2010

2010 Annual Report of the Water Quality Monitoring Project for the Water Quality Protection Program of the Florida Keys National Marine Sanctuary (Summary)

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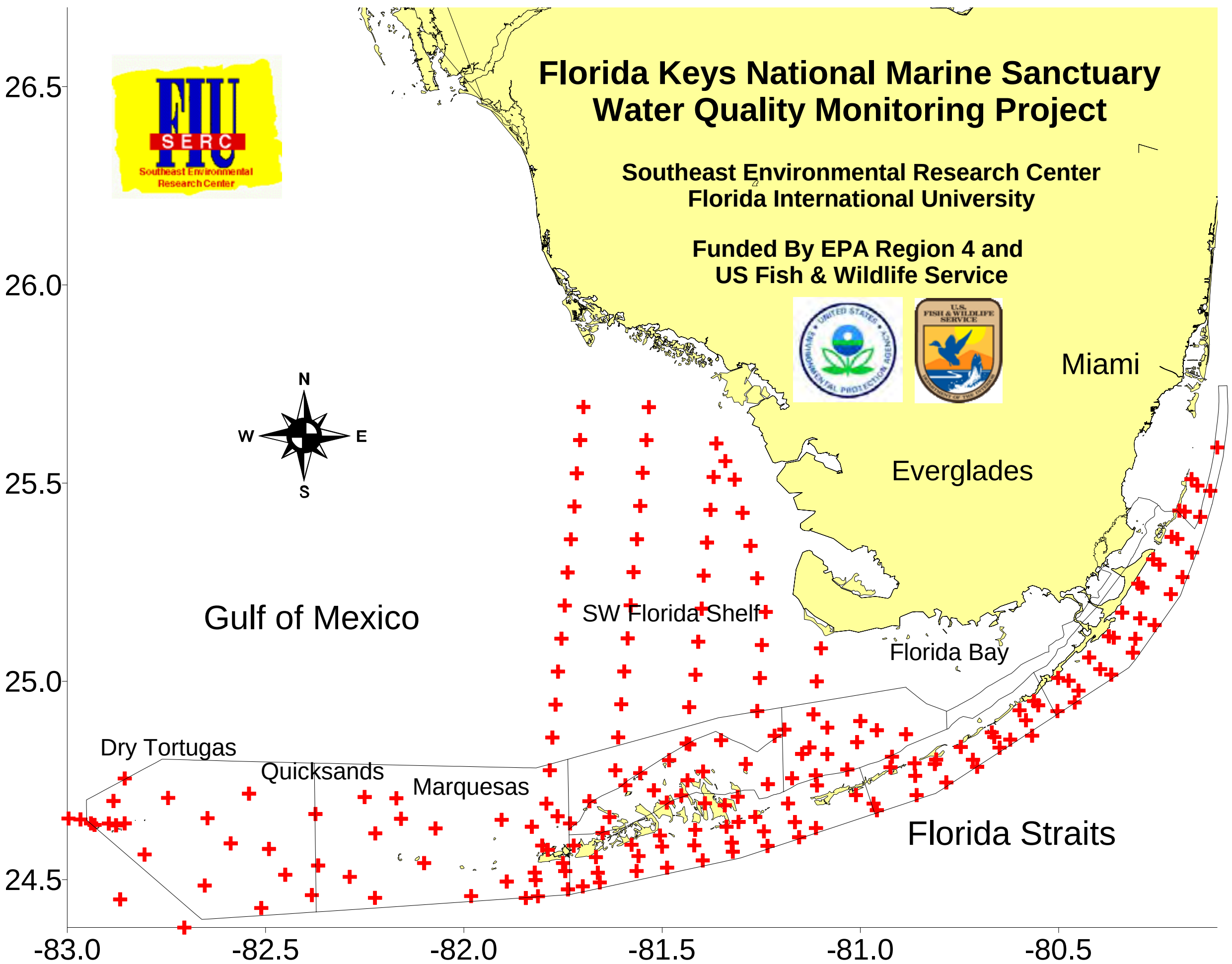

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EXECUTIVE SUMMARY

This report serves as a summary of our efforts to date in the execution of the Water Quality Monitoring Project for the FKNMS as part of the Water Quality Protection Program. The period of record for this report is Mar. 1995 – Dec. 2010 and includes data from 62 quarterly sampling events at 155 stations within the FKNMS and SW Florida Shelf, including the Dry Tortugas National Park.

Field parameters measured at each station include salinity (practical salinity scale), temperature (ºC), dissolved oxygen (DO, mg l^{-1}), turbidity (NTU), relative fluorescence, and light attenuation (K_d, m^{-1}). Water quality variables include the dissolved nutrients nitrate (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+), dissolved inorganic nitrogen (DIN), and soluble reactive phosphate (SRP). Total unfiltered concentrations include those of nitrogen (TN), organic nitrogen (TON), organic carbon (TOC), phosphorus (TP), silicate (SiO_2) and chlorophyll *a* (CHLA, µg l^{-1}).

The EPA developed Strategic Targets for the Water Quality Monitoring Project which state that beginning in 2008 through 2011, they shall annually maintain the overall water quality of the near shore and coastal waters of the FKNMS according to 2005 baseline. For reef sites, chlorophyll *a* should be less than or equal to 0.2 micrograms/l and the vertical attenuation coefficient for downward irradiance (K_d, i.e., light attenuation) should be less than or equal to 0.13 per meter. For all monitoring sites in FKNMS, dissolved inorganic nitrogen should be less than or equal to 0.75 micromolar and total phosphorus should be less than or equal to 0.2 micromolar. Table 1 shows the number of sites and percentage of total sites exceeding these Strategic Targets for 2010.

Table 1: EPA WQPP WQ Targets from 1995-2005 Baseline

Targets for reef sites include chlorophyll *a* less than or equal to 0.35 micro grams/l and vertical attenuation coefficient for downward irradiance (K_d, i.e., light attenuation) less than or equal to 0.20 per meter. Targets for all sites in FKNMS include dissolved inorganic nitrogen (DIN) less than or equal to 0.75 micromolar and total phosphorus (TP) less than or equal to 0.25 micromolar. Compliances were calculated as percent of those achieving targets divided by total number of samples. Values in green are those years with % compliance greater than 1995-2005 baseline. Values in yellow are those years with % compliance less than 1995-2005 baseline.

EPA WQPP Water Quality Targets

	Reef Stations		**All Stations**	
Year	**CHLA ≤ 0.35 µg l^{-1}**	**K_d ≤ 0.20 m^{-1}**	**DIN ≤ 0.75 µM (0.010 ppm)**	**TP ≤ 0.25 µM (0.0077 ppm)**
1995-05	1778 of 2367 (75.1%)	1042 of 1597 (65.2%)	7826 of 10254 (76.3%)	7810 of 10267 (76.1%)
2006	196 of 225 (87.1%)	199 of 225 (88.4%)	432 of 990 (43.6%)	316 of 995 (31.8%)
2007	198 of 226 (87.6%)	202 of 222 (91.0 %)	549 of 993 (55.3%)	635 of 972 (65.3%)
2008	177 of 228 (77.6%)	181 of 218 (83.0%)	836 of 1,000 (83.6%)	697 of 1,004 (69.4%)
2009	208 of 228 (91.2%)	189 of 219 (86.3%)	858 of 1,003 (85.5%)	869 of 1,004 (86.6%)
2010	170 of 227 (74.9%)	176 of 206 (85.4%)	843 of 1000 (84.3%)	738 of 1,003 (73.6%)

Several important results have been realized from this monitoring project. First, is documentation of elevated nitrate in the inshore waters of the Keys (Fig. 1). This result was evident from our first sampling event in 1995 and continues to be a characteristic of the ecosystem. Interestingly, this gradient was not observed in a comparison transect from the Tortugas (no human impact). This type of distribution implies an inshore source which is diluted by low nutrient Atlantic Ocean waters. Presence of a similar gradient in TOC and decreased variability in salinity from land to reef also support this concept. There were no trends in either TP or CHLA with distance from land.

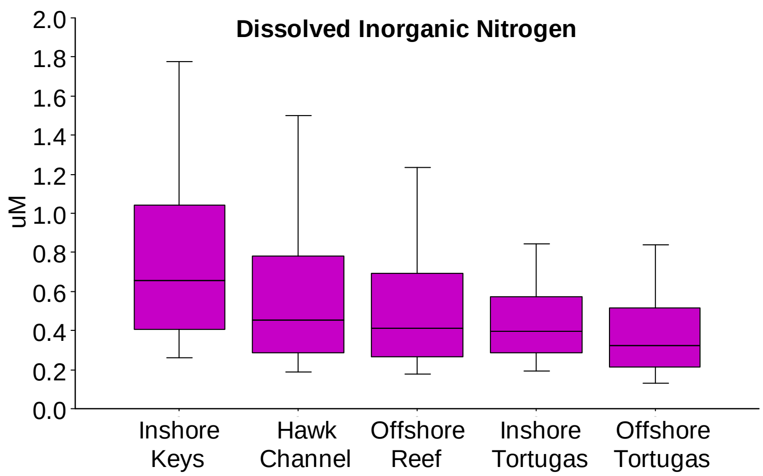

Figure 1.

Some variables showed noteworthy differences over the period of record (Fig 2). Since the 2005 hurricane season, water quality on the reef, especially DIN, have been elevated but have mostly returned to normal levels.

This brings up another important point; when looking at what are perceived to be local trends, we find that they seem to occur across the whole region but at more damped amplitudes. This spatial autocorrelation in water quality is an inherent property of highly interconnected systems such as coastal and estuarine ecosystems driven by similar hydrological and climatological forcing. It is clear that trends observed inside the FKNMS are influenced by regional conditions outside the Sanctuary boundaries.

Trend analysis has shown that many variables have undergone significant changes in concentration over the 15 year period of record. Examples for salinity, DO, TN and TP are shown in Figures 3-6.

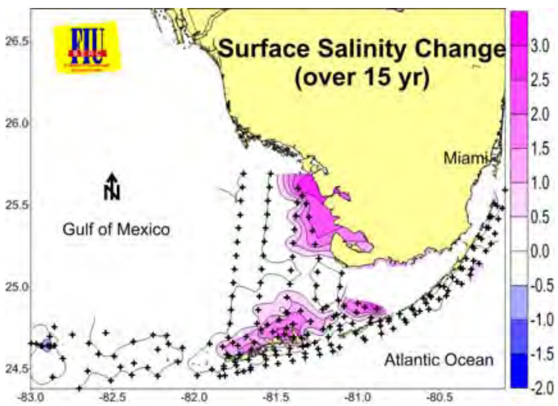

Figure 3

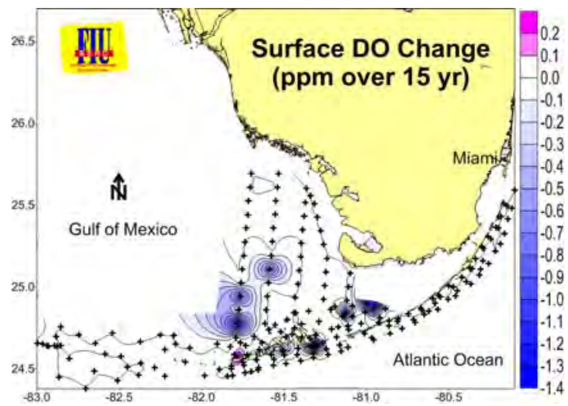

Figure 4

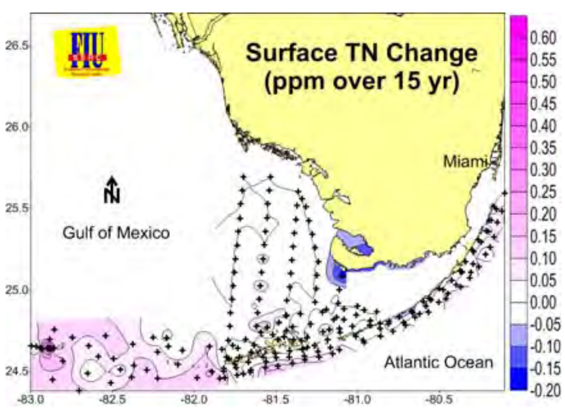

Figure 5

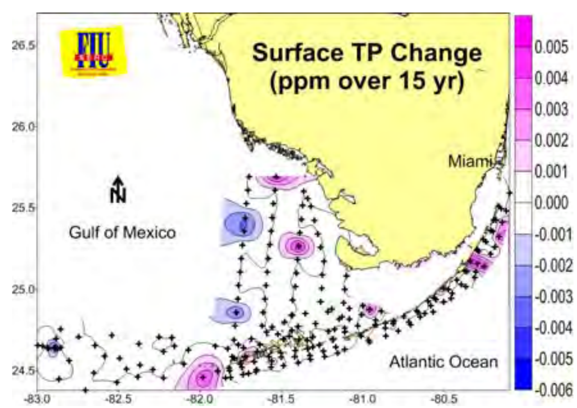

Figure 6

For 2010, in all regions of the FKNMS, water quality has returned to conditions prior to 2005 hurricane season (Fig. 7). Overall, TOC remains lower than the long term median mostly because it has been declining over the years. DO and light penetration were better than the norm.

The large scale of this monitoring program has allowed us to assemble a much more holistic view of broad physical/chemical/biological interactions occurring over the South Florida hydroscape. Much information has been gained by inference from this type of data collection program: major nutrient sources have be confirmed, relative differences in geographical determinants of water quality have been demonstrated, and large scale transport via circulation pathways have been elucidated. In addition we have shown the importance of looking "outside the box" for questions asked within. Rather than thinking of water quality monitoring as being a static, non-scientific pursuit it should be viewed as a tool for answering management questions and developing new scientific hypotheses.

We continue to maintain a website (http://serc.fiu.edu/wqmnetwork/) where data and reports from the FKNMS is integrated with the other programs are available.