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Research Bits

RECENT CHANGES IN SOIL TOTAL PHOSPHORUS IN THE EVERGLADES: WATER CONSERVATION AREA 3

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In this study we utilized two datasets from Water Conservation Area 3 (WCA-3) of the Everglades to produce maps of the recent changes in the spatial distributions of soil total phosphorus (TP). Changes in hydrology combined with increased nutrient loading have caused significant alterations to ecosystem structure and function in the Everglades wetlands. Nutrient concentrations in Everglades soils are integrators of long-term environmental conditions. Furthermore, nutrient inputs to these wetlands are primarily stored in the peat soils. Thus, the spatial distribution of soil nutrients can be used as a means of assessing long-term impacts to this system. As WCA-3 will be the centerpiece of future Comprehensive Everglades Restoration Plan activities, it is essential to quantify the recent changes in the spatial distributions of TP. Documenting such changes will provide feedback for future management and restoration of this area.

Specifically, we created maps of the distribution of soil TP in WCA-3 in 1992 and 2003. We utilized map algebra functions within a GIS to calculate change in soil TP maps for WCA-3 over this 11 year period. Such "change maps" express the data not in terms of simple concentrations but in terms of change in concentrations from 1992 to 2003. While change maps have been produced for soil properties such as total carbon in terrestrial ecosystems, to our knowledge, this is the first time change maps have been produced for TP in a wetland ecosystem.

The interpolated map for TP in 1992 (Fig. 1) revealed generally low and homogeneous TP concentrations across WCA-3. However, areas of 3AN and 3AS that received surface water inputs from water control structures had higher TP concentrations. For example, the TP concentrations observed in the western section of WCA-3 in an area near a water control structure ranged from 800-1,600 mg kg^{-1}. This was considerably higher than the values in the 300-600 mg kg^{-1} range that generally occurred in the remainder of WCA-3.

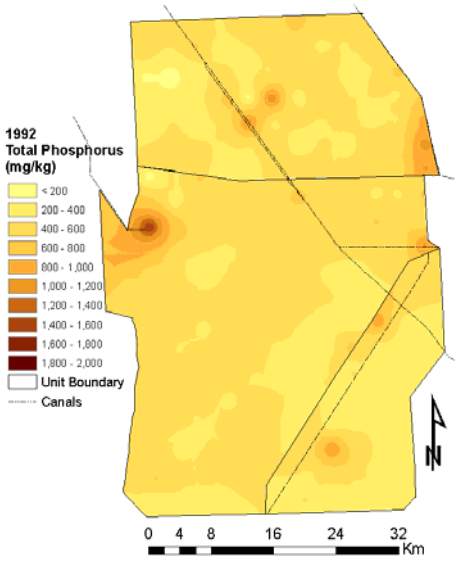

Fig. 1. Interpolated map of the spatial distribution of TP in the 0-10 cm layer of WCA-3 in 1992.

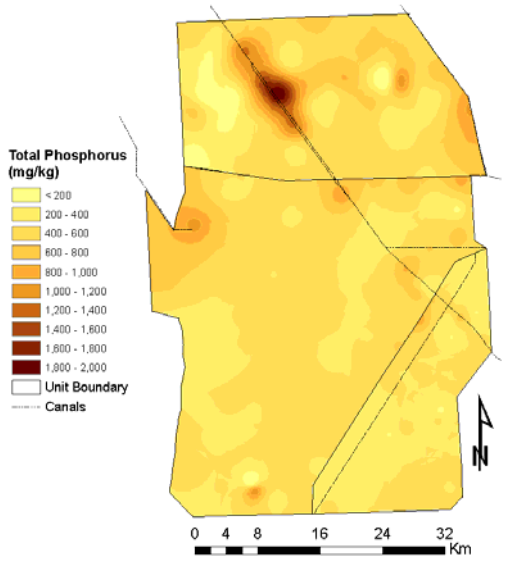

Fig. 2. Interpolated map of the spatial distribution of TP in the 0-10 cm layer of WCA-3 in 2003.

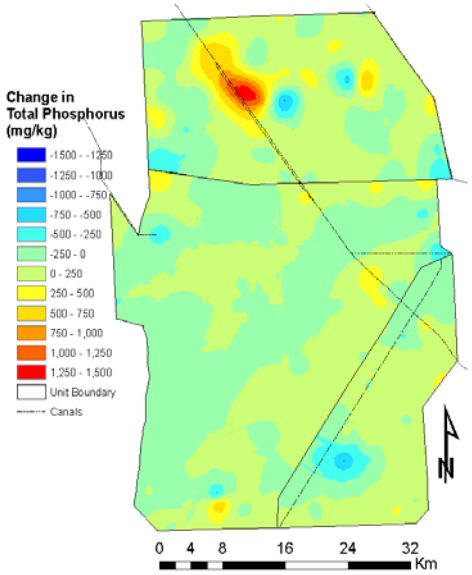

Fig. 3. Interpolated map of the change in the spatial distribution of TP from 1992 to 2003. (Reds, oranges, yellows = increase in TP; light blue, dark blue =decrease in TP.)

In general, the interpolated map of TP in 2003 (Fig. 2) showed a similar spatial pattern than that of 1992. Total P was highest in the peripheral areas of WCA-3 that received surface water inputs from canals. As in 1992, high TP concentrations in 2003 were observed in areas that have received inputs from water control structures. The 2003 map also indicated the TP hotspot that was noticeable in north central WCA-3 in 1992, had expanded considerably by 2003 and contained TP concentrations in the 1,200-2,000 mg kg^{-1} range.

As shown with the TP change map (Fig. 3), changes in TP ranged between ± 250 mg kg^{-1} for approximately 91 % of WCA-3. The area with the greatest increases in TP was the hotspot that had developed in the north central section of WCA-3. In this area TP showed increases from 500-1,500 mg kg^{-1} over the 11 year period. Large decreases in TP also occurred in areas to the east of section of WCA-3. Total P increased in approximately 53 % of the area of WCA-3. Historical background TP concentrations in the WCAs have been estimated to be less than 500 mg kg^{-1}. Adopting this estimate for WCA-3, according to our maps for 1992, 23 % of 3AN, 21 % of 3AS, and 16 % of 3B showed elevated TP levels in 1992. By 2003, elevated TPm levels had increased to cover 53 % of 3AN, 23 % of 3AS, and decreased to cover 10 % of 3B. Thus, during this 11 year period, we estimated that the area of WCA-3 with TP > 500 mg kg^{-1} increased at a rate of approximately 1 % $year^{-1}$. We also investigated changes in bulk density and volumetric P during this period.

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