



Sampling Methodologies for Monitoring Water Quality at ENP Inflows

Background

The South Florida Water Management District (SFWMD) and Everglades National Park (ENP) share an interest in protecting the water quality of the southern Everglades, particularly the quality of waters entering the park. Water samples routinely are collected and analyzed for concentration of total phosphorus (TP), total nitrogen (TN), and other parameters in order to assess the health of the ecosystem through nutrient levels, flow dynamics, concentration spikes and gradients, and nutrient loads (the total mass of nutrients carried by water). Successful monitoring involves collecting data that represent actual water quality conditions. Any factor contributing to unrepresentative samples or inconsistent results must be identified and eliminated to protect the integrity of the data.

The cooperation between ENP and SFWMD builds on the mutual need for successful monitoring of the water quality in the C-111 Basin and along the northern boundary of ENP. The purpose of this study is to implement sampling regimes that were developed from previous monitoring experience gained at pump station S-5A located north of ENP in the northern Everglades. Data collected during this study will help validate new collection systems and methods that can be used to quantify detailed temporal dynamics of nutrient loading from canals to the Everglades marsh.

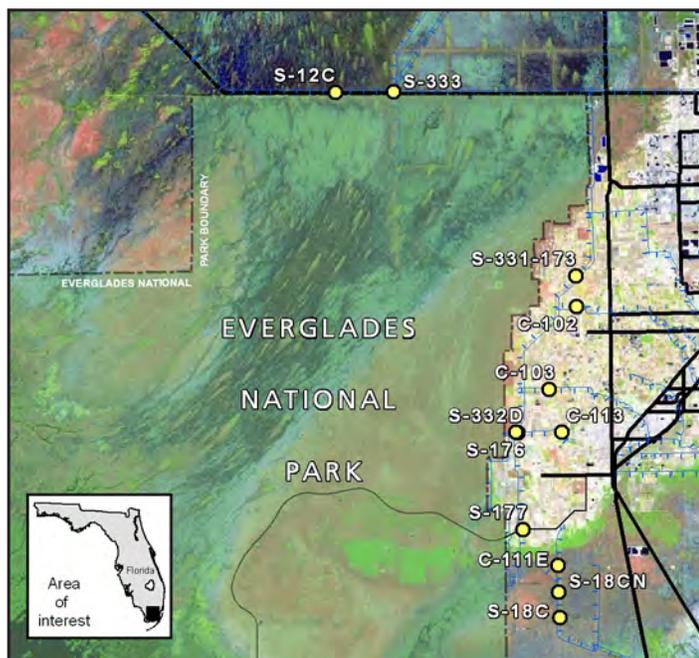


Figure 1. Location of water quality stations monitored in this study.

Project Objectives

Extensive additional monitoring is needed to determine the influence of contamination, flow dynamics, short-term concentration spikes, and concentration gradients on TP measurements, and to estimate TP loads entering ENP. This project was designed to collect nutrient information at frequent intervals and at multiple stations to meet the following objectives:

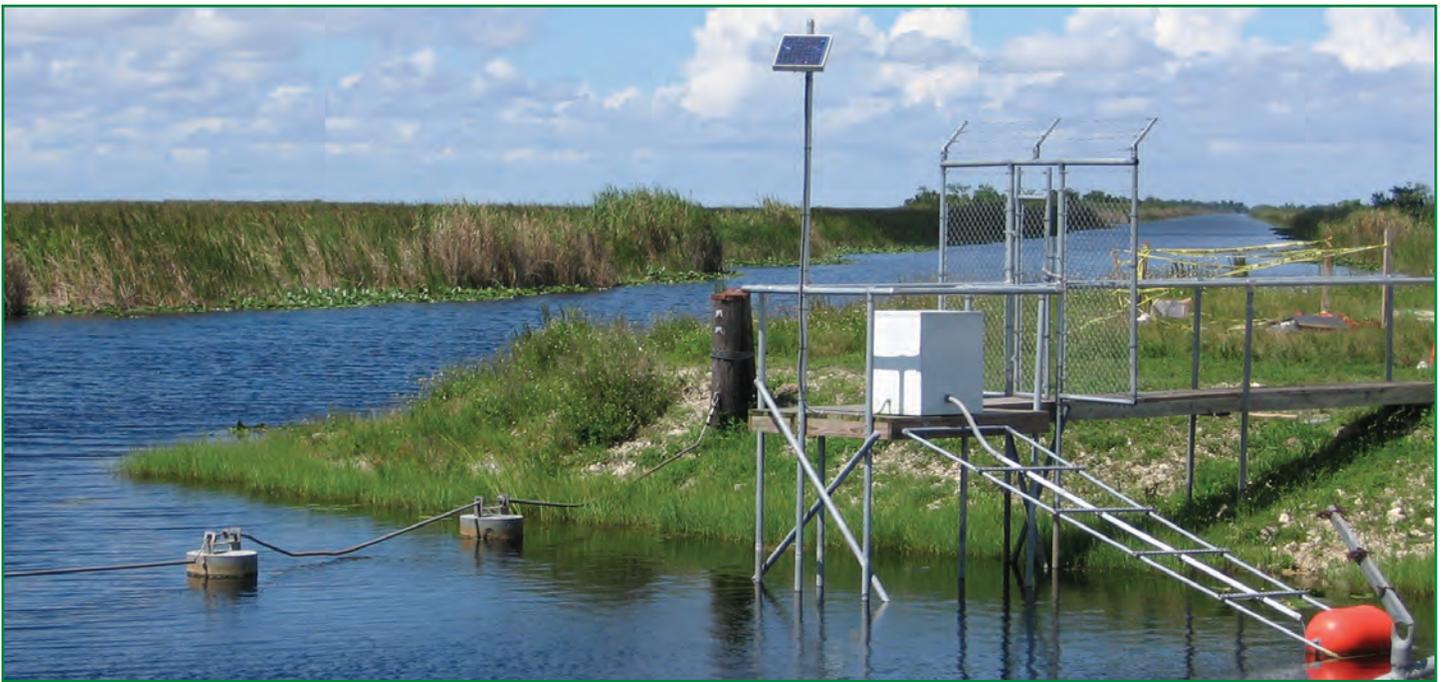
- Investigate differences in TP concentration between manually collected (grab) samples and autosampler-collected composite (ACC) samples.
- Install new water quality monitoring stations with time-proportional autosamplers to capture and analyze TP and TN dynamics.
- Investigate optimization of sample retrieval frequency (7 vs. 14 days) from autosamplers.
- Design and test a continuous flow-proportional system with an onsite TP analyzer.

Results

Task A: Monitoring data collected at stations S-18C and S-332D (Fig. 1) were examined to investigate the differences observed in TP concentrations measured in grab and ACC samples. A series of statistical tests revealed that median TP concentrations were significantly higher in ACC samples than in grab samples at both locations (Barnes, Ferland and Associates, Inc. 2006).

Task B: Ten autosamplers were installed and operated at different locations surrounding ENP from January 2006 to July 2007. Autosamplers were installed to evaluate water quality data with respect to sample collection methods (grab vs. time-proportional ACC) and frequency of collection and to determine spatial dependence among proximate sites. This investigation revealed that (Milian, Swain and Associates, Inc. 2008):

- The difference in TP concentration between grab and ACC samples collected at several stations was significant more often than not with the exception of two stations (S-12C and C-111E) that were predominantly surrounded by natural areas. Overall, the TP concentration in grab samples was significantly lower than the concentration in ACC samples.
- Frequently, the nitrate+nitrite concentration in grab and ACC samples was significantly different (grab > ACC) over the period of record and during the wet and dry seasons.
- In all cases, TP loads calculated with data from grab samples were significantly lower than loads calculated with data from ACC samples.



Water quality monitoring station S-333, located along the northern boundary of Everglades National Park. Photo by Bahram Charkhian, SFWMD.

Task C: The majority of installed autosamplers are programmed to collect flow-proportional samples composited over 7 days. A study was conducted at stations S-18C and S-332D to evaluate the feasibility of increasing the holding time from 7 to 14 days as part of an optimization and cost-saving effort. Statistically significant differences in TN concentration between samples composited over 7 days and over 14 days were noted for stations S-18C and S-332D (Milian, Swain and Associates, Inc. 2006).

Task D: An integrated sampling system (ISS) was designed and installed at pump station S-332D to obtain accurate measurements of TP loads entering the S-332D detention area. The ISS combined a continuous flow-proportional ACC-sampling unit and an automatic grab-sampling unit both connected to an onsite TP analyzer. By continuously sampling the water when the pumps were in operation, the ISS was able to capture short-duration drops and spikes in nutrient concentrations. Analysis and comparison of TP data sets from the ISS with the nearby S-332DX station that collects time-proportional ACC samples and grab samples revealed that (Charkhian et al. 2009):

- ◆ TP concentrations in continuous flow-proportional ACC samples collected by the ISS were significantly higher than concentrations in time-proportional ACC samples collected at S-332DX.
- ◆ TP concentrations in daily flow-proportional ACC samples collected by the ISS were significantly higher than concentrations in weekly grab samples collected at S-332DX.
- ◆ TP loads estimated from continuous flow-proportional ACC samples collected by the ISS were significantly higher than the loads estimated using the time-proportional ACC samples and grab samples collected at S-332DX.

Conclusions

These studies indicate that grab-sampling methods tend to underestimate nutrient concentrations and loads in comparison to ACC-sampling methods. In addition, the flow-proportional ACC samples, collected by the ISS, provided accurate measurement of TP concentrations and estimation of nutrient loads discharged into the S-332D detention basin. Factors that contribute to differences in TP concentrations measured at the same or proximate locations may be related to sampling methods (grab versus ACC), sampling location differences, frequency of data collection, and changes in SFWMD field sampling procedures.

Literature Cited

- Barnes, Ferland and Associates, Inc. 2006. Total phosphorus variation in grab and autosamples at ENP inflow stations. Final report to ENP submitted by SFWMD.
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- Milian, Swain and Associates, Inc. 2008. Analysis of water quality data collected at 10 monitoring sites adjacent to the Everglades National Park to investigate the influence of flow dynamics and short-term spikes on concentration and load estimates. Final report to ENP submitted by SFWMD.

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