The Laguna de Bay Ecosystem Health Report Card: An Assessment and Planning Tool for Integrated Lake Basin Management

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Special Event - EAS Congress
Technical and Policy Workshop on Sustainable Nutrient Management
in support of the Asian Platform of Global Partnership on Nutrient Management (GPNM)

18 November 2015
Furama Resort Hotel, Da Nang, Vietnam

THE PHILIPPINE ARCHIPELAGO   THE LAGUNA DE BAY BASIN

AC Santos-Borja

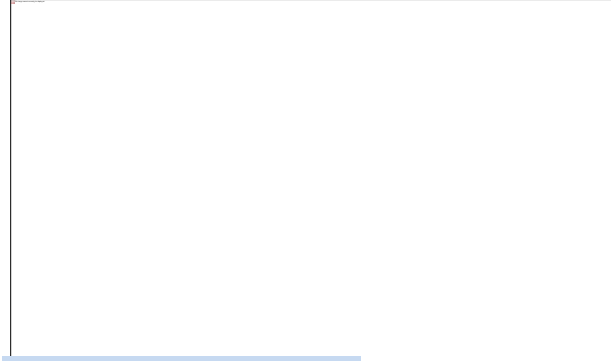| Land Cover	Area (ha)	Percentage
Urban	51962.005	16.98
Forest	27508.01	8.99
Arable Land	33379.274	10.91
Plantation	50555.323	16.52
Grassland	48467.553	15.84
Brushland	74913.958	24.49
Marsh	2649.84	0.87
Water	2319.941	0.76
Unclass	13539.179	4.43
Cloud	647.156	0.21
Total	305942.239	100.00

The lake is a multiple use resource
BUT these uses bring negative impacts

Fisheries

Irrigation

Transport Route

Floodwater Reservoir
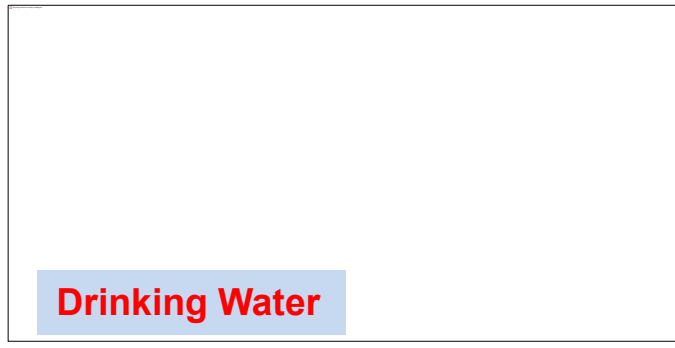
Hydro-electric power generation

Industrial Cooling

Recreation

Drinking Water
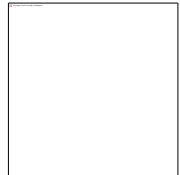
LAGUNA DE BAY IS AN EXTREMELY STRESSED LAKE

THREATS
- Population expansion
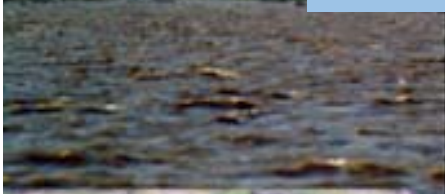- Rapid economic development:

Impacts on the ecosystem
- Siltation and sedimentation
- Increased inputs of pollutants
  - solid wastes

TWO MAJOR PROBLEMS

1. **SILTATION**

1. **POLLUTION** (domestic, industrial, agricultural sources)

eutrophication due to excessive macro nutrients

- Uncoordinated and conflicting policies

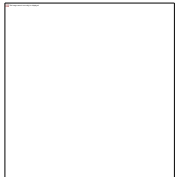# Infestation of water hyacinth in the lake and tributary rivers
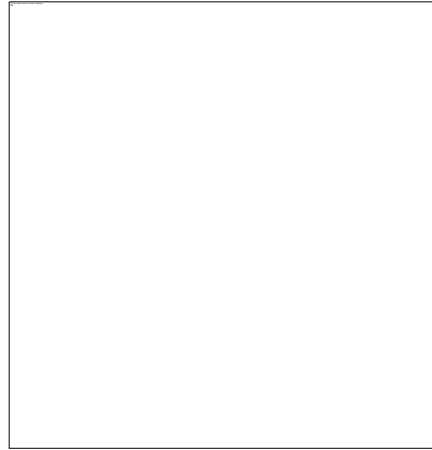

AC Santos-Borja

Photo by A.C.Santos-Borja, August 27, 2015

Harmful Algal Bloom

Photo by O.L. Privaldos, August 27, 2015

The LAGUNA LAKE DEVELOPMENT AUTHORITY

- ❖ The only lake basin management authority in the Philippines
- ❖ Created through Republic Act 4850 (1966) as amended by Presidential Decree 813 (1975)
- ❖ Promulgates rules and regulations with quasi-judicial functions
- ❖ Monitors the water quality of the lake and the tributary rivers

- ◆ *Transform the technical data into a simple and easy to understand language*
- ◆ *Use an effective communication tool to enjoin the stakeholders in taking responsibility to conserve the resources of the lake and its watershed*

THE FIRST LAGUNA DE BAY ECOYSTEM HEALTH REPORT CARD

❖ Funded by the United Nations Environment Programme (UNEP/GEF) through the project on Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution, in support of Global Nutrient Cycle;

❖ Jointly implemented by the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA Resource Facility) and the Laguna Lake Development Authority (LLDA);

❖ Aimed at providing stakeholders, decision makers and policy makers a simple yet scientifically developed assessment of the Ecosystem Health of Laguna de Bay;

❖ Expected to be an effective tool for communication and for planning actions by various stakeholders to improve the ecosytem health.

Funding Institutions

Implementing Institutions:

Consultants:

Science communication:

Partnerships in Environmental Management for the Seas of East Asia*: Mr. S. Adrian Ross (not in photo), Ms. Nancy Bermas, Ms. Daisy Padayao*
Laguna Lake Development Authority: *Ms. Adelina Santos-Borja, Ms. Jocelyn Sta. Ana, Ms. Rose Bonifacio, Mr. Neil Varcas, Mr. Ireneo Bongco, Ms. Rosemary Cabrera, Mr. Gregory Alexis Ongjoco, Ms. Marilyn Apacionado*
Experts*: Dr. Adelaida Palma (Bureau of Fisheries and Aquatic Resources)*
       Dr. Gil Jacinto (University of the Philippines – Marine Science Institute)
       Dr. Macrina Zafaralla (University of the Philippines – Los Banos)
       Dr. Rey Donne Papa and Milette Mendoza (University of Santo Tomas)
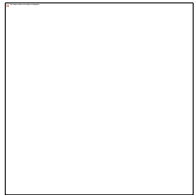**University of Maryland Center for Environmental Science:** *Mr. David Nemazie, Dr. Simon Costanzo,*
       Ms. Vanessa Vargas, Ms. Jane Hawkey (not in photo)

Laguna de Bay: Values and Threats

**Outcome of the Stakeholders Consultation on December 12-13, 2013**

Water Quality Indicators

Nitrates in excess amounts cause dramatic increases in aquatic plant growth and changes in the types organisms that live in the lake. Sources include fertilizers, drainage from livestock feeds, as well as domestic and industrial discharges.
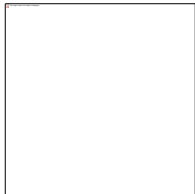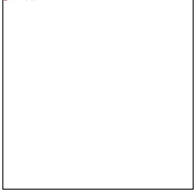
**Phosphates** come from agricultural runoff, animal waste and sewage.
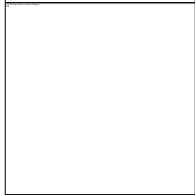
Chlorophyll a measures the amount of phytoplankton that can cause algal blooms. Algal blooms by blue-green algae are an indicator of deteriorating water quality and polution.
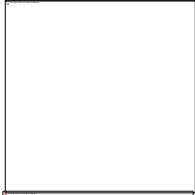
Dissolved oxygen (DO) is vital for the survival of fish and benthic organisms in the lake.

Biological oxygen demand (BOD) is the amount of oxygen required by microorganisms for stabilizing biologically decomposable organic matter in water under aerobic conditions. High BOD levels are associated with organic pollution, such as sewage.
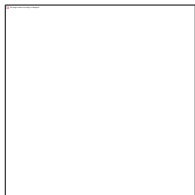
Total coliforms is a measure of animal bacteria that enters the lake by direct deposition of waste in the water and runoff from areas with high concentrations of animals or humans.

How are the scores calculated?

- Measured the indicators for water quality and fisheries in the West, Central, East and South Bays (2004-2013).

- Six water quality indicators: nitrate, phosphate, chlorophyll *a*, dissolved oxygen and biochemical oxygen demand were compared to the National Water Quality Criteria (DENR-DAO 34), Class C water (for fisheries) which were combined and then represented as a percent score for each bay.

- The 3 Fisheries indicators: zooplankton ratio, native fish species and catch per unit effort (CPUE) were calculated as ratios or percentage that are then combined for each bay. The scores are then normalized to form a fisheries index.

Philippine Grading Scale

What do the grades mean?

All the indicators meet desired levels. Quality of water in these locations tends to be very good, most often leading to preferred habitat conditions for aquatic life.

Most indicators meet desired levels. Quality of water in these locations tends to be good, often leading to acceptable habitat conditions for aquatic life.

There is a mix of good and poor levels of indicators. Quality of water in these locations tends to be fair, leading to sufficient habitat conditions for aquatic life.

Some or few indicators meet desired levels. Quality of water in these locations tends to be poor, often leading to degraded habitat conditions for aquatic life.

Very few or no indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to unacceptable habitat conditions for aquatic life.

Water Quality

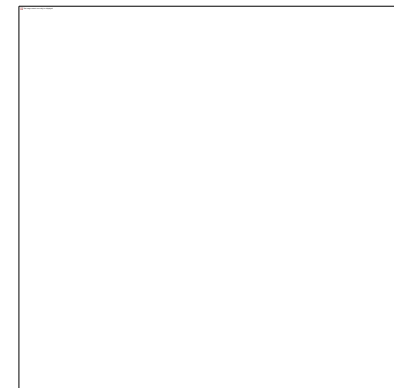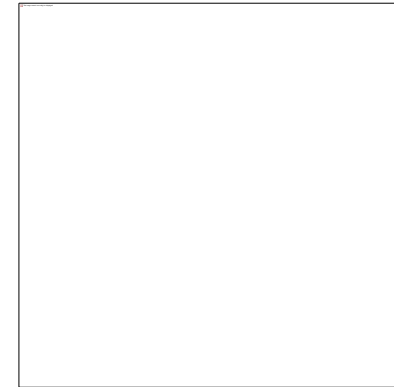| Region	Indicator	Score	Overall Score	Grade
West Bay	Nitrate	100	76	C-
	Phosphate	56		
	Chl a	0		
	DO	100		
	BOD	100		
	Total Coliforms	98		
Central Bay	Nitrate	100	71	D
	Phosphate	25		
	Chl a	0		
	DO	100		
	BOD	100		
	Total Coliforms	100		
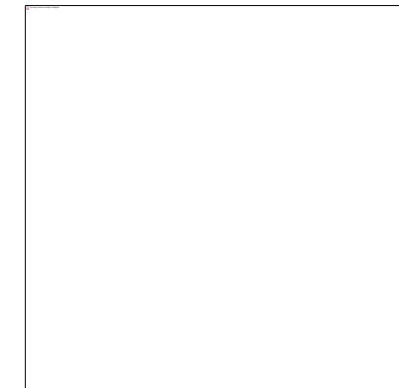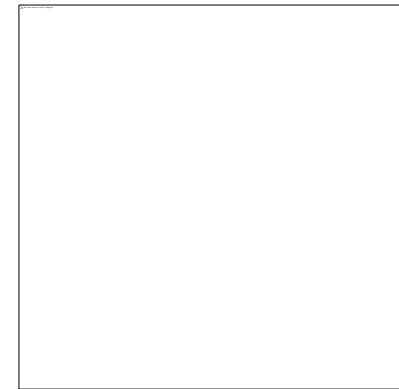
Based on DENR Class C water quality criteria (DAO 34):
Nitrate: 10mg/L   Phosphate: 0.05mg/L   Chl a: 10ug/L   DO: 5mg/L   BOD: 7mg/L   Total coliforms: 5000MPN/100ml

Water Quality

| Region	Indicator	Score	Overall Score	Grade
East Bay	Nitrate	100	81	C+
	Phosphate	92		
	Chl a	0		
	DO	100		
	BOD	100		
	Total Coliforms	96		
South Bay	Nitrate	100	77	C
	Phosphate	63		
	Chl a	0		
	DO	100		
	BOD	100		
	Total Coliforms	100		

*Based on DENR Class C water quality guidelines:
Nitrate: 10mg/L   Phosphate: 0.05mg/L   Chl a: 10ug/L   DO: 5mg/L   BOD: 7mg/L   Total coliforms: 5000MPN/100ml
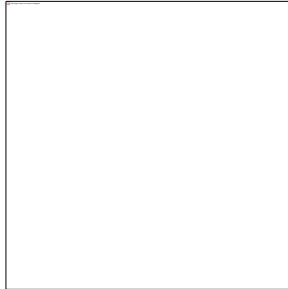
Water Quality - Total Score

| Region	Indicator	Score	Overall Score	Grade	
Laguna de Bay	Nitrate	100	76	C-	
	Phosphate	59			
	Chl a	0			
	DO	100			
	BOD	100			
	Total Coliforms	99			
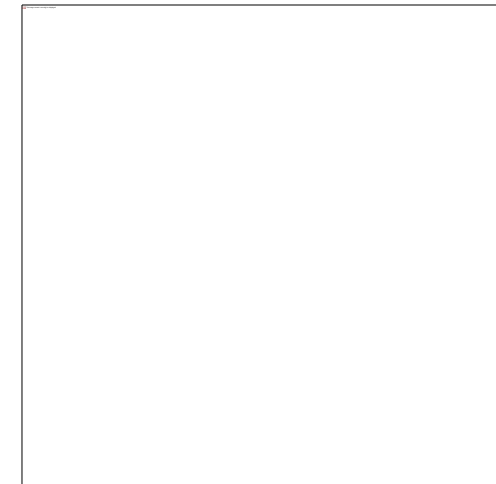
Based on DENR Class C Water Quality Criteria:
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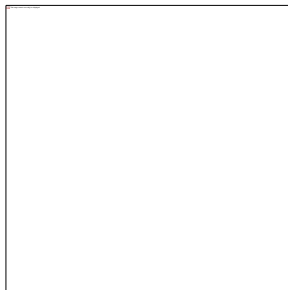
Fisheries Indicator

Zooplankton ratio can be used to indicate changes in the trophic state of the lake, level of eutrophication and warming history. Decreasing calanoid to cyclopoid ratio indicates deteriorating trophic state; the lower the calanoids, the higher the trophic state of the lake. In Laguna de Bay, the only remaining calanoid copepod is the invasive *Arctodiaptomus dorsalis*, which has already displaced previously recorded native calanoid species in the lake.
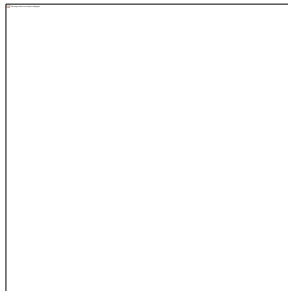
Native fish species composition measures the proportion of native against introduced/invasive species in major catch composition.

Catch per unit effort (CPUE) is computed from the average total daily catch and the total number of fishing hours.
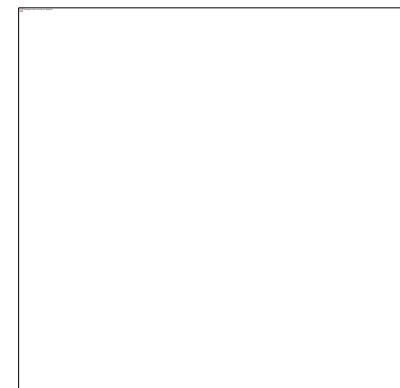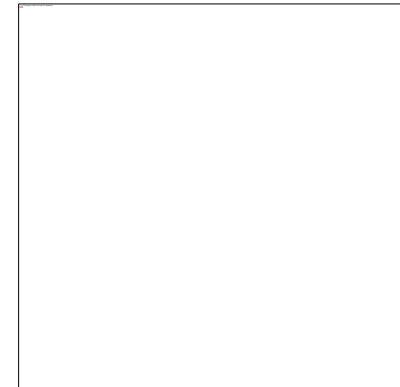
Fisheries

Region	Indicator	% Score	% Sub Score	Grade
West Bay	Percent composition of Fish Native Species	47		
	Zooplankton ratio	35	39	D
	CPUE	35		
Central Bay	Percent composition of Fish Native Species	59		
	Zooplankton ratio	33	40	C-
	CPUE	27		

*Graded using a Fisheries Index; scores subject to change pending additional data and data normalization

Fisheries Index	A 80-100%	B 60-80%	C 40-60%	D 20-40%	F 0-20%

Fisheries

| Region	Indicator	% Score	% Sub Score	Grade
East Bay	Percent composition of Fish Native Species	26	17	F
	Zooplankton ratio	22		
	CPUE	3.4		
South Bay	Percent composition of Fish Native Species	24	25	D-
	Zooplankton ratio	29		
	CPUE	21		

*Graded using a Fisheries Index; scores subject to change pending additional data and data normalization

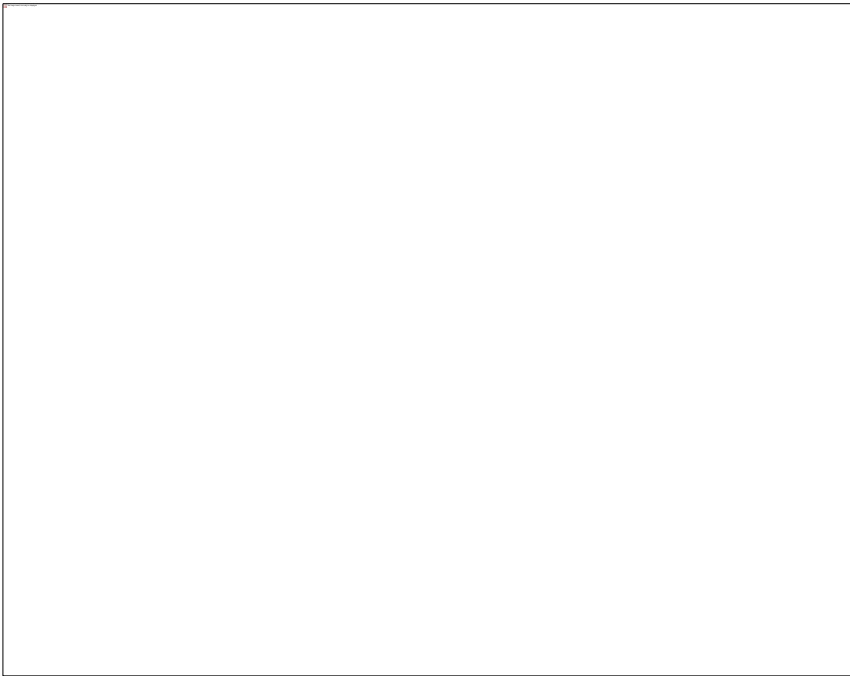Fisheries Index | A 80-100% | B 60-80% | C 40-60% | D 20-40% | F 0-20% |

Fisheries – Total Score

Region	Indicator	% Score	% Sub Score	Grade
Laguna de Bay	Percent composition of Fish Native Species	39	30	D
	Zooplankton ratio	29.75		
	CPUE	21.6		
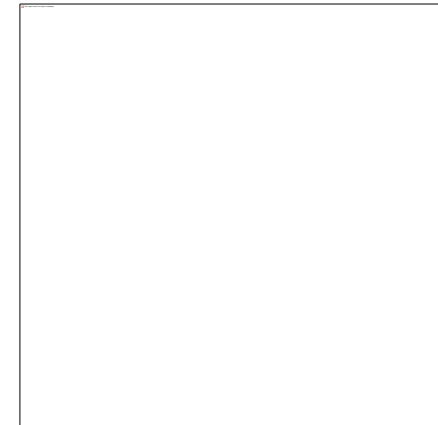
*Graded using a Fisheries Index; scores subject to change pending additional data and data normalization

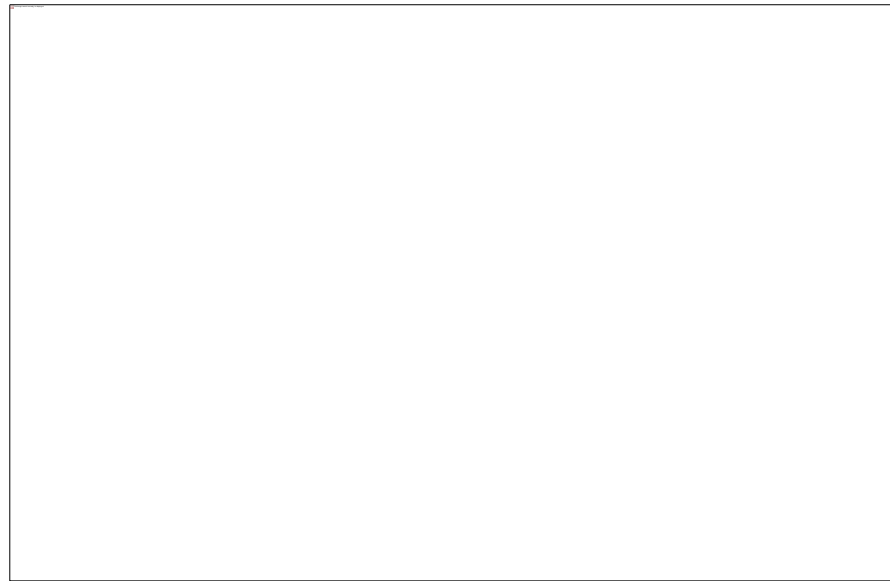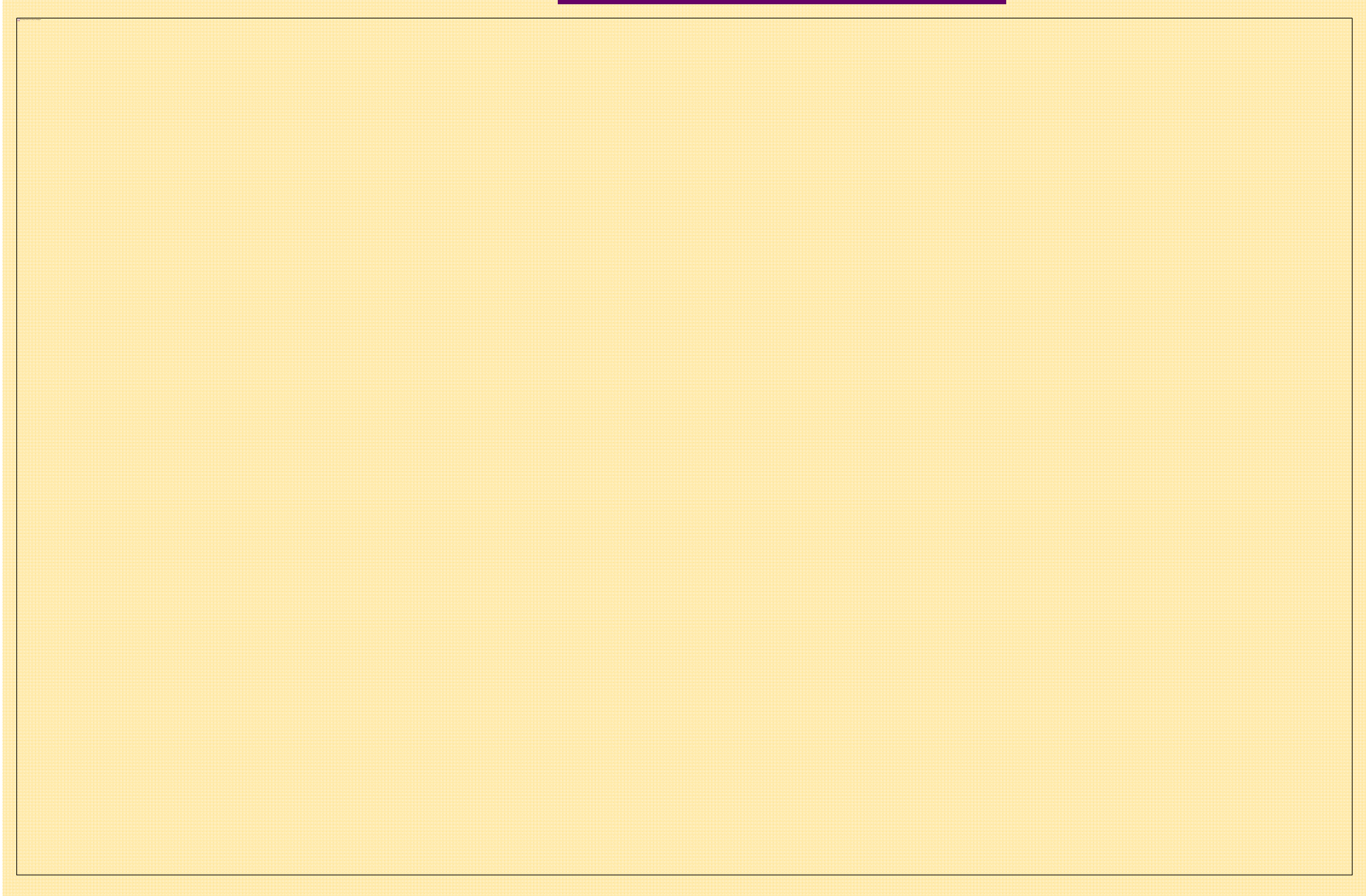| Fisheries Index	A	80-100%	B	60-80%	C	40-60%	D	20-40%	F	0-20%

Fisheries

Ten year production trend in Laguna de Bay. Data source: Bureau of Agricultural Statistics.

Comparison of clown knife fish and ayungin catch from actual sampling in Laguna de Bay in 2013. Data source: Bureau of Fisheries and Aquatic Resources

Over-all Score, 76% or C-

People can make a difference

✓ Youths are being educated and getting involved
- CLEAR (Conservation of Laguna de Bay's Environment and Resources) Youth Network

✓ Government agencies and local communities work together
- "Panganib ng Knife Fish Sugpuin; Laguna de Bay Muling Pasiglahin"
- "Mapanganib na Dayuhang Isda Pigilang Makawala sa mga Ilog at Lawa"

✓ A new technology helps restore water quality
- UPLB Aquatic Macrophyte Biosorption System (AMBS)
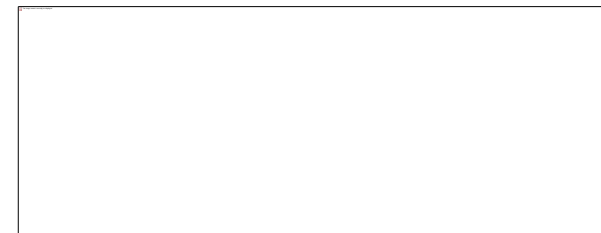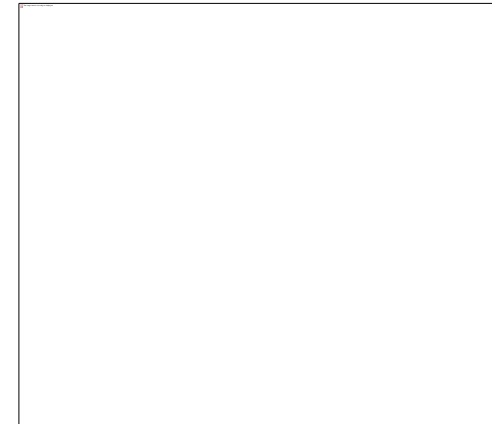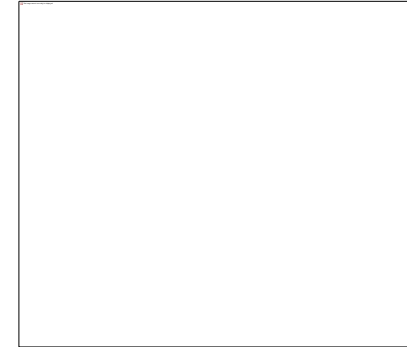
You can help save the Lake!

Thank You Very Much

First Laguna de Bay Ecosystem Health Report Card Dissemination Forum
October 28, 2015