

Recent Increase in Submersed Aquatic Vegetation in Lake Pontchartrain

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ABSTRACT

Submersed aquatic vegetation (SAV) in Lake Pontchartrain has been in a state of decline since 1953. Annual SAV surveys in the Lake have been conducted by using line-intercept method since 1996. Data collected (1996-2001) were compared by three-way ANOVA with fixed variables of year, site, and depth. Additional shoreline surveys were conducted in the summer of 2000 to determine lake-wide SAV distribution and composition. In contrast to the previous continuous decline, there was an 18-fold increase in *Ruppia maritima* in 1999. North shore *Ruppia* beds extended from west of the Tchefuncte River to Pt.du Chien, persisted to a depth of 1.8 m and covered about 1.3 km² in 2000. Quantifiable *Ruppia* beds (*ca.* 0.8 hectares) were also present on the south shore near Lincoln Beach. Increases in salinity and water clarity since the 1998 passage of Hurricane Georges appeared to be responsible for the *Ruppia* increase in 1999. The most abundant species in previous years, *Vallisneria americana*, has continued to decline with the increase of salinity. Salinity and turbidity of the Lake returned to historic averages in 2001, ending the 2-year-drought. In fall of 2001, *Vallisneria* near Bayou Lacombe expanded with the salinity decrease but *Ruppia* near Fontainebleau State Park disappeared. Attempts continue to establish relationships between SAV dynamics and environmental factors to predict total SAV abundance, relative species composition and distribution from water clarity, salinity, depth contours and wind-wave action.

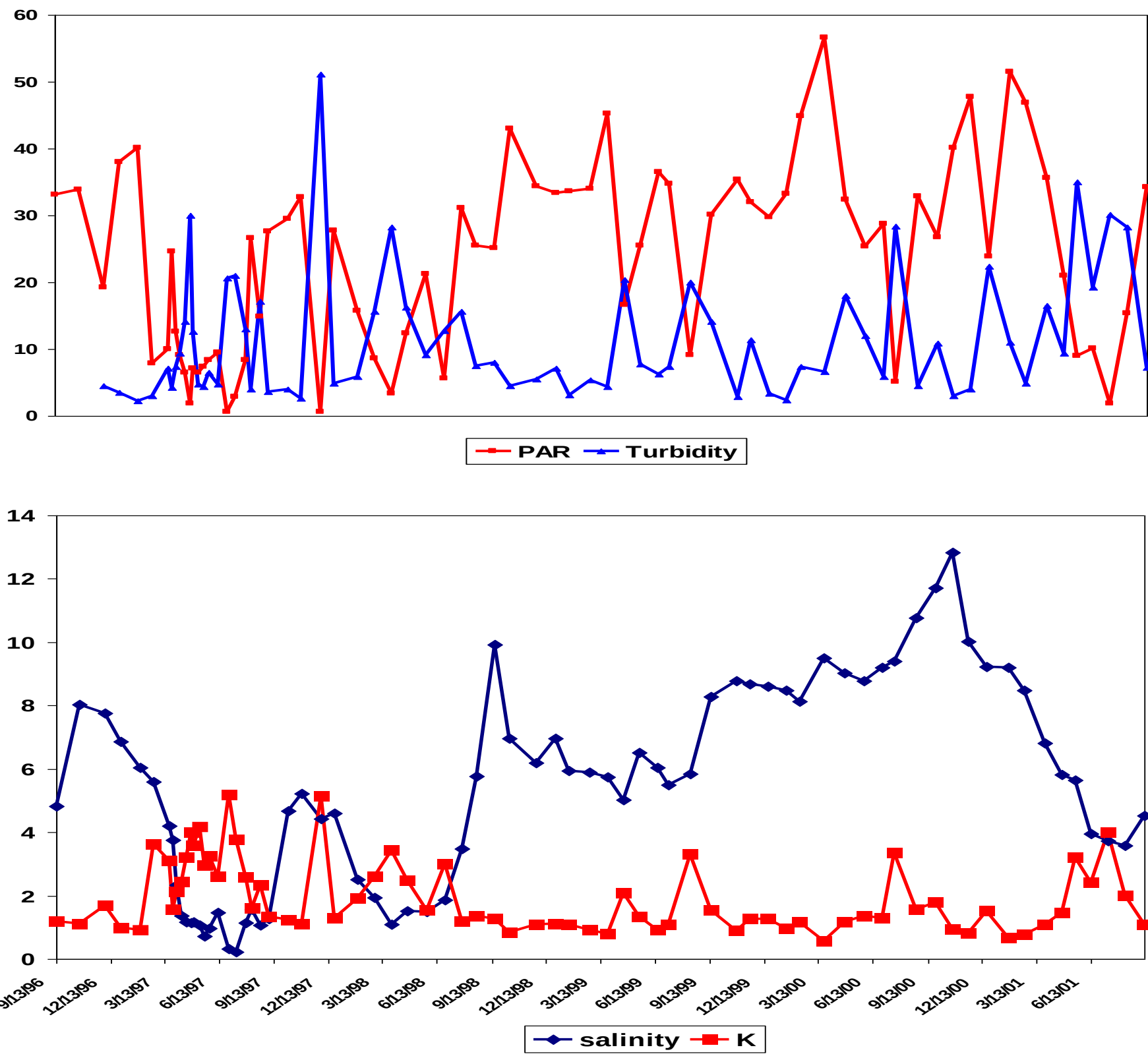


Figure 1. PAR (photosynthetically active radiation, % surface irradiance), Turbidity (NTU), salinity (ppt) and k (vertical absorption coefficient) of Lake Pontchartrain (Sep 96-Sep 01).

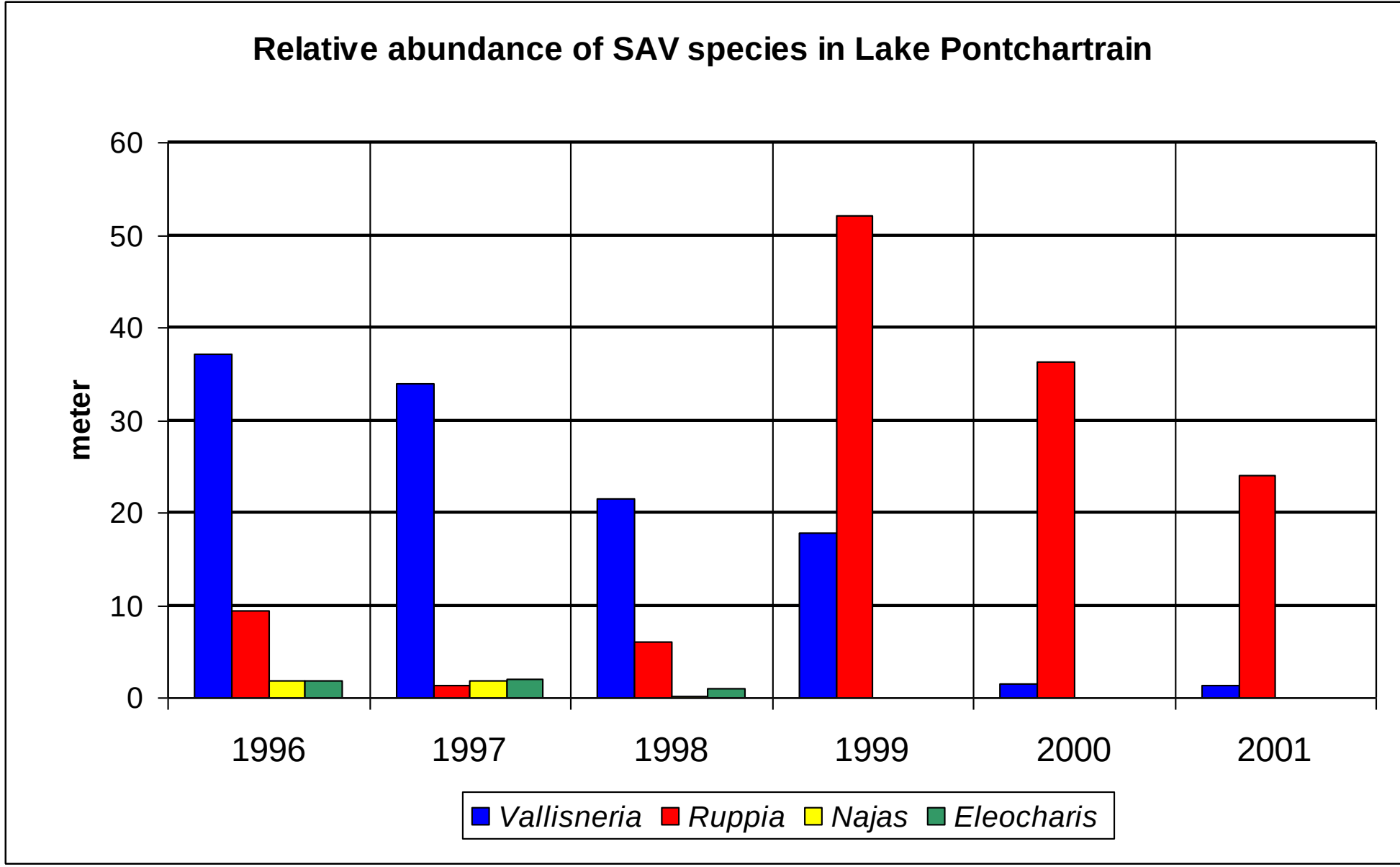


Figure 2. Relative abundance of SAV species in Lake Pontchartrain

INTRODUCTION

Submersed aquatic vegetation (SAV) plays several important ecological roles. It provides habitat and food sources for numerous aquatic organisms. It is important in trapping and stabilizing sediments and reducing wave energy. In addition, the distribution, abundance and composition of SAV are excellent indicators of water quality.

Areal coverage of SAV in Lake Pontchartrain has decreased since the first report in the early 1950's. During 1991-1992, SAV foliar coverage was estimated to be approximately 76 ha on the north shore, and 12 ha on south shore. The maximum water depth of SAV distribution was reduced from 1.8-1.9 m in 1954 to 1m in 1997.

Annual surveys (1996-1998) indicated a continual decrease of SAV in the Lake. *Ruppia maritima* and *Myriophyllum spicatum* were affected by the 1997 Bonnet Carre Spillway opening due to significantly reduced light penetration based on PAR (photosynthetically active radiation) measurements. Surface cyanobacterial blooms lowered PAR in water column and increased epiphytic growth by *Cladophora* also shaded SAV.

Tropical storms and Hurricanes in the fall of 1998 did not affect the SAV foliar coverage in the Lake. However, Hurricane Georges introduced more saline water into the basin and drought conditions have occurred in the Lake watershed since then.

MATERIALS AND METHODS

SAV Foliar Coverage

Foliar coverage was estimated by the line-intercept method at study sites in Fontainebleau State Park, Lacombe, Goose Point, and Pointe aux Herbes in 1996, 1997, 1998, 1999, 2000 and 2001. Five randomly placed transect lines were extended 200 m perpendicular from the shoreline at each site. SAV composition, distribution and depth were recorded by snorkeling along each transect.

Lake Wide Shoreline Survey

Lake wide shoreline surveys were conducted in 2000 to quantify SAV areal coverage. The area between the shoreline and a depth of 1.5 m was surveyed by cruising with a small boat and snorkeling.

Water Quality

Photosynthetically active radiation (PAR), pH, temperature, salinity and dissolved oxygen were measured at Fontainebleau A and C, Lacombe, Pointe aux Herbes and Bayou St. John. Water quality was measured monthly from September 1996 to March 1997, weekly from March 20 through May, twice a month during June, July and August, and monthly from September 1997 to present.

Data Analysis

Data for foliar coverage were analyzed by three-way ANOVA with time period, sampling site, and depth as fixed variables. A one-way ANOVA for each of the water quality parameters was conducted. Vertical absorption coefficient (k) for each site was calculated from the PAR datasets. Light availability at maximum depth of SAV presence was estimated by using the calculated k ($I_z = I_0 e^{-kz}$).

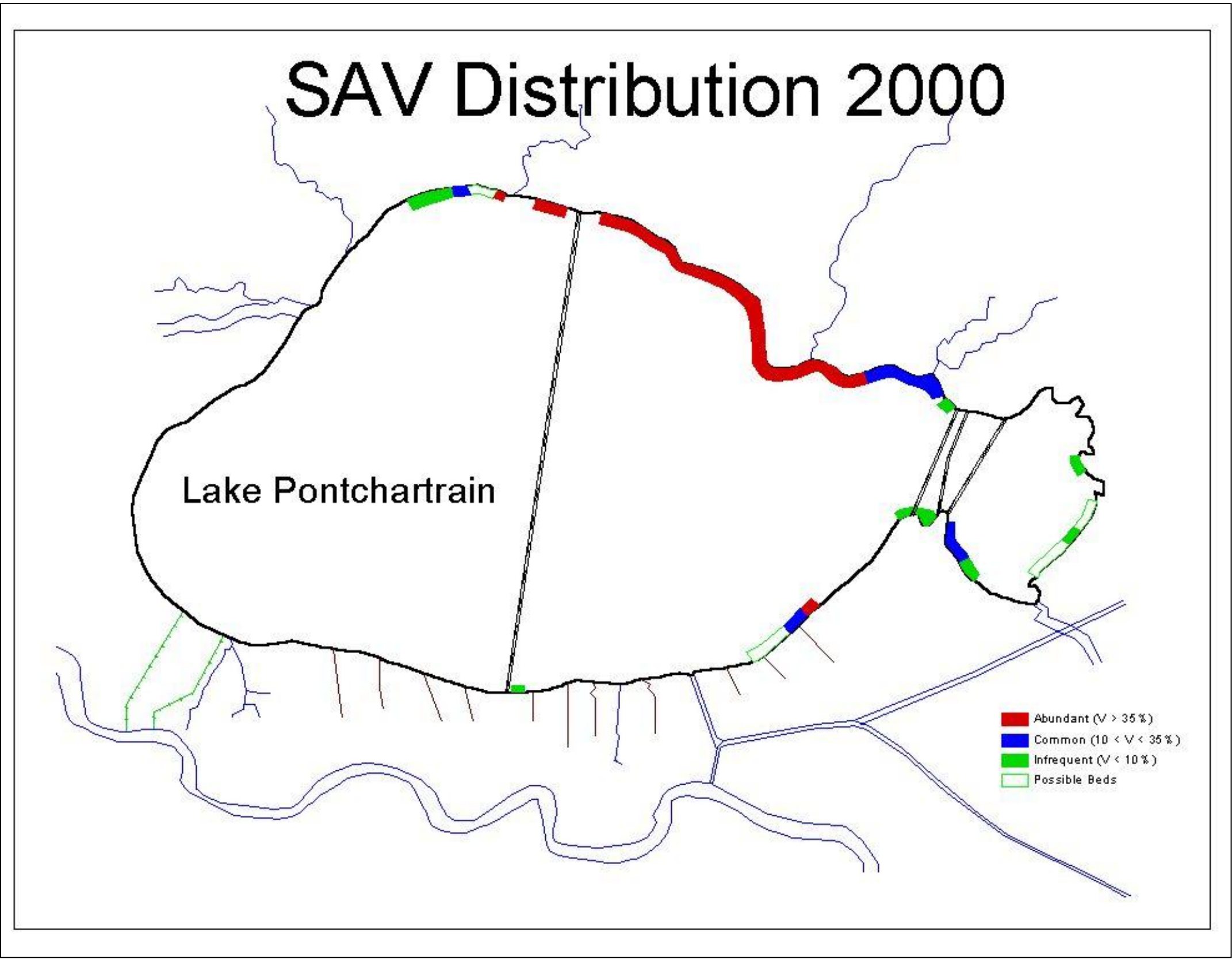


Figure 3. Distribution of Submersed Aquatic Vegetation in Lake Pontchartrain (2000)

RESULTS

Water Quality in 1999 and 2000

More saline water was introduced into Lake Pontchartrain with the passage of Hurricane Georges and drought conditions occurred in the Lake water shed since then. A comparison of salinity and photosynthetically active radiation (PAR) at a depth of one meter among all study period (1996-2001) indicates statistically significant higher values in 1999 and 2000 (Figure 1). Vertical absorption coefficient (k) was reduced to about one half (Table 1). Due to the increased water clarity, over 8% of surface irradiance was available in depth of 1.8m.

Table1. Comparison of vertical absorption coefficient (k) before and after the 1998 Hurricane Georges. PAR measurements at depths of 1 and 1.8 m are expressed as percent surface irradiance.

	K	Depth of 1m	Depth of 1.8m
Sep 96~Sep 98	2.2-2.7	7-10 %	0-2 %
Oct 98~Feb 01	1.2-1.4	25-31 %	8-10 %

SAV Foliar Coverage

There was an overall 18-fold increase in *Ruppia maritima* (Figure 2) based on combined data from all sites, and a 200-fold increase at the three Fontainebleau sites between fall 1998 and fall 1999. The increase in *Ruppia* appeared to be related to the relatively higher salinity and water clarity that occurred in 1999. *Ruppia* and *Vallisneria* also extended to the 2-m depth contour (compared to 1-m in previous years) in 1999 due to increased light availability in deep water. Water level during the early summer of 2000 was considerably lower (0.5-1m) than normal due to unusual westerly winds. As a result, a large area along the north shore was exposed to air and caused lethal drying of SAV in shallow water.

SAV Distribution and Areal coverage in 2000

By June 2000, *Ruppia* expanded to west of the Tchefuncte River on the north shore and on south shore, a bed was present in eastern Jefferson Parish (Figure 3). These areas represent the western most range of *Ruppia* ever reported from Lake Pontchartrain.

Correcting for patchiness, the estimated SAV coverage in 2000 was 150 ha of *Ruppia maritima* plus 12 ha of *Vallisneria americana*. Total SAV habitat was about 450 ha.

Table 2. Estimated SAV areal coverage in Lake Pontchartrain.

Montz 1978: 810 ha (2000 acres) Mayer 1986: 357 ha Burns et al. 1993: 88.1 ha (217.4 acres) 2000 survey: north shore only → SAV habitat of 450 ha (Actual foliar cover <i>Ruppia</i>>130 ha and <i>Vallisneria</i>~ 13 ha)
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Changes in Species Composition

Until 1999, *Vallisneria americana* had been the dominant SAV species, followed by *Ruppia maritima*. Based on our 1996-2001 surveys, *Vallisneria americana* has continued its state of decline, and in 1999 *Ruppia maritima* increased to become the most abundant species (Figure 2).

Status of SAV in 2001

The salinity of Lake Pontchartrain returned to historic levels in summer of 2001 ending of a prolonged drought (Figure 1). Turbidity was exceptionally high at the north shore sites in May through August (Figure 1). SAV distribution was retreated to 1-m depth contour on the north shore between Lacombe and Pt. Du Chien. In September, *Ruppia maritima* disappeared from Fontainebleau State Park. However, several large new patches of *Vallisneria americana* appeared in the late summer of 2001.

DISCUSSION

Light Availability and SAV

Light availability appeared to be the primary factor controlling the maximum depth distribution of SAV. Analyses on SAV distribution along transects and vertical light absorption revealed that 10 % of surface irradiance is required for maintenance of SAV survival in Lake Pontchartrain (Table 1). The maximum depth of SAV occurrence during the 1997 algal blooms was only 1 m, it increased to 1.8-2.0 m in 1999 and 2000 due to the improved water clarity. Growth of SAV in water deeper than 1.5 m was limited again in 2001 after the turbid period (Figure 1).

Geomorphology and SAV

Shoreline slope determines SAV abundance under the same light conditions. SAV was present up to 600 m from the shore in areas of gradual slope, such as mouths of streams on the north shore (Figure 3). On the other hand, SAV was restricted to 10 m from shore in the eastern part of the Lake where the slope is steeper.

Effect of Surrounding Habitat and Wind-Wave Action on SAV

Submersed aquatic vegetation tends to occur along marsh shorelines rather than swamp or manmade structures (e.g. seawall) due to the wave-buffering effect of marsh. The shoreline of the western part of the Lake generally experiences strong wave energy during a period of easterly winds. The wind-generated waves interact with trees to create strong turbulence near shore. Disturbed bottom sediment, increased turbidity and steep slope created by the turbulence prohibit SAV growth. Historically the western part of the Lake has been devoid of SAV probably because of the increased bottom disturbance, high shoreline retreat rates and increased turbidity. SAV is not present along the south shore seawall for the same reason.

Salinity and SAV composition

Salinity of Lake Pontchartrain exhibits spatial variation as well as seasonal variation. Hurricanes, prolonged precipitation or drought can affect the overall salinity significantly (Figure 1). The annual SAV surveys demonstrated that salinity changes affect SAV species composition and total amount of vegetated area (Figure 2). Although the total SAV beds increased significantly as a result of *Ruppia* increase when the salinity was high, the species diversity decreased due to the loss of freshwater species (Figure 2). High salinity probably suppresses flowering of freshwater SAV species. *Vallisneria* flowers were not observed in 1999 and 2000, but it has been blooming near Bayou Lacombe since the summer of 2001.