Appendix 12-3: Regional Long-Term Annual Trends and Patterns in Biscayne Bay (1980–2005)

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INTRODUCTION

The following section summarizes long-term annual average water quality parameters for each of the six sub-regions of Biscayne Bay: Oleta River, North Bay, Miami River, North-Central Bay, South-Central Bay, and South Bay (**Figure 1**). The period of record for the nutrient and turbidity data available for inclusion in this appendix spans Water Years (beginning in May and ending with April) 1981 through 2005 (WY1981–WY2005). The period of record for canal flows and salinity data spans WY1980–WY 2005. The water quality parameters presented here are ammonia-nitrogen (NH_3 + NH_4^+), nitrate plus nitrite-nitrogen (NO_X), total phosphate (TP), turbidity, and salinity. Miami-Dade County Department of Environmental Resource Management (DERM) water quality samples were collected at various depths at various times. Data was available most consistently for samples collected at a depth of 1 meter (m) and are therefore used to examine long-term annual water quality trends (**Figure 3**). However, because salinity data at 1-m depth were unavailable for water years prior to 1988, salinity data (**Figure 2**) is averaged throughout the water column (i.e., averaged for all depths for all stations). Regional data is averaged for all stations within each of the six sub-regions (**Table 1**). Data is reported as annual averages over the course of the typical water year.

Table 1. Biscayne Bay water quality regions and DERM water quality sampling stations.

Oleta River	North Bay	Miami River	North-Central	South-Central	South Bay
BB01	BB05	BB19	BB27	BB36	BB45
BB02	BB06	BB22	BB28	BB37	BB46
BB03	BB07	BB23	BB29	BB38	BB47
BB04	BB09	BB24	BB31	BB39A	BB48
	BB10	BB25	BB32	BB41	BB50
	BB11	BB26	BB34	BB42	BB51
	BB14		BB25	BB43	
	BB15			BB44	
	BB16			BB53	
	BB17				
	BB18				

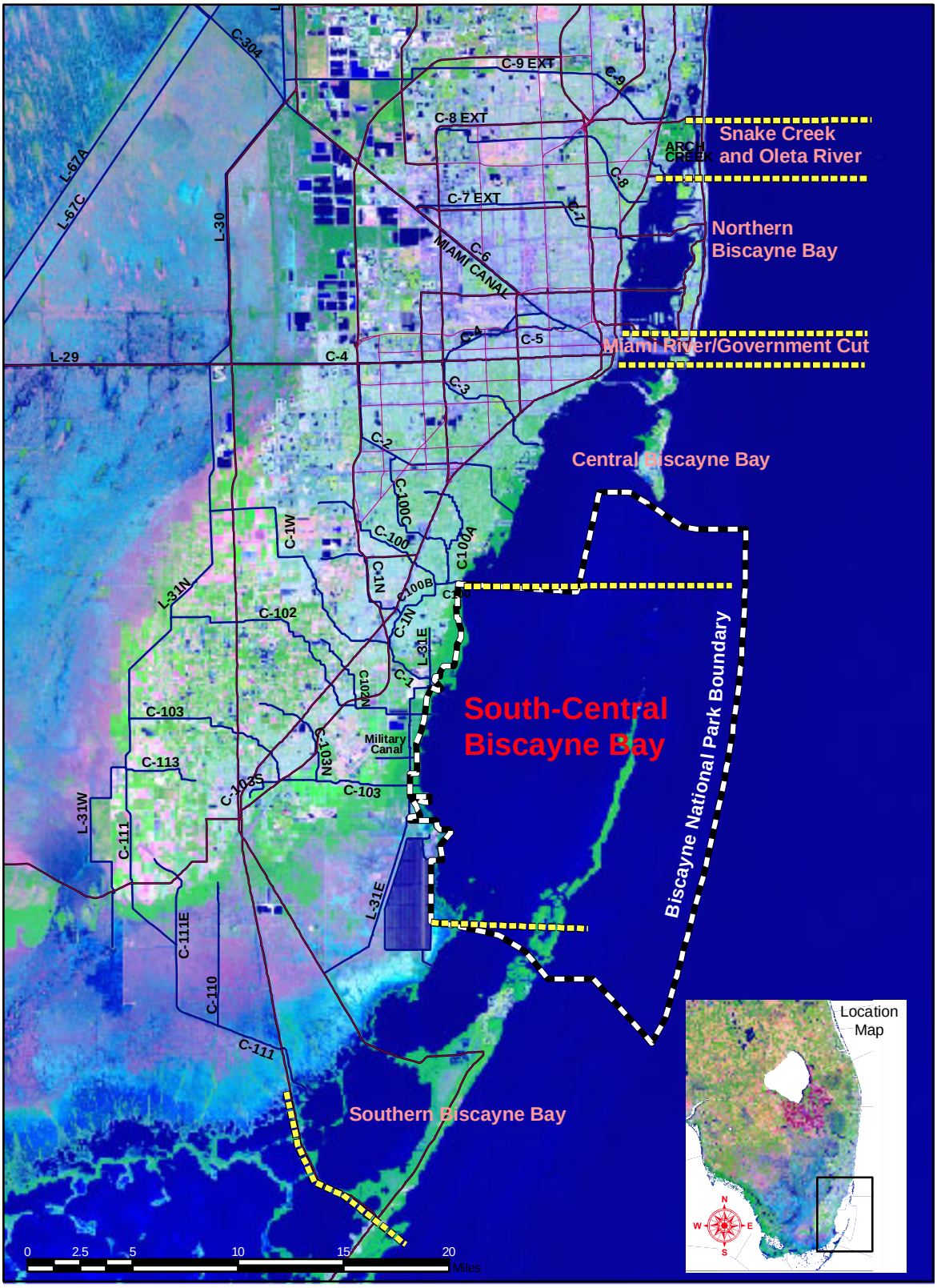

Figure 1. The geographic location and approximated sub-regions of Biscayne Bay.

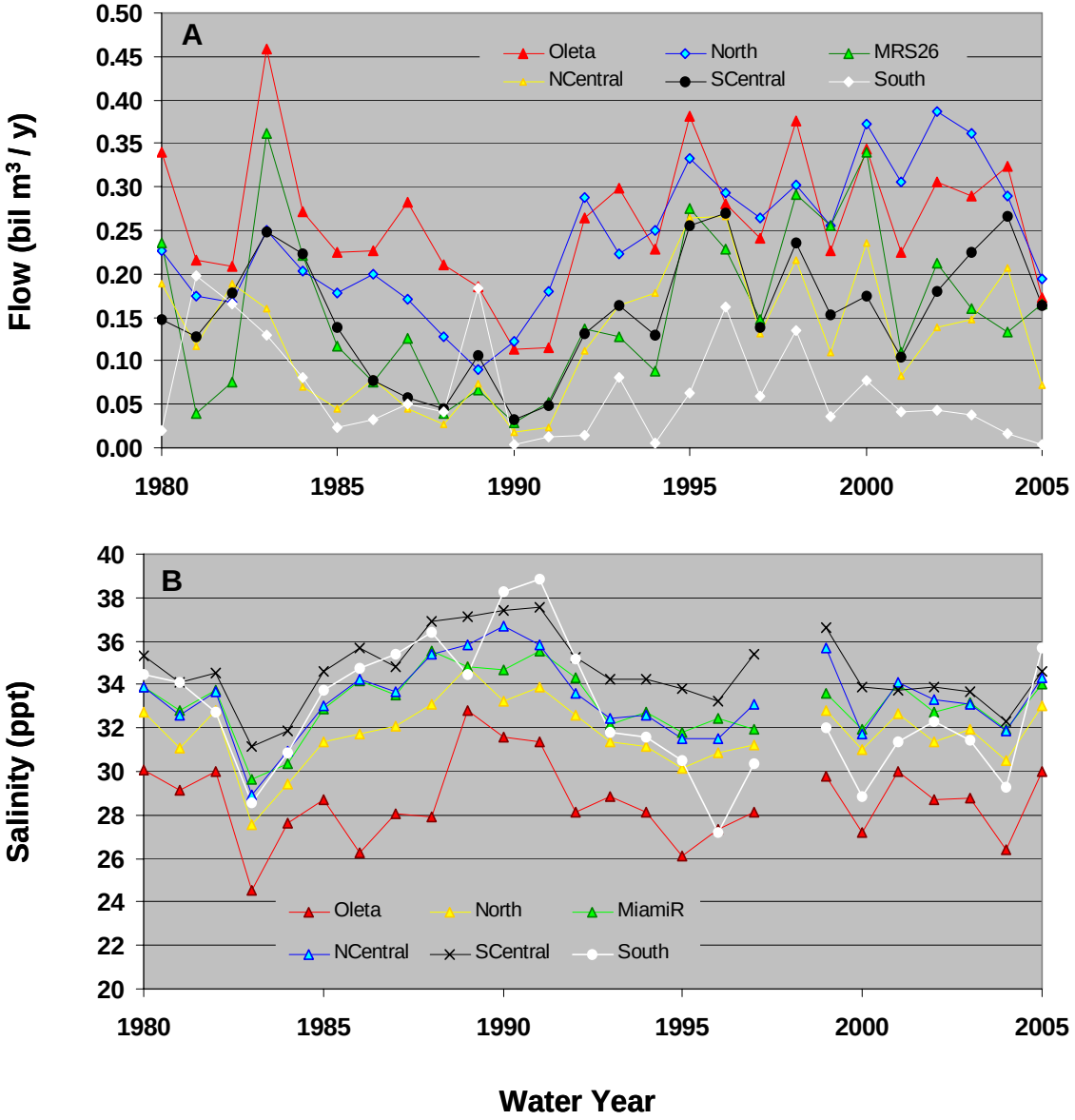

Figure 2. Long-term regional average annual values for (A) freshwater canal flows into sub-regions of Biscayne Bay and (B) salinity within each sub-region of Biscayne Bay.

LONG-TERM ANNUAL TRENDS AND PATTERNS

Total freshwater flows into Biscayne Bay from canals were generally greater in the northern regions (Oleta River, North, and Miami River regions) relative to the southern regions, particularly since 1990 (**Figure 2**, Panel A). Long-term annual average salinities were inversely lower in the north and higher in the south, with the exception of salinities in the South Bay region, where annual average salinities were more consistent with values measured in the northern regions from 1993 through 2004 (**Figure 2**, Panel B).

Average annual data for ammonium, total phosphate, nitrate plus nitrite and turbidity were analyzed for long-term trends using linear regression of concentration on year and F-values statistics. Mean ammonia concentrations were similar for all regions of Biscayne Bay, and showed no long-term trends for the period of record prior to WY2001, with the exception of decreasing ammonia observed in the Oleta River region. Since WY2001, ammonia concentrations have increased in all regions of the bay (**Table 2** and **Figure 3**, Panel A). Mean NO_X, TP, and turbidity all exhibited decreasing long-term trends for the period of record (**Table 2** and **Figures 3**, Panels B–D). Although NO_X concentrations were higher in the Oleta River region, the interannual pattern of NO_X in the Oleta River region was similar to patterns observed in other regions of Biscayne Bay for most years (**Figure 3**, Panel B). Regionally, TP concentrations were higher in the north and lower in the south (**Figure 3**, Panel C), similar to the regional pattern observed for freshwater canal flows into the bay (**Figure 2**, Panel A). Interannual regional turbidity patterns also ranged from high in the north to low in the south, with the exception of the Oleta River region (northern most region), where turbidity values were similar to those observed in the North-Central Bay region (**Figure 3**, Panel D).

Table 2. Long-term annual average water quality trends for the sub-regions of Biscayne Bay. Values are p-values of F-tests evaluating the null hypothesis that slopes of linear regressions of concentrations on year are zero. For example, $p<0.10$ indicates a slope (a change in concentration over time) statistically different from zero with 90% confidence. Linear regressions and F-values were calculated using Microsoft Excel computer software. F-values were compared to critical F-values to determine p-values reported here**. No significant trend is indicated by n.s.

	1981-2001	2001-2005	1981-2005	1981-2005	1981-2005
	$NH_3 + NH_4^+$	$NH_3 + NH_4^+$	TP	NO_X	Turbidity
Oleta River	$p < 0.10$	$p < 0.10$	$p < 0.005$	$p < 0.10$	$p < 0.005$
North	n.s.	$p < 0.025$	$p < 0.025$	$p < 0.005$	$p < 0.005$
Miami River	n.s.	$p < 0.025$	$p < 0.025$	$p < 0.005$	$p < 0.005$
North Central	n.s.	$p < 0.005$	$p < 0.005$	$p < 0.005$	$p < 0.005$
South Central	n.s.	$p < 0.005$	$p < 0.01$	$p < 0.01$	$p < 0.005$
South	n.s.	$p < 0.05$	$p < 0.005$	$p < 0.005$	$p < 0.10$

**Critical F-values and p-values taken from Table A-6 in *Steel, R.G.D., and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrial Approach, 2nd Edition. McGraw-Hill, Inc. pp. 633.*

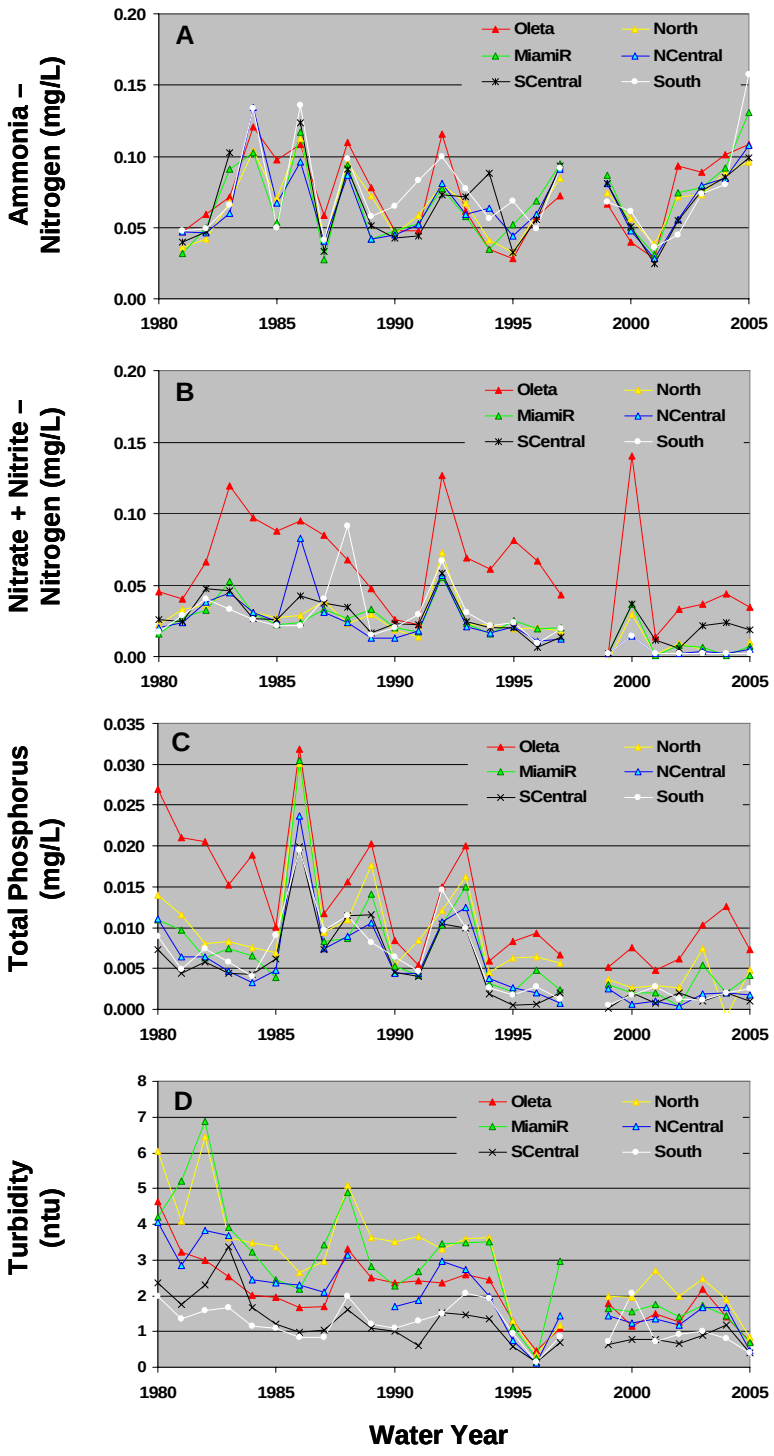

Figure 3. Regional average annual values for inorganic nitrogen: (A) ammonia, (B) nitrate plus nitrite, (C) total phosphate phosphorus, and (D) turbidity within Biscayne Bay.