Annual Update
2008-2009
Duval County Manatee Protection Plan
Population Inventory and Analysis

Prepared by
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for the
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EXECUTIVE SUMMARY

This document is the 2008-**09** annual update to the Duval County Manatee Protection Plan. It represents additional population inventory and analysis of data gathered between October 1, 2008 and August 31st, **2009** by Jacksonville University. In 2004, the recommendation was made that the 1999 Edition of the Duval County MPP be updated into a new edition. Data, figures, tables and agency names were outdated or no longer appropriate. The latter, was considered to be an administrative update and did not affect the inner workings of the Duval MPP itself. The new updated document was approved by the FWC in November 2006. Among the plan's changes are clarifications of the applicability of the MPP to multi-family boat facilities and revisions to the "Unacceptable" category. **In 2008, a boating study by Florida Sea Grant was undertaken by the City of Jacksonville, the results of which are to be incorporated into the latest plan rewrite and update in 2010.**

Aerial Sightings: **The Single Highest Day Count (SHDC) of manatees represents the highest number of animals counted on a single survey day throughout the year. For the Lower St. Johns River (LSJR), the SHDC of 55 animals per survey (June 2009) was the lowest on record, with no apparent reason at this time. In 2008, it was 140 animals per survey which was lower than in previous years, but still greater than the general mean of 121 manatees per survey (1994-2009).** In April of 2007, there were 151 manatees per survey. This represented the highest number of animals sighted so early in the season, most likely due to an unusually mild winter. In September of 2006, the count was 153 manatees per survey. A peak of 170 manatees per survey was seen in June 2005. Prior to this, it was 160 (May 2004); 150 (June 2003); 106 (May 2002). Dry weather (1999–2001) caused higher salinity in the LSJR that lead to poor or no regeneration of tape grass beds *(Vallisneria americana)* that manatees primarily rely on for food. As a result, over all per survey counts were generally lower than expected. Apart from the year 2000/2001 data, it appears that SHDC increased until 2005 and then begun to decline to normal levels seen in the late 1990's (range 124-136 manatees per survey). Increased counts were probably also influenced by better knowledge of the survey area and where manatees are likely to occur. **In the Intracoastal Waterway (ICW) the SHDC was 18 manatees per survey (June 2009). In May of 2008, it was 30 manatees per survey, which represented a record high for the ICW**. It was 21 and 19 manatees per survey (April 2007, and April 2006, respectively); 29 manatees per survey (July 2005); 23 manatees per survey (2003 and 2004); 28 manatees per survey (April 2002) was the highest since 1994. In 2001, SHDC was 23 manatees that was higher than the 13 reported in 2000. Counts between 2001 and 2005 appear to be more consistent with counts prior to the period of drought for years 1994-1998.

In LSJR, the mean number of manatees per survey by year increase from 16-51 manatee/survey (2000-2006, respectively). In 2007, numbers decreased to 34 manatees/survey, probably due to the return of drought conditions that negatively impacted the manatee grass bed habitat. **In 2008, there was a period of recovery (41 manatees /survey) and then a decline to 17 manatees/survey in 2009.** General means in the ICW have been consistent for the last seven years 2000-20**09** (5 manatees/survey/yr.).

The proportion that calves represented of the total number of manatees sighted ranged from 3.40 % to 11.53 % with a mean of **8.04 %** (LSJR); and 0.91 % to 12.05 % with a mean of 6.67 % (ICW) over the duration of the study. Percentages for the 2002 season were lower in the ICW (0.91 %) but not significantly different for the same months in 2003 (1.20 %), possibly attributed to unusual weather conditions. In 2004, percent calves was higher than

the general mean in both the LSJR (9.52 %) and ICW (10.68 %) but in 2005 the percentages are similar to the general mean in LSJR and below the general mean in the ICW.

Cumulative counts of manatees at various locations in the ICW and LSJR are included to show density abundance and location of manatees in the County. The latter does not appear to have changed in spite of the lower numbers of manatee observed during the 2001/2002 season. The 2002-2006 numbers indicate a rebound similar to the pre-drought years.

Highest concentrations of manatees occurred south of Fuller Warren Bridge (east and west banks) and Doctor's Lake in summer where substantial submerged aquatic vegetation exists. Spatial distribution of manatees (2002-2007) was well spread throughout the county similar to the drought years 2000/2001. Since the latter half of 2006 and into 2007, average salinity levels have remained relatively high resulting in reduced availability of tape grass in the county. Higher salinity was caused by drought conditions (lack of precipitation). As a result, animals were traveling more in search of food further south of the study area which resulted in a lower summer count. **During 2008-2009, the amount of rainfall increased significantly throughout the summer resulting in lower salinities which favored grass bed and algae growth. However, a corresponding increase in manatee numbers as a result of this was not realized, and the reason for this is not yet clear.**

Manatee Mortality: **As of September 2009, there were a total of 13 deaths, of which 8 were watercraft-related, 3 perinatal, 1 cold stress and 1 undetermined (FWRI 2009). In 2008, there were a total of 14 reported deaths, of which 11 were watercraft related, 2 cold stress and 1 undetermined (FWRI 2009). The county has surpassed an "unacceptable" level of watercraft related mortality, as stipulated in the MPP, on five occasions since 2002 (1st in 2002, 2nd in 2004, 3rd in 2006, 4th 2008, 5th 2009). This unacceptable level is triggered when there have been five or more watercraft related mortalities in all county waters within the last 12 months. County, State and Federal agencies met October 30th, 2009 to discuss 19 watercraft deaths that occurred in Duval County from May 5th 2008 to September 11th 2009. Issues of inadequate signage and enforcement were discussed.** The same agencies met September 18th, 2008 to discuss 8 watercraft deaths in Duval County during that year, and how Duval County should respond to those incidents. It was suggested that there was an identifiable pattern of activity associated with large vessels that caused three of the mortalities recovered near Lions Club. **In order to address the increasing trend in large vessel caused mortalities, City of Jacksonville (COJ), Jacksonville Marine Transportation Exchange (JMTX), and the Port of Jacksonville developed a manatee awareness placard similar to the Right Whale placard for commercial vessel operators to be made available later this year.**

Habitat: **Salinity measured at the Jacksonville University dock during 2009 was generally lower compared to 2008 because of more rainfall. The fresher conditions, high water temperature, and nutrient input caused by run-off from precipitation, lead to the emergence of toxic algae blooms in the St. Johns River. As in the past, the algae blooms did not seem to adversely impact manatees. Increased run-off from rain, most likely elevated the amount of color in the water reducing light availability to the grasses. In addition, extensive algae blooms probably also caused shading and reduced light availability for optimum grass growth. Grass bed data in 2008 was not yet available from the St. Johns River Water Management District's SAV monitoring program**

(SJRWMD). Salinity recorded at the Jacksonville University dock remained elevated during the first half of 2008 (January to August) then decreased with the onset of tropical storm activity. Data from SJRWMD indicated a further decline in grass bed indices for 2007. The grass beds remain stressed due to periodic drought conditions. Grass beds north of the Buckman Bridge regenerated significantly since late 2002 to 2006 and then declined again in 2007. In 2007, drought conditions returned and numbers of manatees sighted declined in the summer due to a die back of submerged aquatic vegetation. The lack of precipitation led to elevated salinity levels in the river that forced animals to move further south within the St. Johns in search of food. Indices for percent feeding indicated more animals feeding each year subsequent to 2002. Numbers feeding remain similar to 2004 levels. This may be because the food supply leveled off in 2004/2005/2006 and there were more total numbers of manatees. However, food supply still remains below 1998 levels in terms of the grass bed length, percent cover, diversity index and proportion of tape grass. All these indices show a fall as a result of the drought (2001/2002) and then recovery with the return to more normal conditions (Figure 3).

Warm Water Attractants: Manatees have been observed assembled in groups at warm water out falls since March, 1994. *Jacksonville Electric Authority's Southside (JEASS)* and *Kennedy Generating Stations (JEAKS)* and *Jefferson Smurfit's* paper mill were all located within a 7 mile radius of Downtown. It has been several years since these facilities dismantled, removed, or stopped discharge warm water into the St. Johns River. As a result, ever decreasing numbers of animals have been observed at these locations. During the winters between 2002/03 to 2005/06 JEA undertook monitoring for manatees. In spite of the Southside plant being shut down in October 2002, manatees continued to be congregated at the site but did not remain for very long before departing. JEA also installed a retaining gate to prevent manatees moving up and into the old discharge pipes where they could potentially become trapped and die. No animals were seen at Southside Generating Station after December 3rd 2002. In 2003, no manatees were reported by JEASS until 4 adults were seen on 05/05/2003 and 2 adults and 2 calves were seen 04/15/2003. During the winters of 2004 and 2005 no manatees were observed at this site. **Aerial observation since then indicates that manatees have stopped using this site to congregate.**

Ortega River: During the winters of 2004/05 to 2008/09, no manatees were observed at the warm water source identified in Ortega River. However, on January 3rd 2008, a cold stressed manatee was rescued from the Ortega River by Sea World of Florida and FWC.

JEA District # 2 Outfall: **A few animals were seen at the JEA District # 2 waste water treatment outfall near north Bartram Island.** Rescue attempts were made and one animal was relocated by Sea World of Florida and FWC on Dec 19th 2006. On August 15th 2007 an entrapped manatee was rescued from the JEA North Side Generating Station. In addition, on January 18th 2008, two manatees were rescued from the JEA District # 2 outfall north of Bartram Island by Sea World of Florida and FWC. **The discharge from the site is fresher than the surrounding ambient waters. As a result, it is likely to serve as an attractant for manatees throughout the entire year, and not just during colder weather. Manatees are attracted to the site in winter, when the discharge is also warmer than the surrounding ambient waters. The close proximity of this site to the location of shipping lanes in St. Johns River means that there possibly exists a higher potential for**

vessel/manatee interactions. Recently, some manatees killed by large vessels have been recovered close to this location.

Symposium on freshwater withdrawals from the St. Johns River: **the 2nd meeting of the University of Florida Water Institute Symposium meeting is scheduled for February 24-26th 2010 in Gainesville, Florida.** The 1st meeting occurred September 16-18th 2008 and indicated that, from salinity modeling conducted by SJRWMD, harbor deepening activities have a significant potential to alter salinity profiles and cause harm to biological systems.

THIS REPORT CONTAINS THE FOLLOWING UPDATED SECTIONS TO THE 2009 EDITION OF THE DUVAL COUNTY MANATEE PROTECTION PLAN:

EXECUTIVE SUMMARY

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Introduction

The Duval County Manatee Protection Plan (MPP) was developed by the Jacksonville Waterways Commission for the Jacksonville City Council. Jacksonville University conducted the research on which the plan is based. Extensive studies were conducted beginning in 1994 and have continued to present. In 1999, the State of Florida approved the Duval County Manatee Protection Plan. The Plan had initially been approved by the Florida Department of Environmental Protection. In April 2000, the state rule implementing the boat speed zones were adopted by the Florida Fish and Wildlife Conservation Commission. New federal manatee protection slow speed zones by the U.S. Fish and Wildlife Service were effective September 5th 2003 for Duval, Clay and St. Johns Counties. The biggest change is the area located downstream of the Hart Bridge which requires watercraft to travel under 25 miles per hour (mph). The manatee protection is also expanded approximately one mile further downstream (Federal Register. August 6th 2003. 68(151): 46869-46917) in order to complement existing state and local governmental manatee protection measures. A signage plan was implemented in May 2005 and completed September 2007. **In 2008, a boating study was undertaken, the results of which are to be incorporated into the latest plan rewrite and update (2010).**

The MPP contains a provision that the plan be reviewed and updated annually. This report contains additional data concerning the manatee population in Duval County and is the 200**9** annual update. **Updated information is shown in bold**.

Inventory and Analysis

Manatees

Distribution and Abundance: Aerial surveys by Jacksonville University (March, 1994 – **August**, 200**9**) conform to current FDEP Manatee Aerial Survey Protocol. Intensive bimonthly surveys were conducted in areas manatees frequent: (1) the St. Johns River, its tributaries and (2) the Atlantic Intracoastal Waterway (Nassau Sound to Palm Valley). **These two flight paths do not overlap.** During winter months, industrial warm water sources in Northeast Florida were also monitored. **During 622 bimonthly surveys (327 SJR; 295 ICW), a total 12,875 manatee sightings were recorded (11,530 SJR; 1,345 ICW), 7 % calves (Table 1).** When water temperatures decrease (December through March), the majority of manatees in Duval County waters migrate south to Blue Springs and/or other warmer South Florida waters.

Historical manatee survey data from Jacksonville University indicate that manatees were observed feeding, resting and mating in greater numbers south of the Fuller Warren Bridge relative to other waters in Duval County. Sightings in remaining waters consisted mostly of manatees traveling or resting. The data suggested that manatees use the Intracoastal Waterway as a travel corridor during their seasonal (north/south) migrations along the east coast and that they stay close to the shore, utilizing small tributaries for feeding when in these waters.

Aerial survey counts of manatees are indices of abundance at the time of each survey. As a result, counts must be viewed as relative only to trends in general abundance, distribution countywide, and habitat use patterns (Irvine 1980). *Map Series A, Manatee Aerial Sightings*, provides graphical distribution information about manatees. **Differences in seasonal distribution patterns for manatees in 2008–2009 was not found to be significantly different from past years, except that in 2009 the Single Highest Day Count (SHDC) was the lowest on record.** In 2007, **the SHDC 2007 was reached earlier in the year (4/23/07) than in previous years.** ***Map Series A,*** **shows manatee distribution from Summer 2008 through Summer 2009.** Seasons were classified as Winter (December-February), Spring (March-May), Summer (June-August), and Fall (September-November). **The proportion that calves represented of the total number of manatees sighted ranged from 3.40 % to 11.53 % with a mean of 8.04 % (LSJR); and 0.91 % to 12.05 % with a mean of 6.67 % (ICW) over the duration of the study.** Percentages for the 2002 season were lower in the ICW (0.91 %) but not significantly different for the same months in 2003 (1.20 %), possibly attributed to unusual weather conditions. In 2004, percent calves was higher than the general mean in both the LSJR (9.52 %) and ICW (10.68 %) but in 2005 the percentages are similar to the general mean in LSJR and below the general mean in the ICW. These proportions were similar to those reported by Campbell and Irvine (1978) of 9.6 %, Valade (1991) 5 % and Kinnaird (1983a) 7 % for LSJR, Duval County. Percentages for the 2002 season were lower in the ICW (0.91 %) but not significantly different for the same months in 2003, possibly attributed to unusual weather conditions in the past couple of years**.**

The Single Highest Day Count (SHDC) for LSJR was 55 animals per survey (June 2009) was the lowest on record. In June 2008, the SHDC for LSJR was 140 animals per survey, lower than the previous five years, but greater than the general mean of 121 manatees per survey (1994-2009). The SHDC of manatees represents the highest number of animals counted on a single survey day throughout the year. In April of 2007, it was 151 manatees per survey. This represented the highest number of animals sighted so early in the season, due to an unusually mild winter. In September of 2006, it was 153 manatees per survey, but reached a peak of 170 manatees per survey (June 2005). Prior to this, it was 160 (May 2004); 150 (June 2003); 106 (May 2002). Dry weather (1999–2001) caused higher salinity in the LSJR that lead to poor or no regeneration of tape grass beds *(Vallisneria americana)* that manatees primarily rely on for food. As a result, overall per survey counts were generally lower than expected. Apart from the year 2000/2001 data, it appears that SHDC increased until 2005 and then begun to decline to normal levels seen in the late 1990's (range 124-136 manatees per survey). Increased counts were probably also influenced by better knowledge of the survey area and where manatees are likely to occur. The SHDC has alternated between the months of May and June each year since 2000. Prior to 2000 the SHDC occurred in July, August and September. More recently 2006/2007, due to a mild winter the season expanded from April to September (Table 1).

In LSJR, the mean number of manatees per survey by year increase from 16-51 manatees/survey (2000-2006, respectively). Then in 2007, numbers decreased to 34 manatees/survey, probably due to the return of drought conditions that negatively impacted the manatee grass bed habitat. These numbers do not necessarily mean an increase in real population numbers for the Florida manatee, since many anthropogenic threats to manatees and habitat still exist. It is possible that more individuals are migrating into the northeast Florida

region. **In 2008, mean number of manatees/survey increased slightly to 41, but decreased sharply in 2009 (17 manatees/survey). This was unexpected because 741 more animals were observed on the east coast during the State Synoptic Aerial Survey earlier in the year than the previous 2007 survey. The increased sightings did not translate into more animals visiting Northeast Florida.** Moreover, the literature indicates that some growth has indeed occurred in the Atlantic sub population. For the years 1986-2000, the Atlantic population had a growth rate of 3.7 % (95 %CI: 1.1 to 6 %) (Runge *et al.* 2007a). Craig and Renolds (2004) used a Bayesian method and predicted that from 1982-1989, the growth rate was 5-7 % per year, 0-4 % (1990-1993), and then increased 4-6 % per year (1994-2001). The Atlantic sub population represents about 47% of the Florida synoptic count, the Northwest (11 %), the Southwest (37 %), and the Upper St. Johns or Blue Springs (5 %) (U.S. Fish and Wildlife Service. 2001, State Manatee Management Plan, September 2007).

In the Intracoastal Waterway (ICW) the SHDC was 18 manatees per survey (June 2008) and represented a decline from 30 manatees per survey (May 2008). SHDC was 21 and 19 manatees per survey (April 2007, April 2006, respectively); 29 manatees per survey (July 2005); 23 manatees per survey (2003 and 2004); 28 manatees per survey (April 2002) was the highest since 1994. In 2001, SHDC was 23 manatees that was higher than the 13 reported in 2000. Counts between 2001 and 2005 appear to be more consistent with counts prior to the period of drought for years 1994-1998 (range 19-23 manatees) (Table 1). **The general mean (5 manatees/survey/yr.) in the ICW has been consistent for the last nine years 2000-2009.**

Cumulative counts of manatees at various locations in the ICW (Table 2) and LSJR (Table 3) are included to show density abundance and location of manatees in the County. The latter does not appear to have changed in spite of the lower numbers of manatee observed this year 2009, or during 2001/2002. The 2002-2005 numbers indicate a significant rebound similar to pre-drought years and the 2006-2008 numbers indicate slight decrease and stabilization. Numbers in 2007 are lower because of a drought which caused animals to move further south out of the study area, so they were not counted. The 2009 data is some what anomalous because the low numbers of manatees normally associated with droughts were observed during a period of more than adequate rainfall. Also, note that the data for 2009 does not represent a full year.

Increased spring and summer sightings are attributed to an influx of animals from outside the study area **(Figure 1a, b-2a, b). Manatee abundance is correlated with both temperature and photoperiod. LSJR totals exhibit an increasing trend from 2000 to 2005 and a decreasing trend from 2005 to 2009. In the ICW totals remain relatively stable over the past several years.**

Some of these animals could come from Blue Spring (170 Km further south within the St. Johns River system) and the rest are made up of south Florida east coast animals (Kinnaird 1983a). Kinnaird (1983a) mentioned the then current population of Blue Springs animals numbering some 35 in 1982/83. Ackerman (1995) mentions 88 individually identified manatees at Blue Springs in the winter of 1993-94. Between 1990-1999 this population had an annual growth rate of 6.2 % (95 %CI: 3.7-8.1 %) (Runge et al. 2004). This represents the fastest growing sub population unit accounting for about 5 % of the total Florida count (State

Manatee Management Plan, September 2007). **More recent raw data indicate that the Blue Springs management group has continued to grow at a slightly faster rate during 2000-2009 (Table 4).** Satellite telemetry data support that most animals come into the LSJR as a result of south Florida east coast animals migrating north/south each year (Deutsch et al. 2000). Sightings by Jacksonville University seem to indicate that the majority of animals moving into the County come from further south within the LSJR system (Map Series A). However, scar pattern identification suggested that significant numbers of manatees are part of the Atlantic sub-population and, that in the last decade only one manatee carcass recovered in Duval County has been identified as coming from the Blue Spring population (Cathy A. Beck, Wildlife Biologist, Sirenia Project, U.S.G.S. personal communication).

Manatees were distributed throughout LSJR and ICW waters in spring (*Map Series A*). Highest concentrations of manatees occurred south of Fuller Warren Bridge (east and west banks) and Doctor's Lake in summer where substantial submerged aquatic vegetation exists**.** In 2001/2002 manatees seemed to be more spread out throughout the county than in 2000 and this may be due to the fact than manatee were forced to spend more time traveling in search of sparse food resources. In late summer and fall manatees tended to occur in the main stem of LSJR. In winter, most animals moved south out of Duval County. During spring and summer, manatees with new calves were consistently seen in the upstream areas of tributaries because these areas are more sheltered. Wills Branch Creek continues to be one such birthing area in Cedar River**.** In 2003-2005, manatees were observed throughout the County similar to 2001-2003. Also, more manatees were seen on the east bank of St. Johns River and west bank south of NAS JAX than in 2000/2001. Greater numbers in these areas can be attributed to regeneration of *Vallisneria americana* tape grass beds. **We observed the least number of manatees during the spring of 2009 (147),** and the most number of manatees during the spring of 2008 (395) compared to the same time in 2007 (369), and 2006 (218). **In summer 2009 we observed 174 manatees compared to** 560 (2008), 247 (2007), and 441 animals (2006) see *Map Series A*. The higher numbers of animals seen earlier in the season (spring 2007) may be attributed to a relatively mild winter that caused waters to warm sooner. The dip in numbers in summer 2007 may be attributed to drought conditions that affected the grass beds. **At this time there is no apparent explanation for the significant dip in numbers in the study area during 2009.**

LSJR: Prior to 2000, manatees were observed to spend most of the time resting, followed by traveling and feeding and less time was spent cavorting **(Table 5a-d)**. In winter it was difficult to find manatees feeding because manatee abundance was low anyway. Also, no manatees were observed cavorting in winter. In winter 2004 one manatee was seen resting near the Buckman Bridge (east bank of the river). No manatees were seen at power plants. **During the spring of 2009 there was a 12% increase in the animals feeding, compared to 2008. Also, fewer animals in spring 2009 were seen displaying mating type behavior (3%) compared to 12% in 2008. Behavior in 2009 indicated 11% more traveling, and about 11% less resting than in 2008. In the fall there was a significant reduction in the number feeding (6%) compared to prior years. Also, not manatees were seen cavorting in the last two years compared to prior years.** Spring and summer of 2001/2002 data appear to be similar in that the percent of manatees observed traveling was higher in the past two years than before (1998/1999) and percent resting was lower in 2002 than 2001. The apparent change in behavior may be attributed to dry weather conditions, higher than normal

salinity and the resulting low food availability that may have caused the manatees to travel more in search of food than previous years. In 2003, percentages for traveling and resting manatees are similar again to the pre-drought years. That is, manatees spent most of the time resting, followed by traveling and feeding and the least time cavorting. Indices for percent feeding indicated more animals feeding each year subsequent to 2002. This may be because the food supply continued to increase in 2003/2004 and there were more total numbers of manatees. By 2005/2006 these numbers began to stabilize. Feeding animals were for the most part located south of Buckman Bridge. Grass beds north of Buckman Bridge regenerated significantly since late 2002-2006 and then declined again in 2007. This fluctuation in food supply probably caused the increase in percentage of animals cavorting (2006) followed by a subsequent decreased in 2007. In 2007 we saw a return to drought conditions and numbers of manatees sighted in the study area declined in the summer due to a die back of submerged aquatic vegetation. Lack of precipitation led to elevated salinity levels in the river that forced animals to move further south within the St. Johns in search of food. This was reflected in the lower percentage of resting and feeding animals and the increased percentage in the number of traveling animals compared to before the drought. It appears that the same phenomenon occurred post 2000/2001 during a similar period of drought.

ICW: Traveling and resting behavior in the ICW remained predominantly unchanged from 1994-**2009**; the ICW continues to be a travel corridor for migration (Tables 6a-d). No manatees were observed feeding or mating in winter. **In spring 2009, 32 manatees were observed, less than 78 (2008), 55 (2007), 42 (2006), 46 (2005), and 70 (2004).** No feeding behavior was observed in the last 5 years which was unlike prior years. Most animals were resting and traveling. **We observed 28 % of the animals traveling, 50 % resting, no animals were observed feeding, and 22 % were cavorting (Table 6c). In summer 2009, 44 animals were observed compared to 83 (2008), 24 (2007), 32 (2006), 63 (2005), and 25 (2004). Behaviors consisted of traveling animals (36%), resting animals (48%) and 9% feeding and 7% cavorting.** No animals were observed feeding from 2003 to 2008. **During summers, more animals were seen cavorting from 2005-2009 (14-23%) in contrast to 1999-2004 (0%) Tables 6d).**

Grass Beds: **Data for 2008/09 was not yet available from SJRWMD. Also, in 2009, prominent algae blooms were observed throughout the LSJR beginning in Lake George around the March/April time frame. The algae blooms did not seem to be as large as those seen in 2005. Never the less, toxic algae blooms were observed earlier than usual than in previous years.** Data for 2007 showed continued decline in grass bed condition due to stress from periodic drought conditions. Following is information supplied by SJRWMD regarding state of the grass beds in Duval County 2007 **(Figure 3)**. The number of transects was highest in 1998 (26) and lowest in 2000 (6) however, has been 19 for the rest of the years of data provided. As indicated earlier there was a drought experienced between 2000/2001. As a result, there has been a decrease in the mean grass bed length over the past 8 years from 77 m (1998) to 64 m (2006). Total cover percentage (this is the reciprocal of what was considered percentage bare) decreased from 62% (1998) to about 20% (2000-2002) then rebounded after the drought up to 67% (2004) and then began declining again to 37% (2006). The decline in 2005/2006 may have occurred because of deteriorating water quality conditions which was demonstrated by the appearance of toxic blue green algae blooms in

the river firstly in August of 2005. Algae blooms were again observed in 2007 and 2008 to a lesser extent. Excessive algae and turbidity from sedimentation caused by rainfall and upstream construction activities also contributes to shading/smothering which can kill submerged aquatic vegetation. The proportional percentage of tape grass (*Vallisneria*) cover versus other species (calculated as the summed patch lengths of *Vallisneria* divided by the total patch lengths of all species present) shows some improvement since the drought from 42% (2002) to about 60% (2003) then averaged about 55% (2004-2006) but is still below the 1998 level of 69%. The Shannon-Weiner index of diversity has shown a fall in diversity from 92% (1998) to 39% (2002), then a rebound after the drought to 84% (2004) followed by a slight decline to 69% (2006). The diversity index and total cover percent seem to mirror each other. Grass bed condition has not quite returned to pre drought levels.

Salinity: Tape grass grows well from 0-12 ppt and can tolerate waters with salinities up to 15-20 ppt for short periods of time. Growth becomes limited above about 10-12 ppt based on analyses of high-estuarine distribution (Twilly and Barko 1990[1]). The availability of tape grass decreased significantly in the County from 2004 to 2007, because low precipitation in 2005/2006 caused higher than usual salinity values-compare 1999, with 2000-2002 In 2003, environmental conditions returned to a more normal precipitation pattern. As a result, we recorded lower salinity values that favored tape grass growth. In 2004, salinities were initially higher than in 2003 but decreased significantly after August with the arrival of heavy rainfall associated with hurricanes that skirted Northeast Florida (Charley, Francis, Ivan and Jeanne) **(Figure 4a)**. In 2005 salinities remained low throughout the year favoring continued grass bed growth and regeneration. However, in August the development of toxic blue green algae blooms may have hampered growth of submerged vegetation. During the latter part of 2006 and into 2007 salinity levels have been relatively high leading to a decrease in the availability of tape grass in the county. In 2008 the salinity was relatively high from March to July and then decreased in August with the arrival of Tropical Storm Fay. **In 2009, salinity was elevated, and fluctuated above the norm at the beginning of the year for limited periods of time before falling below the norm from June to September, because of above normal rainfall (Figures 4b).**

The pattern of mean numbers of manatees observed seasonally in the LSJR and the ICW seem to be consistent with those observed in previous years. **Figures 5 and 6 show this data pooled over the duration of the study period 1994-2009.**

Mortality Information: **The total of State-wide deaths documented as of August 2009 was 340, of which 74 were watercraft-related. Other causes included Flood gate (5), other human (5), perinatal (95), cold stress (53), other natural (24), undetermined (76) and unrecovered (8). In 2009, watercraft deaths for the key counties totaled 42. Other causes of death for the key counties included Flood gate (3), other human (3), perinatal (71), cold stress (46), other natural (16), undetermined (61) and unrecovered (4) (Table 7). Watercraft caused mortality of manatees in Florida, by month compared for the years 1994–August 2009 is shown in Figure 7. Watercraft, perinatal, undetermined, natural, and cold stress causes of death were the most significant for 2009 (FWRI 2009).**

Total mortality rates for manatees in Duval County decreased from 19 deaths/Yr. (1991) to 5 (1993). Then increased to 13 (1998); decreased to 6 (2001). Then increased

to 19 (2003), decreased to 8 (2007), increased 14 (2008), and as of August were at 12 for 2009 (Table 8, and Figure 8). The five-year running average from watercraft mortality was 3.77 (range 2-7) deaths since 1980 and 4.64 (range 2-7) deaths since 2000 (Figure 8). While the trend in Duval county deaths has edged upwards since 2001, the recent state wide mortalities trend has shown a decline since 2006 (Figure 9).

As of August 2009, there were a total of 12 reported deaths in Duval County, of which 8 were watercraft related, 2 Perinatal, 1 cold stress and 1 undetermined (FWRI 2009). For the fifth time, the county surpassed the "unacceptable" level of watercraft related mortality as stipulated in the MPP (1st in 2002, 2nd in 2004, 3rd in 2006, 4th 2008, and 5th 2009). This unacceptable level is triggered when there have been five or more watercraft related mortalities in all county waters within the last 12 months. County, State and Federal agencies met October 30th, 2009 to discuss 19 watercraft deaths that occurred in Duval County from May 5th 2008 to September 11th 2009. Issues of inadequate signage and enforcement were discussed. Three of the 8 watercraft related deaths were caused by large vessels. The carcasses were recovered in the area from Talleyrand docks to Drummond Point, and included Trout River. Since May 5th 2008, almost half the deaths (8 or possible 9) of 19 total deaths were caused by large vessels. Also, the carcasses were recovered in an area from Lions Club to the mouth of the river. The rest of the watercraft related carcasses recoveries were made from the mouth of Arlington River to the St. Johns River mouth. No carcasses were recovered south of Downtown in 2009. In recent years there seems to have been a shift in the pattern of watercraft deaths towards the mouth of the river, rather than a more county wide spread as in past years. Also, the number of large vessel mortalities appears to have increased (Figures 10).

County, State and Federal agencies met September 18th, 2008 to discuss 8 watercraft deaths in Duval County during 2008. It was suggested that there was an identifiable pattern of activity associated with large vessels that caused three of the mortalities recovered near Lions Club. **Since September, this trend was strengthened by the fact that there were three more deaths caused by large vessels near the mouth of the river during October, bringing the total watercraft related deaths to 11 for 2008. In summary, about half of the deaths in 2008 (5 or possibly 6) were caused by large vessels, and the associated carcasses were recovered from Lions Club to the mouth of the St. Johns River. The rest of the carcasses were recovered from Julington Creek (2), Ortega River (1), Downtown (1), and ICW near the St. Johns County line (1).**

In 2007, there were a total of 8 reported deaths, of which 2 was watercraft related, 3 cold stress and 3 undetermined (FWRI 2008). **The 2 watercraft related deaths were attributed to large vessels, and the carcasses were recovered at Talleyrand docks and near Mayport.**

In 2006, there was a total of 13 reported deaths, of which 8 were watercraft related, 1 perinatal, 1 cold stress, 1 natural, and 2 undetermined (FWRI 2008). **Three of 8 watercraft deaths were attributed to large vessels, with carcasses recovered at Blount Island, Talleyrand docks, and White Shell Bay.** County, State and Federal agencies met January 31st, 2007 to discuss the 8 watercraft deaths in Duval County during 2006 and how Duval County should respond to those incidents. It was agreed that there was no identifiable pattern

of activity that caused the mortalities in 2006 (see September 2006-2007 update for details regarding actions taken by waterways to address the issue).

In 2005, there were a total of 14 reported deaths of that 4 were watercraft, 2 perinatal, 2 cold stress and 6 undetermined (FWRI 2008).

In 2004, there were 15 reported deaths total of which 5 were watercraft, 4 perinatal, 1 cold stress and 5 undetermined. County, State and Federal agencies met November 9th to discuss the five watercraft deaths in Duval County during 2004 and how Duval County should respond to these incidents (see September 2004 update for details regarding actions taken by waterways to address the issue).

In 2003, there were 19 deaths of which 4 were watercraft, 4 perinatal, 3 cold stress, 2 other natural and 6 undetermined.

In 2002, there were a total of 14 reported deaths of which 10 were watercraft, 2 undetermined, 1 unrecovered and 1 perinatal. As a result, this triggered a mortality threshold standard in the MPP that led to a moratorium on permits issued by the state for marine construction (see September 2002 update for details regarding actions taken by waterways to address the issue).

Mortality due to watercraft impacts in 2009 (Table 9) was highest in, Lee County (12), and Duval (8). Intermediate numbers of watercraft-caused deaths were documented in Brevard (5), Broward (3), Collier (4), Martin (5), Palm Beach (3), and Volusia (3); and lower numbers of deaths were documented in Citrus (1), Dade (2), Indian River (2), Sarasota (2) and St. Lucie (0). Table 9 shows manatee mortality caused by watercraft-related impacts and serves as a comparison of Duval County to other "key" counties in Florida from 1991 through August 31st 2009.

Table 10 shows total manatee mortality/yr. and cause in Duval County from 1976 to August 31st 2009 (FWRI 2009).

Map Series B, Duval County Manatee Mortality 2008/2009 **shows locations of carcass recoveries.**

Warm-Water Attractants**:** during the winter of 2006/2007, no manatees were observed at the warm water source in Ortega River. However, on January 3rd 2008 a cold stressed manatee was rescued from the Ortega River by Sea World of Florida and FWC. On January 7th 2008 another cold stressed animals was rescued in Sherman Creek near Mayport, and on June 26th a manatee was rescued from entanglement in a crab trap in Ortega River.

A few animals were seen at the JEA District # 2 waste water treatment outfall near north Bartram Island (Table 11a, b). Rescue attempts were made and one animal was relocated by Sea World of Florida and FWC on Dec 19th 2006. On August 15th 2007 an entrapped manatee was rescued from the JEA North Side Generating Station. In addition, on January 18th 2008, two manatees were rescued from the JEA District # 2 outfall north of Bartram Island by Sea World of Florida and FWC. **The discharge from the site is fresher than the surrounding ambient waters. As a result, it is likely to serve as an attractant for manatees throughout the entire year, and not just during colder weather. Manatees are attracted to the site in winter, when the discharge is also warmer than the surrounding ambient waters. The close proximity of this site to the location of shipping lanes in St. Johns River means that there possibly exists a higher potential for vessel/manatee interactions. Recently, some manatees killed by large vessels have been**

recovered close to this location. On January 6th 2009, a female manatee (Bella) and her calf were rescued from the JEA District # 2 outfall. These animals were rehabilitated at Sea World and reintroduced into Julington Creek on May 28th 2009. On July 15th the calf's carcass was recovered transected, and on July 25th the mother suffered acute impact and was rescued to Sea World, but had to be euthanized. For a summary of recent rescues see Table 12.

No significant warm water discharges exist in Duval County. Historically, warm water discharges consisted of three power generating stations and two paper mills. Area power plants include: St. Johns River Power Park and Southside and J.D. Kennedy Generating Stations. Seminole Kraft and Jefferson Smurfit Containerboard Corporation are the two paper mills in Duval County. Each of these areas provided warm-water refuges for manatees in the winter months and during periods of cold weather. The last of which - Southside Generating Station - was closed on October 31st 2001.

During the winters (2002-2007), it was not possible to gain access to the monitoring sites at Southside Generating Station because construction activities associated with dismantling of the power station caused Jacksonville Electric Authority (JEA) to have concerns about health safety, insurance and liability issues. As a result, JEA undertook monitoring for manatees themselves using their own personnel. In 2002, total daily count varied from 0-14 adults between 11/3/02 to 12/12/02. From 1-3 adults were observed around 11/9/02 with 1 calf. Then, from 2-14 adults were observed around 11/19/02 with 2-4 calves - representing the largest peak. From 2-4 adults were observed around 11/26/02, and then 1-2 adults around 12/3/02. JEA then installed a large mesh metal gate at the end of the effluent canal to prevent manatees from moving up into the effluent discharge pipes. Once this was installed no more manatees were reported (Lindsay Schoppe, Environmental Division, Jacksonville Electric Authority, personal communication). In 2003, no manatees were reported by JEA until 4 adults were seen on 05/05/2003 and 2 adults and 2 calves were seen 04/15/2003. In 2004/2005/2006/2007, no manatees were reported at the site. **Aerial surveys indicated no manatee at this site during 2008/2009.**

JEASS officially closed on Oct 31st 2001. Total daily count at JEASS varied from 0-5 between 11/15/01 to about 2/18/02. Five manatees were observed in mid November. No manatees were seen between mid November to January. Then from 0-2 manatees were seen in the first week of February during the colder weather. On 01/5/02 FWC/Sea World and JU attempted to rescue a manatee but were unsuccessful. JEAK was again not producing warm water effluent and was monitored with less frequency. No animals were observed at JEAK between 11/29/01 to 2/18/02.

Information sources

Manatee Protection Plan 2006 and Annual Update 2007.

The updated document was approved by the FWC in November 2006. Among the plan's changes are clarifications of the applicability of the MPP to multi-family boat facilities and revisions to the "Unacceptable" category.
http://www.coj.net/City+Council/Jacksonville+Waterways+Commission/JWC+MPP.htm

Manatee Protection Plan 1999 and Annual Updates 2000-2005.

In 1999, the State of Florida approved the Duval County Manatee Protection Plan. The Plan had initially been approved by the Florida Department of Environmental Protection. In April 2000, the state rule implementing the boat speed zones were adopted by the Florida Fish and Wildlife Conservation Commission.
http://www.coj.net/Departments/Recreation+and+Community+Services/Waterfront+Management+and+Programming/Waterways+and+Boating/Manatee+Protection+Plan.htm

Duval Manatee Protection Outreach

The Manatee Research Center Online (MARCO) web site at JU, and the Jacksonville Marine Transportation Exchange web site have been updated to show the latest manatee sightings aerial survey maps so that recreational and commercial vessel operators (including personal watercraft) can see where manatees are in the county. These maps have also been shown on a regular basis on the local news weather updates on TV (First Coast News) and the "Outdoors" Section of the news paper (Florida Times Union). **In addition, maps are forwarded to key personnel with JSO Marine Unit, FWC, USFWS and JMTX.**
http://www.ju.edu/MARCO
http://jmtxweb.org/environmental.htm

Duval County Manatee Protection Rule (68C-22.027, FAC):

Amendments to the speed zones rule were adopted on January 10, 2007.
http://www.myfwc.com/docs/WildlifeHabitats/Manatee_68C_22_027_2007.pdf

Federal Protection Areas Map:
http://www.fws.gov/northflorida/Manatee/federal-manatee-protection-areas.htm

Recommendations

There appears to be confusion over signage location and maintenance. Recommend a comprehensive review of all signage and establish responsible parties. A comprehensive list of signage locations needs to be established.

Recommend revision of the MPP Standards.

Recommend continuation of the working group regarding manatees and port activities which includes JMTX, the Port of Jacksonville and other commercial marine operators and businesses that use Port facilities so that the group can obtain manatee observation data from commercial vessels and pilots, and providing each other with manatee information and training on a regular and ongoing basis.

Distribute a manatee awareness placard to all maritime interest who might encounter manatees during their normal operations.

TABLE 1. Summary of the total number of aerial surveys, adults and calves observed, and Single Highest Day Counts (SHDC) by year (1994-August 2009).

Year		No. of surveys	Adults	Calves	Total	% Calves	SHDC Count	SHDC Date	Mean No./survey
LSJR	1994 [1]	19	783	67	850	7.89	113	9/6/94	45
	1995	22	583	36	619	5.82	76	7/20/95	28
	1996	21	706	92	798	11.53	124	7/15/96	38
	1997	23	1,113	89	1,202	7.4	136	8/18/97	52
	1998	26	775	82	857	9.57	125	9/11/98	33
	1999	20	804	87	891	9.76	127	9/28/99	45
	2000	20	294	28	322	8.7	67	5/3/00	16
	2001	18	454	17	471	3.61	85	6/4/01	26
	2002	23	796	28	824	3.40	106	5/14/02	36
	2003	23	1,018	68	1,086	6.26	150	6/25/03	47
	2004	18	836	88	924	9.52	160	5/20/04	51
	2005	21	848	76	924	8.23	170	6/22/05	44
	2006	22	996	115	1,111	10.35	153	9/27/06	51
	2007	19	584	58	642	9.03	151	4/23/07	34
	2008	20	759	58	817	7.10	140	6/4/08	41
	2009 [2]	12	181	21	202	10.40	55	6/3/09	17
Total		327	11,530	1,010	12,540	8.04 [3]	121 [4]		38 [5]
ICW	1994 [1]	12	74	7	81	8.64	21	5/12/94	7
	1995	23	79	6	85	7.06	21	5/30/95	4
	1996	23	84	11	95	11.58	16	5/16/96	4
	1997	24	73	10	83	12.05	20	4/21/97	3
	1998	18	46	3	49	6.12	19	6/12/98	3
	1999	14	32	4	36	11.11	12	6/21/99	3
	2000	21	54	3	57	5.26	13	5/3/00	3
	2001	17	77	2	79	2.53	23	4/27/01	5
	2002	22	109	1	110	0.91	28	4/30/02	5
	2003	18	82	1	83	1.20	23	5/14/03	5
	2004	18	92	11	103	10.68	23	5/20/04	6
	2005	20	111	6	117	5.13	29	7/6/05	6
	2006	19	77	3	80	3.75	19	4/21/06	4
	2007	16	101	8	109	7.34	21	4/23/07	7
	2008	19	184	11	195	5.64	30	5/5/08	10
	2009 [2]	11	70	6	76	7.89	18	6/15/09	7
Total		295	1,345	93	1,167	6.67 [3]	21 [4]		5 [5]

SHDC=Single Highest Day Count

[1] March to the end of December

[2] Untill August

[3] Mean % Calves

[4] Mean highest day count

[5] General Mean of total/survey counts

TABLE 2. Total aerial sightings of manatees in the Intercoastal Waterway, Duval Co., FL. (March 1994-August 2009).

LOCATION	ADULTS*	CALVES*	TOTAL*
Nassau Sound	30	0	30
Sawpit Creek	50	0	50
ICW North of Fort George River	79	1	80
Sisters Creek	34	3	37
Fort George Inlet	9	0	9
Mayport	16	0	16
St. Johns Bluff	46	0	46
Blount Island	142	12	154
Mill Cove	111	5	116
Atlantic Blvd. Bridge to SJR confluence	67	2	69
Beach Blvd. Bridge to Atlantic Blvd.	124	7	131
JTB Bridge to Beach Blvd. Bridge	154	7	161
Palm Valley Bridge to JTB Bridge	265	20	285
Container Corporation, Fernandina	67	9	76

***These numbers indicate total per survey counts of manatees. Individual manatees may migrate to other areas between flights.**
Source Jacksonville University 2009.

Note: No manatees were seen at Container Corp. of America in 1998-2002 since the introduction of a diffuser array on the effluent warm water discharge.

TABLE 3. Total aerial sightings of manatees in Lower St. Johns River, Duval Co., FL. (March 1994-August 2009).

LOCATION	ADULTS*	CALVES*	TOTAL*
Quarantine Island	112	4	116
Dames Point	29	1	30
Trout River	291	26	317
Arlington River	45	3	48
Pottsburg Creek	57	4	61
Miller Creek	28	2	30
Downtown	114	9	123
San Marco	140	3	143
Ortega River	177	17	194
Sadler Point	154	13	167
Pirates Cove	54	3	57
NAS/JAX	239	14	253
Mulberry Cove	147	12	159
Rudder Club	697	69	766
Club Continental	1173	109	1282
Doctors Lake	1872	173	2045
SJR south of Dr.Lake	1500	140	1640
Julington Creek	239	25	264
Durbin Creek	13	0	13
Mandarin Point	1348	116	1464
Plummers Point	340	31	371
Beauclerc Bluff	326	21	347
Goodbys Creek	172	13	185
Christopher Point	885	81	966
Point La Vista	198	5	203
Lions Club Boat Ramp	18	0	18
JEA - Southside	85	8	93
Jefferson Smurfit	14	2	16

*** These numbers indicate total per survey counts of manatees.**
Individual manatees may migrate to other areas between flights.
Source Jacksonville University 2009.

TABLE 4. Manatee yearly attendance at Blue Springs State Park.

Season	Total Seen	Stayed Here	Max. Single Count
1970-71	11	11	11
1971-72	18	16	
1972-73	missing data		
1973-74	missing data		
1974-75	24	14	16
1975-76	23	20	
1976-77	20	16	16
1977-78	21	20	20
1978-79	23	22	23
1979-80	26	23	23
1980-81	35	29	35
1981-82	36	27	27
1982-83	42	33	33
1983-84	43	29	30
1984-85	37	32	31
1985-86	57	44	50
1986-87	50	47	38
1987-88	54	50	47
1988-89	57	45	52
1989-90	63	59	57
1990-91	63	59	54
1991-92	75	67	67
1992-93	73	70	67
1993-94	88	77	81
1994-95	89	71	74
1995-96	94	75	74
1996-97	94	77	72
1997-98	106	92	87
1998-99	114	99	86
1999-00	132	115	112
2000-01	153	120	96
2001-02	141	118	97
2002-03	162	139	123
2003-04	142	142	128
2004-05	200	145	129
2005-06	261	195	182
2006-07	265	188	193
2007-08	279	192	202
2008-09	300	195	231

Source: Wayne Hartley, Park Service Specialist, Blue Spring State Park 2009.

TABLE 5a. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (LSJR).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Fall '94	310	10	87	3	0
Fall '95	113	29	51	12	7
Fall '96	170	20	22	48	9
Fall '97	290	13	82	4	1
Fall '98	298	13	40	40	7
Fall '99	284	26	28	20	25
Fall '00	35	29	63	9	0
Fall '01	43	30	30	28	12
Fall '02	168	24	29	11	36
Fall '03	196	16	52	26	7
Fall '04	31	16	55	19	10
Fall '05	110	30	39	26	5
Fall '06	309	35	25	32	9
Fall '07	45	36	31	33	0
Fall '08	31	48	45	6	0
Falls Mean	162	25	45	21	9
SD	113	10	20	14	10
CI	57	5	10	7	5

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source Jacksonville University 2009.

TABLE 5b. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (LSJR).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Winter '94-95	16	25	75	0	0
Winter '95-96	2	0	100	0	0
Winter '96-97	0	0	0	0	0
Winter '97-98	1	100	0	0	0
Winter '98-99	2	50	0	50	0
Winter '99-00	0	0	0	0	0
Winter '00-01	0	0	0	0	0
Winter '01-02	1	0	100	0	0
Winter '02-03	0	0	0	0	0
Winter '03-04	4	50	50	0	0
Winter '04-05	6	33	67	0	0
Winter '05-06	1	100	0	0	0
Winter '06-07	1	100	0	0	0
Winter '07-08	1	0	50	50	0
Winter '08-09	1	0	100	0	0
Winters Mean	2	31	36	7	0
SD	4	40	43	18	0
CI	2	20	22	9	0

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source Jacksonville University 2009.

TABLE 5c. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (LSJR).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Spring '94	226	23	38	33	7
Spring '95	189	14	69	1	16
Spring '96	96	50	31	1	18
Spring '97	350	23	9	51	17
Spring '98	113	24	41	22	13
Spring '99	290	26	48	12	15
Spring '00	186	27	44	12	17
Spring '01	140	34	35	14	18
Spring '02	330	34	15	39	12
Spring '03	161	30	45	19	6
Spring '04	374	33	24	29	14
Spring '05	187	21	41	33	6
Spring '06	186	46	19	8	27
Spring '07	354	41	42	11	6
Spring '08	308	28	37	23	12
Spring '09	71	32	30	35	3
Springs Mean	223	30	35	21	13
SD	99	9	14	14	6
CI	48	5	7	7	3

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source Jacksonville University 2009.

TABLE 5d. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (LSJR).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Summer '94	311	8	79	2	11
Summer '95	313	23	57	15	4
Summer '96	532	12	45	39	4
Summer '97	561	19	51	22	8
Summer '98	446	17	53	12	17
Summer '99	389	15	48	13	23
Summer '00	102	36	35	16	13
Summer '01	288	26	36	8	29
Summer '02	326	43	24	22	11
Summer '03	725	26	23	31	20
Summer '04	504	21	18	52	9
Summer '05	626	18	31	41	10
Summer '06	616	26	43	16	15
Summer '07	235	41	31	19	9
Summer '08	475	24	43	23	10
Summer '09	130	35	32	26	8
Summers Mean	411	24	41	22	13
SD	180	10	15	13	7
CI	88	5	7	6	3

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source Jacksonville University 2009.

TABLE 6a. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (ICW).

Year/Season	Total No.	Percentage T	R	F	C
Fall '94	5	40	60	0	0
Fall '95	2	0	100	0	0
Fall '96	4	100	0	0	0
Fall '97	5	20	80	0	0
Fall '98	4	75	25	0	0
Fall '99	5	80	20	0	0
Fall'00	5	60	40	0	0
Fall '01	0	0	0	0	0
Fall '02	12	75	17	8	0
Fall '03	2	100	0	0	0
Fall '04	7	29	57	14	0
Fall '05	7	86	14	0	0
Fall '06	5	80	20	0	0
Fall '07	22	45	45	0	9
Fall '08	10	0	100	0	0
Falls Mean	6	53	39	1	1
SD	5	36	34	4	2
CI	3	18	17	2	1

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source: Jacksonville University 2009.

TABLE 6b. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (ICW).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Winter '94-95	47	0	100	0	0
Winter '95-96	20	10	85	5	0
Winter '96-97	38	0	100	0	0
Winter '97-98	0	0	0	0	0
Winter '98-99	2	100	0	0	0
Winter '99-00	0	0	0	0	0
Winter '00-01	1	100	0	0	0
Winter '01-02	3	100	0	0	0
Winter '02-03	0	0	0	0	0
Winter '03-04	0	0	0	0	0
Winter '04-05	2	50	50	0	0
Winter '05-06	0	0	0	0	0
Winter '06-07	0	0	0	0	0
Winter '07-08	20	0	100	0	0
Winter '08-09	1	0	100	0	0
Winters Mean	9	24	36	0	0
SD	15	41	47	1	0
CI	8	21	24	1	0

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source: Jacksonville University 2009.

TABLE 6c. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (ICW).

Year/Season	Total No.	Percentage T	R	F	C
Spring '94	42	57	12	26	5
Spring '95	60	42	42	2	15
Spring '96	32	53	13	28	6
Spring '97	45	62	33	4	0
Spring '98	10	30	50	20	0
Spring '99	16	63	0	0	38
Spring '00	36	39	36	6	19
Spring '01	50	60	26	14	0
Spring '02	62	42	53	5	0
Spring '03	48	83	6	10	0
Spring '04	70	50	19	20	11
Spring '05	46	59	37	0	4
Spring '06	42	36	40	0	24
Spring '07	55	36	64	0	0
Spring '08	87	55	31	0	14
Spring '09	76	20	66	0	14
Springs Mean	49	49	33	8	9
SD	20	16	20	10	11
CI	10	8	10	5	5

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard deviation
CI = 95% Confidence interval for the mean
Source: Jacksonville University 2009.

TABLE 5d. Number percent of manatees engaged in various activities between spring 1994-summer 2009 (ICW).

Year/Season	Total No.	Percentage T	R	F	C
Summer '94	4	100	0	0	0
Summer '95	9	78	22	0	0
Summer '96	21	71	10	19	0
Summer '97	13	38	62	0	0
Summer '98	35	34	51	0	14
Summer '99	15	87	13	0	0
Summer '00	16	63	38	0	0
Summer '01	26	69	31	0	0
Summer '02	35	60	31	9	0
Summer '03	33	70	30	0	0
Summer '04	25	96	4	0	0
Summer '05	63	44	41	0	14
Summer '06	32	69	13	0	19
Summer '07	35	49	29	0	23
Summer '08	83	60	34	0	6
Summer '09	44	36	48	9	7
Summers Mean	31	64	28	2	6
SD	20	20	17	5	8
CI	10	10	9	3	4

T = Traveling; R = Resting; F = Feeding and C = Cavorting

SD = Standard deviation

CI = 95% Confidence interval for the mean

Source: Jacksonville University 2009.

TABLE 7. Causes of manatee mortality for Florida's Key Counties, August 2009.

County	Watercraft	Flood Gate	Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
Brevard	5	2	1	37	13	6	21	0	85
Broward	3	0	1	0	4	3	4	0	15
Citrus	1	0	0	2	0	2	0	0	5
Collier	4	0	0	4	7	0	4	3	22
Dade-Miami	2	0	0	2	0	0	2	1	7
Duval	8	0	0	2	1	0	1	0	12
Indian River	2	0	0	5	3	2	4	0	16
Lee	12	1	1	8	4	1	10	1	38
Martin	5	0	0	3	3	1	2	0	14
Palm Beach	3	0	1	1	3	1	6	0	15
Sarasota	2	0	0	6	0	1	1	0	10
St.Lucie	0	0	0	1	2	0	5	0	8
Volusia	3	0	0	11	6	0	6	1	27
Total	50	3	4	82	46	17	66	6	274

Source: FWCC/FWRI 2009

TABLE 8. Florida manatee mortality, 1991- August 2009.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	# Total	% of Total
Brevard	38	31	30	42	40	57	62	47	46	49	52	50	42	65	57	87	57	72	85	1009	24.74
Broward	3	9	4	4	5	6	3	7	15	4	9	10	8	6	9	15	4	10	15	146	3.58
Citrus	5	9	8	5	6	6	5	4	8	6	10	9	10	7	18	10	12	22	5	165	4.05
Collier	14	19	18	13	10	70	21	14	19	35	31	13	37	23	34	14	16	17	22	440	10.79
Dade-Miami	7	10	5	11	14	7	14	9	12	8	11	9	9	7	5	7	13	9	7	174	4.27
Duval	19	8	5	6	7	10	10	13	9	11	6	14	19	15	14	13	8	14	12	213	5.22
Indian R.	4	1	-	2	5	10	7	5	6	10	5	7	6	6	16	6	7	12	16	131	3.21
Lee	18	19	17	33	31	145	43	31	33	44	51	58	81	51	75	82	91	45	38	986	24.18
Martin	9	8	3	7	6	6	6	8	9	6	7	9	6	5	9	17	7	4	14	146	3.58
Palm Bch.	6	3	5	3	6	7	6	5	7	9	8	14	12	9	8	7	3	8	15	141	3.46
Sarasota	5	1	5	6	12	8	3	4	13	11	5	16	22	7	20	20	5	8	10	181	4.44
St. Lucie	1	4	4	2	2	4	2	1	2	2	4	4	0	1	8	5	2	6	8	62	1.52
Volusia	10	5	5	6	10	9	9	15	12	13	27	13	14	13	22	22	26	26	27	284	6.96
Total	139	127	109	140	154	345	191	163	191	208	226	226	266	215	295	305	251	253	274	4,078	100

*** = August**

Source: FWCC/FWRI 2009.

TABLE 9. Watercraft caused mortality in Florida's Key Counties, 1991- August 2009.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	# Total	% of Total
Brevard	13	7	9	9	6	13	12	9	12	13	7	17	8	11	6	22	10	10	5	199	20.52
Broward	2	2	2	3	0	1	0	2	5	2	4	3	5	1	2	6	1	3	3	47	4.85
Citrus	0	3	1	2	0	2	1	2	4	1	1	3	3	1	6	2	5	8	1	46	4.74
Collier	5	4	5	4	4	5	4	7	10	5	8	6	7	5	4	1	6	6	4	100	10.31
Miami-Dade	0	4	0	1	2	0	5	2	1	2	5	1	2	2	1	1	4	2	2	37	3.81
Duval	9	2	2	2	3	3	2	3	2	4	1	10	4	5	4	8	2	11	8	85	8.76
Indian R.	1	0		0	1	4	1	3	1	4	1	2	1	1	5	2	0	2	2	31	3.20
Lee	7	2	5	10	8	14	9	9	10	13	23	13	9	13	12	21	14	14	12	218	22.47
Martin	2	1	0	1	1	2	3	1	2	1	1	2	1	1	0	5	2	1	5	32	3.30
Palm Bch.	1	0	3	2	2	3	1	2	2	3	3	6	5	3	6	0	0	6	3	51	5.26
Sarasota	1	0	2	2	0	1	2	0	4	5	2	4	1	2	3	6	0	2	2	39	4.02
St. Lucie	1	1	1	0	0	1	0	0	0	1	1	1	0	0	1	0	1	2	0	11	1.13
Volusia	3	1	0	1	1	2	1	8	5	4	11	3	2	3	8	3	8	7	3	74	7.63
Total	45	27	30	37	28	51	41	48	58	58	68	71	48	48	58	77	53	74	50	970	100.00

*** = August**

Source: FWCC/FWRI 2009.

TABLE 10. Causes of manatee mortality in Duval County, Florida. 1976 - August 2009.

Year	Watercraft	Human	Perinatal	Cold Stress	Other Natural	Undetermined	Unrecovered	Total/Year
1976	2	0	0	0	0	4	0	6
1977	1	0	1	0	0	9	0	11
1978	5	0	0	0	0	5	1	11
1979	6	1	1	0	0	1	2	11
1980	0	0	1	0	0	1	1	3
1981	1	0	0	0	1	5	0	7
1982	1	0	1	0	0	1	0	3
1983	2	0	0	0	0	5	1	8
1984	7	0	0	0	6	3	0	16
1985	4	0	0	0	2	3	0	9
1986	2	0	0	2	0	8	1	13
1987	5	0	2	3	1	1	0	12
1988	4	0	0	2	2	1	0	9
1989	6	1	3	4	2	4	0	20
1990	3	3	0	4	0	3	0	13
1991	9	2	4	0	1	3	0	19
1992	2	0	1	0	3	2	0	8
1993	2	0	2	0	0	1	0	5
1994	2	1	1	1	1	0	0	6
1995	3	0	0	0	1	3	0	7
1996	3	0	0	1	2	4	0	10
1997	2	0	3	1	0	4	0	10
1998	3	0	3	2	0	5	0	13
1999	2	0	1	1	1	4	0	9
2000	4	0	2	2	0	2	1	11
2001	1	0	1	2	0	2	0	6
2002	10	0	1	0	0	2	1	14
2003	4	0	4	3	2	5	1	19
2004	5	0	4	1	0	5	0	15
2005	4	0	2	2	0	6	0	14
2006	8	0	1	1	1	1	1	13
2007	2	0	0	3	0	3	0	8
2008	11	0	0	2	0	1	0	14
2009*	8	0	2	1	0	1	0	12
Total	134	8	41	38	26	108	10	363

*** = August 2009.**

Source: FWCC/FWRI 2009.

TABLE 11a. Boat based manatee observations at the JEA # 2 Waste Water Treatment Outfall: October 2008-April 2009.

Date	Observer	Location	Time	Manatees		Temperature (°C)		
				Total	Size class	River	Boil	Air
11/6/2008	NLW, RWB	JEA District 2	1355	3	2 adults, 1 calf	19.5		28
11/13/2008	NLW, RWB	JEA District 2	1315	4	3 larger, 1 calf/juvenile	20		29
11/14/2008	NLW, RWB	JEA District 2	1128	3?	adult,	21	20.5	26
11/17/2008	NLW, RWB	JEA District 2	1100	3	2 adults	19	19.2	13
11/18/2008	NLW, RWB	JEA District 2	1405	3	adults	17.5		14
11/19/2008	NLW, RWB	JEA District 2	1220	1	sm. Adult or juvenile	17.5		10
11/20/2008	RWB	JEA District 2	950	3	1 adult, 2 juveniles	15.5	18	14
11/24/2008	NLW, RWB	JEA District 2	1045	1	adult	14.5	17	17
12/3/2008	NLW, RWB	JEA District 2	1340	1	adult	15	17.5	19
12/17/2008	NLW, RWB, Glenna	JEA District 2	1216	1	adult	15.5		24
12/18/2008	NLW, RWB	JEA District 2	830	1	sm juvenile	15		17
12/23/2008	NLW	JEA District 2	1214	0		15.5		18
12/29/2008	NLW, RWB	JEA District 2	1505	0		18		24
1/23/2009	RWB, NLW, NG	JEA District 2	1205	3	Adult, calf, juvenile	12.5		23
1/24/2009	RWB, AJM	JEA District 2	925	1	adult			
1/24/2009	NLW, MAV, AJM	JEA District 2	1430	1	adult	15		19
1/25/2009	RWB, AJM	JEA District 2		0				
1/26/2009	RWB, NLW	JEA District 2		0				
1/27/2009	NLW	JEA District 2		0				
1/28/2009	NLW	JEA District 2		0				
2/4/2009	NLW	JEA District 2	1257	1	adult	13.5		5
2/5/2009	RWB, NLW, SR, BG	JEA District 2	1045	2	adult, calf			
2/5/2009	RWB, SR, BG, MG	JEA District 2	1500	1	adult			
2/6/2009	RWB	JEA District 2	700	5				
2/17/2009	RWB, NLW	JEA District 2	1322	0				
3/26/2009	NLW, DMW, KAW	JEA District 2	1705	2	1 Adult, 1 calf			
3/30/2009	RWB, Carrie,	JEA District 2	1100	0				

Source: Ryan Berger and Noel Wingers, Florida Fish and Wildlife Conservation Commission, unpublished data, 2009.

TABLE 11 b. Aerial manatee observations at the JEA # 2 Waste Water Treatment Outfall: May 2004-September 2009.

Date	Observer	Tide	Manatees				Time	Weather	Air Temp (°C)
			Adults	Calves	Total	Activity			
5/7/2004	GFP	L	4	0	4	C	16:06	CLR 12000 HZY	31
6/22/2005	GFP	M	1	0	1	T	12:55	FEW CLDS 1100	30
7/6/2005	GFP	H	1	0	1	T		CLR	33
3/27/2006	GFP	L	3	0	3	R		CLR BETTER 5K	17
5/21/2007	GFP	H	1	0	1	T		CLR	27
6/18/2007	GFP	H	1	0	1	T	14:20	CLR CLD	31
8/22/2007	GFP	L	2	0	2	R		CLR	26
8/22/2007	GFP	L	1	0	1	R		CLR	26
10/10/2007	GFP	L	1	0	1	T	14:10	CLR BETTER 5005	29
11/19/2007	GFP	L	3	0	3	R		CLR SUN BET 5K	23
1/7/2008	GFP	L	1	2	3	R	14:00	CLR SUN BET5K	22
2/29/2008	GFP	H	2	1	3	R	10:00	CLR SUN	16
3/28/2008	GFP	L	2	1	3	R	10:00	CLR SUN	17
4/14/2008	GFP	L	2	0	2	R	09:45	CLR SUN FEW CLD	13
7/21/2008	GFP	H	1	0	1	T		SUN CLD ex HZY	28
11/10/2008	GFP	H	2	2	4	R	10:45	CLR 1 FLT PER MO	15
5/6/2009	GFP	H	2	1	3	R	14:30	CLR OVER CLD SUN	27
6/15/2009	GFP	L	2	2	4	R		CLR HZY SUN	28
6/15/2009	GFP	L	3	0	3	C		CLR HZY SUN	28
7/27/2009	GFP	L	2	0	2	R	10:00	>5k SUN HI CLD	25
7/27/2009	GFP	L	1	0	1	T	10:00	>5k SUN HI CLD	25
8/11/2009	GFP	L	2	0	2	R		CLR SUN HZY FEW	28
9/28/2009	GFP	H	1	0	1	R	10:10	CLR SUN NO CLD	23

Source: Jacksonville University 2009.
Note: Tide = Low (L), Medium (M), and High (H); Activities = Traveling (T), Resting (R), Feeding (F), and Cavorting/mating (C).

TABLE 12. Manatee Rescues in the Duval County area 2000-2009.

Date	Field Number & Aliases	Size (cm)	Sex	Location	Circumstance
2/6/2009	RNE0901_Bella	336	F	SJR,nr. BP Refinery Sta.	Natural: Cold Stress
2/6/2009	RNE0902_Bella's calf	180	F	SJR,nr. BP Refinery Sta.	Natural: Cold Stress
7/25/2009	SWFTM0916B(RNE0908/RNE0901)	336	F	Trout River	Watercraft: Propeller
1/3/2008	SWFTM0801B (RNE0801)_Ana Lucia	230	F	Ortega River	Natural: Cold Stress
1/7/2008	SWFTM0802B (RNE0802)	213	M	Sherman Creek, Mayport	Natural: Cold Stress
1/18/2008	SWFTM0803B (RNE0803)_Libby	204	F	SJR, JEA Dist. #2	Natural: Cold Stress
1/18/2008	SWFTM0804B (RNE0804)_Sawyer	197	M	SJR, JEA Dist. #2	Calf by itself:Cold Stress
6/26/2008	RNE0810	~215	U	Ortega River	Entanglement; crab trap
1/2/2007	RNE0701			Goodbys Creek	Natural: Cold Stress
8/16/2007	RNE0705_dependant calf			San Carlos Creek	Entrapment; JEA Northside
4/25/2006	RNE0601_died during transport			SJR nr. Prudential Drive	Watercraft: Propeller
10/18/2006	RNE0602_died following day			Cedar River	Watercraft: Propeller
12/19/2006	RNE0603/RNE0311_moved & released			Drummond Pt./Creek	Natural
1/13/2005	RNE0501			ICW: south of Beach Blvd	Natural: Cold Stress
10/30/2005	RNE0508			Mill Cove	Watercraft
7/30/2004	RNE0402_tide rose, swam away			Hugenot Park	Natural: Stranded/mud flat
5/11/2003	RNE0302			Doctors Lake (Clay Co.)	Entanglement; crab trap
11/11/2003	RNE0307_mother			Doctors Lake (Clay Co.)	Entanglement; crab trap
11/11/2003	RNE0308_dependant calf			Doctors Lake (Clay Co.)	Calf of rescued mother
12/5/2003	RNE0310/REC0002_moved & released			Ortega River_basin	Natural: Cold Stress
12/5/2003	RNE0309_moved & released			Ortega River_basin	Natural: Cold Stress
12/7/2003	RNE0311_calf by itself			Ortega River_basin	Natural: Cold Stress
12/18/2003	RNE0313			Ortega River_basin	Natural: Cold Stress
12/18/2003	RNE0312_calf by itself			Ortega River_basin	Natural: Cold Stress
12/18/2003	RNE0314			Ortega River_basin	Natural: Cold Stress
1/11/2002	RNE0201			Ortega River_basin	Natural: Cold Stress
1/11/2002	RNE0202			Ortega River_basin	Natural: Cold Stress
1/3/2001	RNE0101			JEA Southside	Natural: Cold Stress
1/3/2001	RNE0102			JEA Southside	Natural: Cold Stress
1/4/2001	RNE0103			JEA Southside	Natural: Cold Stress
1/24/2001	SWFTM0107B (Dynamo)			JEA Southside	Natural: Cold Stress
7/1/2001	RNE0105_calf by itself			Little Jetties Park	Stranded on shore
4/20/2000	RNE0001_died during transport			JU dock 1 mile west	Watercraft collusion
6/5/2000	RNE0002_captured/moved & released			SJR 4524 River Trail Rd.	Entrapment: culvert

Source: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Marine Mammal Pathobiology Laboratory, Manatee Rescue Database, unpublished data, 2009.

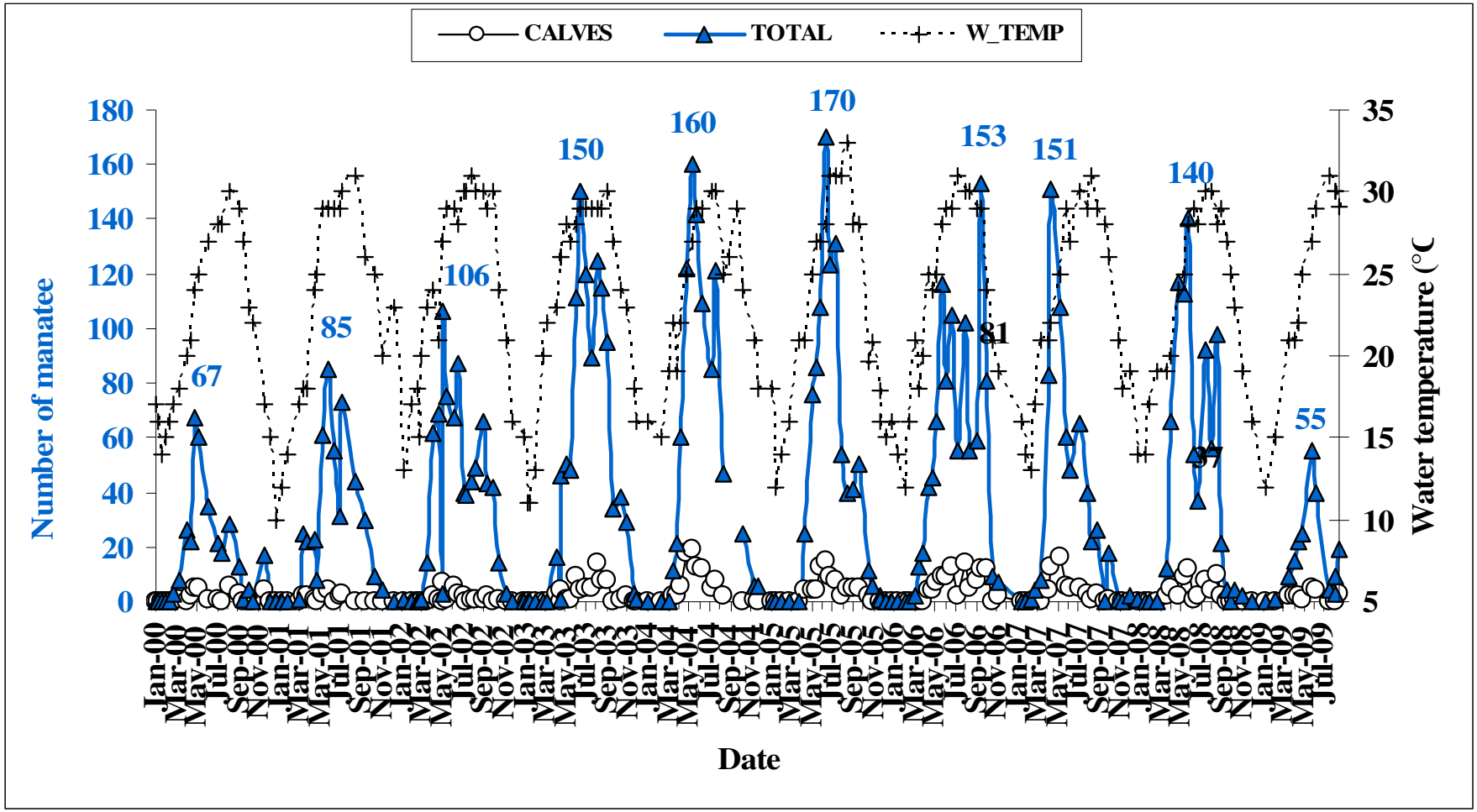


FIGURE 1. Aerial sightings of manatees and water temperature in the St. Johns River 2000–August 2009.

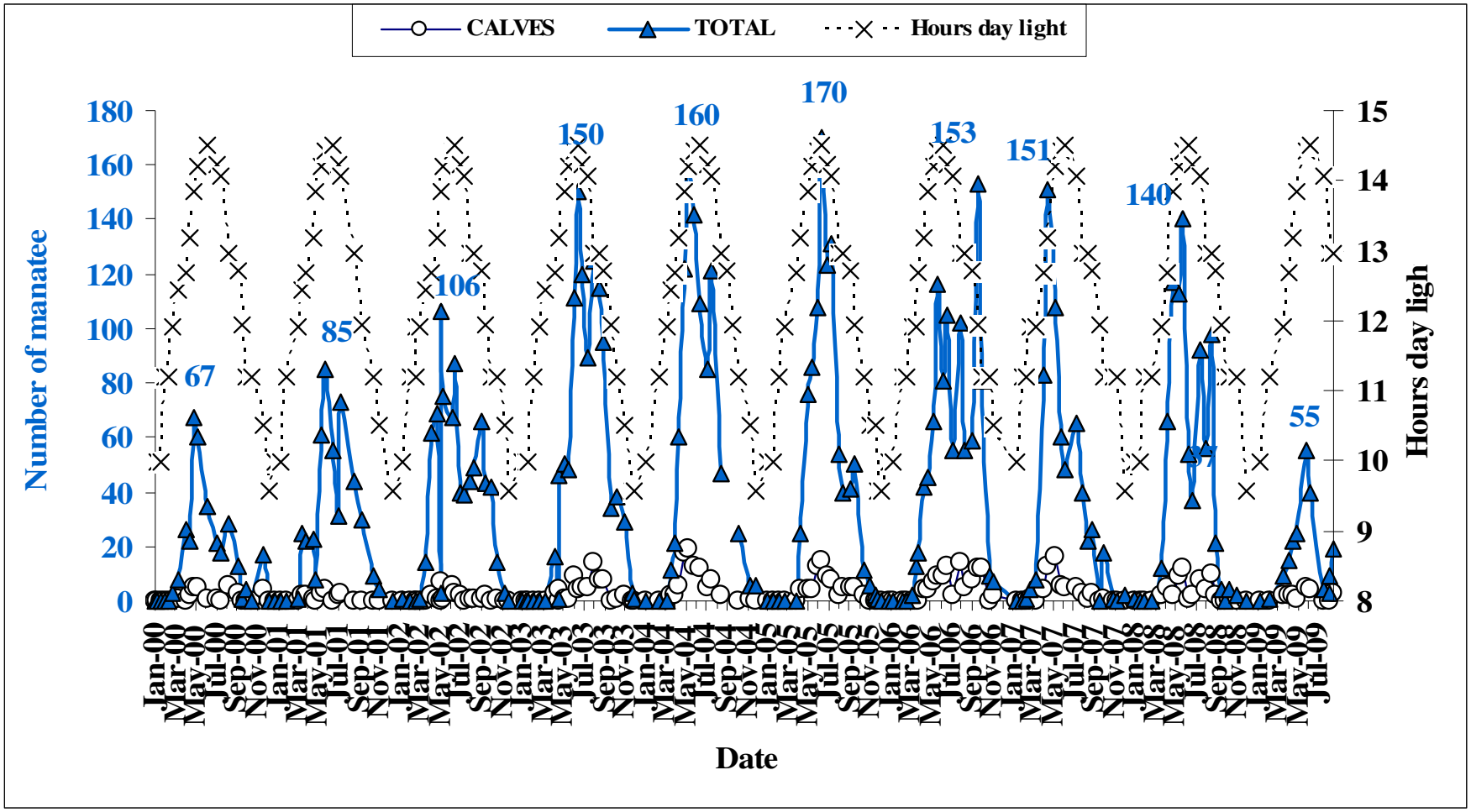


FIGURE 1a. Aerial sightings of manatees and hours daylight in St. Johns River 2000–August 2009.

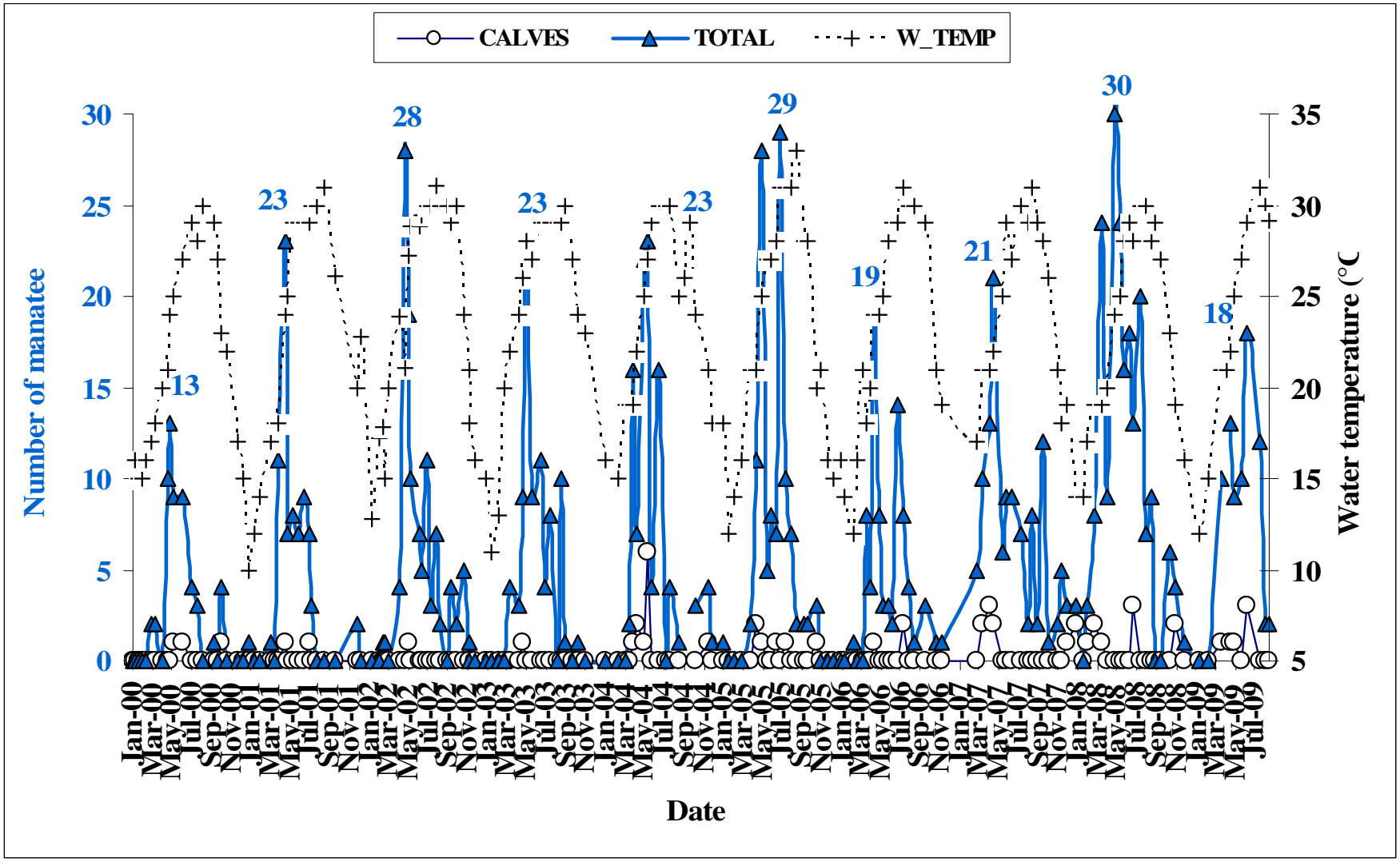


FIGURE 2. Aerial sightings of manatees and water temperature in the Intracoastal Waterway 2000–August 2009.

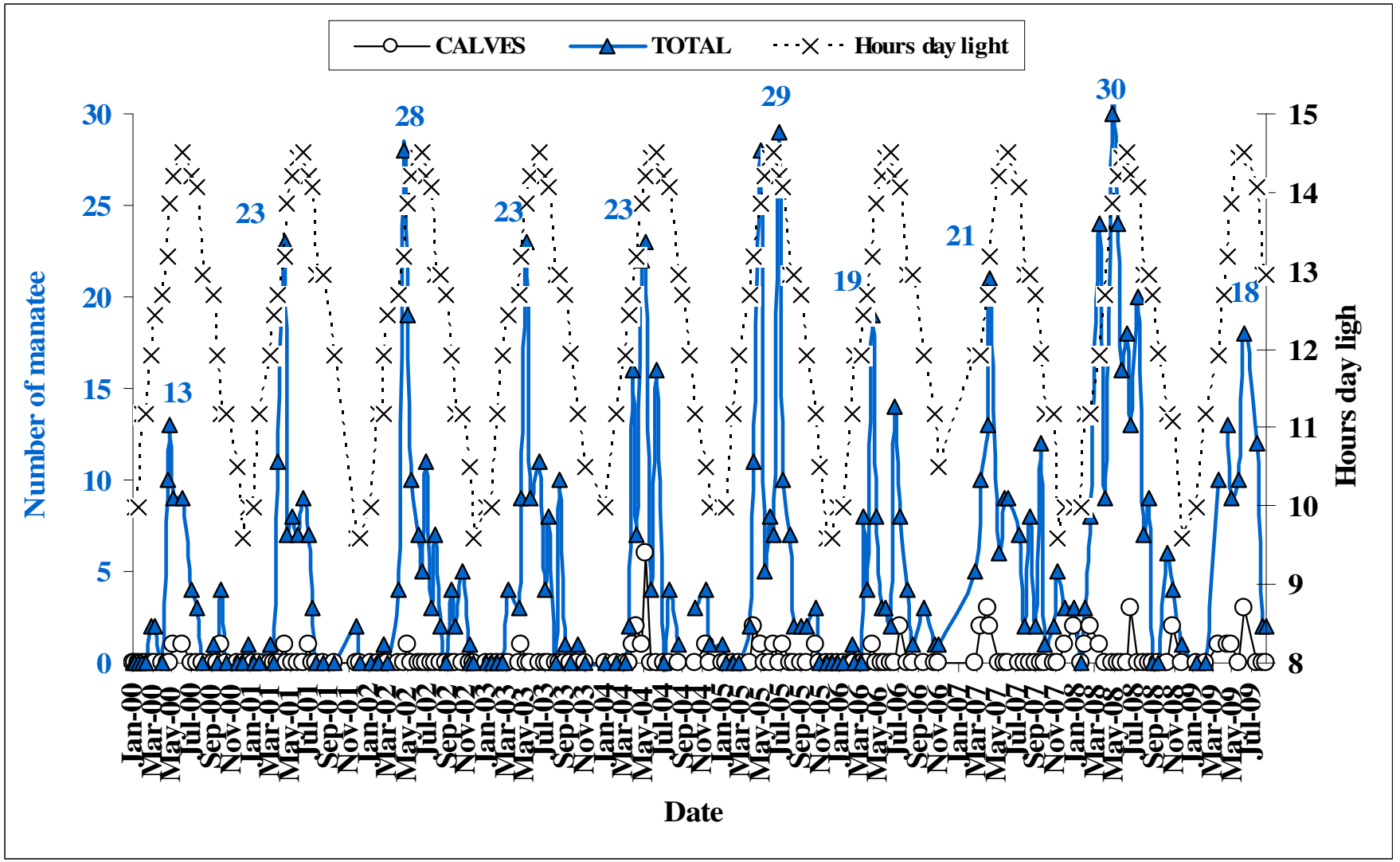
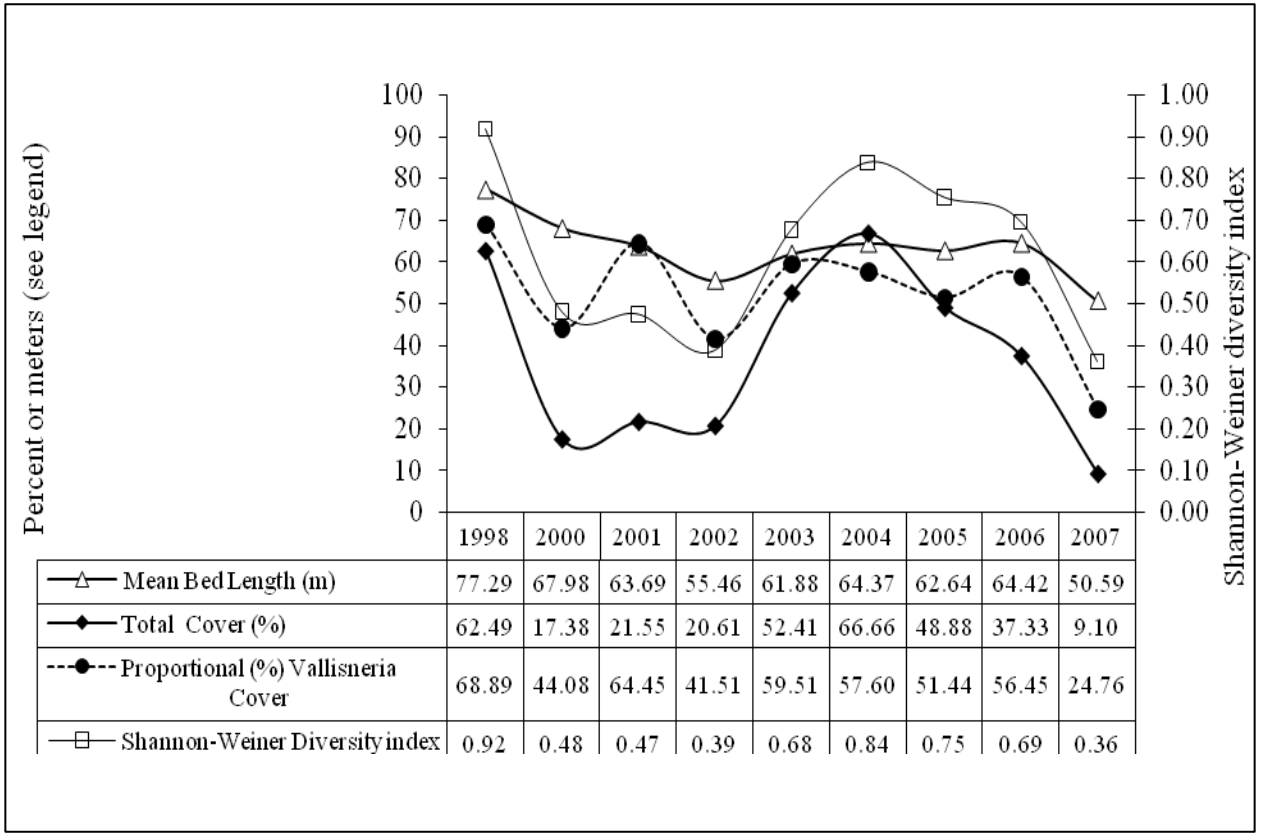


FIGURE 2a. Aerial sightings of manatees and hours daylight in The Intracoastal Waterway 2000-August 2009.



	1998	2000	2001	2002	2003	2004	2005	2006	2007
Mean Bed Length (m)	77.29	67.98	63.69	55.46	61.88	64.37	62.64	64.42	50.59
Total Cover (%)	62.49	17.38	21.55	20.61	52.41	66.66	48.88	37.33	9.10
Proportional (%) Vallisneria Cover	68.89	44.08	64.45	41.51	59.51	57.60	51.44	56.45	24.76
Shannon-Weiner Diversity index	0.92	0.48	0.47	0.39	0.68	0.84	0.75	0.69	0.36

Source data: SJRWMD 2008. Lower St. Johns River Basin Submerged Aquatic Vegetation Monitoring Program.
Note: 2008 Data not yet available.

FIGURE 12. Submerged Aquatic Vegetation data for Duval County.

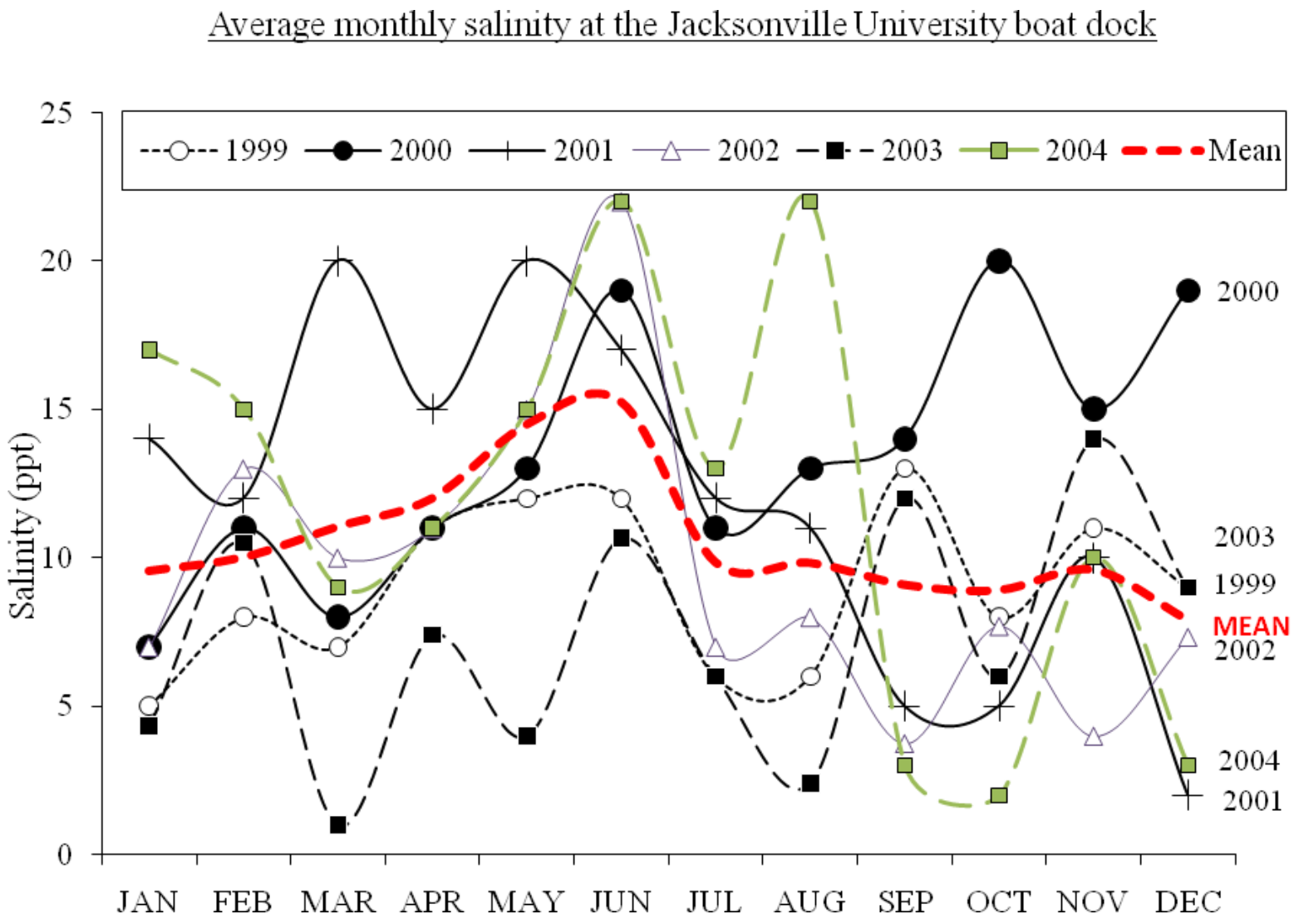


FIGURE 4a. Mean monthly salinity recorded at Jacksonville University dock for each month by year (1999-September 2004). The thick dotted line indicates the general mean for each month over all years (See Figure 4b. for 2004-2009).

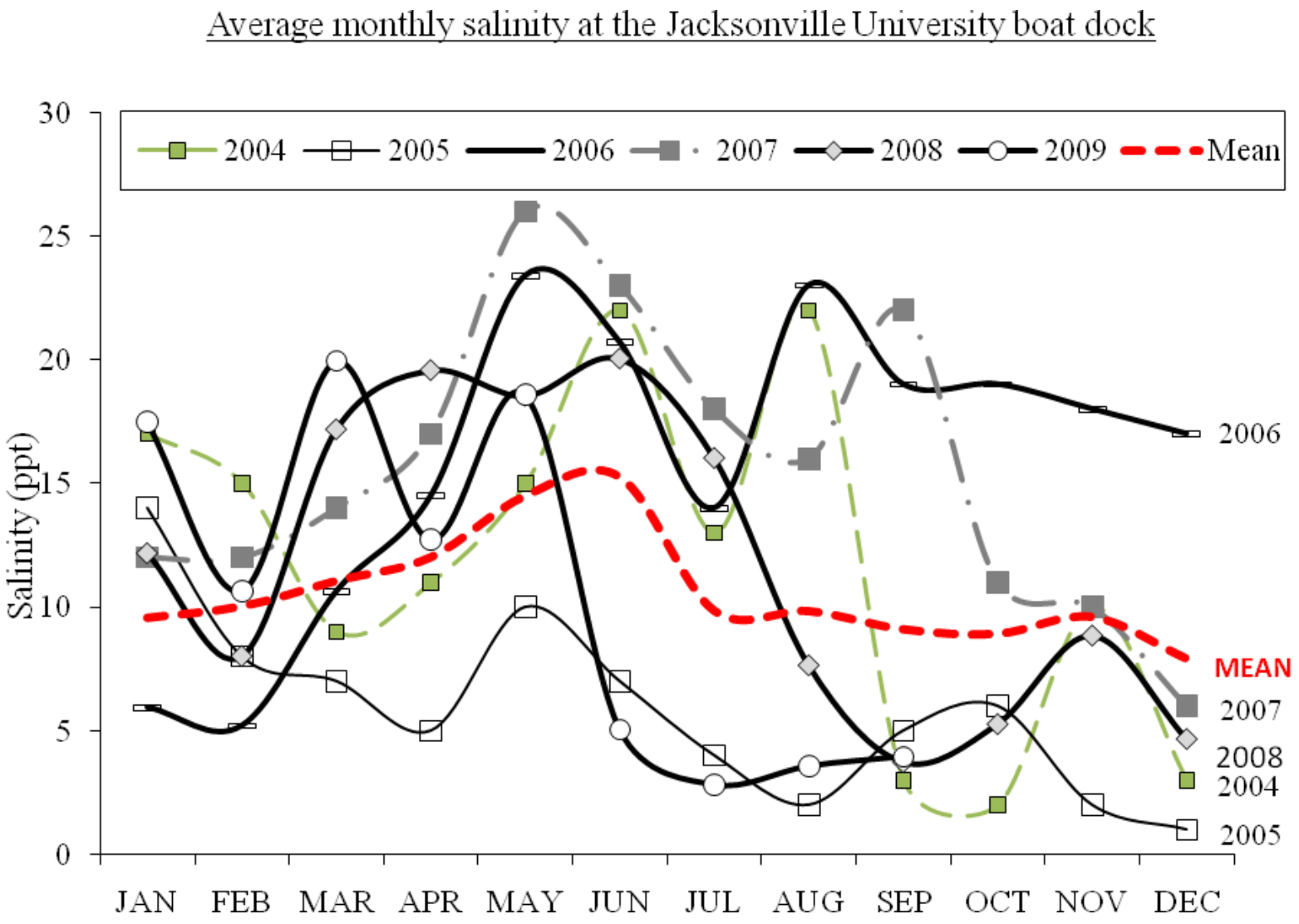


FIGURE 4b. Mean monthly salinity recorded at Jacksonville University dock for each month by year (1999-September 2004). The thick dotted line indicates the general mean for each month over all years (Figure 4b. for 2004-2009).

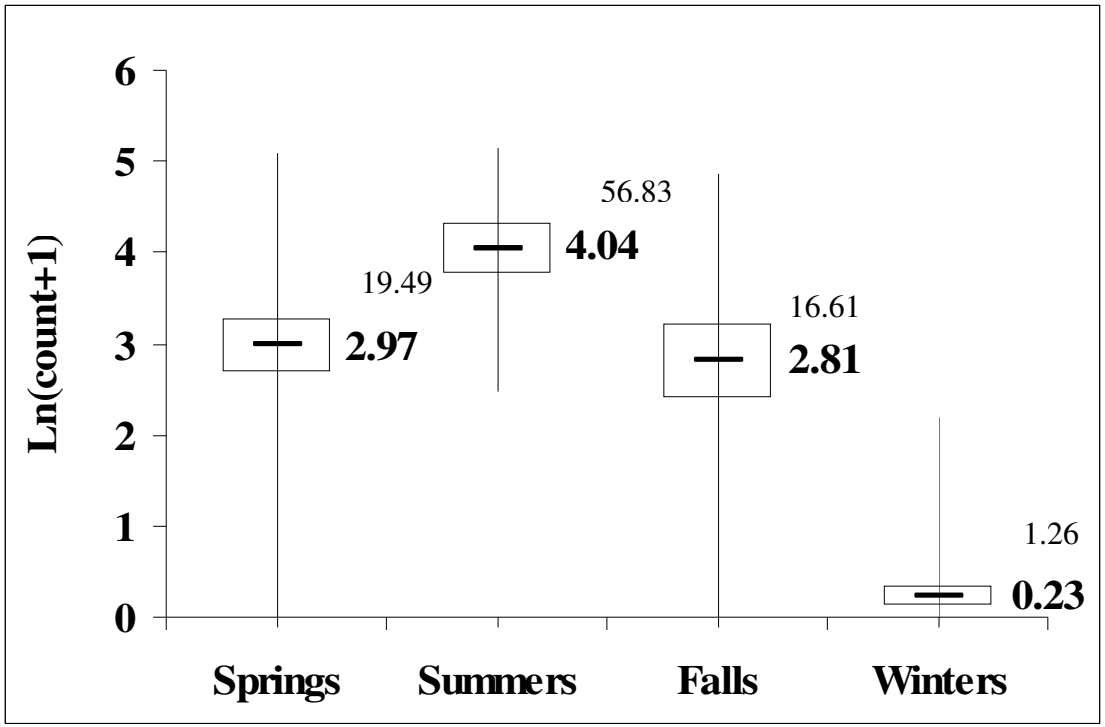


FIGURE 5. Mean counts of manatees in the LSJR by season (horizontal lines) 1994-2009. Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).

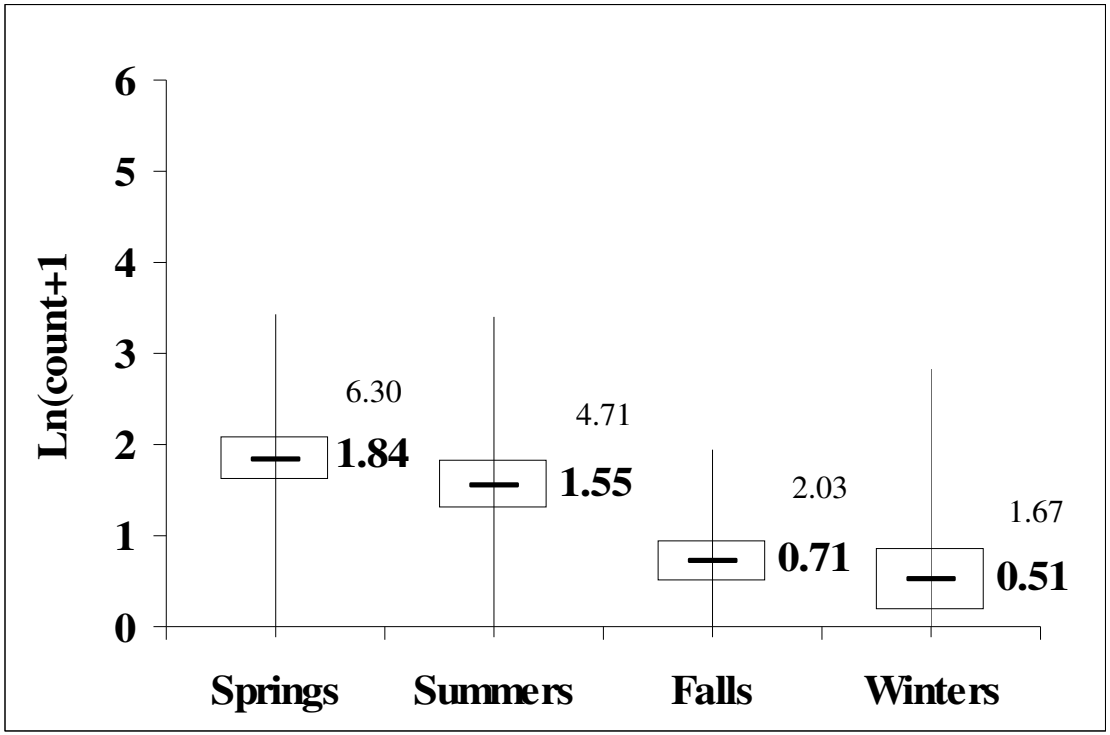
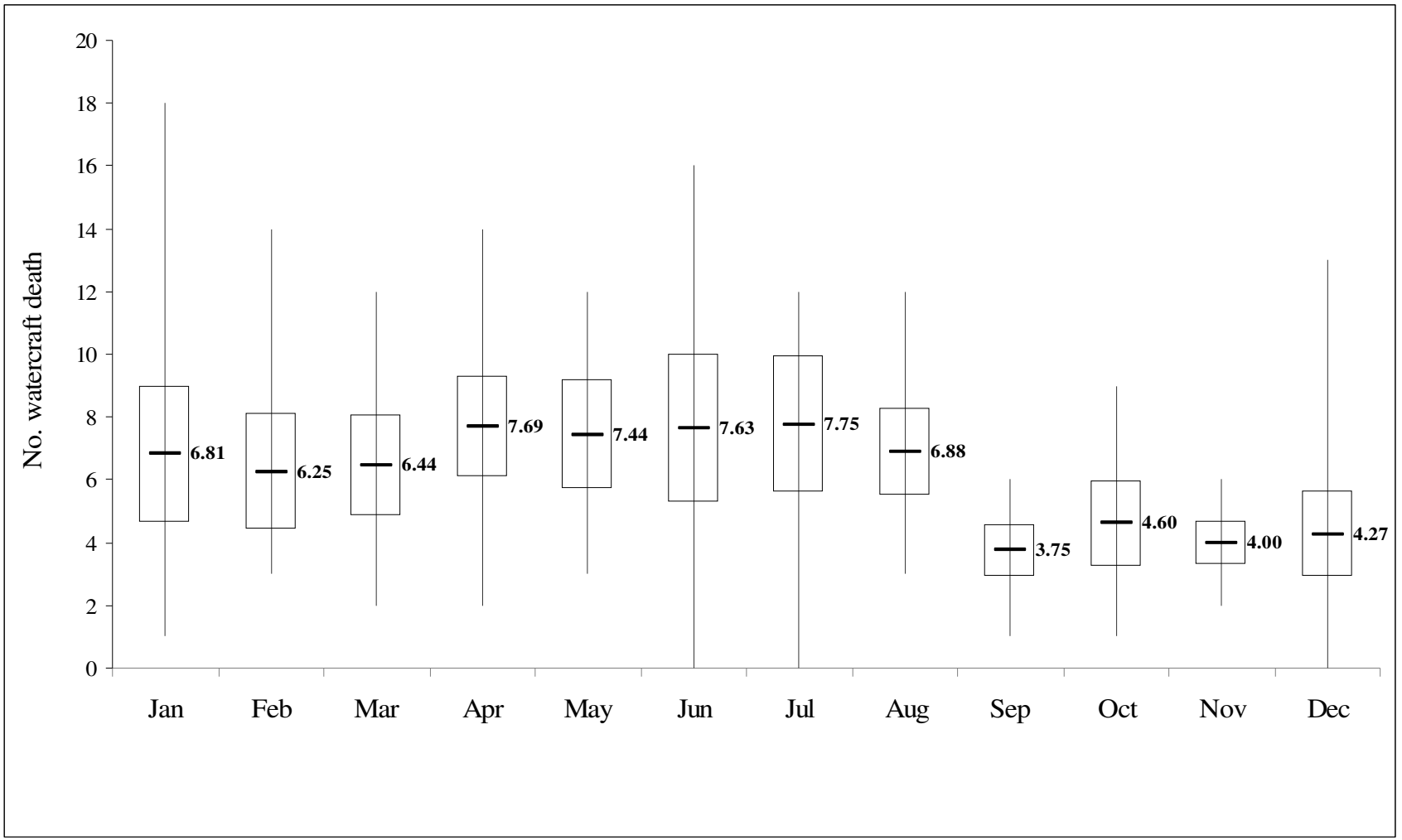
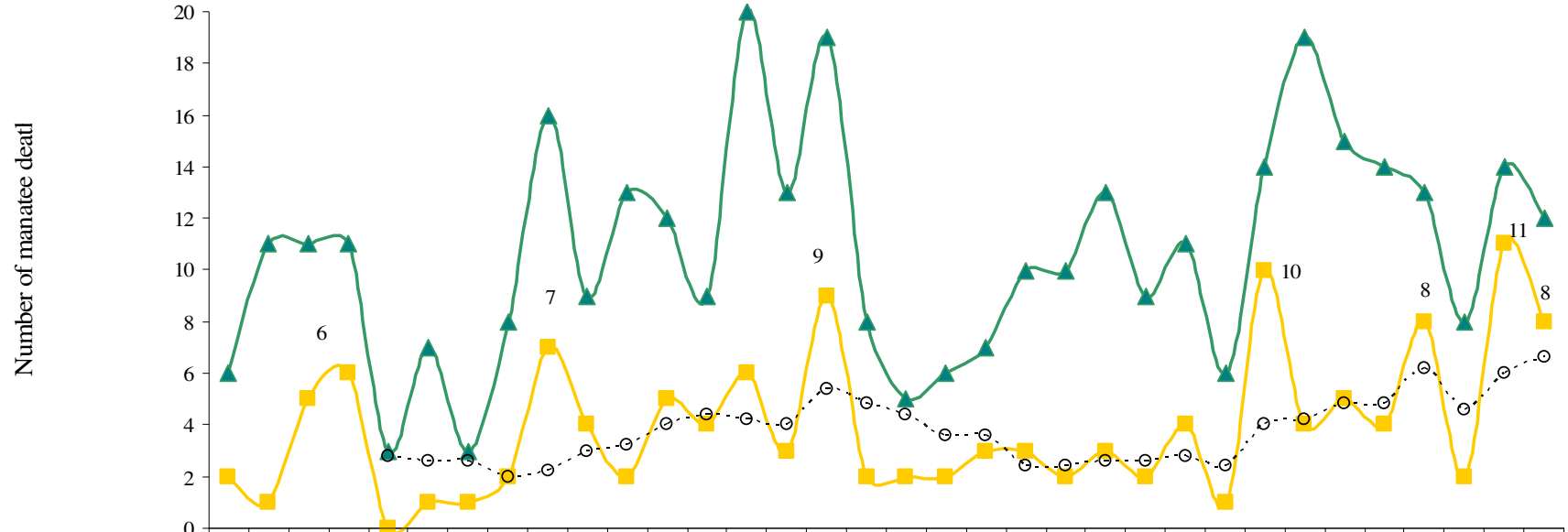


FIGURE 6. Mean counts of manatees by season in the ICW 1994 – 2009 (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).



Source data: FWRI 2009.

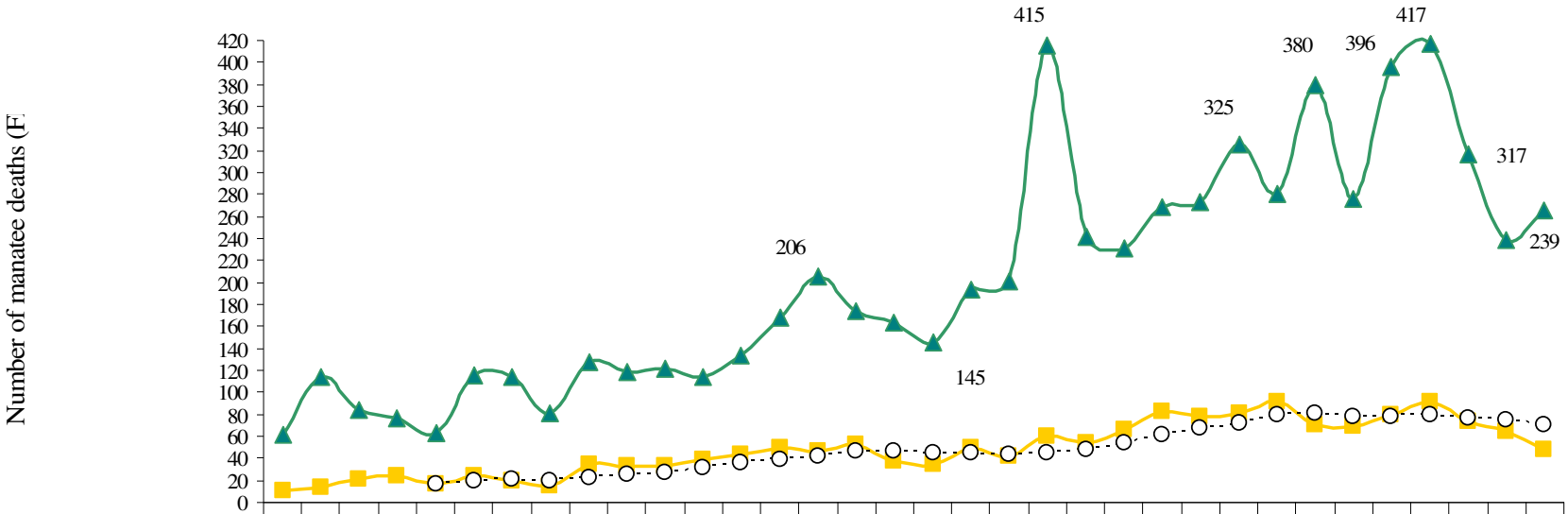
FIGURE 7. Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2009. Mean monthly counts of manatees (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals for the mean.



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09*
Duval WC	2	1	5	6	0	1	1	2	7	4	2	5	4	6	3	9	2	2	2	3	3	2	3	2	4	1	10	4	5	4	8	2	11	8
Duval TD	6	11	11	11	3	7	3	8	16	9	13	12	9	20	13	19	8	5	6	7	10	10	13	9	11	6	14	19	15	14	13	8	14	12
D5yr.WC ave.					3	3	3	2	2	3	3	4	4	4	4	5	5	4	4	4	2	2	3	3	3	2	4	4	5	5	6	5	6	7

09* = August 2009
Duval WC = Watercraft deaths of manatees.
Duval TD = Total deaths of manatees (all causes).
D5Yr.WC ave. = Five year running average of watercraft deaths of manatees.
(Source: FWRI 2009).

FIGURE 8. Watercraft and total manatee mortality in Duval County, Florida (1976–August 2009).

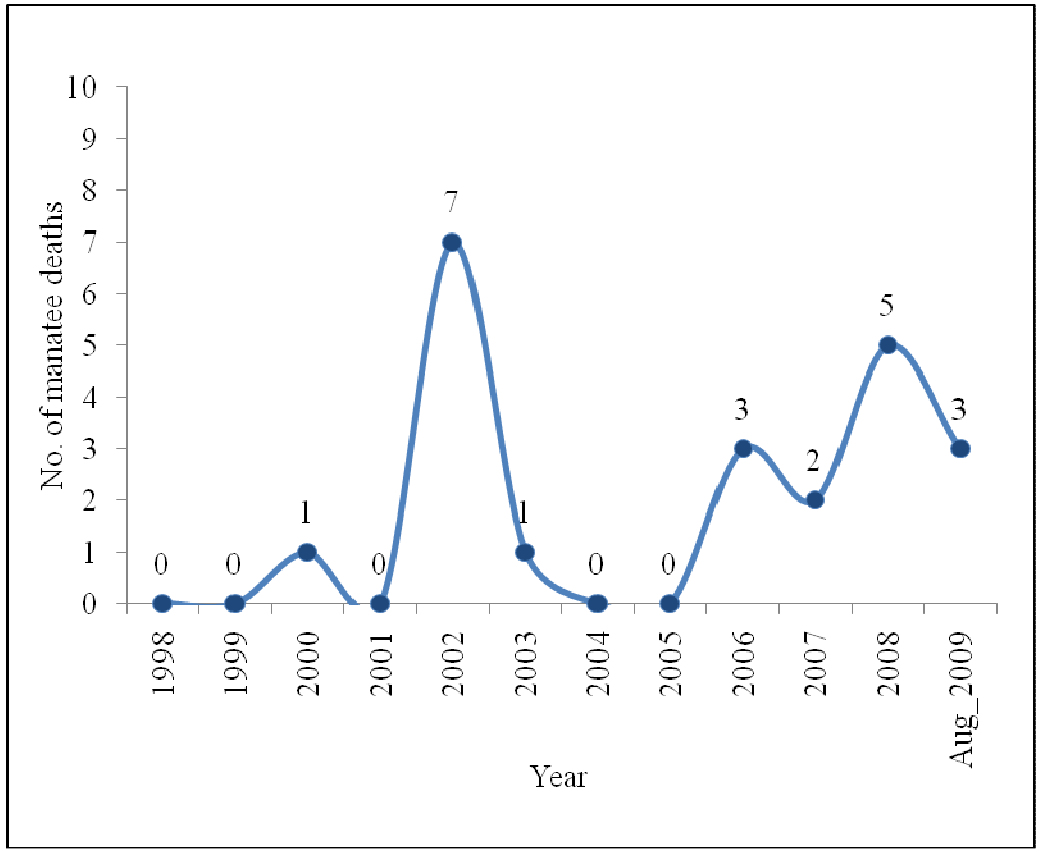


	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09*
Florida WC	10	13	21	24	16	24	20	15	34	33	33	39	43	50	47	53	38	35	49	42	60	54	66	82	78	81	91	70	69	79	92	73	64	48
Florida TD	62	114	84	77	63	116	114	81	128	119	122	114	133	168	206	174	163	145	193	201	415	242	231	269	273	325	281	380	276	396	417	317	239	265
FL5yr.WC ave.					17	20	21	20	22	25	27	31	36	40	42	46	46	45	44	43	45	48	54	61	68	72	80	80	78	78	80	77	75	71

Source: FWRI 2009

09* = August 2009.
Florida WC = Florida watercraft mortality.
Florida TD = Florida total mortality (all causes).
FL5yr.WC ave. = Florida five year running average of watercraft deaths of manatees.

FIGURE 9. Watercraft and total manatee mortality in Florida 1976–August 2009.



Source data: FWRI 2009

FIGURE 10. Manatee mortalities with cause attributed to large vessels. In 2008, there was one death attributed to a mid-size vessel (MMPL Category II or higher), not included in the above count.

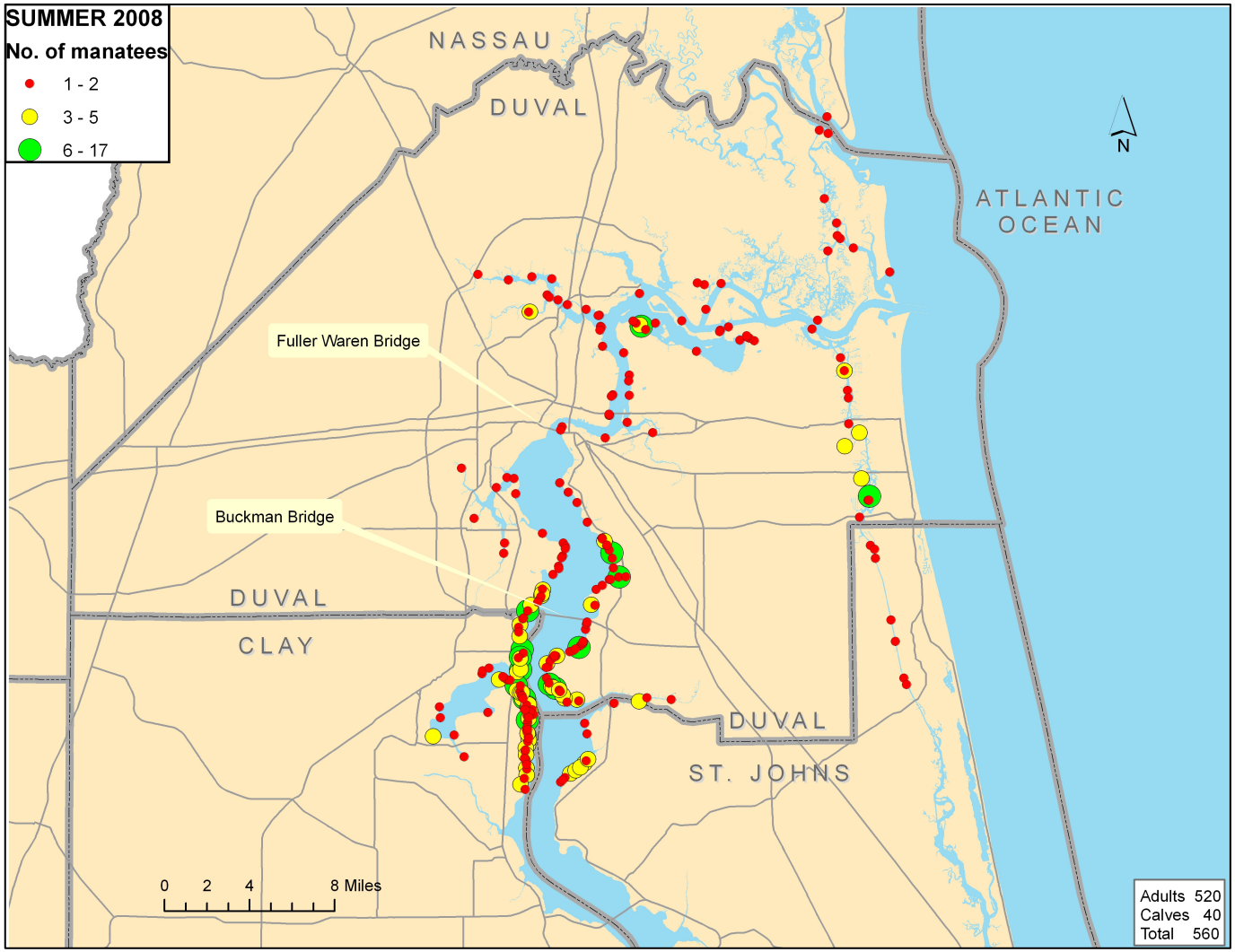
Aerial sightings of manatees

1. The following maps show manatee distribution from **Summer 2008– Summer 2009.**

2. Seasons were classified as follows:
   Winter - December - February
   Spring - March - May
   Summer - June - August
   Fall - September - November

SERIES A - MANATEE AERIAL SIGHTINGS

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2008).



Source: Jacksonville University 2009.

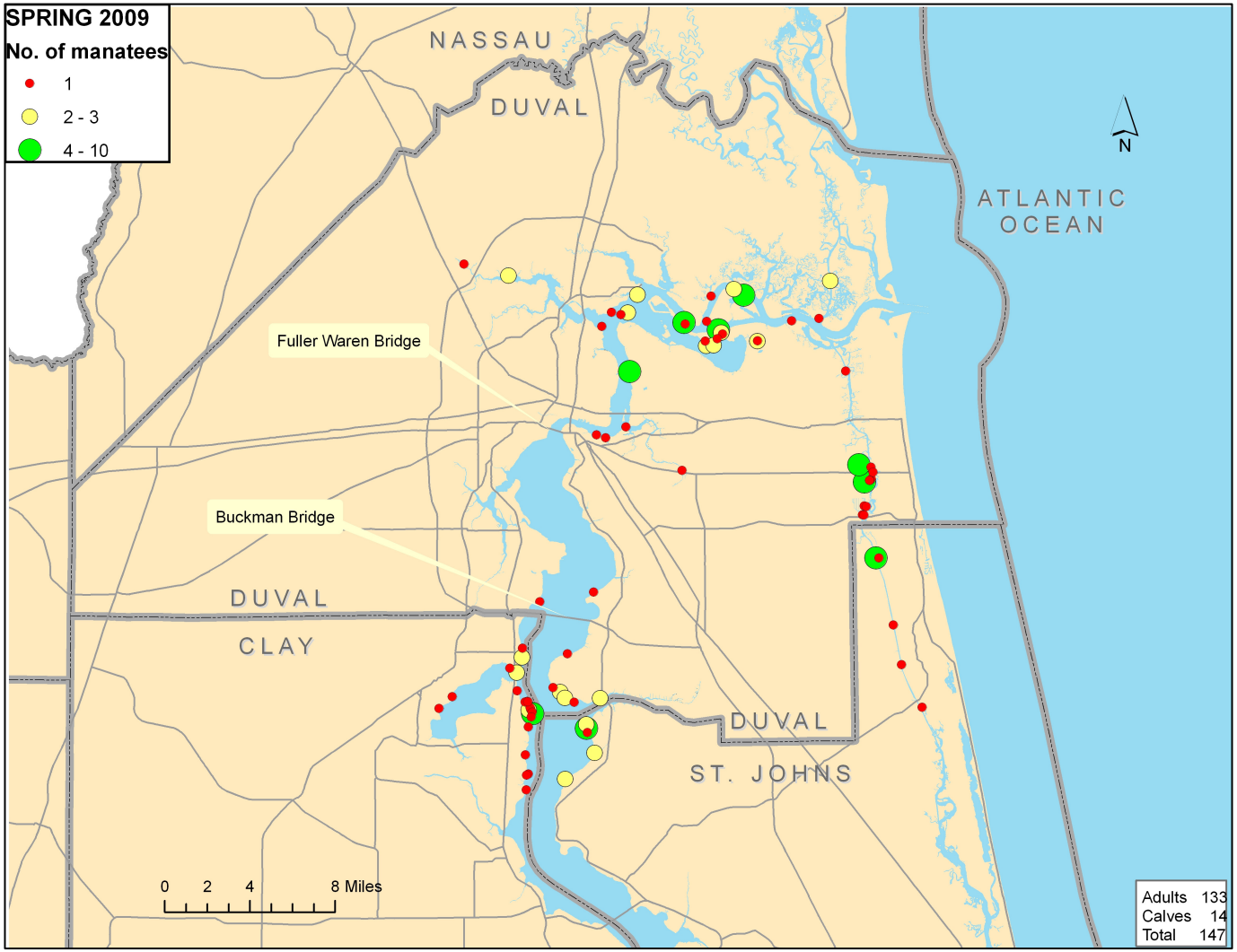
SERIES A – Manatee aerial sightings, Duval Co., FL. (Fall, 2008).

Source: Jacksonville University 2009.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Winter, 2008-2009).

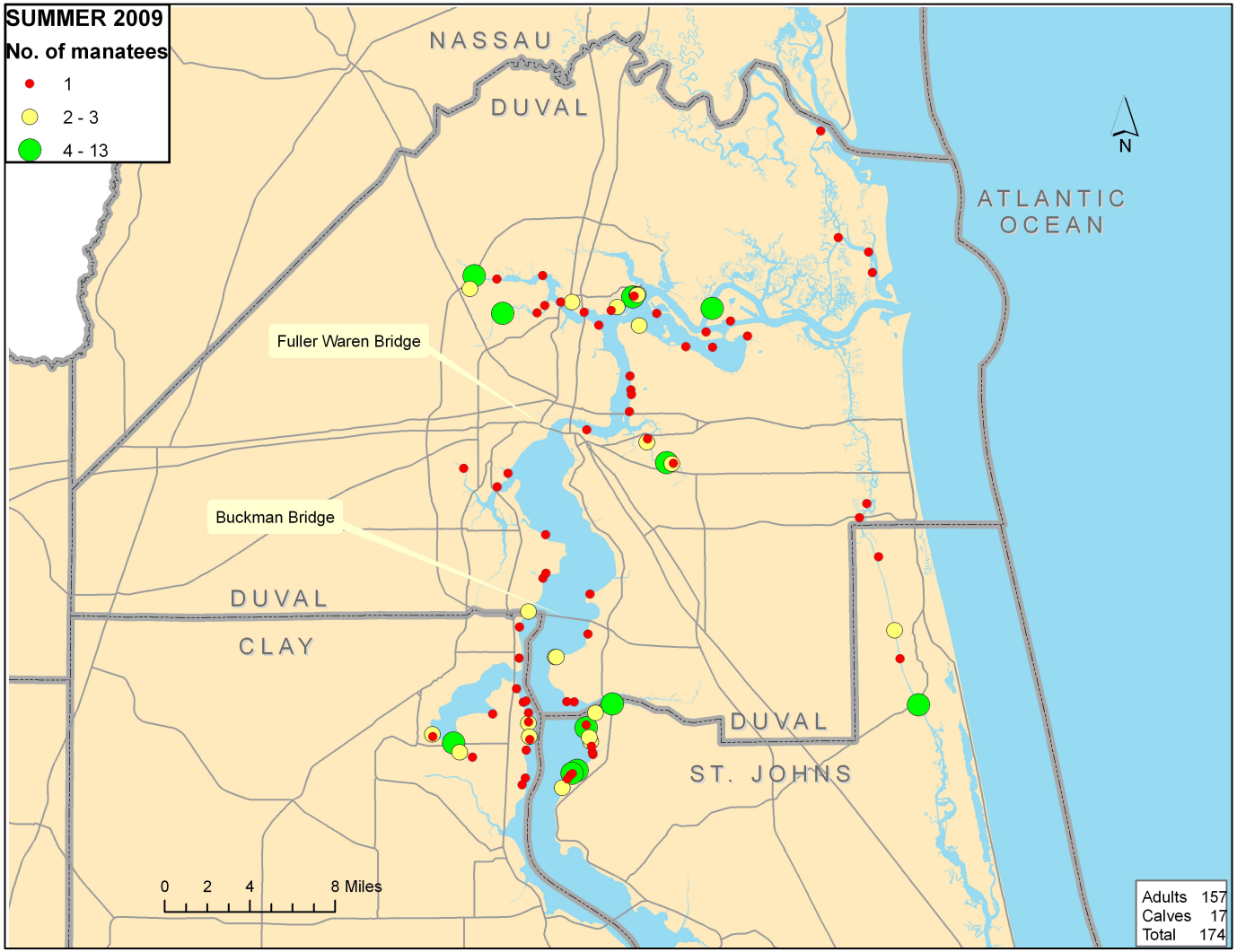
Source: Jacksonville University 2009.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Spring, 2009).



Source: Jacksonville University 2009.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2009).



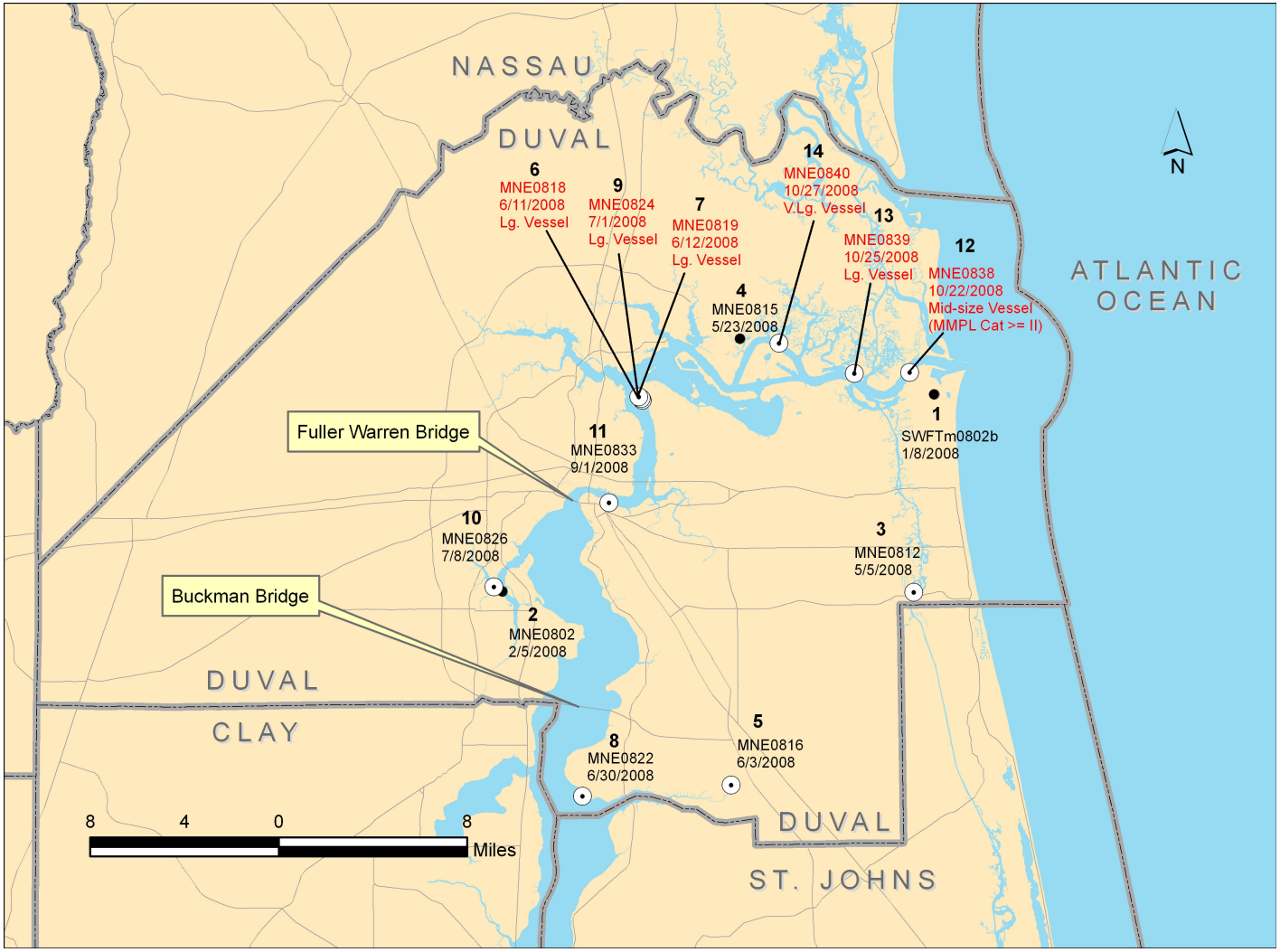
Source: Jacksonville University 2009.

Manatee mortality

1. Map of manatee mortality 2008, Duval Co., FL.
2. Table of manatee deaths from all causes (2008) Duval Co., FL.
3. Map of manatee mortality, August 2009, Duval Co., FL.
4. Table of manatee deaths from all causes (August 2009) Duval Co., FL.

SERIES B – MANATEE MORTALITY

SERIES B – Manatee mortality, Duval Co., FL. 2008.



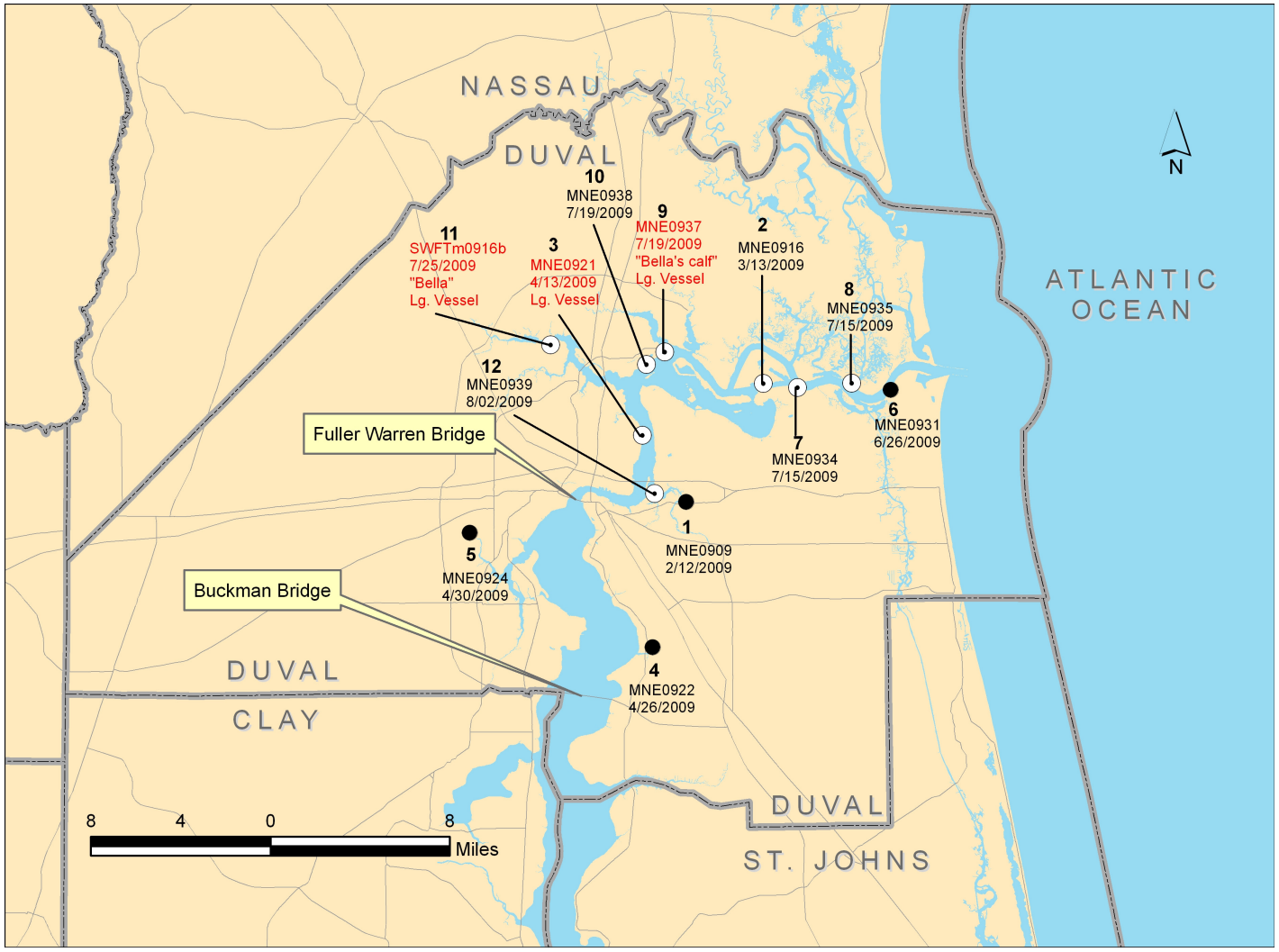
Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2009.

Table 11. Manatee deaths from all causes 2008, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total Length	Mortality category
1	1/8/2008	SWFTm0802b	M	213	5-Natural-Cold Stress
2	2/5/2008	MNE0802	F	217	5-Natural-Cold Stress
3	5/5/2008	MNE0812	M	312	1-Watercraft
4	5/23/2008	MNE0815	M	280	8-Undetermined
5	6/3/2008	MNE0816	F	124	1-Watercraft
6	6/10/2008	MNE0818	M	326	1-Watercraft
7	6/12/2008	MNE0819	M	303	1-Watercraft
8	6/26/2008	MNE0822	M	265	1-Watercraft
9	7/1/2008	MNE0824	M	325	1-Watercraft
10	7/5/2008	MNE0826	M	272	1-Watercraft
11	9/1/2008	MNE0833	F	222	1-Watercraft
12	10/22/08	MNE0838	M	320	1-Watercraft
13	10/25/08	MNE0839	U	300	1-Watercraft
14	10/27/08	MNE0840	M	315	1-Watercraft

Source: FWC, FWRI 2009.

SERIES B – Manatee mortality, Duval Co., FL. August 2009.



Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2009.

Table 12. Manatee deaths from all causes until August 2009, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total Length	Mortality category
1	2/12/2009	MNE0909	M	262	5-Natural-Cold Stress
2	3/13/2009	MNE0916	F	298	1-Watercraft
3	4/13/2009	MNE0921	U	300	1-Watercraft
4	4/26/2009	MNE0922	F	119	4-Perinatal = 150 cm
5	4/30/2009	MNE0924	F	146	4-Perinatal = 150 cm
6	6/26/2009	MNE0931	M	317	8-Undetermined
7	7/15/2009	MNE0934	M	253	1-Watercraft
8	7/15/2009	MNE0935	M	270	1-Watercraft
9	7/19/2009	MNE0937	M	316	1-Watercraft
10	7/19/2009	MNE0938	M	220	1-Watercraft
11	7/25/2009	SWFTm0916b	F	336	1-Watercraft
12	8/2/2009	MNE0939	F	290	1-Watercraft

Source: FWC, FWRI 2009.