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Research Brief

University of Florida Institute of Food and Agricultural Sciences

LONG-TERM CHANGES IN THE SEDIMENT CHEMISTRY OF A LARGE SHALLOW SUBTROPICAL LAKE

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Lake Okeechobee, a large shallow subtropical lake, has been culturally eutrophied, largely from agricultural runoff of P. A large proportion of this P runoff has accumulated in the mud sediments. In 1988, a synoptic survey of Lake Okeechobee estimated that the surface 10 cm of mud sediment (44% of the lake) in Lake Okeechobee contained 28,600 metric tons of total P (TP). Flux measurements using sediment cores indicate that mud sediments may have contributed approximately 200 metric tons of dissolved P to the lake water column in 1988.

There is a concern that the accumulation of mud sediments has continued over the past decade both in depth and extent, and that it may be impacting water quality in certain lake regions. Phosphorus budgets of Lake Okeechobee for the last ten years indicate that P has accumulated in the sediments at the rate 303 metric tons of P year^{-1}, representing a net increase of 10 percent in TP mass of surface sediments. Since sediments tend to function as net long-term sinks for TP, external load reduction and other lake restoration efforts may be reflected in the forms and storage of P in sediments. To decrease external P loading to the lake, Best Management Practices (BMPs) have been adopted in the Lake Okeechobee drainage basin. Some BMPs have been in place for a decade. Therefore, we hypothesized that the effectiveness of improved farm-level P management practices may be apparent in changes of lake sediment P chemistry.

The objectives of this study were to determine: (1) the changes in extent of mud and other sediment types in the lake, (2) the storage and forms of P and N in sediments and (3) the influence of external loading on long-term changes in sediment composition. In the current study, we collected and analyzed sediment cores at the same sampling locations used during the 1988 synoptic survey. The chemical and physical data were mapped and used to determine the changes in the lake sediments over the past decade.

Nitrogen (N) and phosphorus (P) content and selected physico-chemical properties of Lake Okeechobee sediments were measured in 1988 and 1998. Based on these measurements,

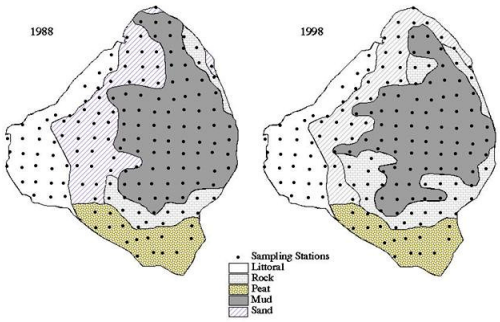

Figure 1. Maps of sediment zones and sampling locations in 1988 and 1998. Sediment zones are based on physical description of the surface 10-cm sediment.

sediments were classified as mud, littoral, peat, sand or rock (Fig. 1). Although some minor redistribution has occurred over the previous decade, mud sediments of Lake Okeechobee

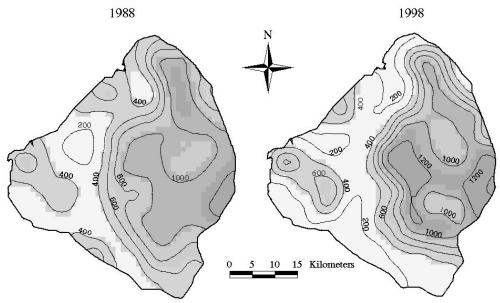

Figure 2. Map showing the total P content (mg/kg) in Lake Okeechobee surface (0-10 cm) sediment in 1988 and 1998.

essentially occupy the same total area. Total surface sediment P showed little overall change in the ten-year period (Fig. 2). However, lake-wide spatial patterns indicate some localized decreases of total P content in the littoral and northern regions of the lake.

Porewater dissolved reactive P showed significant increases at most sites, suggesting that the surface sediments are losing their ability to absorb soluble P. Nutrient management practices in the drainage basin did not lead to

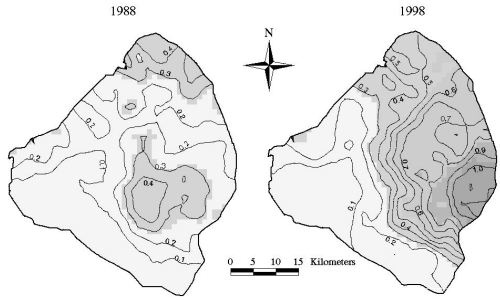

Figure 3. Maps of dissolved reactive P content of Lake Okeechobee surface (0-10 cm) sediments in 1988 and 1998.

decreased levels of N and P in the sediments of the lake. Measurements of nutrients within lake sediments are an indication of their past history. Despite a 19 percent increase of surface sediment TP estimated from P budgets, the sediments displayed little overall change in TP between 1988 and 1998 (Fig. 4). This can be attributed to variability in the samples, where the standard deviation was greater than 25 percent of the mean for mud sediments. There also was no significant change in TN, in part due to the high variability of the data. However, when lake-wide spatial patterns were examined, it appears that there may be some decreases, especially in TP content in the littoral and northern regions of the lake. Porewater DRP showed increases in all sediment regions, possibly indicating that the surface sediments are saturated with respect to their ability to buffer soluble P at lower solution concentrations. This is of concern because it indicates that more soluble P could be available to the water column and thus increase the eutrophication of Lake Okeechobee.

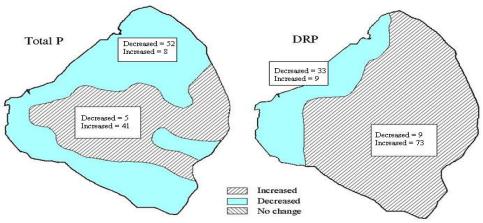

Figure 4.

Figure 4. Change detection maps of TP and DRP in Lake Okeechobee. For a station to be counted as increased or decreased, data had to differ by at least 15% between years.

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