Florida Bay Watch

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Goals

Florida Bay Watch was a volunteer-driven program with a two-fold mission in Florida Bay and the Florida Keys: 1) to collect scientific information about the health and status of the Florida Bay ecosystem, and 2) to involve concerned citizens of the Keys in formulating solutions for the problems of Florida Bay. Through the Florida Bay Watch program, volunteers were trained in basic methods of sampling water quality, which they employed to collect water quality data and samples for one or more Florida Bay Watch projects. These projects were designed to augment studies conducted by scientists in public agencies and academic institutions.

Florida Bay Watch was a partnership. The Nature Conservancy (TNC), a private, non-profit conservation organization, was the managing partner, providing staff support and coordination for the Florida Bay Watch program. Part of the program's commitment to volunteers, scientists, and agencies that made the program possible was the presentation of results of various Florida Bay Watch projects and the dissemination of Florida Bay Watch data to interested parties.

Methods

Nearshore Fixed Stations

Water quality data were obtained from a series of fixed stations located throughout the Florida Keys. Sampling at some stations began as early as June 1994; the addition of new stations and discontinuation of others occurred over the course of the project (until 2002). Stations included plugged canals, open-ended canals, boat basins, and natural/unobstructed shorelines. Besides these obvious differences, sites varied in many aspects, including water depth, circulation and flushing rates, nearby vegetation, and type and number of adjacent On-Site Sewage Disposal Systems (OSDSs). Most volunteers sampled from docks, seawalls, or the shoreline.

Volunteers who routinely sampled at nearshore water quality stations were trained in basic methods of sampling water quality. Training included instruction on filling out data forms, techniques for calibrating field equipment, and emphasis on careful handling of water samples to ensure the integrity of the data. The TNC Marine Conservation Program Manager supervised a trained intern who periodically evaluated volunteers on the care and manner with which they sampled, and all data went through a quality-control check to identify possible sampling errors. A quality-assurance plan for this project was filed with the Region IV Water Management Division of the U.S. Environmental Protection Agency.

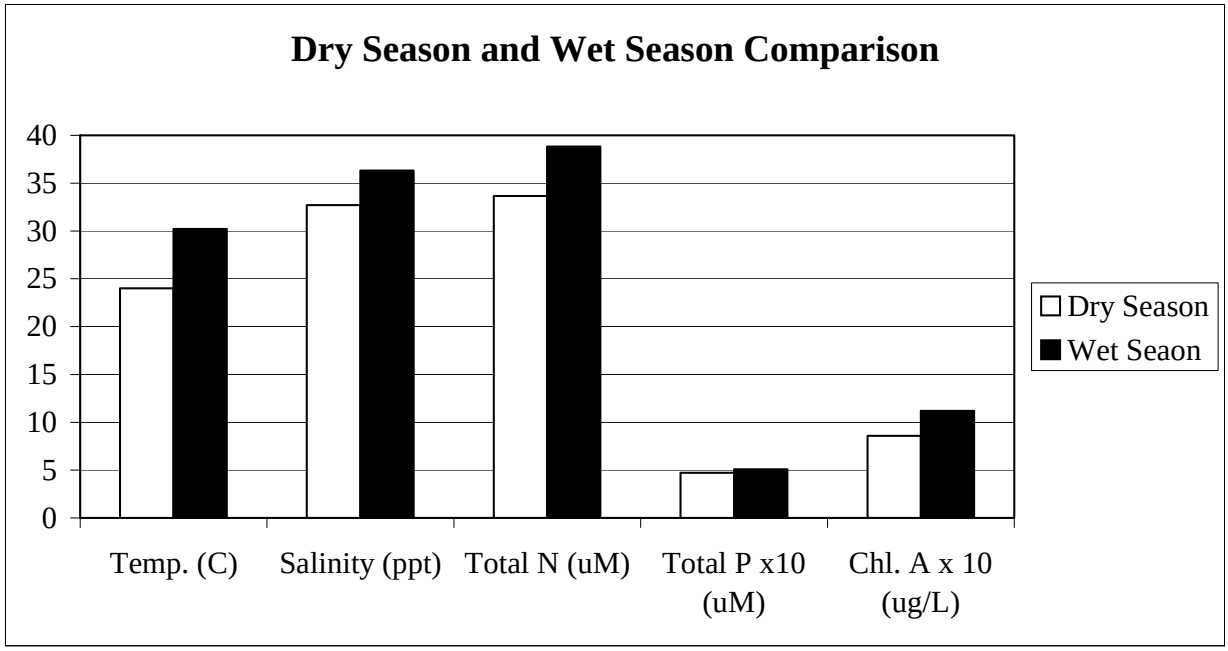
Volunteers were instructed to sample weekly at their station during a low tide. Data sets for most stations followed this routine, with some exceptions. The following information was recorded on a standardized data form: date, time, tide, Beaufort number for wind and sea state, wind direction, current strength, current direction, Secchi depth, time of Secchi reading, sea-surface temperature, specific gravity, sea surface salinity (from hydrometer tables), and rainfall in the last 24 hours. In addition, volunteers collected a water sample to be analyzed for total nitrogen (TN) and total phosphorus (TP) concentration, and filtered a second sample for determination of the concentration of chlorophyll *a* (Chl. A). Analyses of water samples for nutrients and

chlorophyll was conducted by the analytical laboratory at the Southeast Environmental Research Center, Florida International University. Volunteers were trained to collect, handle, and store water samples properly to meet the quality-assurance/quality-control standards of the laboratory.

Content Keys
Research conducted by coral reef scientists at the Florida Fish and Wildlife Research Institute showed that there was a drastic decline prior to 1997 in the amount of live coral at the Content Keys, north of Big Pine Key. A special Florida Bay Watch station was established at this locality in August 1997 to provide water quality data in conjunction with ongoing biological monitoring of the reef. The protocol for this station followed that of the nearshore fixed stations (see above) with two exceptions. First, there were no data on rainfall during the previous 24 hours. Second, in addition to the seawater samples collected at the surface, additional samples were collected one meter above the bottom using a Wildco Water Bottle Kit. The water depth at this site (24°49.323 N, 83°29.335 W) was approximately 6 m.

Key West Salt Ponds
Like all Keys waters, the Salt Ponds in Key West are naturally low in nutrients. This ecosystem, Key West's only remaining tidal wetland, is home to various species of plants, birds, and other animals. Increased nutrients from stormwater runoff or wastewater disrupt the system. Several sampling stations were established in the Salt Ponds in March 2001 to provide a year-long water quality data set. The protocol for these stations followed that of the nearshore fixed stations (see above).

Findings to Date
Nearshore Fixed Stations
A long-term analysis of data collected from all stations since the inception of the program was conducted. A total of 8,510 sampling events were conducted since 1994. Five parameters were analyzed: temperature, salinity, TN, TP, and Chl. A. Student's t-tests were performed to determine significant differences. A p value < 0.05 was defined as statistically significant. Because of high numbers of samples and low variances, many significant differences were detected. Figure 1 illustrates values for these parameters collected in the wet and dry season. All five parameters were significantly greater during the wet season (denoted by asterisks). Data from all bayside and oceanside stations are presented in Figure 2. Salinity was significantly greater for oceanside stations, while samples collected from the bayside were significantly greater for TN, TP, and Chl. A. There was no significant difference between oceanside and bayside temperatures. Figure 3 illustrates the differences between developed and natural shorelines. Developed shorelines were defined as canals and boat basins. Natural shorelines were undeveloped areas such as beaches and the ends of docks. Temperature, TN, and Chl. A levels were significantly higher in developed shorelines (canals/boast basins) compared to natural shorelines. A comparison between different geographic regions in the Keys is shown in Figure 4. Temperature values were similar for all three regions, as were salinity and TP. The upper Keys had the highest TN and Chl. A levels.

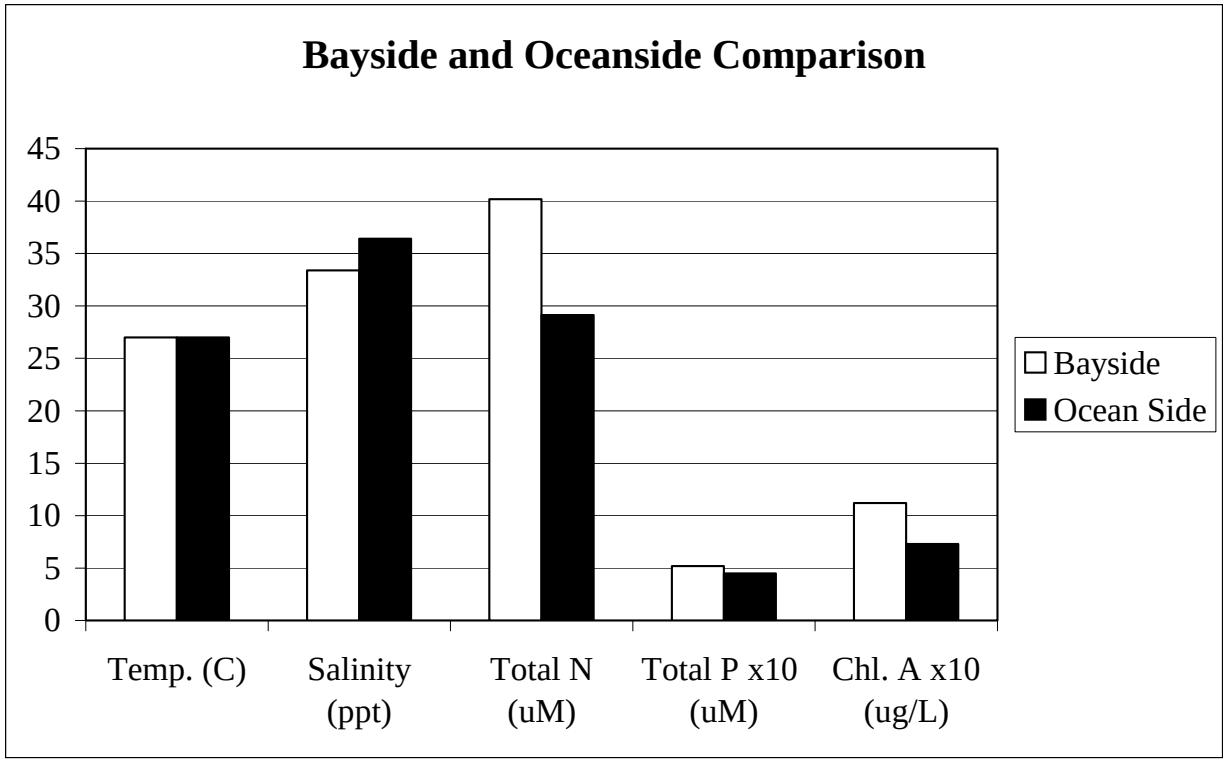


Dry Season					
	Temp	Salinity	Total N	Total P	Chl. A
Mean	24.0	32.7	33.64	0.47	0.86
Std. Error	0.1	0.1	0.24	0.01	0.02
Count	4290	4210	4247	4229	4112

Wet Season					
	Temp*	Salinity*	Total N*	Total P*	Chl. A*
Mean	30.2	36.3	38.82	0.51	1.12
Std. Error	0.0	0.1	0.33	0.01	0.15
Count	4061	3936	3971	3928	3775

Figure 1. Comparison of Dry Season and Wet Season water quality parameters.

The results of this study generally support a model of nearshore phosphorus loading of Florida Bay from various locations throughout the Keys, with an associated increase in the concentration of phytoplankton. Previously, when we compared nearshore Florida Bay Watch data for the five bayside, upper Keys stations sampled November 1996 – October 1997 at developed sites with data collected by FIU at five offshore stations in Florida Bay, we saw why. The concentration of Chl. A at developed, bayside shorelines in the upper Keys (0.86 μg/L) was more than twice the offshore concentration in Florida Bay (0.33 μg/L). Total phosphorus also was elevated at developed shorelines (0.49 μM), nearly three times the offshore value (0.17 μM). However, total nitrogen was virtually the same at developed shorelines (41.3 μM) and offshore (39.4 μM).



Bayside					
	Temp.	Salinity	Total N*	Total P*	Chl. A*
Mean	27.0	33.4	40.18	0.52	1.12
Std. Error	0.1	0.1	0.24	0.01	0.02
Count	5351	5186	5245	5204	5067

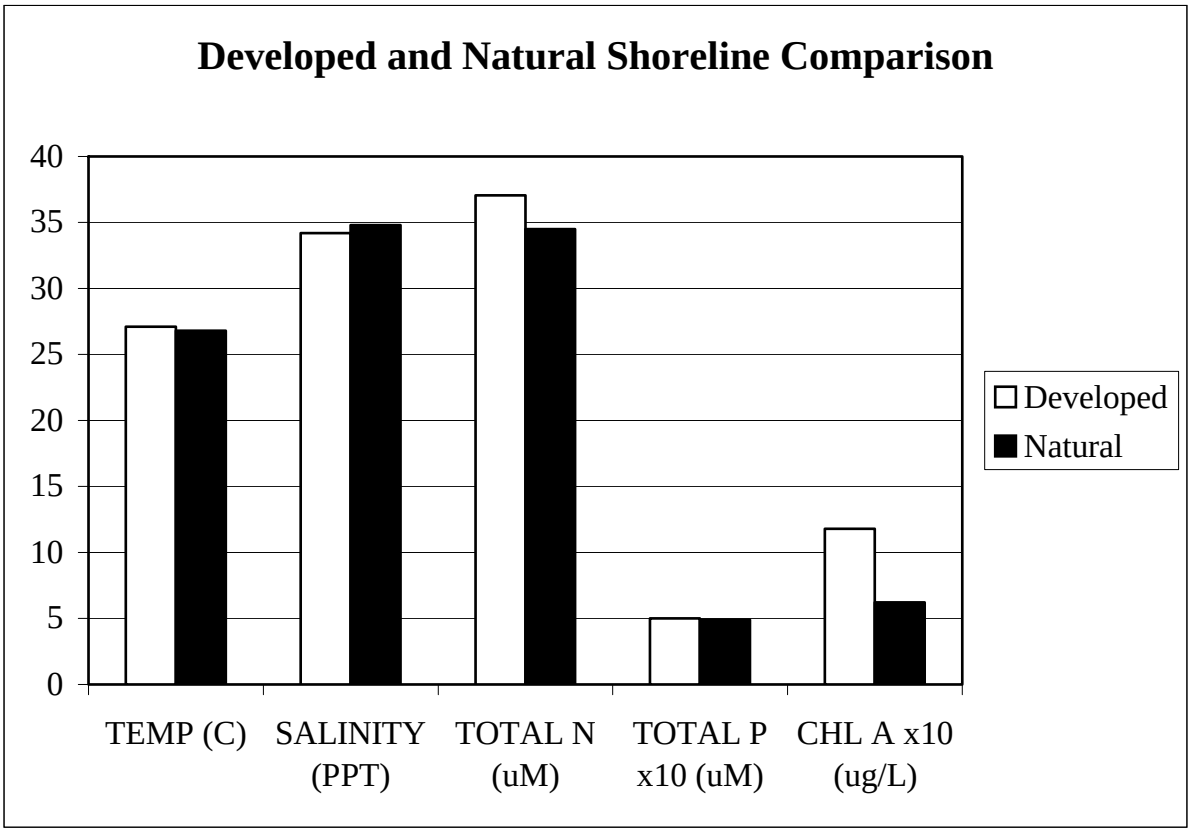
Oceanside					
	Temp.	Salinity*	Total N	Total P	Chl. A
Mean	27.0	36.4	29.12	0.45	0.73
Std. Error	4.2	0.1	0.31	0.01	0.20
Count	3042	2998	3016	3007	2873

Figure 2. Comparison of bayside and oceanside water quality parameters.

Content Keys

A graph comparing temperature, salinity, TN, TP, and Chl. A for samples collected at the surface and at depth is shown in Figure 5. These samples were collected between August 1997 and June 2000. Salinity was significantly higher for samples collected near the surface, while TN, TP and Chl. A levels were significantly higher for samples collected at depth. Since the mid-1990's,

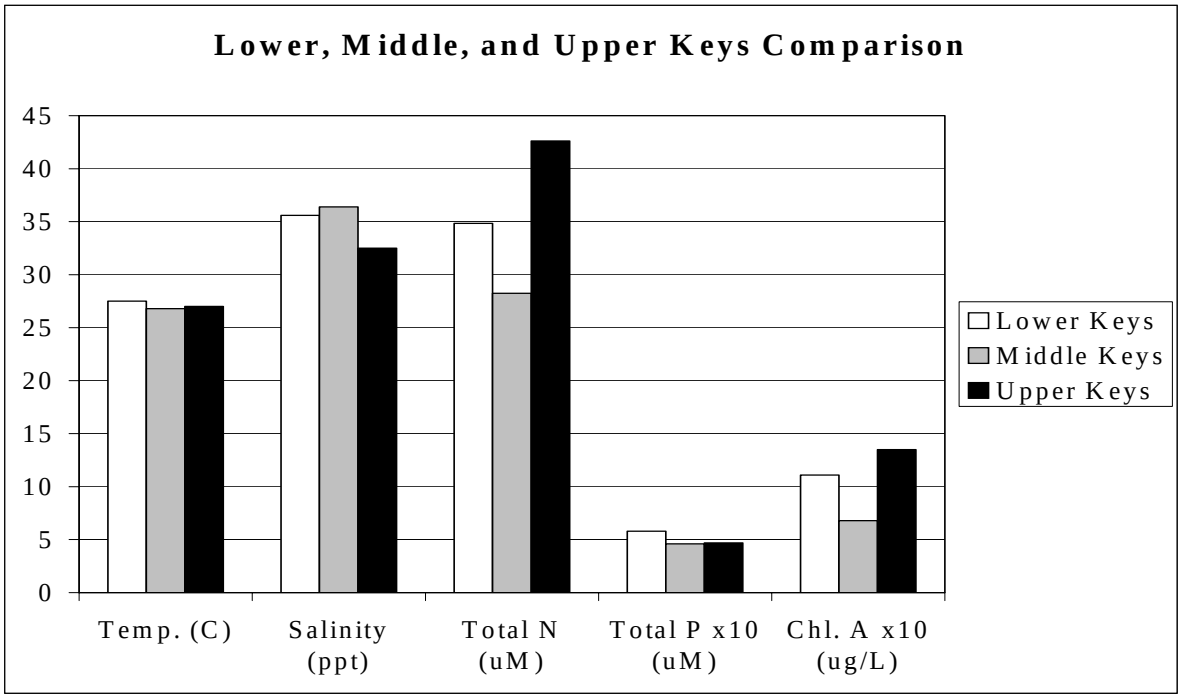
coral health in this area has declined. These higher nutrient and Chl. A levels at depth may have had a negative impact on coral health.



Developed					
	Temp.*	Salinity	Total N*	Total P	Chl. A*
Mean	27.1	34.3	37.05	0.50	1.18
Std. Error	0.1	0.1	0.26	0.01	0.11
Count	5356	5239	5300	5255	5063

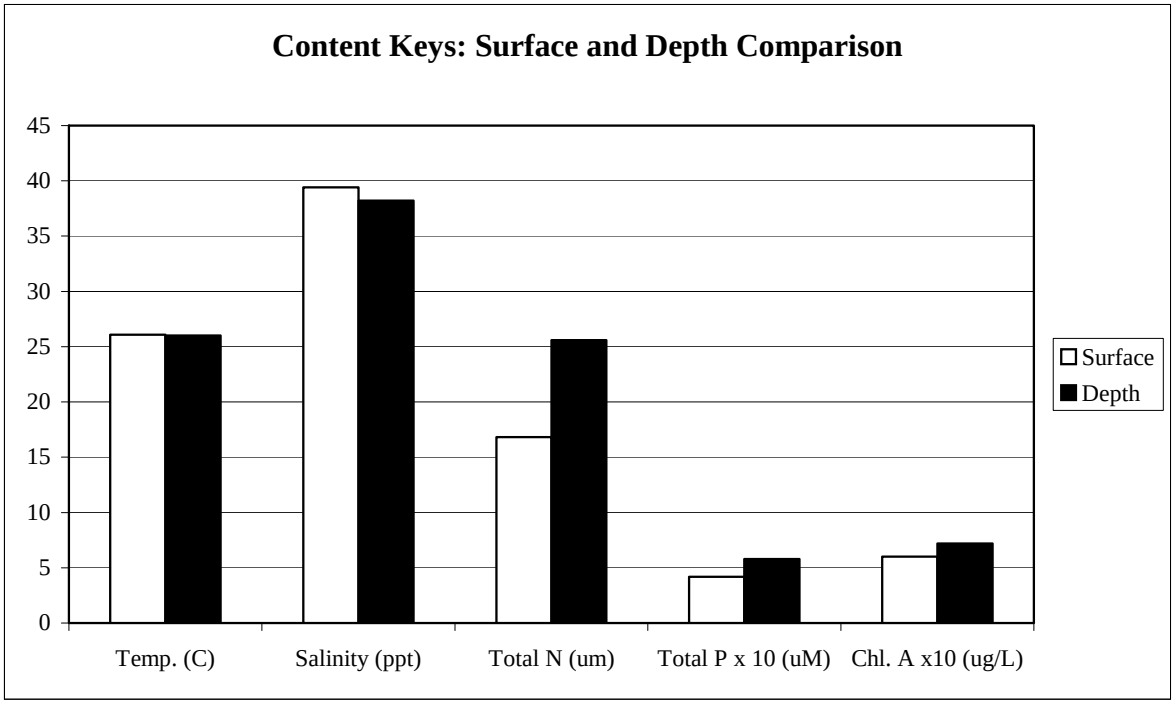
Natural					
	Temp.	Salinity *	Total N	Total P	Chl. A
Mean	26.8	34.8	34.50	0.49	0.62
Std. Error	0.1	0.1	0.32	0.01	0.02
Count	2999	2908	2918	2905	2824

Figure 3. Comparison of developed and natural shoreline water quality parameters.



Lower Keys					
	Temp.	Salinity	Total N	Total P	Chl. A
Mean	27.5	35.6	34.83	0.58	1.11
Std. Error	0.1	0.1	0.39	0.02	0.05
Count	1794	1731	1772	1689	1734
	Middle Keys				
	Temp.	Salinity	Total N	Total P	Chl. A
Mean	26.8	36.4	28.24	0.46	0.68
Std. Error	0.1	0.1	0.11	0.01	0.02
Count	2810	2767	2774	2778	2623
Upper Keys					
	Temp.	Salinity	Tot. N*	Total P	Chl. A*
Mean	27.0	32.5	42.61	0.47	1.35
Std. Error	0.1	0.1	0.29	0.01	0.16
Count	3794	3691	3712	3734	3601

Figure 4. Comparison of Lower, Middle, and Upper Keys water quality parameters.



Surface					
	Temp.	Salinity *	Total N	Total P	Chl-a
Mean	26.1	39.4	16.82	0.42	0.60
Std. Error	0.3	0.3	0.66	0.02	0.04
Count	184	184	176	176	171

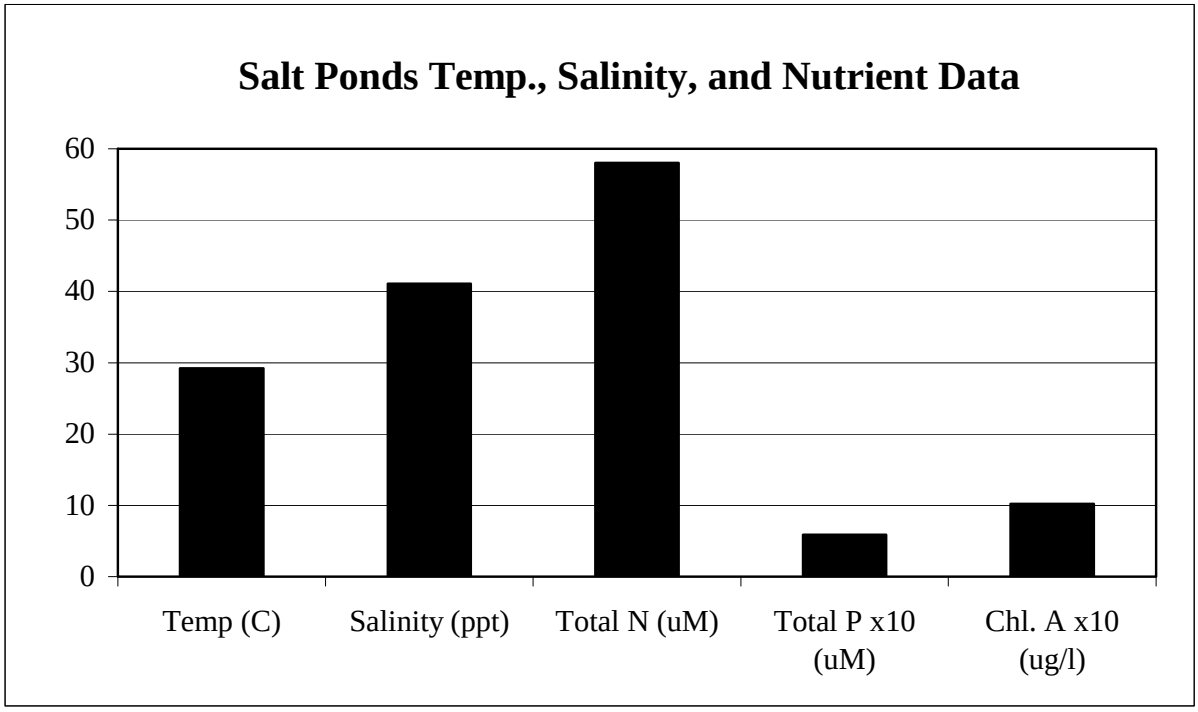
	Depth				
	Temp.	Salinity	Total N *	Total P*	Chl-a*
Mean	26.0	38.2	25.59	0.58	0.72
Std. Error	0.3	0.3	1.52	0.05	0.05
Count	177	174	169	169	164

Figure 5. Comparison of Content Keys surface and subsurface water quality parameters.

Key West Salt Ponds

Salt Ponds water quality was monitored from March 2001 through May 2002 (Fig. 6). Average temperature, salinity, and TN values were all higher in the Salt Ponds with respect to all lower

Keys nearshore fixed stations. With shallow depths and high rates of evaporation, the Salt Ponds are typically characterized by higher average temperature and higher salinity than nearshore waters. The average TN value in the Salt Ponds (58.0 µM) was higher than any fixed nearshore station average in the Florida Bay Watch database. The source of these increased nutrients may be from stormwater runoff retention, wastewater, or natural inputs such as bird droppings.



	TEMP	SALINITY	TOTAL N	TOTAL P	CHL A
Mean	29.2	41.1	58.04	0.59	1.02
Std. Error	0.6	2.2	5.20	0.06	0.19
Count	77	77	60	59	58

Figure 6. Salt Ponds water quality parameters.