Hydro-biological monitoring for sustainable management of Lake Chilika, Odisha

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Hydro-biological monitoring
Relevance for wetland management

- Wise Use commits managers to the goal of ‘maintenance of ecological character’

- State of ecological character is influenced by biophysical as well as social processes

- Monitoring system required to assess
  Assess status and trends
  Risk of adverse change
Chilika
Biodiversity and ecosystem service values

211 bird species; largest Irrawaddy Dolphin population; ~ 300 fish species, livelihood of 0.2 million fishers
Riverine and coastal processes
Lake degradation

Choking of mouth to the sea

Dominance of freshwater environment

Included in Montreaux Record in 1993

Weed Infestation

Decrease in fish landing

Shrinkage in lake area and volume

Chilika Lagoon

1972 - 73 (824 sq.km)

2001 (790 sq km)
Putting governance in place

Governing Body

CHAIRMAN (CHIEF MINISTER)

Working Chairman (Minister of Environment)

MEMBERS

Members of Parliament

Secretaries of key departments

Representatives from premier organizations

Representatives of Fishermen Federations

Executive Body

Chair: Principal Secretary (Forest and Environment)
Member: Director (Environment)
Convenor: Chief Executive, CDA
Hydrological Intervention - 2000

Rejuvenating sea connectivity

BAY OF BENGAL

Chilika Lagoon

Old Mouth

New Mouth
Ecological impacts

- Restoration of salinity gradient
- Increase in population and habitat utilization by dolphins
- Reappearance of marine and brackish forms of biodiversity
- Restoration and maintenance of fish catch levels
Monitoring Stations

12 Hydrological monitoring stations + 3 Meteorological yards
5 Tide Gauge Stations
30 Water Quality and Ecological Sampling Stations
Institutional Coordination
Wetland Research and Training Center

Auditorium, Training Room and Conference Room
Lake monitoring laboratory
Library
Computing facilities
Scientist Hostel (12 rooms)
Chemical / Instrumentation
• Water quality (physico-chemical and nutrients)
• Geochemical fractionation (heavy metal, metal accumulation, petroleum hydrocarbons)

Biology
• Spatial and temporal dynamics of plankton and macro-benthos
• Fisheries

Modelling
• Seawater, freshwater exchange, bathymetry, inlet dynamics, ecological modelling

Bio-technology
• Molecular analysis of macrophytes-microbe interaction
• Molecular analysis of pico and nano phytoplankton
• Bioprospecting of novel bacteria
Real-time water quality monitoring

Sensors mounted on floating buoys

Automated transmission of data every 15 mins

Calibration unit at WRTC

Salinity, temperature, conductivity, DO, pH, Depth, Turbidity, Chlorophyll-a, Blue Green Algae
Monitoring ecological processes
Monitoring coastal processes

- Inlet monitoring (GIS based) bi-monthly + Monthly GPS Surveys
- Daily tide-gauge
Environmental flows for Chilika

Question – How much water do you need? When do you need it?

**EF Team:** World Bank, CDA, Wetlands International, CSIRO, Department of Water Resources, CWPRS
Defining flow scenarios

Scenario 1: Pre Barrage
60% undivided Mahanadi flow through Naraj

Scenario 2: Multi Objective
Regulate flows above $15,000 \text{ m}^3/\text{sec}$ to control large floods d/s Naraj

Scenario 3: Sediment Control
No flows in July, first month of monsoon

Scenario 4: Euroconsult II
Control sediments and minimize structure failure risk
Flow perceptions

Structural Engineers
Reduced flows ->
Reduced silt ->
Longevity of wetland systems

Fishers
Floods -> Flush the system and keep mouth open -> high fish productivity

Farmers
Floods -> bring silt -> high agricultural productivity
Embarkments create waterlogging

Knowledge Systems

Scientific measurements Anecdotal
## Communication and outreach

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>Desired condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>Water clarity</td>
<td>$\leq 30$ NTU</td>
</tr>
<tr>
<td></td>
<td>Dissolved oxygen</td>
<td>$\geq 5$ mg/L or 60% sat.</td>
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<tr>
<td></td>
<td>Total chlorophyll</td>
<td>$\leq 5$ $\mu$g/L</td>
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<tr>
<td>Fisheries</td>
<td>Total catch</td>
<td>% deviation above or below maximum sustainable yield ($11,500$ t/yr)</td>
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<tr>
<td></td>
<td>Commercial species diversity</td>
<td>Ratio of species landed: desired ($45$ sp. desired)</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>Proportion of species landed above a sustainable size limit.</td>
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<tr>
<td></td>
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<td>M. cephalus: $219 - 461$ mm, P. monodon: $116 - 197$ mm, S. serrata: $87$ mm</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Bird count and richness</td>
<td>Ratio to maximum bird count and diversity recorded since 2003</td>
</tr>
<tr>
<td></td>
<td>Dolphin abundance</td>
<td>Ratio to maximum dolphin count recorded since 2001</td>
</tr>
<tr>
<td></td>
<td>Benthic infauna diversity</td>
<td>Simpson's Index of Diversity ($1-D$)</td>
</tr>
<tr>
<td></td>
<td>Phytoplankton diversity</td>
<td>Simpson's Index of Diversity ($1-D$)</td>
</tr>
</tbody>
</table>

## Grades

- **A** 100-80%
- **B** 80-60%
- **C** 60-40%
- **D** 40-20%
- **F** 20-0%
Communication and outreach

2012

2014

Bay of Bengal

Northern Zone

Central Zone

Southern Zone

Outer Channel

B

B

B

B

B

B

B

New mouth
Conclusions

• Robust monitoring as the basis of adaptable management
• Monitoring systems should be purposive and address management needs
• Stakeholder communications should be made a part of monitoring system design
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