EFFECTS OF A CATASTROPHIC FOREST FIRE ON TROPHIC PARAMETERS OF AN OUTSTANDING FLORIDA WATER SYSTEM

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
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To Pedro, for his support and love

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LIST OF ABBREVIATIONS

CaCO3	calcium carbonate
Chl	chlorophyll *a* concentration (µg/L)
FDEP	Florida Department of Environmental Protection
ha	hectares
LAKEWATCH	Florida LAKEWATCH
m	meters
µg/L	micrograms per liter
mL	milliliters
Pt-Co	platinum-cobalt units
SFLG	Santa Fe Lake Group
SFS	Santa Fe Swamp
TN	total nitrogen concentration (µg/L)
TP	total phosphorus concentration (µg/L)
USEPA	United States Environmental Protection Agency

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The Santa Fe Lake Group (Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay) is a designated Outstanding Florida Water system in north-central Florida (Alachua County). This designation provides special protection to prevent impairment of water quality due to anthropogenic activities. In late 2007, total phosphorus and total nitrogen concentrations in Little Lake Santa Fe more than doubled, sparking interest in determining what factors were causing such a rapid change and whether the other two lakes were being impacted. Analysis of long-term (24 years) total phosphorus, total nitrogen, chlorophyll *a*, color, and Secchi disk data for the Santa Fe group demonstrated that the trophic upsurge occurred in all lakes. The sudden increase in nutrient concentrations was linked to a catastrophic, 5,100-ha, forest fire (the 2007 Dairy Road Fire) that occurred in the adjacent Santa Fe Swamp. This fire burned not only above-ground material, but below-ground material, a muck fire. Further analyses of the data for the Santa Fe lake group documented the impact of the hurricanes that struck Florida in 2004 and the impacts of droughts during the 24-year period of record. The Dairy Road Fire and the other natural climatic events demonstrated that for the Santa Fe Lake

Group, periodic disturbance events or even a single stochastic event can alter an ecosystem’s relative “stability”. This study emphasizes the need for understanding the importance of natural stochastic events on Florida’s water resources, while trying to assess the impact of anthropogenic activities.

CHAPTER 1
INTRODUCTION

There is an increasing demand for water as the human population grows. At the same time, there is a degradation of water resources. This situation concerns both the public and regulatory agencies. In an attempt to respond to public demands and concerns, the United States Environmental Protection Agency (USEPA) established numeric nutrient criteria for Florida lakes in 2010 (USEPA 2010) to prevent further degradation of water quality and use impairment. The criteria stipulate that any lake, with an alkalinity >50 mg/L as $CaCO_3$, is out of compliance if the water has an average chlorophyll *a* concentration greater than 20 µg/L, which would classify the lake as eutrophic by USEPA definition.

In Florida, the Florida Department of Environmental Protection (FDEP) has the authority under Section 403.061(27) of the Florida Statutes to establish rules that provide for a special category of water bodies within the state, to be referred to as "Outstanding Florida Waters", which shall be worthy of special protection because of their natural attributes. The Santa Fe Lake Group (SFLG), which includes Little Lake Santa Fe, Lake Santa Fe, Melrose Bay, and the adjoining Santa Fe Swamp (Figure 1-1), is located in north-central Florida (Alachua and Bradford County), is designated as an Outstanding Florida Water.

There is a concern about the SFLG because the system has been reported to be experiencing drastic changes in water chemistry over a short period of time. Elevated nutrient, especially phosphorus, concentrations measured in late 2007 did not decline in early 2008 and lake-users recognized that USEPA and FDEP could classify the SFLG as impaired, costing millions of dollars to restore the SFLG. The objectives of this study were: (1) to assemble the 24 years of trophic-parameter data collected by Florida LAKEWATCH; (2) to determine if any changes in water chemistry and trophic state occurred in the Santa Fe Lake System; and (3) to work with the staff and volunteers of Florida LAKEWATCH to determine what factors might be responsible for the in-lake trends in trophic parameters. Because the SFLG’s waters are outstanding Florida waters and the lake residents were adamant that there were no major anthropogenic activities in the watershed to pollute the SFLG, I focused on natural stochastic events as the probable causative agent(s).

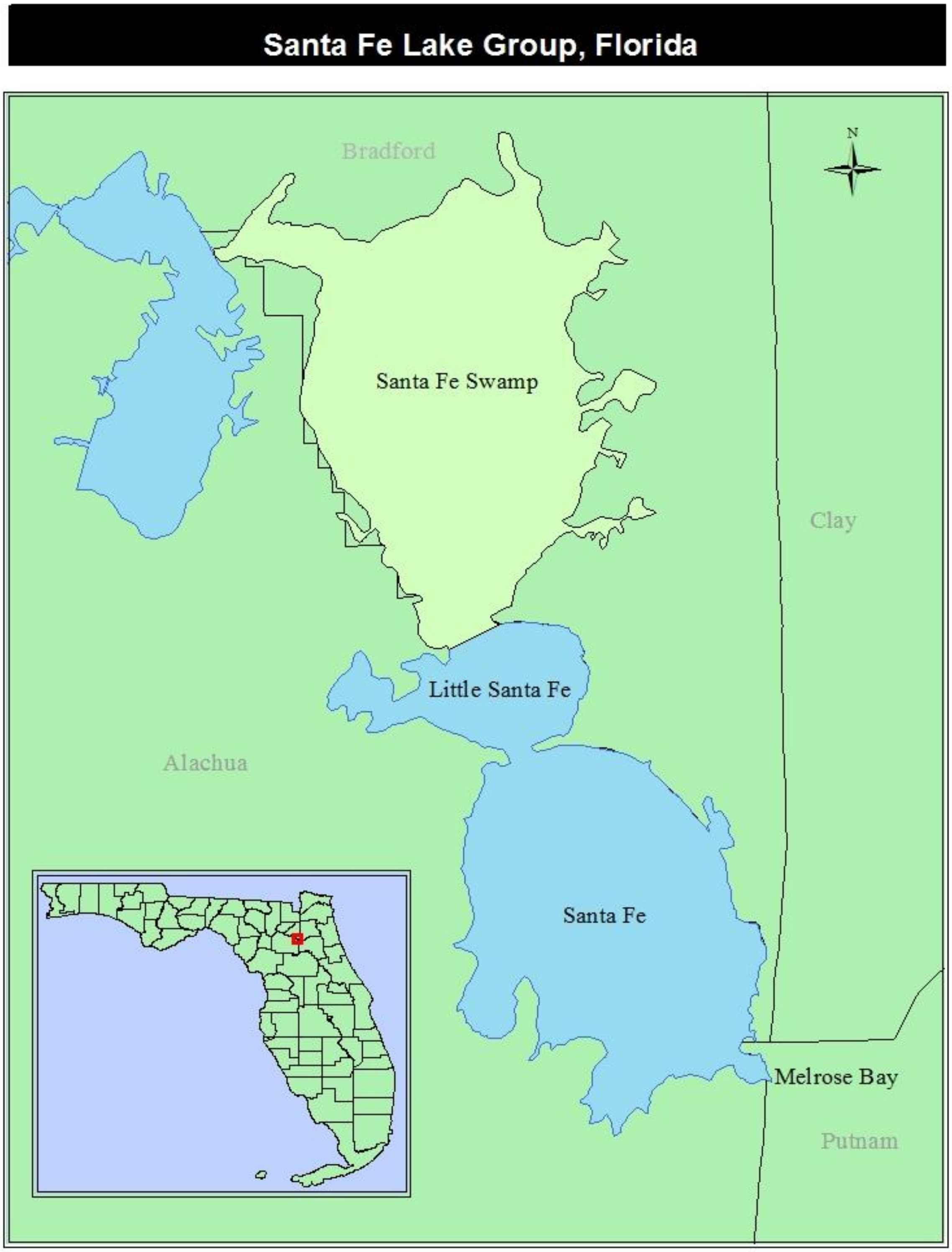

Figure 1-1. Study area showing the Santa Fe Lake Group (lakes Little Santa Fe, Santa Fe and Melrose Bay, and the Santa Fe Swamp) located in north-central Florida, United States.

CHAPTER 2
METHODS

Study Site

The Santa Fe Lake Group is composed of three lakes, Little Santa Fe, Santa Fe, and Melrose Bay (Figure 1-1). They are located in northeastern Alachua County and southeastern Bradford County, Florida (29°44’33”N; 82°4’37”W). The lakes and the adjoining Santa Fe Swamp (SFS) are considered the headwaters of the Santa Fe River, which drains into the Suwannee River (its largest tributary) and then finally the Gulf of Mexico. SFLG are spring-fed lakes, but most of their water comes from rainfall and run-off from the watershed of which the SFS is a major component (Pirkle and Brooks 1959).

Little Lake Santa Fe has a surface area of 577 ha, with 367 ha of open water (Shannon and Brezonik 1972). The lake is shallow (maximum depth of 7 m and 4.2 m average depth). It is directly connected to SFS and is the first lake in the SFLG to receive water from the SFS. Directly south is Lake Santa Fe. The two lakes are connected by a short waterway called “The Pass.” Lake Santa Fe is the largest lake (2,370 ha) of the SFLG. It is spring-fed and has a maximum depth of 8 m and an average depth of 5.9 m. Melrose Bay is the smallest of the three lakes and is connected directly to Lake Santa Fe. It is also located the farthest from the SFS. Melrose Bay has a surface area of 21 ha, a maximum depth of 7 m, and an average depth of 4.6 m.

The SFS is a fresh-water swamp of 2,851 ha located along the northern part of Little Lake Santa Fe (Figure 1-1). It is a wildlife and environmental conservation area that provides numerous ecological services by providing habitat for different plants and animals, and nesting and resting habitat for upland and aquatic species.

Field Sampling

LAKEWATCH's volunteers started collecting water samples, measuring water transparency by use of a standard white Secchi disc, and making visual observations of the lakes' conditions in 1986. The volunteers collect the water samples every month. On each sampling date, volunteers used their own boats to collect surface water samples from three mid-lake stations in Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay. No samples were taken in Santa Fe Swamp. Volunteers, following the LAKEWATCH protocols, provide credible data comparable to data collected by professionals (Canfield et al. 2002).

Water samples for nutrient (total phosphorus and total nitrogen) and color analyses were collected in 250-mL, acid cleaned, tripled-rinsed, Nalgene bottles provided by LAKEWATCH. Additional water was collected at each station in 4-L, tapwater-rinsed, plastic milk jugs. Sample bottles were placed into covered coolers in the boat until they were returned to the residence of the volunteer where the 250-mL bottles were placed into a freezer. To estimate the concentration of planktonic algae at each sampling station, a measured volume of lake water from each 4-L milk jug was filtered through a Gelman Type A-E glass fiber filter. Filters were folded, blotted dry, wrapped in a larger paper filter, labeled with date, lake, and station information, stored over silica gel desiccant, and then frozen. Water samples and the glass fiber filters were stored in the home of the volunteer for up to three months. All samples were then delivered by the volunteer to the LAKEWATCH water laboratory.

Laboratory Analyses

All samples, delivered to the LAKEWATCH laboratory, were analyzed for total phosphorus (TP), total nitrogen (TN), and chlorophyll *a* (Chl). Total phosphorus concentrations (µg/L) were determined using procedures of Murphy and Riley (1962) following persulfate digestion (Menzel and Corwin 1965). Total nitrogen concentrations (µg/L) were determined by oxidizing water samples with persulfate and measuring nitrate-nitrogen with second derivative spectroscopy (D'Elia et al. 1977; Simal 1985, Wollin 1987). Chlorophyll *a* concentrations (µg/L) were determined spectrophotometrically following pigment extraction with 90% ethanol (Sartory and Grobbelaar 1984, Method 10200 H; APHA 1992). Chlorophyll values were not corrected for phaeophytin. Color (Pt-Co) was determined spectrophotometrically on filtered water samples (APHA 1989). Color was not measured on every sample.

Data Analyses

Descriptive statistical analyses were performed using JMP statistical program (JMP, Version 5.0.1. SAS Institute Inc., Cary, NC, 1989-2007). The monthly, annual and per period of time mean concentration and distribution was calculated for each water chemistry parameter to determine the variation through time.

CHAPTER 3
RESULTS

From August 1986 to November 2010, total phosphorus concentrations ranged from 3 to 129 µg/L in the SFLG and total nitrogen concentrations ranged from180 to 1680 µg/L (Figure 3-1). Chlorophyll concentration ranged from 1 µg/L to 95 µg/L (Figure 3-1). Secchi depths ranged from 5.5 to 0.4 m and color ranged from 7 to 378 Pt-Co units (Figure 3-1). Despite the extreme variability, there were notable patterns of change over time (Figure 3-1). SGLG exhibited relative stability in nutrient (TP and TN) values through time, then there was a drastic upsurge. The time, when this upsurge occurred, was different for each nutrient (Figure 3-1). TP concentration drastically increased in late 2007 and beginning 2008 while total nitrogen concentrations increased during 2004 and 2005 in the SFLG and started decreasing afterwards in 2005 until 2007, when the concentrations started increasing again (Figure 3-1).

Total phosphorus concentrations in Little Lake Santa Fe averaged 13 µg/L from August 1986 to October 2007 (Figure 3-2). Total nitrogen and chlorophyll concentrations averaged 582 µg/L and 8.8 µg/L, respectively. Water clarity, as measured by use of a Secchi disc depth, averaged 1.5 m and color averaged 76 Pt-Co units (Figure 3-2). From November 2007 to November 2010, total phosphorus, total nitrogen, chlorophyll, Secchi disc, and color values averaged 51 µg/L, 970 µg/L, 20 µg/L, 0.9 m, and 152 Pt-Co units, respectively (Figure 3-2).

Similar changes were also measured in Lake Santa Fe and Melrose Bay. Prior to November 2007, total phosphorus concentrations averaged 11.2 µg/L and 12.3 µg/L in Lake Santa Fe and Melrose Bay, respectively (Figure 3-2). From November 2007 to November 2010, total phosphorus concentrations in the lakes averaged 23 µg/L and 21 µg/L, respectively (Figure 3-2). Total nitrogen concentrations, prior to November 2007, averaged 461 µg/L (Lake Santa Fe) and 467 µg/L (Melrose Bay), and 739 µg/L and 732 µg/L from November 2007 to November 2010, respectively (Figure 3-2). Chlorophyll concentrations increased 6.9 and 7.3 µg/L, respectively, to more than 18 and 17 µg/L, respectively (Figure 3-2). There was a decrease in water clarity with same Secchi disc readings in both lakes declining from an average of 2.3 to 1.5 m. Color values increased from an average of 32 Pt-Co units before November 2007 to 63 Pt-Co units after November 2007 in both lakes.

A notable change in the trophic state variables, especially total nitrogen concentrations, occurred in the summer of 2003. Prior to July 2003, total phosphorus concentrations in Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay averaged 12.6, 11, and 11.6 µg/L, respectively (Figure 3-3). Total nitrogen concentrations in the lakes averaged 518, 425, and 432 µg/L, respectively. Chlorophyll concentrations in the lakes averaged 9, 6.7, and 7.1 µg/L, respectively, and Secchi values averaged 1.6 , 2.4, and 2.3 m, respectively. Color averaged 58, 24 and 24 Pt-Co units, respectively.

For the July 2003 to October 2007 period (Figure 3-1), total phosphorus concentrations in Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay averaged 17, 13, and 15 µg/L, respectively, and total nitrogen concentrations in the lakes averaged 853, 608, and 615 µg/L, respectively. Chlorophyll concentrations changed little, averaging 7.8, 7.9, and 8.4 µg/L, respectively. Secchi values, however, decreased, averaging 1.1, 1.6, and 1.6 m, respectively. Color increased, with averages of 135, 60, and 59 Pt-Co units, respectively.

Total phosphorus concentrations in the SFLG were extremely elevated in December 1986 (Figure 3-1). In Little Lake Santa Fe, concentrations averaged 46 µg/L, 39 µg/L in Lake Santa Fe, and 77µg/L in Melrose Bay (Figure 3-4). From September to November 1986, total phosphorus concentrations were fairly equal among the three water bodies, averaging 9.9 µg/L in Little Lake Santa Fe, 9.4 µg/L in Lake Santa Fe, and 10 µg/L in Melrose Bay (Figure 3-4). In Little Lake Santa Fe, total phosphorus concentrations were above 100 µg/L and total nitrogen concentrations exceeded 1400 µg/L in November and December 2007. By August 2010, total phosphorus concentrations were less than 20 µg/L and total nitrogen concentrations were less than 900 µg/L.

The trophic state of these water bodies were determined using these total phosphorus, total nitrogen data and chlorophyll data, and the trophic state classification system of Forsberg and Ryding (1980) and the chlorophyll standards of USEPA for Florida (USEPA 2010). The SFLG experienced a change in trophic state classification after 2007. All three trophic state parameters indicate that the SFLG was usually oligo-mesotrophic and then changed to eutrophic after 2007. Eutrophic values of TN occurred after 2003 and were sustained until 2010.

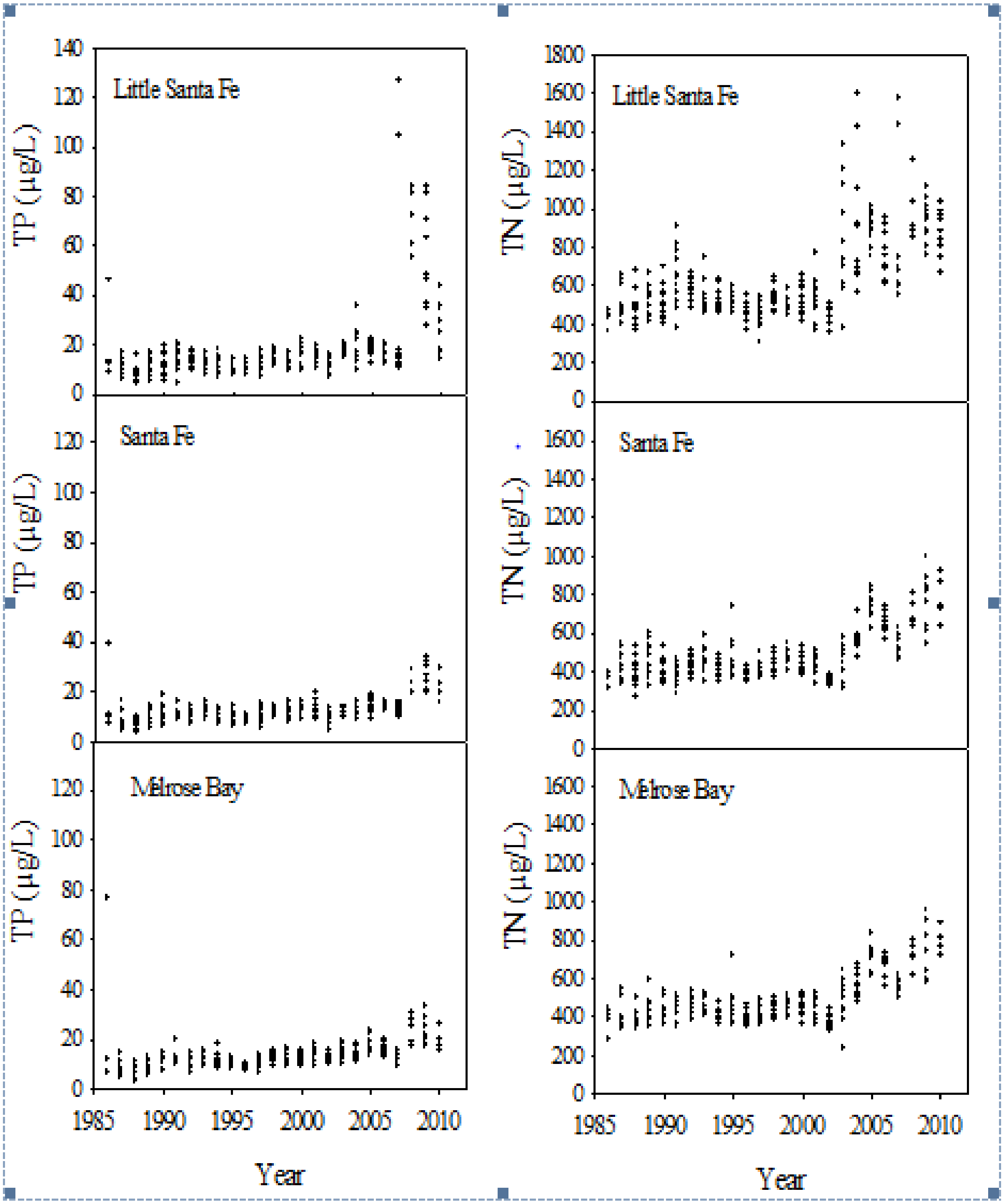

Figure 3-1. Distribution of the monthly mean values per year during 1986 to 2010 for total phosphorus (µg/L) and total nitrogen (µg/L) for Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay in Florida, United States.

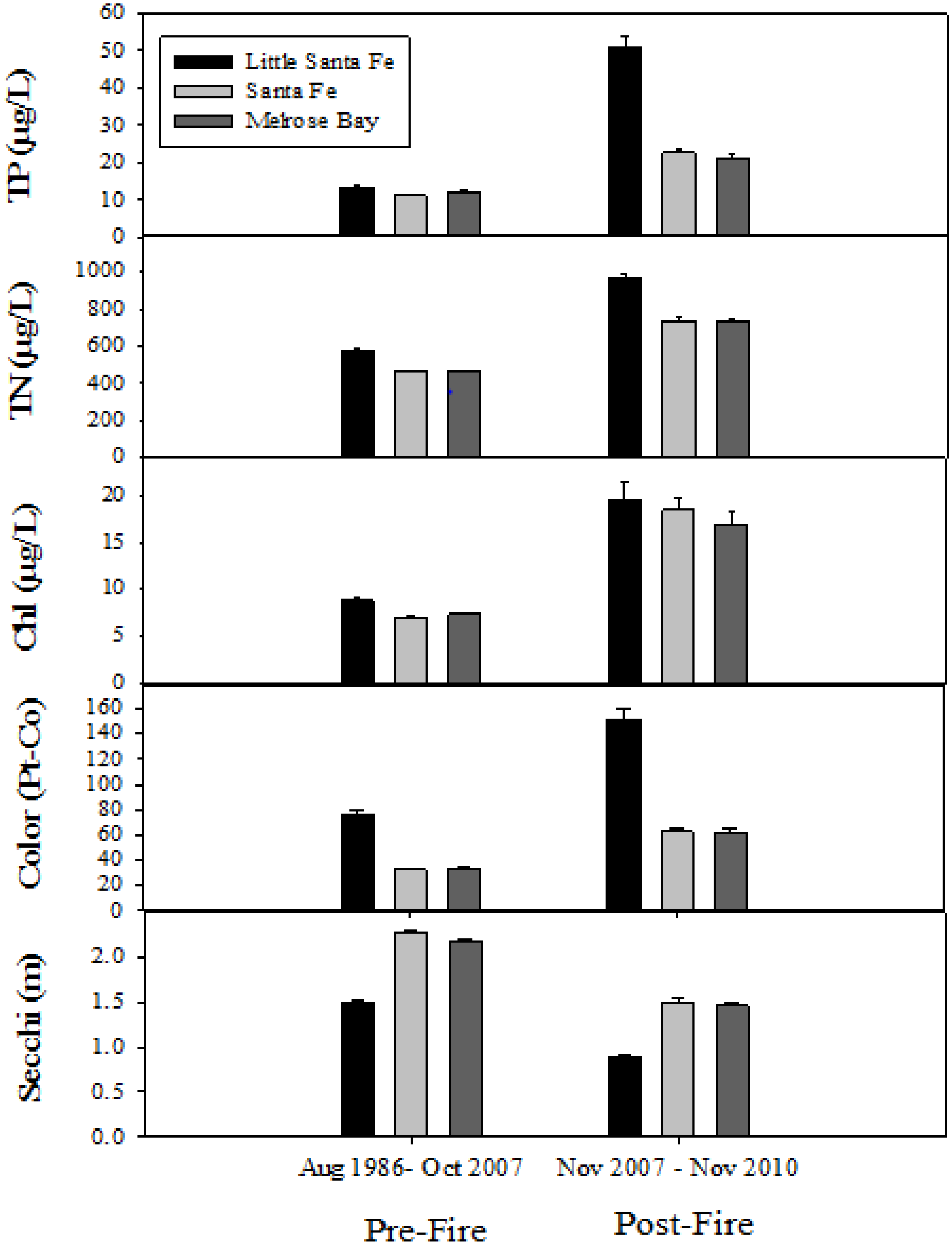

Figure 3-2. Mean values of trophic state parameters August 1986 to October 2007 (Pre-Fire) and November 2007 to November 2010 (Post-Fire) for Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay in Florida, United States.

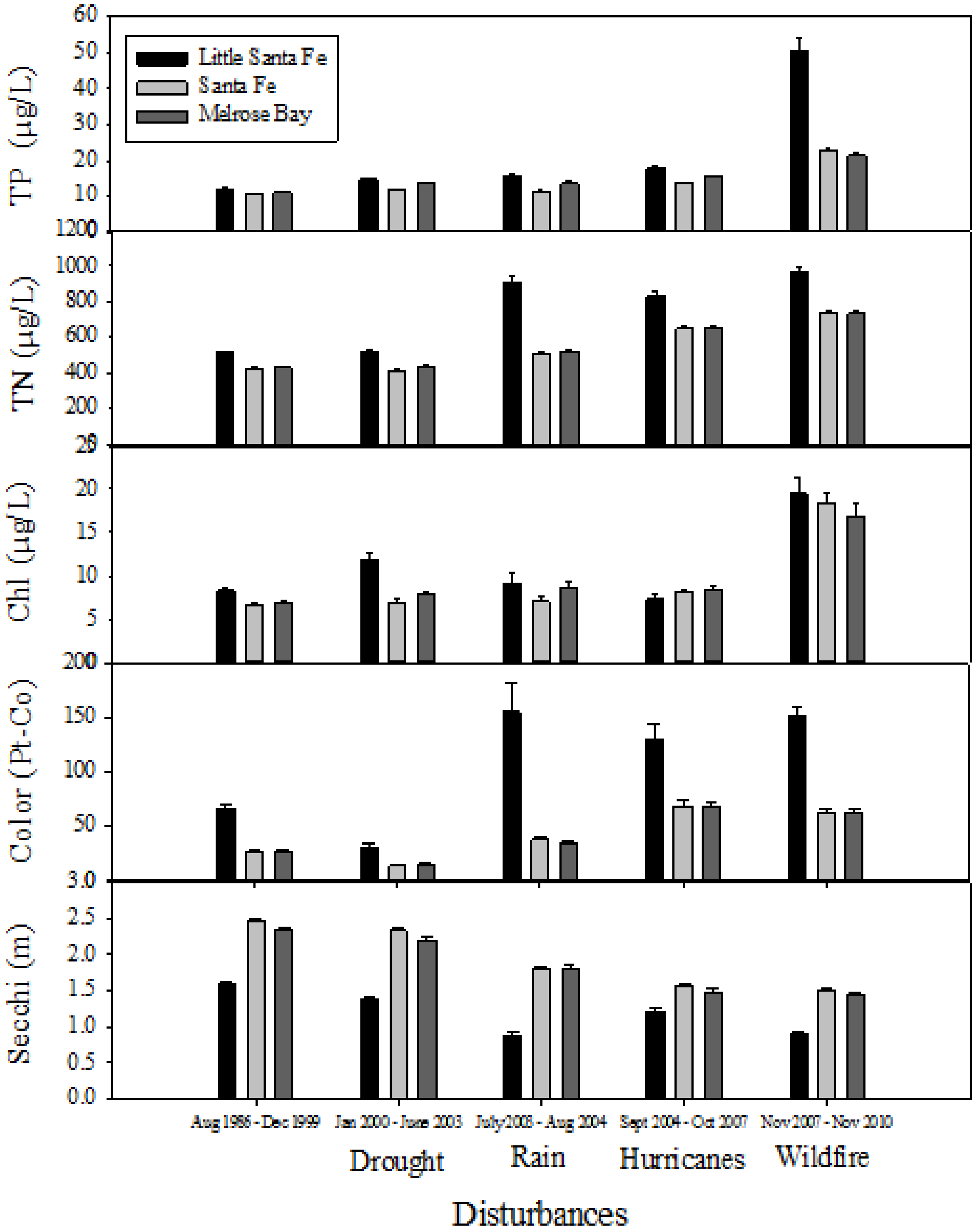

Figure 3-3. Mean values of trophic state parameters associated with several major natural disturbances from August 1986 to November 2010 for Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay in Florida, United States.

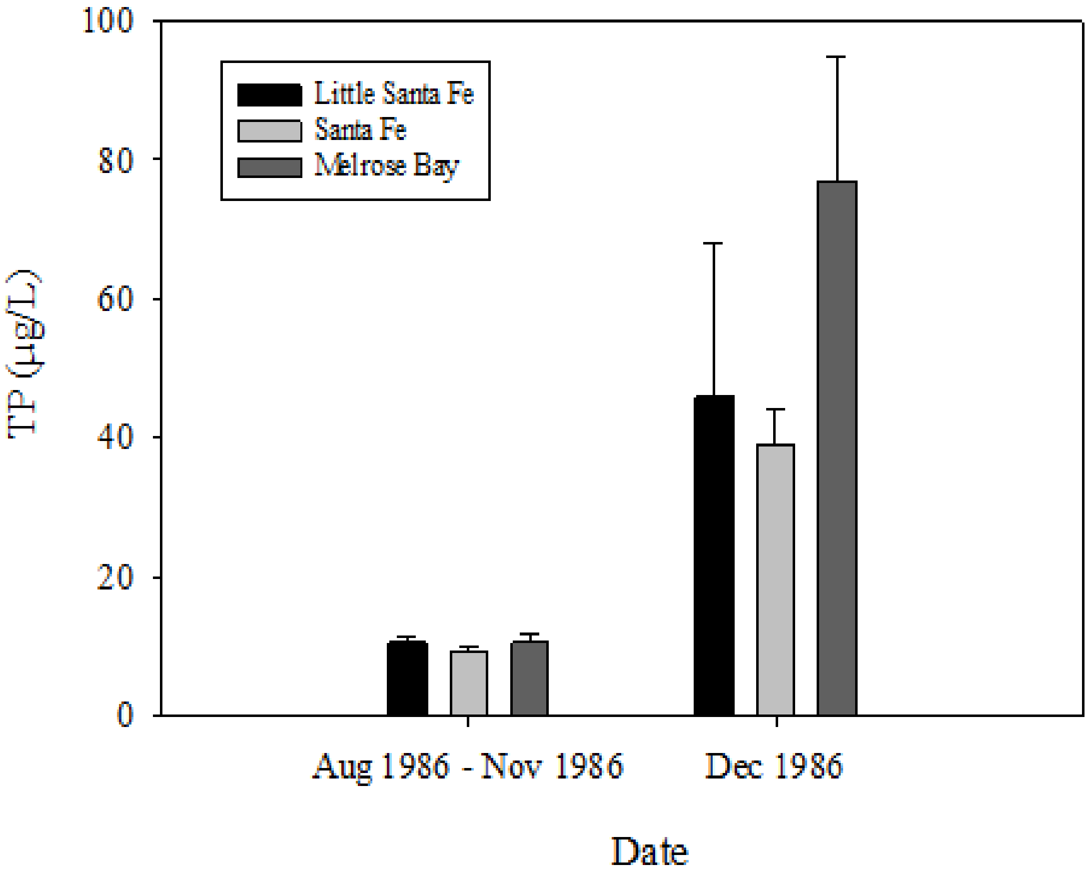

Figure 3-4. Mean total phosphorus (µg/L) for August to November 1986 and December 1986 for Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay in Florida, United States.

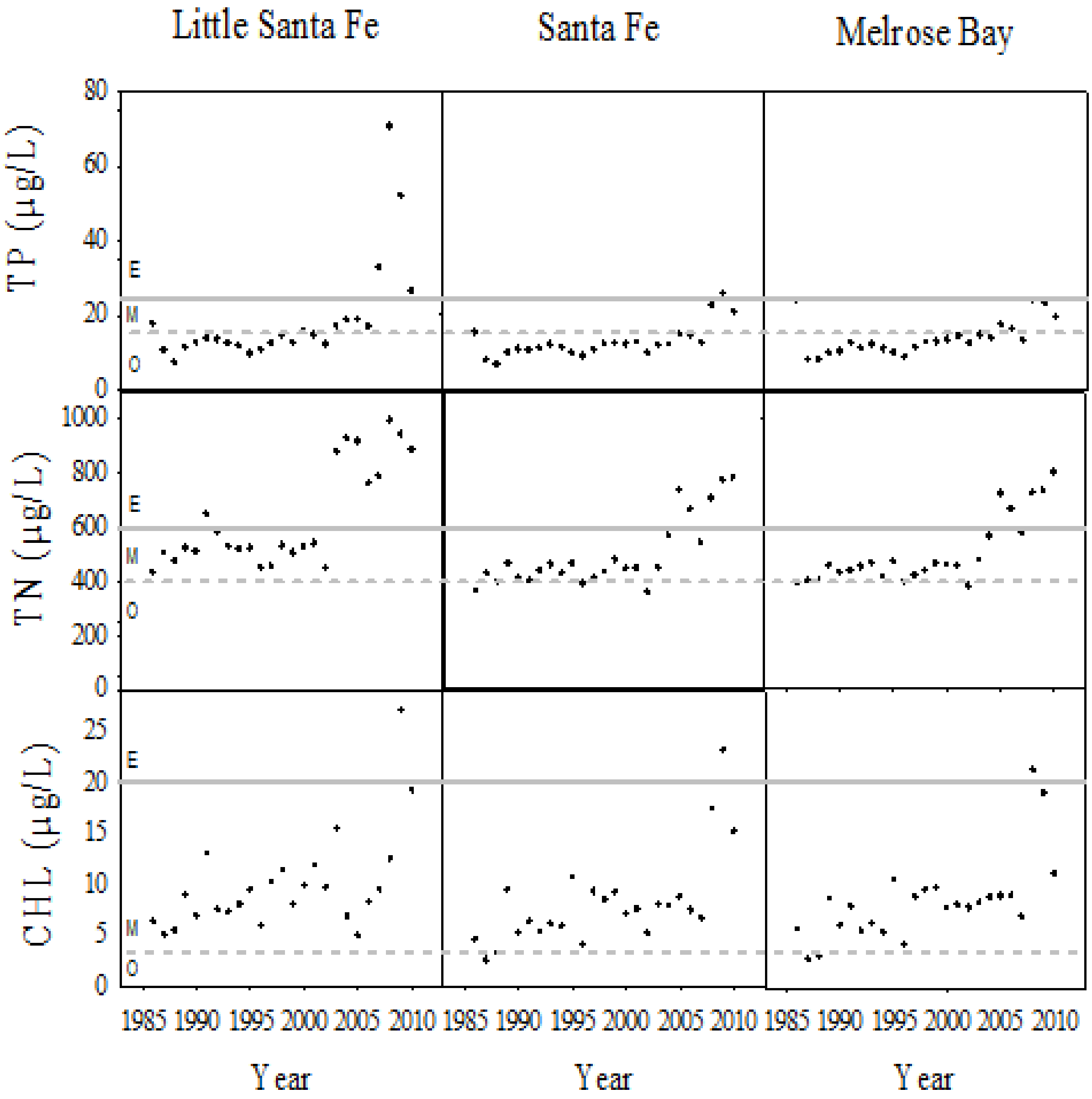

Figure 3-5. Trophic state index based on annual mean values of surface concentrations of total phosphorus, total nitrogen, and chlorophyll during 1986 to 2010 for Little Lake Santa Fe, Lake Santa Fe, and Melrose Bay in Florida, United States. Oligotrophic (O), mesotrophic (M), and eutrophic (E).

CHAPTER 4
DISCUSSION

Volunteers and staff of Florida LAKEWATCH, as well as professional groups, revealed no major anthropogenic activities in the watershed of the SFLG that could account for the trophic upsurge observed in November 2007. The observed reduction in water transparency was primarily due to increased color, which suggested the change in water quality had to be linked to something happening in the watershed. Upon reviewing the field notes of the volunteers, it was noted that they recorded seeing flames from a forest fire along the north shore of Little Lake Santa Fe in May 2007. The observed flames were part of a wildfire called the Dairy Road Fire. Prior to 2007, the Santa Fe Swamp (SFS) was a mostly undisturbed wetland.

The Dairy Road Fire was originally three fast-moving fires that joined together and burned about 5,100 ha (15,100 acres). The fire was among the top 10 largest fires in Florida during 2007 and burned 66% of the SFS by mid-May. The fire burned organic soils (a muck fire) and continued burning for months until the fall rains extinguished the underground fires. Once the rain filled the depressions in the SFS in fall of 2007, water flowed from the SFS into Little Lake Santa Fe, eventually reaching Lake Santa Fe and finally Melrose Bay (farthest from the SFS). Little Lake Santa Fe had higher TN, TP, CHL, and color values than Santa Fe (second highest) and Melrose Bay (third highest). This study highlights the importance of the distance effect between the fire (disturbance) and the water body.

Fires events have been a frequent and important mechanism of disturbance in North America for many centuries (Alhgreen and Alhgreen 1960, Cypert 1961, Boerner 1982, Paterson et al. 2002). Wildfire is the disturbance that has the greatest potential to change watershed conditions (Carignan and Steadman 2000, Neary et al. 2005). Loss of vegetation, increase of run off, soil erosion, and nutrients in areas with significant relief are the most visible effects of fire (Spencer and Hauer 1991, Pierson et al. 2001, Neary and Ffolliott 2005). But equally devastating are the wildfire after-effects that include changing the watershed hydrological patterns and nutrient cycling, and alteration of water quality of downstream aquatic systems (Ahlgren and Ahlgren 1960, Butry et al. 2001, Pierson et al. 2001, Paterson et al. 2002).

The resultant leaching of nutrients and sediments following a fire can result in little to substantial impacts to water quality in lakes, streams, and rivers (Ahlgren and Ahlgren 1960, Neary and Ffolliott 2005). The burning of the organic soils, deposited over many years, mineralized a substantial amount of nutrients making SFS a major nutrient source for the SFLG. The input of nutrients (TP and TN), increase of biological productivity (CHL), and decrease in water clarity of the SFLG after this catastrophic stochastic event is consistent with other studies of aquatic systems (Tiedemann et al. 1979, Spencer and Hauer 1991, Carignan et al. 2000, Townsend and Douglas 2004). The SFLG also experienced a change in trophic state classification from an oligo-mesotrophic to a eutrophic lake system due to the increase of TN, TP, and CHL (biological productivity) concentrations.

Previous studies on wildfires established that the export of materials such as nutrients, sediments, and dissolved organic matter is usually temporary (Spencer and Hauer 1991, Carigman and Steedman 2000). How long the SFS will continue to release elevated levels of nutrients due to the Dairy Road Fire is unknown. Total nitrogen and total phosphorus concentrations decreased, in the SFLG, 5 and 1.5 fold by August

2010, from their peaks in November and December 2007. This suggests that the effects of the Dairy Road Fire are diminishing after three years. This return to baseline values can be explained by a recovery of the pre-fire nutrient cycling processes in the SFS or to the weather becoming drier. Florida is again in a drought (http://www.ncdc.noaa.gov/sotc/drought/), a portion of the wet-dry cycle that dominates the weather of this part of the country, so less run off goes from SFS to SFLG

Contradictions on the effect of wildfires can be found in the scientific literature (Townsend and Douglas 2004) making it impossible to make general conclusions as to the ecological effects of fire on aquatic ecosystems, as potential impacts depend on the fire type (size, intensity, and severity) (Townsend and Douglas 2004), local weather (Brenner 1991), watershed nutrient component (soil and vegetation) (Boerner 1982), nutrient solubility, when the fire occurs (season) (Townsend and Douglas 2004), the condition of the watershed when rainfall starts (Gresswell 1999), and precipitation regime (the intensity, duration, total amount of rainfall, and timing of rain after the fire) (Carigman and Steedman 2000, Elliot and Vose 2006, Paterson et al. 2002). Each of these ecological driving factors must be considered to assess the effects of fires on specific aquatic ecosystems.

Precisely determining the effects of a single event on the limnology of the SFLG is difficult because it is clear from examining the 24-year SFLG database that climatic events (wet/dry cycles) also have a major influence by impacting hydrology (Cordeiro et al. 2008). In 2000-2001, Florida experienced a record drought and the water transparency increased with clarity values exceeding 2.1 m in Little Lake Santa Fe. By 2003, rains had returned filling depressions in the SFS and flowing to the Little Lake

Santa Fe. The water that drained into the lake brought an increased amount of humic material produced by the decomposition of organic matter in the SFS. Color is the product of the presence of these humic materials in the water (Carignan and Steedman 2000, Yount 1966). Nitrogen is a major component of vegetation. When vegetation dies off, it is released into the water, resulting in increased total nitrogen concentrations and decreased water transparency. Color increased in the SFLG after the 2000-2001 drought, but this increase was more drastic after hurricanes in 2004 and the Dairy Road wildfire in 2007.

In 2004, Florida experienced four major hurricanes that brought substantial rain and wind to North Florida (Figure 4-1; Verdi 2005). Run off from the watershed carried colored dissolved humic materials and nutrients to the SFLG. The increase in TN, observed after the hurricanes in 2004, likely came from the leaching of nitrogen from decomposition of vegetation in the watershed of the SFLG by the hurricanes. The winds from hurricanes can defoliate trees and kill small plants. This can lead to an increase in the amount of dead organic matter and an increase in its decomposition and release of nutrients into the system. North-central Florida had not been directly struck by a major hurricane since 1960 when Hurricane Donna passed over North Florida. While hurricanes are natural events that can directly influence limnology as seen in the SFLG, their occurrence is unpredictable.

Thus, any assessment of human impacts on a Florida water body must be placed in context with Florida’s wet/dry cycles and stochastic events that are often viewed by the public as catastrophic (Butry et al. 2001). Fires, hurricanes, and drought are frequent disturbances in Florida. More than 2,000 fires per year have been reported in

Florida. In 1998, 2,282 fires burned nearly 200,000 hectares of land during a prolonged summer drought (Jacobson et al. 2001). In 2007, severe drought conditions (due to a La Niña) were present in Florida and the state was under a State of Emergency. The fires became widespread for months as dry ground and gusty winds made the perfect conditions for wildfires spread. Florida natural ecosystems have evolved under the influence of these disturbances and most Florida ecosystems are adapted to them (Putz 2003). The effects of fires on different forest stands and ecosystem development are relatively well documented in the state, but their effects on the water quality of its lakes are unknown. Florida is the third wettest state in United States, with approximately 7.5% of the state covered by water (1,146,000 ha of the State's total area of 15,170, 000 ha) (Verdi et al 2006) including more than 7,000 lakes, Due to this abundance of water, it is likely that sooner or later fires and hurricane events are going to affect the aquatic ecosystems and the water resources of the state.

The importance of stochastic events to the limnology of lakes has been reemphasized at the SFLG. However, limnologists are often called upon to explain why nutrients suddenly increase and then decrease as in December 1986 at the SFLG. This event, like the Dairy Road Fire, emphasizes the value of trained volunteers such as those in the Florida LAKEWATCH program. These individuals are observing events at the lakes every day and their field notes become a valuable resource trying to understand changes at lakes. For example, the elevated December 1986 nutrient concentrations coincided with the arrival of massive flocks of sea gulls. The gulls roosted at the SFLG after being driven from the coast by severe coastal storms. The increase recorded in TP was likely due to input of phosphorus into the water by their defecation (Manny et al. 1994). In this case, the birds increased a trophic parameter, total phosphorus. Eutrophication of water bodies by birds has been reported in other parts of the world (Manny et al. 1975, Brandvold et al. 1976, Gere and Andrikovics 1994, Manny et al. 1994).

How long it takes for the resilience (defined as the ability of an ecosystem to return to its original state after being disturbed) of the SFLG to recover to previous trophic state, following a perturbation from a stochastic event, is unknown. Total phosphorus, TN, CHL, and color have decreased and water clarity has increased to similar values to the ones reported before 2003. Because the resilience will vary according to the severity, intensity, and frequency of the disturbance, different disturbances will have different time to recovery (e.g., elevated levels of TP from birds lasted one). Nutrient concentrations began decreasing after 2 to 3 years after the 2004 hurricanes. The system has still not recovered 3 years after the Dairy Road wildfire. This study documents how stochastic events influence the water chemistry of lakes on varying time scales – months to years.

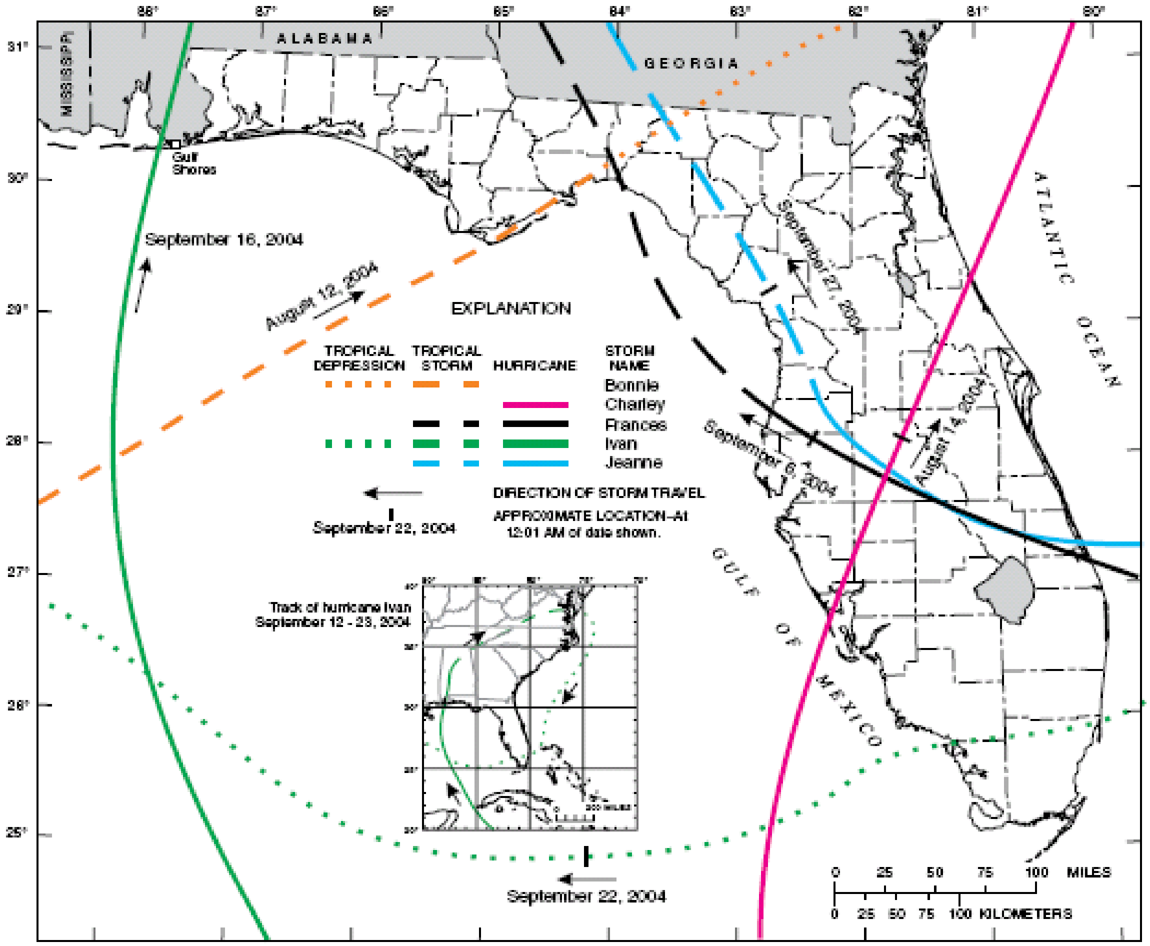

Figure 4-1. Tracks of tropical storm systems in Florida in 2004 (Verdi 2005).

CHAPTER 5
CONCLUSIONS

In this study, I showed that (1) the proximity between a disturbance event in a watershed and the water body is an important factor to consider when we want to determine its impact on an aquatic ecosystem; (2) the mechanisms of action of these catastrophic stochastic events might be different (e.g., amount of organic matter, leaching and runoff from the watershed, mineralization of terrestrial nutrients) but the effects on the aquatic ecosystem can be similar (increase in primary productivity with nutrient input, and decrease in water clarity with increase in color and CHL); (3) while anthropogenic disturbances have the capacity to change the water chemistry of the lakes in a relatively short period of time, natural disturbances (due to extremes in weather conditions) can as well; and (4) natural stochastic events may have an effect on the trophic state classification of lakes.

Governmental agencies, charged with protecting water quality in lakes such as the USEPA and the FDEP, often focus on anthropogenic activities as the primary source of lake water quality impairment. This study clearly shows that single catastrophic events, happening alone or in sequence, can have a short-term or longer-term influence on water chemistry. Certainly, the Dairy Road Fire has resulted in a longer-term trophic upsurge. Thus, predicting long-term trends in limnology may be difficult to impossible when catastrophic natural stochastic events can occur.

Limnologists, governmental agencies, and concerned citizens must be careful when interpreting published literature. Many environmental studies last only one to three years. For example, Lake Santa Fe was described as a softwater clear water lake by Shannon and Brezonik (1972), leading some individuals to call Lake Santa Fe one of

Florida’s clearest lakes. However, Secchi values are reduced during wet periods as indicated by the 24-year Florida LAKEWATCH database. Clearly, ecosystem components and their processes are never constant in nature. All lakes are exposed to subtle or gradual changes (e.g., weather, nutrient loading), but it is incorrect to assume that any responses will be gradual and smooth. Sometimes nature provides periodic severe and intense disturbance events that alter the relative “stability” of terrestrial and associated aquatic ecosystems (Scheffer et al. 2001). Thus, there is a need for long-term water quality databases such as the one assembled by the staff and volunteers of Florida LAKEWATCH.

Limnological data have been collected for hundreds of Florida lakes by LAKEWATCH volunteers for more than two decades. The availability of long-term data, the frequency of catastrophic stochastic events (wildfires, hurricanes, and droughts), and their importance and influence on watershed processes make this a case study of the effects of forest fires on water quality in Florida and much of the southeast United States. The combination of these factors makes this study of great importance to understanding the influence of catastrophic natural stochastic events on water resources and the intricate interaction between terrestrial and aquatic ecosystems. There are not many studies on this topic in the US Southeast. Because disturbances vary in their intensity, severity, and frequency, there is a need for more studies such as this one.

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BIOGRAPHICAL SKETCH

Ivelisse Ruiz-Bernard is originally from Puerto Rico. She is an ecologist with extensive experience in terrestrial and aquatic ecosystems, especially in the subtropical and tropical areas. She has a B.S. degree in biology and graduate credits in tropical forest ecology from the University of Puerto Rico. She was pursuing a Masters of Science in the School of Forest Resources and Conservation at the University of Florida with a major in Fisheries and Aquatic Sciences and a minor in Forest Resources and Conservation. Ivelisse has been accepted in the Ph.D. program of Interdisciplinary Ecology in the School of Natural Resources and Environment at the University of Florida.

Ivelisse’s professional career has been centered in several areas of community and landscape ecology focused on understanding how disturbances (natural and anthropogenic) affect ecosystem components and functions, with the application towards restoration, conservation and management of forest and aquatic ecosystems. She has participated in several laboratory and field research projects in the area of plant biology, forest ecology and more recently in aquatic ecosystems. Her work experiences were at the University of Puerto Rico, governmental and non-governmental institutions as an undergraduate research assistant, a graduate research assistant, an ecologist for a consulting company, teaching assistant, a biology technician for the U.S.D.A. Forest Service International Institute of Tropical Forestry in Puerto Rico, and a laboratory technician for Florida LAKEWATCH at the University of Florida. At the International Institute of Tropical Forestry, she participated in different types of research projects at the community and ecosystem level that included population dynamics of single species, to community restoration and vegetation response to large-scale disturbances.

She also had experience teaching undergraduate laboratory and field courses in botany and general biology. Her research experiences have been in various ecosystems including coral reefs, mangroves, subtropical dry forest, subtropical moist forest, tropical wet forest, and lake systems in Puerto Rico, Panama, Costa Rica, and Florida.