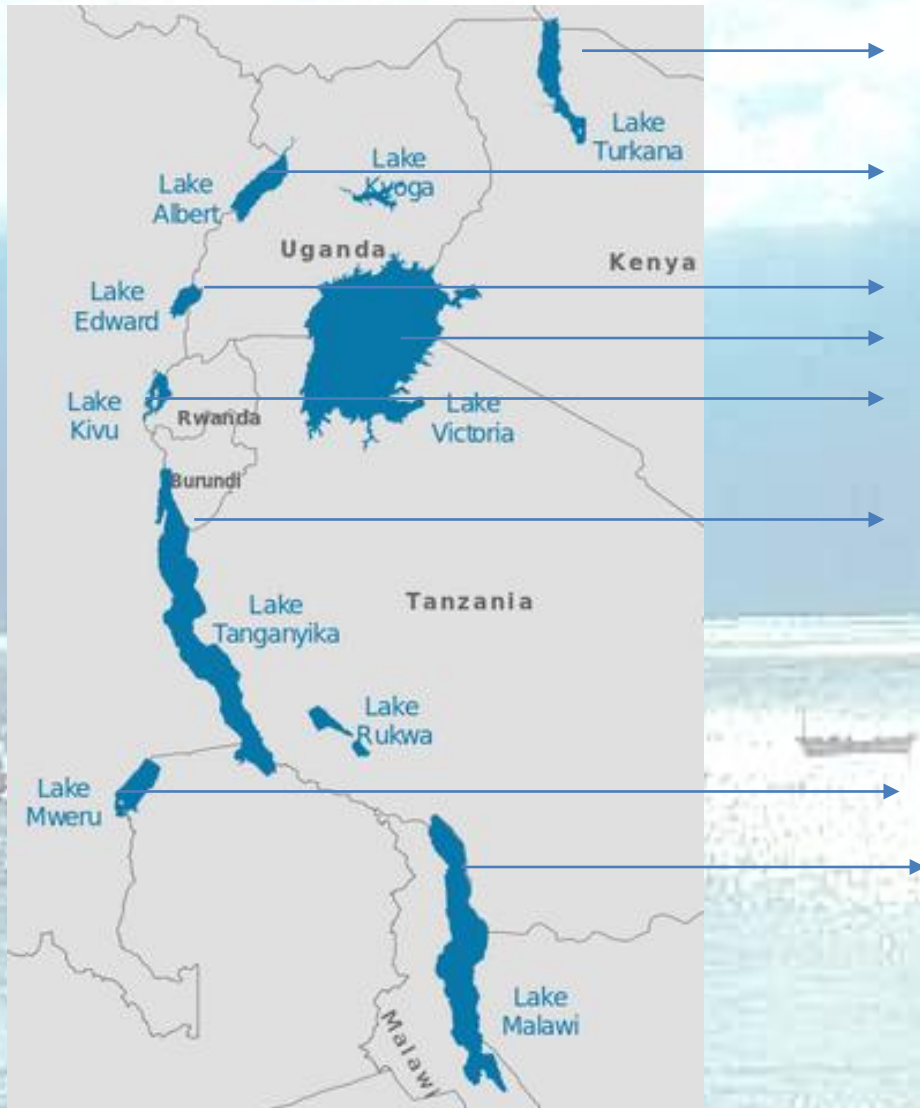
- Meteo
- ✕ Fisheries
- Water Quality
- ▲ Land use
- Biodiversity



Parameters	Units	Sampling System		
		Frequency	Season	Period
Water T	°C	1	1	1
Water conductivity	µS/cm	1	1	1
Dissolved oxygen	mg/l	1	1	1
pH		1	1	1
Chlorophyll a	µg/l	1	1	1
Chlorophyll b	µg/l	1	1	1
Chl. Total	µg/l	1	1	1
Chl. TSS	µg/l	1	1	1
Water transparency	NTU	1	1	1
Water temperature	°C	1	1	1
Wind direction	°	1	1	1
Wind speed	km/h	1	1	1
Relative humidity	%	1	1	1
Barometric pressure	hPa	1	1	1
Cloud cover	%	1	1	1
Soil moisture	%	1	1	1
Soil temperature	°C	1	1	1
Soil pH		1	1	1
Soil salinity	mg/l	1	1	1
Soil nutrients	mg/l	1	1	1

Location	Site	Type of sampling		
		Water	Soil	Air
Analamanga	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
D.R. Congo	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
Dromadaire	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1
	Antananarivo	1	1	1





TOWARD AN
EAST AFRICAN
GREAT LAKES
MONITORING ?

CONCLUSIONS

- Climate & anthropic **THREATS** on Lake Tanganyika
- Present **monitoring** needs **reinforcement**
- Proposals for a *Lake Tanganyika Regional Integrated environmental monitoring program (LTRIEMP)*



THANK YOU !

Acknowledgments also to :

The **Lake Tanganyika Authorities**,
& the project

“Partnership Interventions for the Implementation
of the SAP on Lake Tanganyika (**GEF**)

FISHERIES MONITORING

Fisheries survey	Priority	Parameters	Frequency
A. Frame survey (FS)	1	Boats and fishing gears	5 years
B. Catch assessment survey (CAS)	1	Catch & efforts	monthly
C. Biological fish cohort studies	2	Length frequencies	monthly
D. Biological analysis	2	Lt, W,S,M,GW,F,St.C,Par.,...	3 months/occ.
E. Gear Selectivity	3		yearly/occ.
F. Biomass/stock assessments	3	Biomass	yearly/occ.

WATER MONITORING

Parameters	Units	Sampling types		
		Frequent	Seasonal	Punctual
		<= Monthly	<= Semestrial	
Water T°	°C	x	x	x
pH		x	x	x
Electrical conductivity	µS/cm	x	x	x
Dissolved oxygen	mg/l	x	x	x
Turbidity	NTU	x	x	x
Transparency	cm	x	x	x
Chlorophyll a	µg/l	x	x	x
NO ₃ ⁻ , PO ₄ ⁻⁻⁻	mg/l		x	x
TP, TN, SiO ₂	mg/l		x	x
TDS, TSS	mg/l	x	x	x
Flow measurements	m ³ /s	x	x	x
coliform, faecal, E.coli	Col./100ml	x	x	x
BOD, COD	mg/l		x	x
As, Ni, Pb,Cd, CN, Hg, Mn	mg/l		x	x
Cr,Co,Sn,Cu,Zn,Ra,U,Al	mg/l			x
Ag,Be,Se,Ba,Sr,S,V,Au	mg/l			x
Pesticides	µg/l			x
Hydrocarbons	µg/l			x
Ca ⁺⁺ ,Mg ⁺⁺ ,Na ⁺ ,K ⁺	mg/l			x
Cl ⁻ ,SO ₄ ⁻⁻ ,F ⁻	mg/l			x
Fe	mg/l			x
H ₂ S	mg/l			x
Alkalinity	mg/l (CaCO ₃)			x
Total hardness	mg/l (CaCO ₃)			x

SITES

Water quality and quantity

Location	Site	Type of sampling			
		Frequent		Seasonal	Punctual
		weekly	monthly		
Burundi					
Bujumbura	Lake-coast	x		x	x
Bujumbura	Lake-pelagic		x	x	x
Bujumbura	Harbor		x	x	x
Bujumbura	Ntahangwa River		x	x	x
Ruzizi	River mouth		x	x	x
Kinyankonge	River at the mouth			x	x
Kanyosha	River at the mouth			x	x
Rumonge	Fish landing site				x
Nyanza lac	Lake-coast				x
D.R.Congo					
Uvira	Lake-coast	x		x	x
Uvira	Lake-pelagic		x	x	x
Uvira	Harbor		x	x	x
Uvira	Kalimabenge River		x	x	x
Uvira	Mulongwe River		x	x	x
Uvira	Luhanga River		x	x	x
Uvira	Pemba River		x	x	x
Uvira	Ruzizi River		x	x	x
Uvira	Kigongo River		x	x	x
Kalemie	Lake-coast		x	x	x
Kalemie	Harbor		x	x	x
Kalemie	Lukuga		x	x	x
Moba	Lake-coast				x
Moliro	Lake-coast				x
Luhanga	Pot.protected area				x
Pemba	Pot.protected area				x
Tanzania					
Kigoma	Lake-coast TAFIRI site	x		x	x
Kigoma	Harbor		x	x	x
Kigoma	Lake-pelagic		x	x	x
Ujiji	Ujiji Forodhani		x	x	x
Malagarasi	Uvinza bridge			x	x
Uvinza	Ruchugi River			x	x
Kipili	landing site				x
Mahale Nat. Park	Lake-coast/pelagic				x
Gombe Nat. Park	Lake-coast/pelagic				x
Zambia					
Mpulungu	Lake-coast	x		x	x
Mpulungu	Lake-pelagic		x	x	x
Mpulungu	Harbor		x	x	x
Lusalala Village	Lusalala river			x	x
Kambole Bridge	Lunzua River			x	x
Simumbele village	Lunzua River			x	x
Mbete Village	Izi River			x	x
Munjela Village	Munjela stream			x	x
Kabyolwe	Lufubu River			x	x
Nsumbu Nat. Park	Lake-coast/pelagic				x

LAND USE & EROSION

Parameters	Units	Frequency
Surface and use (agriculture, forest, pasture, savanna...)	km ²	2 years
Surface used on exposed soil by categories of slopes	km ²	2 years
Erosion hazard risk assessment		2 years
Population and its distribution	inh/km ²	4 years
Land use maps from remote sensing		3 years

BIODIVERSITY

Survey type	Group target	Frequency
Baseline survey	Littoral fish, phytoplankton, zooplankton, vegetation & other possible taxonomic groups	10 years
Changes from baseline	Key species (particularly littoral fish)	2 years
	Riparian vegetation	5 years
Intermittent survey	Submerged macrophytes	2 years
	Phytoplankton & zooplankton	5 years
	Arthropods	5 years
	Mollusks	5 years
	Other species (animal & vegetal)	5 years

BIODIVERSITY AND INVASIVE SPECIES

TYPE OF SITES	Observations sites	LTRIEMP	
		Biodiv.	Inv. Species
Rocky shoreline	2	x	x
Sandy beach	2	x	x
Pelagic waters	1	x	x
Landing-beach	1	x	x
River mouth	3	x	x
Lake-edge wetland/swamps	2	x	x
Basin catchment	2 to 6*	x	x
Urban and ports extensions /lake edge	All	x	x
Aquarium fish collectors	All		x
Aquaculture/ponds	10		x
Aquaculture/cage in the lake	All		x
Other pathways	variable		x