Chilika Lake
2012 Ecosystem Health Report Card
Chilika Lake is rich in natural and cultural beauty, and important to local livelihoods

Chilika Lake stores monsoon floodwaters and provides a level of safety needed to sustain its amazing biodiversity. Local communities depend on the Lake to provide water for fish and shellfish for food and income, village transport, and tourism income. It is for all these reasons that Chilika needs our protection.

Pressures affecting the Chilika Lake ecosystem

While tourism is providing welcome income to local communities, the activities, if not managed properly, adversely impact the environment. Air pollution, trash, and fishing cooperative representatives.

Tourism

Sedimentation

During monsoon season, an excess of sediment from the Lake, mostly from tributaries, is dispersed in the Lake, mostly from tributaries, and agricultural lands. As the Lake becomes more shallow and its sea surface fills it with sediment, it becomes more shallow and its sea surface.

Fishing and Aquaculture

The recent abundance of fish stocks is not sustainable with overfishing and no new fish. These large fish often return back into the water contaminating the Lake. Active shrimp ponds and abandoned nets trap sediment and kill juvenile fish.

Pollution

Air and land changes from forest to settlements and pastoral agriculture result in increased runoff. Sediment and fertilizer increase into the Lake. Algae blooms that float and sit on the bottom are the result of that excess nutrient input.

www.chilika.com
How the report card was prepared

This is the first of a proposed series of annual Ecosystem Health Report Cards for Chilika Lake. The report card was developed in order to enhance understanding and management of the Chilika Lake ecosystem through a collaborative, UNEP/GPA/GPM project entitled “Lake Chilika: Status, Trends, and Ecosystem Health under a Changing Climate.” The project was initiated by Chilika Development Authority (CDA), National Centre for Sustainable Coastal Management (NCSCM), and UNEP/GPA/GPM (Centralized Global Partnership on Nutrient Management/GPM). The CDA, in partnership with NODIM and the Integration & Application Network from the University of Maryland Center for Environmental Science, convened a science workshop bringing together local, regional, and international experts and water managers together identified 10 indicators of ecosystem health currently monitored within the Lake, and developed thresholds for each. Due to data limitations, Nitrogen and Phosphorus were not considered in this report card. However, CDA is currently monitoring Nitrogen and Phosphorus, and this dataset will be included in the next Report Card. Additional indicators may be included in future once measures for data collection are in place. This first Report Card serves as a baseline that will be used as a point of comparison to measure progress towards Chilika Lake management goals and targets.

Measures of ecosystem health

Measuring the ecosystem health of Chilika Lake is conducted using 10 indicators organized into three main indices: Water Quality, Fisheries, and Biodiversity. Together, these indicators represent the ecosystem features of Chilika Lake that are valued (e.g., fishing, tourism, recreation) and are critical to the survival of Chilika Lake’s aquatic life. The amount of dissolved oxygen needed before aquatic organisms are stressed, or even die, varies from species to species. Dissolved oxygen levels can reduce water clarity and decomposing phytoplankton can reduce dissolved oxygen levels.

Biodiversity

Simpson's Index of Diversity (D) is used to assess the condition of this microscopic algal organisms living in or on the soft bottom areas of the Lake (e.g., clams and worms) and are a key food source for many species. Benthic infauna diversity — indicate a score that is within 2% of a score's high or low boundary. Some or few water quality and biological health indicators.

FISHERIES

Total catch — total catch of fish, prawns, and crabs recorded monthly at 27 sampling stations around this Lake. Allow Lake managers to monitor annual yield in comparison to a calculated maximum sustainable yield.

Commercial species diversity — number of species landed each year that are commercially important for the livelihood of fishermen. Size — body weight of selected taxa or size range (mean, minimum, maximum) and Chilika Lake (cyprinids should be above 2 kg for bream) is prescribed weight-to-ensure sustainability of the species.

Water Quality

Water clarity — a measure of how much light penetrates through the water column which plays an important role in determining lake greases and phytoplankton distribution and abundance.

Dissolved oxygen — critical to the survival of Chilika Lake's aquatic life. The amount of dissolved oxygen needed before aquatic organisms are stressed, or even die, varies from species to species. Total chlorophyll — a measure of primary production (microalgae biomass). Dissolved oxygen levels can reduce water clarity and decomposing phytoplankton can reduce dissolved oxygen levels.

Dissolved oxygen

Water clarity: 15% is the maximum acceptable level for the Lake.

Fisheries

Total catch: 40-60% is the maximum acceptable level for the Lake.

Biodiversity

Simpson's Index of Diversity (D): 2-4 is the maximum acceptable level for the Lake.

Water Quality

Total chlorophyll: 5 μg/L is the maximum acceptable level for the Lake.

Dissolved oxygen

Water clarity: 15% is the maximum acceptable level for the Lake.
Calculating the ecosystem grade for Chilika Lake

Chilika Lake was divided into four reporting zones, each of which received a report card grade. The grades were calculated from the average of water quality, fisheries, and biodiversity indices, compiled of data collected over the 2011-2012 period. Ongoing monitoring will allow grades to be updated on a periodic basis, providing a means to track change over time.

### What do the grades mean? *

- **A: 80-100%** - All water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very good; most often leading to very good habitat conditions for fish and shellfish.
- **B: 60-80%** - Most water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be good; often leading to good habitat conditions for fish and shellfish.
- **C: 40-60%** - There is a mix of good and poor levels of water quality and biological health indicators. Quality of water in these locations tends to be fair, leading to fair habitat conditions for fish and shellfish.
- **D: 20-40%** - Some or few water quality and biological health indicators meet desired levels of quality. Water in these locations tends to be poor; often leading to poor habitat conditions for fish and shellfish.
- **F: 0-20%** - Very few or no water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very poor; often leading to very poor habitat conditions for fish and shellfish.

* Grades denoted with a “+” indicate a river that is within 2% of a reach high or low boundary. For example a “B+” is indicative of 78-80%.

### How the report card was prepared

Measuring the ecosystem health of Chilika Lake is conducted using 10 indicators organized into three main indices: Water Quality, Fisheries, and Biodiversity. Together, these indicators should be above (or between) a prescribed length to ensure sustainability of the species.

#### Biodiversity
- Dolphin abundance
- Bird count and richness

#### Fisheries
- Total catch
- Size
- Commercial species diversity

#### Water Quality
- Total chlorophyll
- Dissolved oxygen
- Water clarity
- Phytoplankton diversity

### Zones

The four zones used in this Chilika Lake Report Card are based mostly on salinity variations that occur within the Lake. Salinity in the Lake is driven by freshwater river flow from the north and west, and tidal seawater from the east and south. This results in a variation of salinity in the Lake, from freshwater in the north, brackish waters in the center and south, and full saline waters to the east.

The four zones are:
- **Northern Zone**
- **Central Zone**
- **Southern Zone**
- **Outer Channel Zone**

#### Overall Grade

<table>
<thead>
<tr>
<th>Zone</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Zone</td>
<td>B</td>
</tr>
<tr>
<td>Central Zone</td>
<td>B+</td>
</tr>
<tr>
<td>Southern Zone</td>
<td>B</td>
</tr>
<tr>
<td>Outer Channel Zone</td>
<td>B</td>
</tr>
</tbody>
</table>

#### Calculations

Chilika Lake as a whole displayed excellent results for fisheries, biodiversity, and water quality. The Southern Zone also displayed excellent results for fisheries, biodiversity, and water quality. The Central Zone displayed good results for fisheries, biodiversity, and water quality. The Northern Zone displayed fair results for fisheries, biodiversity, and water quality. All water quality and biological health indicators met desired levels. Quality of water in these locations tends to be good, often leading to good habitat conditions for fish and shellfish.
Overall, Chilika Lake scored a B+ for ecosystem health based on performance of water quality, fisheries, and biodiversity indices. The Lake as a whole displayed excellent (B+) dissolved oxygen concentrations, water clarity, fishery catch and size, and benthic infauna diversity. The Lake failed, however, for total chlorophyll concentrations (F) based on desired conditions. Of the ten indicators that were assessed within water quality, fisheries, and biodiversity, 75% (B+) in the Central Zone, followed by 76% (B) in the Southern Zone, 71% (B) in the Outer Channel Zone, and 64% (B) in the Northern Zone. A breakdown of these indicators by zone is provided below.

The Northern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and average biodiversity largely due to an absence of dolphin sightings.

The Central Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by dolphin abundance and benthic infauna diversity.

The Southern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by dolphin abundance and benthic infauna diversity.

The Outer Channel Zone displayed good results for fisheries, good water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by excellent dolphin abundance and benthic infauna diversity.

There’s more to this story: Salinity

The four zones used in this Chilika Lake Report Card are based mostly on salinity variations that occur within the Lake. Salinity in the Lake is driven by freshwater flow from the north and west, and tidal seawater from the east and south. This results in a variation of salinity in the Lake, from freshwater in the north, blackish waters in the center and south, and full saline waters in the east around the islands and outer channel. The boundaries between these zones shift throughout the year, driven by monsoonal rains and associated wind.

During the 1980s, extreme salinity conditions in the Lake were limiting access to the sea, reducing tidal flushing and decreasing salinity to such an extent that the Lake was declared a site of biodiversity. However, this led to an influx of invasive aquatic weeds. The decline in biodiversity has had a highly negative impact on the Lake’s biodiversity, leading to a loss of wildlife and fishery resources. In 1993, the Central Zone was identified as a key area for biodiversity restoration. This led to a significant increase in biodiversity and the recovery of fish species and habitats. The Central Zone continues to display excellent biodiversity, with dolphin sightings and excellent benthic infauna diversity.

The Northern Zone, however, failed to meet desired levels for biodiversity and water quality, with high levels of invasive species. Despite efforts to control and manage these invasive species, the Northern Zone continues to display poor overall health due to negative impacts on biodiversity.

The Southern Zone and Outer Channel Zone display varying levels of health, with the Southern Zone displaying good biodiversity and water quality, while the Outer Channel Zone displays excellent biodiversity and water quality, with a mix of invasive and non-invasive species.

In conclusion, the Chilika Lake Report Card highlights the need for continued monitoring and management efforts to ensure the health and sustainability of the Lake’s ecosystems.
Where do we go from here?
This report marks a significant step in progressing our understanding of the pressures on Chilika Lake and the potential for sustainable management. The Chilika Lake Development Authority (CLDA) has been working to assess the impact of human activities on the lake and its ecosystem. Based on this assessment, the CLDA has developed a Pressure-State-Response (PSR) framework to guide future management actions.

Key management Response strategies to be adopted include the following:

- Ensuring hydrological connectivity of Chilika Lake and its water sources.
- Establishing hierarchical and multidisciplinary invigoration of the lake ecosystem to enhance its health and resilience.
- Promoting sustainable catchment management practices to reduce pollution and protect the lake and its surroundings.
- Adopting environmental policies and practices that support conservation and development activities.
- Supporting eco-tourism development for enhancing awareness, income generation, and livelihood diversification.
- Promoting sustainable fisheries for maintaining nutritional security while ensuring maintenance of biodiversity and ecosystem services.
- Reducing poverty through sustainable resource development and utilization and livelihood diversification.
- Promoting institutional arrangements enabling integration of wetland management planning and river basin and coastal zone management.
- Strengthening CDD with adequate legal and administrative powers to regulate detrimental activities.
- Building capacity at all levels for technical and managerial skills for implementation of integrated management planning.

Workshop participants

ACKNOWLEDGEMENTS
The authors would like to thank the WRTC/CLDA and NCSCM researchers who contributed to this report card. They acknowledge the support of the Workshop on Coastal Ecosystem Restoration and Management (WREC) participants, and the extensive work of the workshop facilitators.

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References

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