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Research Brief

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SOIL PHOSPHORUS ENRICHMENT IN THE EVERGLADES WATER CONSERVATION AREA-2A

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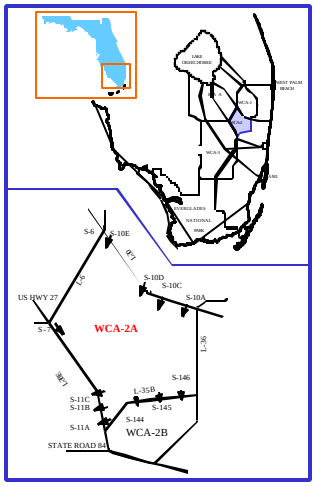
The Everglades, a mosaic of sawgrass marsh, sloughs and tree islands, once encompassed the vast expanse of south Florida from Lake Okeechobee to Florida Bay. Essentially all of the modern-day Everglades is contained within Everglades National Park and the Water Conservation Areas (WCAs). The WCAs were created some 40 to 50 years ago, primarily for the purposes of water storage, flood control and recreation. Since their creation, the WCAs have experienced sustained inputs of nutrient-laden drainage water from the Everglades Agricultural Area, and consequently have shown strong evidence of ecological change.

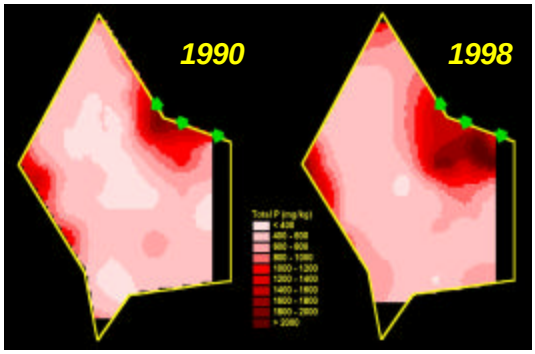


Among the more noticeable ecological changes in WCA-2A have been the transformation of native sawgrass (*Cladium jamaicense* Crantz) marsh and openwater sloughs to dense stands of cattail (*Typha domingensis* Pers. and *T. latifolia* L.) and replacement of endemic periphyton communities by algal species typically associated with more eutrophic waters . Soil P concentration in WCA-2A has been strongly linked to productivity, community structure of macrophytes, periphyton , and nutrient cycling. Increased biological production, stimulated by loading of P from external sources, has resulted in accelerated rates of peat accretion, and P storage in impacted areas near surface water inflows.

The overall objective of our study was to evaluate recent (1990 to 1998) changes in the spatial extent and patterns of soil P enrichment (total P concentration) in Everglades WCA-2A. The study was accomplished by conducting a comprehensive sampling and analysis of surface soil across WCA-2A. Comparison of results of the initial and follow-up studies formed the basis of our analysis of recent spatio-temporal patterns of soil P enrichment.

Surface soil (peat) and overlying flocculent material was sampled to a depth of 10 cm at 62 sites within WCA-2A during October 1990 and 1998, for analysis of total phosphorus (TP)

content. Geostatistical methods were used to create an interpolated grid of soil TP values across WCA-2A.



Approximately 73% (31, 777 ha) of the total land area of WCA-2A was considered P-enriched (soil total P > 500 mg kg^{-1}) in 1998, compared with 48% of the land area (20 829 ha) in 1990, an average increase of 1327 ha y^{-1}. Our results indicate that a soil P enrichment "front" has maintained its southerly progression into the relatively unimpacted interior sawgrass marsh of WCA-2A during the past several years.

Several decades of loading of nutrient-laden agricultural drainage is reflected in the now widespread P enrichment of surface soils in WCA-2A. Historical and current spatial patterns of soil P enrichment indicate that the main source of P loading has been the S-10 surface inflow structures along the northeastern boundary of the study area. A secondary source of P loading and subsequent soil P enrichment has been the area downstream of the S-7 pump station, at the western corner of WCA-2A.

Areal expansion of P-enriched soils in WCA-2A may be viewed as a P front advancing southward from the S-10 inflows across the unimpacted interior sawgrass marsh and slough region. Given that the P enrichment gradient is relatively broad, however, the front is actually quite diffuse and therefore difficult to map as such. If the P enrichment front is defined by the extent of the proposed soil P concentration that facilitates cattail invasion (650 mg kg^{-1}) its location has progressed from about 5.5 km south of S-10C in 1990 to 9.1 km in 1998. The movement is equivalent to an average rate of 436 m yr^{-1} into the interior marsh of WCA-2A. Using a similar approach we estimate that the 1000 mg P kg^{-1} front has advanced from 4.2 to 6.0 km to the south of S-10C during the same period, equivalent to a rate of 218 m yr^{-1}.

Soil P enrichment above historical background concentrations can be considered an indicator of ecological impact, or change. Dynamic patterns of soil P enrichment have been closely aligned with documented changes in vegetation patterns, most notably the change from native sawgrass marsh to cattail marsh. Results of this soil characterization study, showing a substantial increase in the extent of moderate soil P-enrichment, is indicative of the magnitude of recent increases in the ecologically-impacted area of WCA-2A.

Full text of this paper can be found at: DeBusk, W.F., S. Newman, and K.R. Reddy. 2001. Spatio-temporal patterns of soil phosphorus enrichment in Everglades WCA-2A. Journal of Environmental Quality (in press).

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