# Imprint of cyclone *Phailin* on water quality of Chilika lagoon

The very severe cyclonic storm *Phailin*, a category-5 hurricane, was developed over the north of Andaman and Nicobar Islands on 9 October 2013. Subsequently, it propagated towards north-northwest and made landfall at the Gopalpur coast, Odisha on 12 October[1]. Chilika lagoon, the largest brackish water lagoon in Asia, is in close proximity to Gopalpur. This lagoon on the east coast of India lies between 19°28′–19°54′N and long. 85°05′–85°38′E (Figure 1). The lagoon spreads over three districts of Odisha, namely Puri, Khordha and Ganjam. It is well recognized for its wide array of flora and fauna. The water spread area varies between 1020 and 704 sq. km during monsoon and summer respectively[2]. Large areas of these coastal districts were inundated due to storm surge up to 3.5 m during *Phailin*.

The water quality of this lagoon largely depends on influx of freshwater as a result of precipitation and river runoff (52 rivers and rivulets). The average rainfall in this area is 1238 mm with a peak during the southwest monsoon period. Subsequent to the passage of *Phailin*, the lagoon experienced heavy precipitation amounting to a cumulative measure of 738 mm during the cyclone month (Figure 2). In this context, the water quality status of the lagoon was monitored after *Phailin* (during December 2013) in all the four sectors (northern sector (NS), southern sector (SS), central sector (CS) and outer channel (OC)) of the lagoon (Figure 1). As we have been monitoring the lagoon regularly, the post-*Phailin* observations were compared with those of the southwest monsoon of 2013 (pre-*Phailin*) and post-southwest monsoon of 2012. The results showed significant changes in the distribution of salinity, ammonia and silicate.

Salinity, the important aquatic parameter that influences water quality of any lagoon ecosystem, was in the range between 1.10 and 19.15 PSU during pre-*Phailin* period and between 2.90 and 20.30 PSU during the previous year, whereas it was in the 0.10–11.70 PSU range in the post-*Phailin* phase (Figure 3). The post-*Phailin* observations have indicated significant decline of salinity in all the sectors. The outer channel that connects the main lagoon to the Bay of Bengal was observed with highest decrease in salinity. The SS of the lagoon which generally receives saline water influx from Rushikulya estuary, through Palur Canal, was observed with average salinity value of 3.34 PSU, which was four times less than the salinity encountered during pre-*Phailin*. This might be due to the chocking of the mouth of Palur Canal. Taxonomic studies also showed freshwater phytoplankton species, viz. *Microcystis* sp., *Cylindrospermum* sp. and *Phormidium* sp. in the SS. The appearance of these cyanobacterial freshwater planktonic forms in this

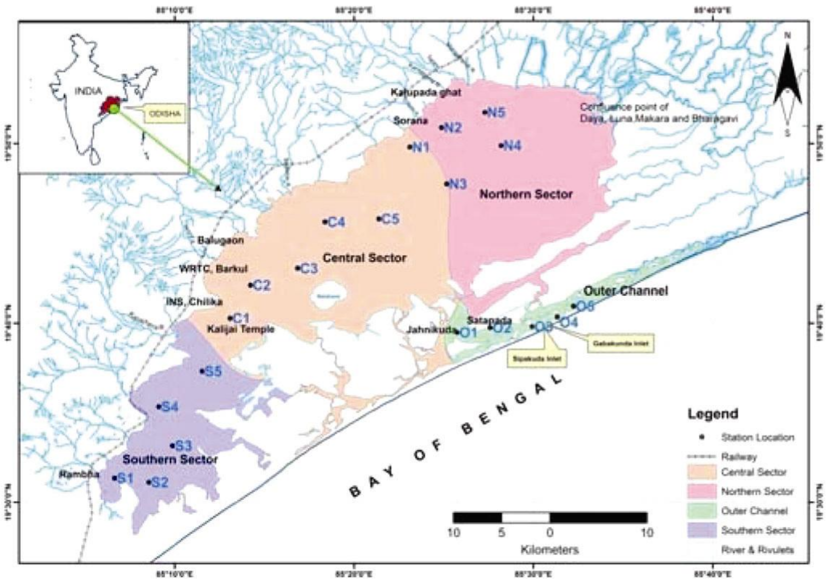


**Figure 1.** Map of Chilika lagoon showing all the sampling locations in different stations.

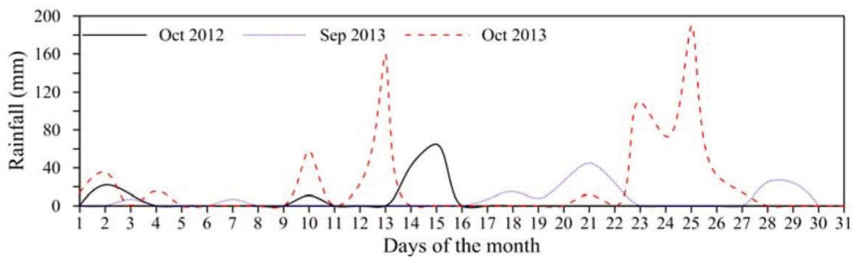


**Figure 2.** Diurnal variability of rainfall during October 2012, September 2013 (pre-*Phailin* period) and October 2013 (*Phailin* period).

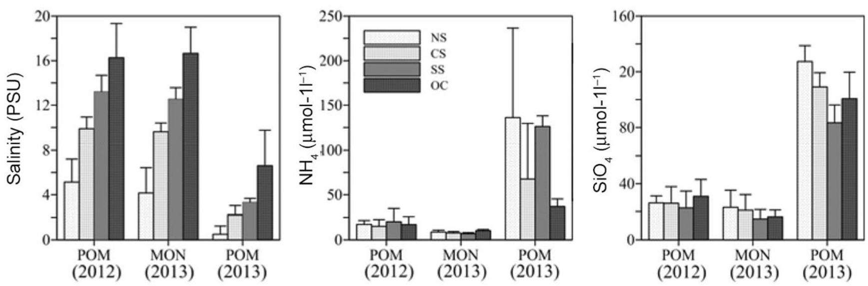


**Figure 3.** Average distribution of salinity, ammonia ($NH_4$) and silicate ($SiO_4$) in northern sector, central sector, southern sector and outer channel during post-*Phailin* (POM 2013), pre-*Phailin* (southwest monsoon of 2013; MON 2013) and post-southwest monsoon of 2012 (POM 2012).

particular sector is a subject of concern due to their toxic nature.

Among nutrients, silicate ($SiO_4$) and ammonia ($NH_4$) have shown significant increase during post-*Phailin* period in comparison to the pre-*Phailin* period and the same period during the previous year. Silicate concentration was in the range 7.59–43.38 μmol-$l^{-1}$ during pre-*Phailin* period and 11.23–40.38 μmol-$l^{-1}$ during the previous year, whereas it was in the range 19.11–235.19 μmol-$l^{-1}$ in the post-*Phailin* phase (Figure 3). Silicate enrichment in the lagoon might be due to the dilution of silicate-rich silt in the lagoon water resulting due to enhanced river influx. All the sectors were observed with high silicate concentration, among which maximum was in the NS as major tributaries of the lagoon empty into this region. It is established that a change in nutrient affects the phytoplankton composition, distribution and concentration. Therefore, increased concentration of silicate in the lagoon water may promote growth of diatomic species[3].

The concentration of ammonia was in the 5.76–12.05 μmol-$l^{-1}$ range during pre-*Phailin* period and 2.84–43.89 μmol-$l^{-1}$ during the previous year, whereas it was in the 62.05–140.77 μmol-$l^{-1}$ range in the post-*Phailin* phase (Figure 3). Except for OC, the other sectors were observed with high values of ammonia. On an average, ammonia concentration of the lagoon increased 11 and 5 times in comparison to pre-*Phailin* and the same period of the previous year respectively. The potential sources of ammonia into the coastal waters are from terrestrial run-off, excretion by zooplankton or demineralization of organic matter[4]. In the present case, freshwater influx was responsible for enrichment of ammonia in the lagoon. Ammonia is one of the most important nitrogen sources for phytoplankton growth. However, preference for ammonia is group-specific and generally observed in green algae and cyanobacteria. The appearance of freshwater cyanobacterial species in the SS might be also attributed to the enrichment of ammonia. The increased inputs of nitrogen as ammonium may result in a shift in phytoplankton community composition towards a dominance of cyanobacteria and green algae[5].

The heavy rainfall following landfall of cyclone *Phailin* has significantly altered the concentration of silicate and ammonia in the Chilika lagoon. This large variation may lead to alteration in phytoplankton species composition and in turn, will have profound implication on the food web and subsequent lagoon economy. The significant reduction in the salinity also resulted in the appearance of the toxic freshwater cyanobacterias that may be the subject of concern. The lagoon is internationally recognized for its fishery resources that support livelihood of millions of fishermen. The ecological disruption in the lower order food chain may have a significant impact on fishery. Hence continuous monitoring of the Chilika lagoon is essential to address the ecological alterations and recovery status.


1. Lotliker, A. A., Srinivasakumar, T., Reddem, V. S. and Nayak, S., *Curr. Sci.*, 2014, **106**(3), 360–361.
2. Gupta, G. V. M., Sarma, V. V. S. S., Robin, R. S., Raman A. V., Kumar, M. J., Rakesh, M. and Subramanian, B. R., *Biogeochemistry*, 2008, **87**, 265–285.
3. Officer, C. B. and Ryther, J. H., *Mar. Ecol. Prog. Ser.*, 1980, **3**, 83–91.
4. Ketchum, B. H., *Rapp. P. V. Reun. Cons.: Int. Explor. Mer.*, 1962, **153**, 142–147.
5. Domingues, R. B., Barbosa, A. B., Sommer, U. and Galvao, H. M., *Aquat. Sci.*, 2011, **73**(3), 331–343.



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# Assessing leopard occurrence in the plantation landscape of Valparai, Anamalai Hills

Interactions between humans and large carnivorous mammals have a long history in Africa[1] and Asia[2]. Some adaptable carnivores with wide ranges occur in landscapes with humans and their increasing interface with people sometimes results in conflicts[3–5]. Encounters between carnivores and people that lead to economic losses due to livestock depredation or injuries/deaths of humans and wildlife[6] may result in negative attitude towards wild carnivores and hinder management and conservation efforts[7].

Negative interactions between humans and carnivores in India may occur due to high human population densities and presence of these species even outside wildlife protected areas (PAs)[8,9]. Among carnivores of the family Felidae, the common leopard *Panthera pardus* has the largest distribution of any wild cat, a diversified diet, and the ability to use various forest types and human-modified land uses such as croplands, and tea and coffee plantations. As leopards in such areas are known to prey on livestock, domestic dog, pig and poultry, and occasionally attack humans resulting in injuries or deaths, they are implicated in conflicts with people[9]. Inadequate understanding of social and ecological context of such conflicts hinders the formulation of effective mitigation and management strategies[10].

The Valparai plateau in the Anamalai Hills of the Western Ghats, India has experienced human–leopard conflict in the past. Although leopards in the area primarily subsist on wild prey species