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Annual Update
2007-2008
Duval County Manatee Protection Plan
Population Inventory and Analysis

Prepared by
Jacksonville University
for the
Waterways Commission
of the
Jacksonville City Council.

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EXECUTIVE SUMMARY

This document is the 2007-**08** annual update to the Duval County Manatee Protection Plan. It represents additional population inventory and analysis of data gathered between October 1, 2007 and August 31st, **2008** 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 Data, figures, tables and agency names were outdated or no longer appropriate.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.

***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 140 animals per survey (June 2008) was lower than in previous years, but greater than the general mean of 126 manatees per survey (1994-2008).** 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, 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 30 manatees per survey (May 2008) and represents a new record high for the ICW**. It 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 is 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. General means in the ICW have been consistent for the last seven years 2000-2007 (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 7.88 % (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 this year.

***Manatee Mortality*:** **As of September 2008, there were a total of 11 reported deaths, of which 8 were watercraft related, 2 cold stress and 1 undetermined (FWRI 2008). The county again surpassed the "unacceptable" level of watercraft related mortality as stipulated in the MPP (1st in 2002, 2nd in 2004, 3rd in 2006, 4th 2008). 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 September 18th, 2008 to discuss the 8 watercraft deaths in Duval County during 2008 and how Duval County should respond to these 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.**

***Habitat*:** **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. The latest data from St. Johns River Water Management District's SAV monitoring program 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 has begun to level 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 after the drought (2001/2002) and then recovery after the drought (Figure 3).

***Warm Water Attractants*:** Manatees have been observed assembled in groups at warm water out falls since aerial surveys started in 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. For a number of years now, these facilities have been dismantled and removed or they do not discharge warm water. 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.

Ortega River: **During the winter (2004/05 to 2007/08) no manatees have been 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: In recent years, a few animals started to congregate at the JEA District #2 out-fall near north Bartram Island. Rescue attempts by the agencies were made and one animal was relocated by Sea World of Florida and FWC. **During winter (2007/08) two adults and a calf were observed at this out-fall on the following dates (11/19/07; 1/7/08; 2/29/08; 3/28/08). On January 18th 2008 Sea World of Florida and FWC rescued 2 manatees from this location.**

Symposium on water withdrawals from the St. Johns River: **A major finding from salinity modeling conducted by the St. Johns Water Management District showed that harbor deepening activities have a significant potential to alter salinity profiles and cause harm to biological systems. The meeting occurred September 16-18th 2008 Gainesville, FL.**

THIS REPORT CONTAINS THE FOLLOWING UPDATED SECTIONS TO THE 2008 EDITION OF THE DUVAL COUNTY MANATEE PROTECTION PLAN:

EXECUTIVE SUMMARY

1. INTRODUCTION, INVENTORY ANALYSIS SECTION (Pages 6-13).
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2. TABLES SECTION (Pages 16-27).

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5. SERIES B – MANATEE MORTALITY 2007/2008 (Pages 45-51).

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.**

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**8** annual update. **Updated information is shown in bold**.

Inventory and Analysis

Manatees

Distribution and Abundance: Aerial surveys by Jacksonville University (March, 1994 – **August**, 200**8**) 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 589 bimonthly surveys (310 SJR; 279 ICW), a total 12,591 manatee sightings were recorded (11,333 SJR; 1,258 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 cavorting/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. Preliminary data suggested that manatees use the Intracoastal Waterway as a travel corridor during their seasonal (north/south) migrations along the east coast. Data indicated that manatees 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 2007–2008** was not found to be significantly different from past years **except that the highest daily count in 2007 was recorded earlier (4/23/07) than in previous years. *Map Series A,* shows manatee distribution from Summer 2007 through Summer 2008.** 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 7.88 % (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 140 animals per survey (June 2008) was lower than in previous years, but greater than the general mean of 126 manatees per survey (1994-2008). The Single Highest Day Count (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 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. 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. 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 30 manatees per survey (May 2008) and represents a new record high for the ICW. It 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 is 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). General means in the ICW have been consistent for the last eight years 2000-2008 (5 manatees/survey/yr.).

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 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. Data for 2008 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 with a slight decrease in the last two years. 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 2000-2008 (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 most manatees during the spring of 2008 (395) compared to the same time in 2007 (369), and 2006 (218). In summer 2008 we observed 560 manatees compared to 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.**

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, b and 6a, b)**. 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. 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 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. **Behavior in 2008 indicated less traveling, more resting, feeding and cavorting that in 2007, which would indicate better availability for food resources.**

Grass Beds: **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. 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 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 (Figure 3).

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 during the past two years because low precipitation 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). 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.**

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.

Traveling and resting behavior patterns in the ICW remain predominantly unchanged from those observed between 1994-**2008,** the ICW continues to be a travel corridor. **No manatees were observed in winter (Table 6a). In spring 2008 we observed 78 manatees, higher**

compared to 55 (2007), 42 (2006), 46 (2005), and similar to 70 (2004). No feeding behavior was observed in the last **4 years** which was unlike prior years. Most animals were resting and traveling. **We observed 45 % of the animals traveling, 40 % resting, no animals were observed feeding, and 15 % were cavorting (Table 6b). In the summer 2008 we observed significantly more manatees (83) compared to 2007 (29), 32 (2006), 63 (2005), and 25 (2004). Behaviors consisted of traveling animals (60 %), resting animals (34 %) and 1% feeding and 6 % cavorting. No animals were observed feeding since 2003. More animals were seen cavorting in the past 4 years (14-28 %) in contrast to 2008 (6 %) (Table 6b).**

Mortality Information: **The total of State-wide deaths documented for 2008 (August) was 239, of which 64 were watercraft-related. Other causes included Flood gate (1), other human (5), perinatal (76), cold stress (18), other natural (23), undetermined (47) and unrecovered (5). In 2008, watercraft deaths for the key counties totaled 54. Other causes of death for the key counties included Flood gate (1), other human (3), perinatal (53), cold stress (16), other natural (17), undetermined (34) and unrecovered (2) (Table 7). Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2008 indicated a decreasing trend (Figure 7). Watercraft, perinatal, undetermined, natural, and cold stress causes of death were the most significant for 2008 (FWRI 2008).**

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) and decreased to 8 (2007) and were 10 (August 2008). (Table 8, and Figure 8). The five-year running average from watercraft mortality is 4.36 (range 2-6) deaths since 1980 (Figure 8).

As of September 2008, there were a total of 11 reported deaths in Duval County, of which 8 were watercraft related, 2 cold stress and 1 undetermined (FWRI 2008). The county again surpassed the "unacceptable" level of watercraft related mortality as stipulated in the MPP (1st in 2002, 2nd in 2004, 3rd in 2006, 4th 2008). 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 September 18th, 2008 to discuss the 8 watercraft deaths in Duval County during 2008 and how Duval County should respond to these 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 2007, there were a total of 8 reported deaths, of which 2 was watercraft related, 3 cold stress and 3 undetermined (FWRI 2008).

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). 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 2007 (Table 9) was highest in, Lee County (14), Brevard (10) and Volusia (8). Intermediate numbers of watercraft-caused deaths were documented in Collier (4), Citrus (5) and Miami-Dade (4); and lower numbers of deaths were documented in Martin and Duval (2), Broward and St. Lucie (1) and Indian River, Palm Beach and Sarasota (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 2008.

Table 10 shows total manatee mortality/yr. and cause in Duval County from 1976 to August 31st 2008 (FWRI 2008). Figure 9 shows total and watercraft mortality as well as 5 year running average of watercraft deaths for the State of Florida (FWRI 2008).

Map Series B, Duval County Manatee Mortality 2007/2008 **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. A few animals were seen at the JEA District # 2 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.**

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.

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.

Manatee Rescues: 2006
One manatee on April 25th 2006 St. Johns River Downtown due to watercraft injury.
One manatee on October 18th 2006 in Cedar River due to watercraft related injury.
One manatee on December 19th 2006 at JEA District #2 out-fall due to cold stress.

Manatee Rescues: 2007
One manatee on January 2nd 2007 in Goodby's Creek due to cold stress.
One manatee on August 15th 2007 at JEA North Side Generating Station due to entrapment.

Manatee Rescues: 2008
One manatee on January 3rd 2008 in Ortega River due to cold stress.
One manatee on January 7th 2008 in Sherman Creek, Mayport, due to cold stress.
Two manatees on January 18th 2008 at JEA District #2 out-fall due to cold stress.
One manatee on June 26th 2008 in Ortega River due to entanglement in a crab trap.

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 has 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 and USFWS.**

http://www.ju.edu/MARCO

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

Amendments to the speed zones rule were adopted on January 10, 2007.
http://myfwc.com/manatee/documents/68C-22-027%20(2007).pdf

See Maps.
http://myfwc.com/manatee/data/mapref.htm

Recommendations

No recommendations regarding speed zones at this time.

Recommend a comprehensive review of all signage and responsible parties.

Recommend that the boat facility siting zones be revised or removed from the MPP to be replaced by a sphere of influence criteria around a facility or proposed facility.

Recommend revision of the MPP Standards in light of the new sphere of influence criteria.

Recommend the formation of a working group to include JAXPORT 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.

Jim Mayer of the FDEP recommend coordinating with FDEP Northeast District Office to strengthen manatee protection DEP dredge and marina permitting programs. Possible approaches include reviewing the language and scope of manatee conditions in consultation with FWS; including mobilization notification requirements so projects can be looked at during critical timeframes; spotter reporting requirements; expanding possible response personnel across agencies, and other ideas. The goal will be to develop an increased compliance and enforcement structure to help reduce mortality rates in Duval County.

TABLE 1. Summary of the total number of aerial surveys, adults and calves observed, and Single Highest Day Counts (SHDC) by year (1994-August 2008).

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 [2]	15	743	57	800	7.13	140	6/4/08	53
Total		310	11,333	988	12,321	7.88 [3]	126 [4]		40 [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 [2]	14	167	8	175	4.57	30	5/5/08	13
Total		279	1,258	84	1,167	6.67 [3]	21 [4]		5 [5]

SHDC=Single Highest Day Count

[1] March to the end of December

[2] Until 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 2008).

LOCATION	ADULTS*	CALVES*	TOTAL*
Nassau Sound	29	0	29
Sawpit Creek	50	0	50
ICW North of Fort George River	78	1	79
Sisters Creek	31	3	34
Fort George Inlet	7	0	7
Mayport	16	0	16
St. Johns Bluff	44	0	44
Blount Island	115	10	125
Mill Cove	95	3	98
Atlantic Blvd. Bridge to SJR confluence	66	2	68
Beach Blvd. Bridge to Atlantic Blvd.	118	7	125
JTB Bridge to Beach Blvd. Bridge	134	7	141
Palm Valley Bridge to JTB Bridge	248	19	267
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 2008.

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 2008).

LOCATION	ADULTS*	CALVES*	TOTAL*
Quarantine Island	90	3	93
Dames Point	22	1	23
Trout River	273	20	293
Arlington River	44	3	47
Pottsburg Creek	47	2	49
Miller Creek	26	2	28
Downtown	112	9	121
San Marco	135	3	138
Ortega River	175	17	192
Sadler Point	154	13	167
Pirates Cove	54	3	57
NAS/JAX	238	14	252
Mulberry Cove	145	12	157
Rudder Club	693	69	762
Club Continental	1169	109	1278
Doctors Lake	1851	171	2022
SJR south of Dr.Lake	1465	140	1605
Julington Creek	231	23	254
Durbin Creek	13	0	13
Mandarin Point	1324	112	1436
Plummers Point	340	31	371
Beauclerc Bluff	324	21	345
Goodbys Creek	170	12	182
Christopher Point	884	81	965
Point La Vista	193	5	198
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 2008.

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

Source: Wayne Hartley, Park Service Specialist, Blue Spring State Park 2008.

TABLE 5a. Number percent of manatees engaged in various activities between spring 1994-summer 2008 (LSJR).

Year/Season	Total No.	Percentage			
		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
Mean	172	23	45	22	9
SD	111	9	21	14	10
CI	58	4	11	7	5
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	1	0	0	0
Winter '07-08	3	0	67	33	0
Mean	3	26	33	6	0
SD	4	37	41	15	0
CI	2	19	22	8	0

T = Traveling; R = Resting; F = Feeding and C = Cavorting
SD = Standard Deviation
CI = 95% Confidence interval for the mean
Source: Jacksonville University 2008.

TABLE 5b. Number percent of manatees engaged in various activities between spring 1994-summer 2007 (LSJR).

Year/Season	Total No.	Percentage			
		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	301	28	36	24	12
Mean	232	30	36	21	14
SD	93	10	15	14	6
CI	47	5	8	7	3
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	240	40	32	18	9
Summer '08	475	24	43	24	10
Mean	430	24	41	22	13
SD	169	10	16	13	7
CI	85	5	8	7	4

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

SD = Standard Deviation

CI = 95% Confidence interval for the mean

Source: Jacksonville University 2008.

TABLE 6a. Number percent of manatees engaged in various activities between spring 1994-summer 2008 (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
Falls Mean	6	56	34	2	1
SD	5	34	31	4	2
CI	3	18	16	2	0
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	17	47	53	0	0
Winters Mean	9	29	28	0	0
SD	16	42	41	1	0
CI	8	22	21	1	0

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

SD = Standard Deviation

CI = 95% Confidence interval for the mean

Source: Jacksonville University 2008.

TABLE 6b. Number percent of manatees engaged in various activities between spring 1994-summer 2008 (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	78	45	40	0	15
Springs Mean	46	50	31	9	9
SD	18	14	18	10	11
CI	9	7	9	5	6
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	29	52	21	0	28
Summer '08	83	60	34	1	6
Summers Mean	29	66	27	2	5
SD	21	19	17	5	9
CI	10	10	9	3	5

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

SD = Standard Deviation

CI = 95% Confidence interval for the mean

Source: Jacksonville University 2008.

TABLE 7. Causes of manatee mortality for Florida's Key Counties, August 2008.

County	Watercraft	Flood Gate	Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
Brevard	8	0	0	25	6	4	10	0	53
Broward	2	0	0	0	1	0	2	0	5
Citrus	5	0	0	6	0	2	2	0	15
Collier	4	0	0	1	1	1	4	0	11
Dade-Miami	2	0	1	0	0	0	2	0	5
Duval	7	0	0	0	2	0	1	0	10
Indian River	2	0	0	3	0	0	0	0	5
Lee	12	0	1	5	5	4	10	1	38
Martin	0	1	0	0	0	1	0	0	2
Palm Beach	3	0	0	0	1	0	0	0	4
Sarasota	2	0	0	3	0	1	0	0	6
St. Lucie	2	0	0	1	0	3	0	0	6
Volusia	5	0	1	9	0	1	3	1	20
Total	54	1	3	53	16	17	34	2	180

Source: FWCC/FWRI 2008

TABLE 8. Florida manatee mortality, 1991- August 2008.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*	# Total	% of Total
Brevard	38	31	30	42	40	57	62	47	46	49	52	50	42	65	57	87	57	53	905	24.26
Broward	3	9	4	4	5	6	3	7	15	4	9	10	8	6	9	15	4	5	126	3.38
Citrus	5	9	8	5	6	6	5	4	8	6	10	9	10	7	18	10	12	15	153	4.10
Collier	14	19	18	13	10	70	21	14	19	35	31	13	37	23	34	14	16	11	412	11.04
Dade-Miami	7	10	5	11	14	7	14	9	12	8	11	9	9	7	5	7	13	5	163	4.37
Duval	19	8	5	6	7	10	10	13	9	11	6	14	19	15	14	13	8	10**	197	5.28
Indian R.	4	1	-	2	5	10	7	5	6	10	5	7	6	6	16	6	7	5	108	2.89
Lee	18	19	17	33	31	145	43	31	33	44	51	58	81	51	75	82	91	38	941	25.22
Martin	9	8	3	7	6	6	6	8	9	6	7	9	6	5	9	17	7	2	130	3.48
Palm Bch.	6	3	5	3	6	7	6	5	7	9	8	14	12	9	8	7	3	4	122	3.27
Sarasota	5	1	5	6	12	8	3	4	13	11	5	16	22	7	20	20	5	6	169	4.53
St. Lucie	1	4	4	2	2	4	2	1	2	2	4	4	0	1	8	5	2	6	54	1.45
Volusia	10	5	5	6	10	9	9	15	12	13	27	13	14	13	22	22	26	20	251	6.73
Total	139	127	109	140	154	345	191	163	191	208	226	226	266	215	295	305	251	180	3,731	100

*** = August**

**Note that as of September Duval has 11 total mortalities.

Source: FWCC/FWRI 2008.

TABLE 9. Watercraft caused mortality in Florida's Key Counties, 1991- August 2008.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*	# Total	% of Total
Brevard	13	7	9	9	6	13	12	9	12	13	7	17	8	11	6	22	10	8	192	21.33
Broward	2	2	2	3	0	1	0	2	5	2	4	3	5	1	2	6	1	2	43	4.78
Citrus	0	3	1	2	0	2	1	2	4	1	1	3	3	1	6	2	5	5	42	4.67
Collier	5	4	5	4	4	5	4	7	10	5	8	6	7	5	4	1	6	4	94	10.44
Dade-Miami	0	4	0	1	2	0	5	2	1	2	5	1	2	2	1	1	4	2	35	3.89
Duval	9	2	2	2	3	3	2	3	2	4	1	10	4	5	4	8	2	7	73	8.11
Indian R.	1	0		0	1	4	1	3	1	4	1	2	1	1	5	2	0	2	29	3.22
Lee	7	2	5	10	8	14	9	9	10	13	23	13	9	13	12	21	14	12	204	22.67
Martin	2	1	0	1	1	2	3	1	2	1	1	2	1	1	0	5	2	0	26	2.89
Palm Bch.	1	0	3	2	2	3	1	2	2	3	3	6	5	3	6	0	0	3	45	5.00
Sarasota	1	0	2	2	0	1	2	0	4	5	2	4	1	2	3	6	0	2	37	4.11
St. Lucie	1	1	1	0	0	1	0	0	0	1	1	1	0	0	1	0	1	2	11	1.22
Volusia	3	1	0	1	1	2	1	8	5	4	11	3	2	3	8	3	8	5	69	7.67
Total	45	27	30	37	28	51	41	48	58	58	68	71	48	48	58	77	53	54	900	100.00

*** = August**

Source: FWCC/FWRI 2008.

TABLE 10. Causes of manatee mortality in Duval County, Florida. 1976 - August 2008.

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*	7	0	0	2	0	1	0	10
Total	122	8	39	37	26	107	10	349

*** = August 2008.**

Source FWCC/FWRI 2008.

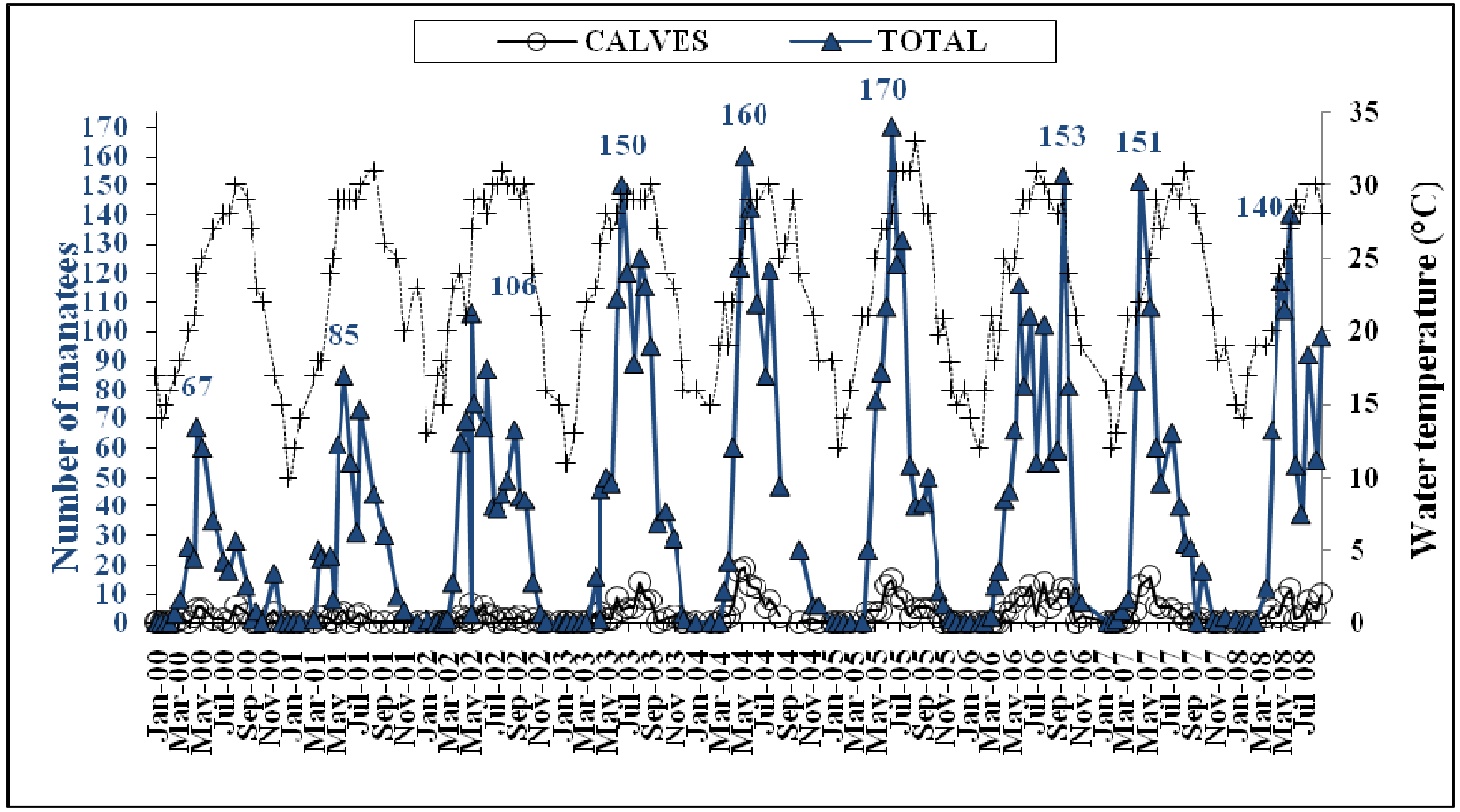


FIGURE 1. Aerial sightings of manatees and water temperature in the St. Johns River 2000–August 2008.

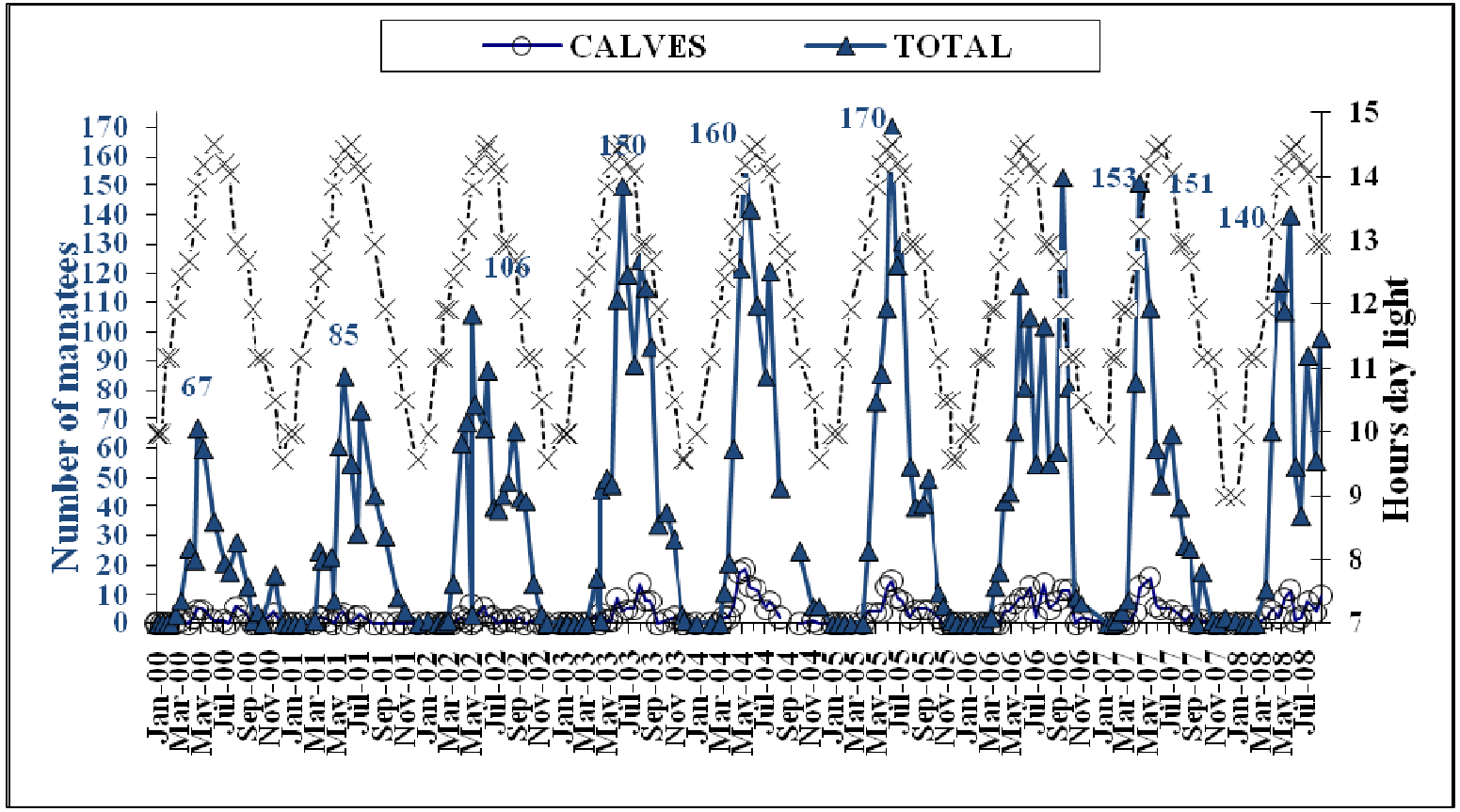


FIGURE 1a. Aerial sightings of manatees and hours daylight in St. Johns River 2000–August 2008.

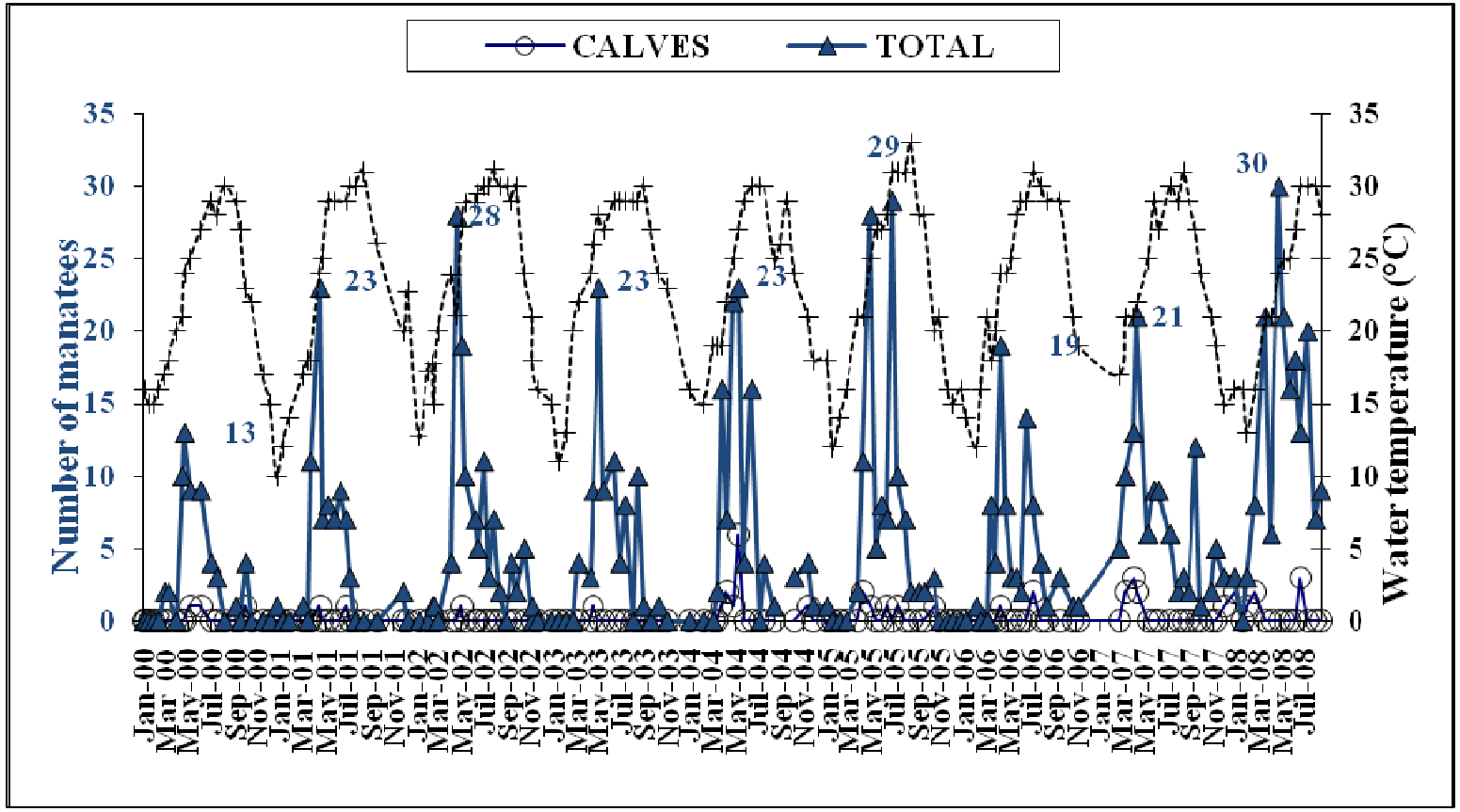


FIGURE 2. Aerial sightings of manatees and water temperature in the Intracoastal Waterway 2000–August 2008.

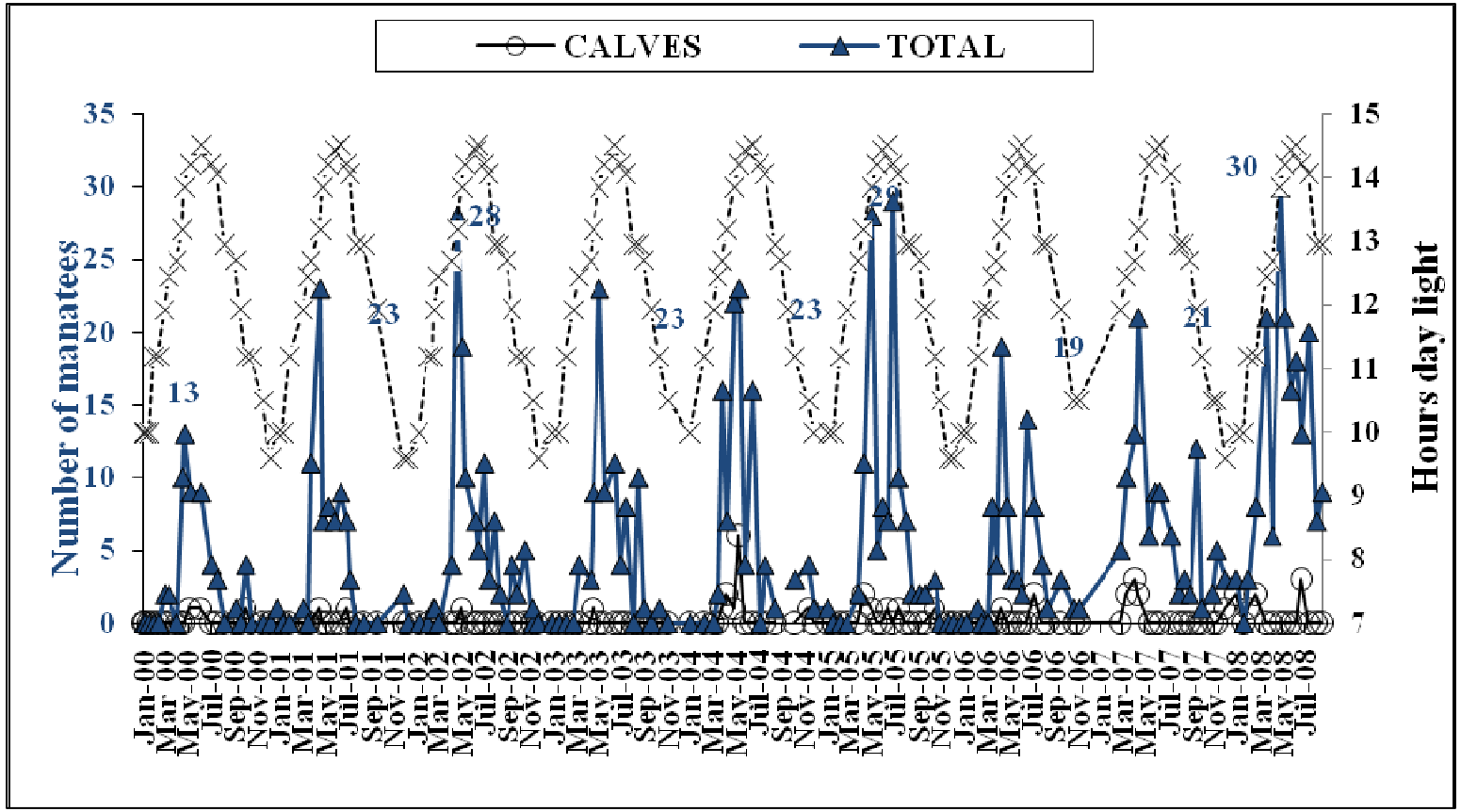
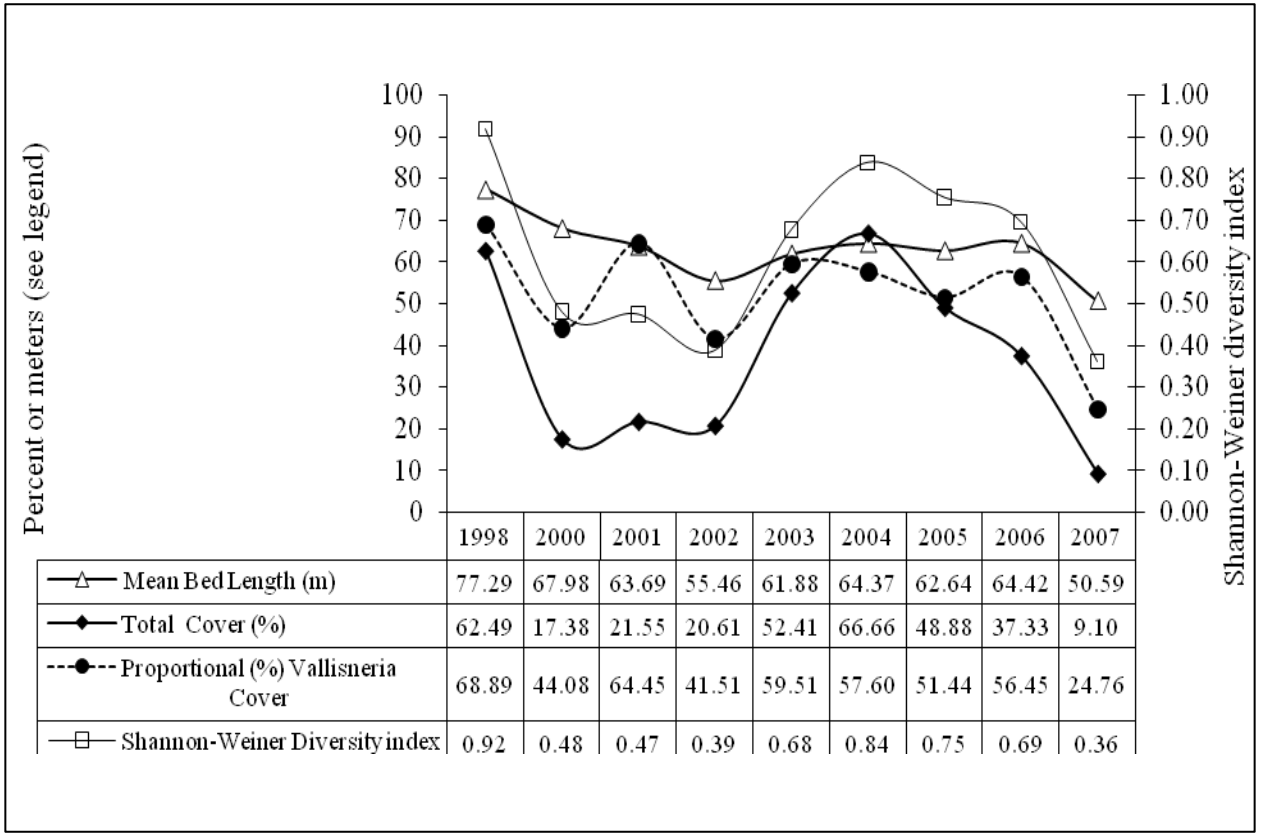


FIGURE 2a. Aerial sightings of manatees and hours daylight in The Intracoastal Waterway 2000-August 2008.



	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.

FIGURE 3. Submerged Aquatic Vegetation data for Duval County.

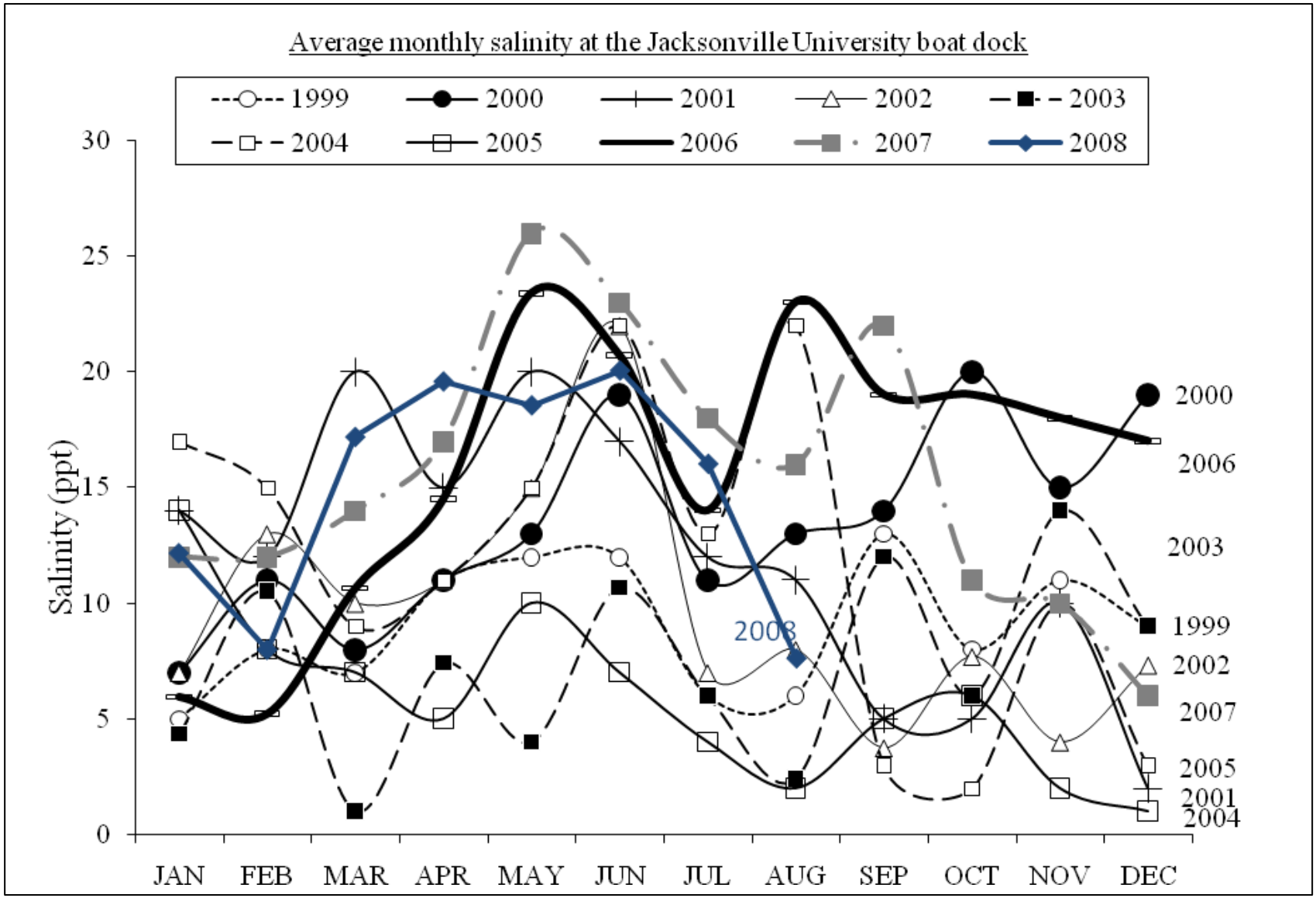


FIGURE 4. Mean monthly salinity recorded at the Jacksonville University dock, 1999-August 2008.

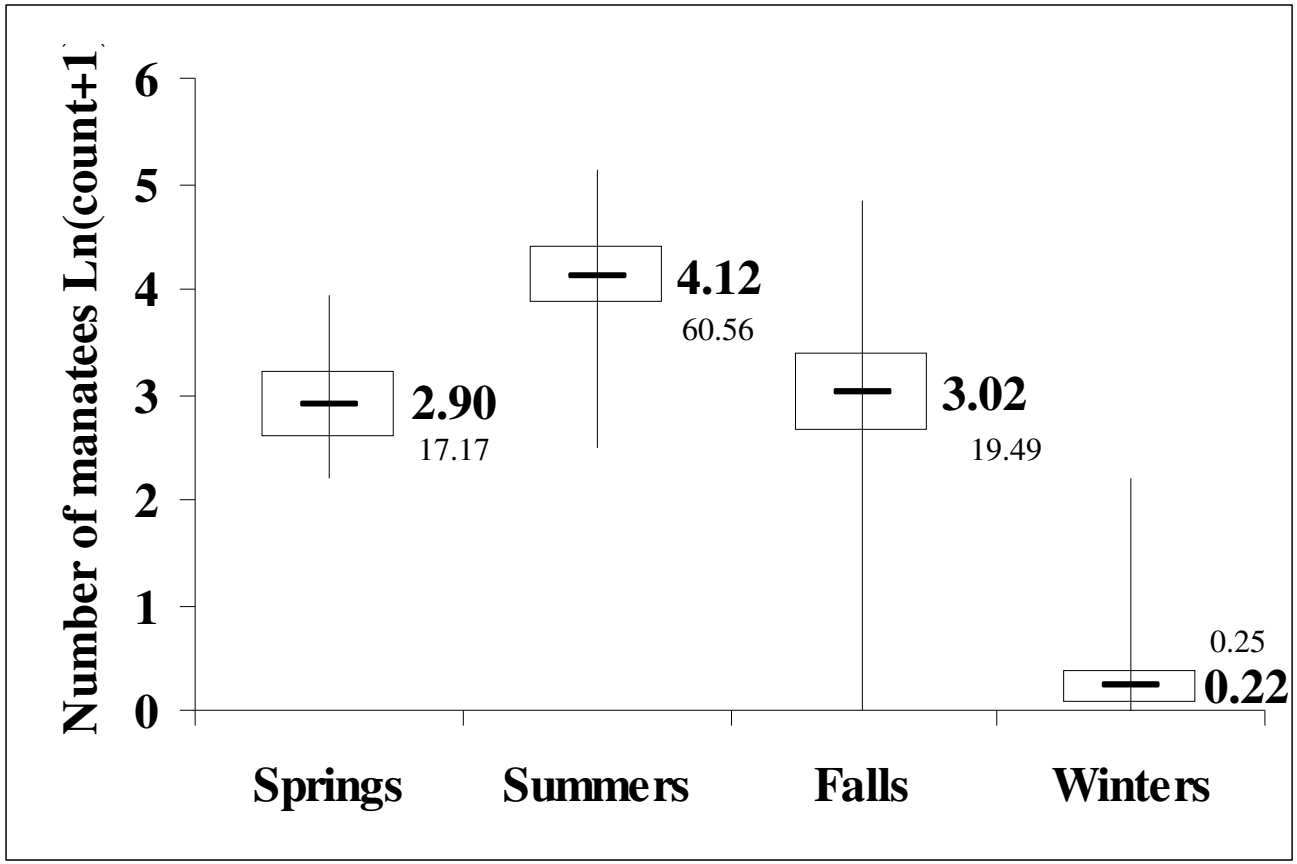


FIGURE 5. Mean counts of manatees in the LSJR by season (horizontal lines) 1994-2008. Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).

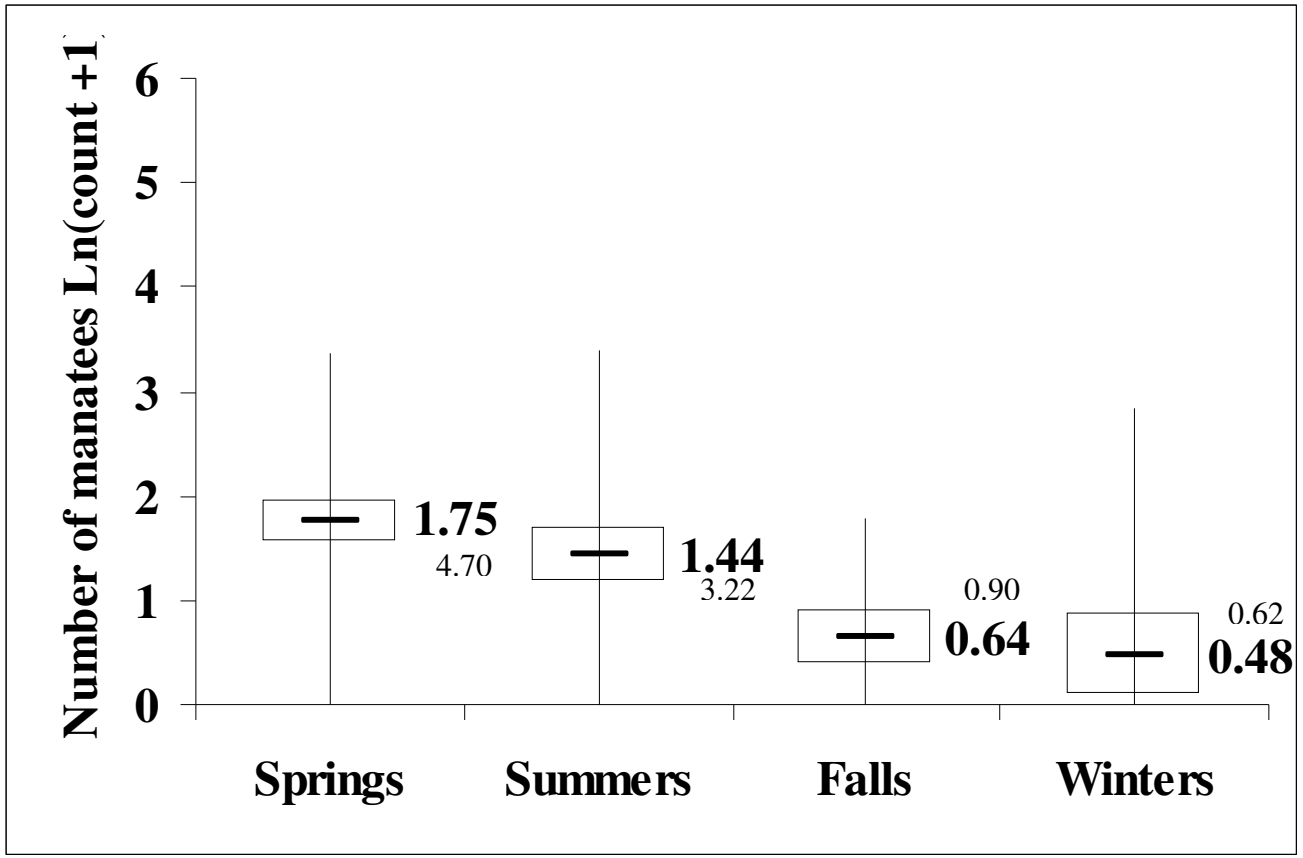
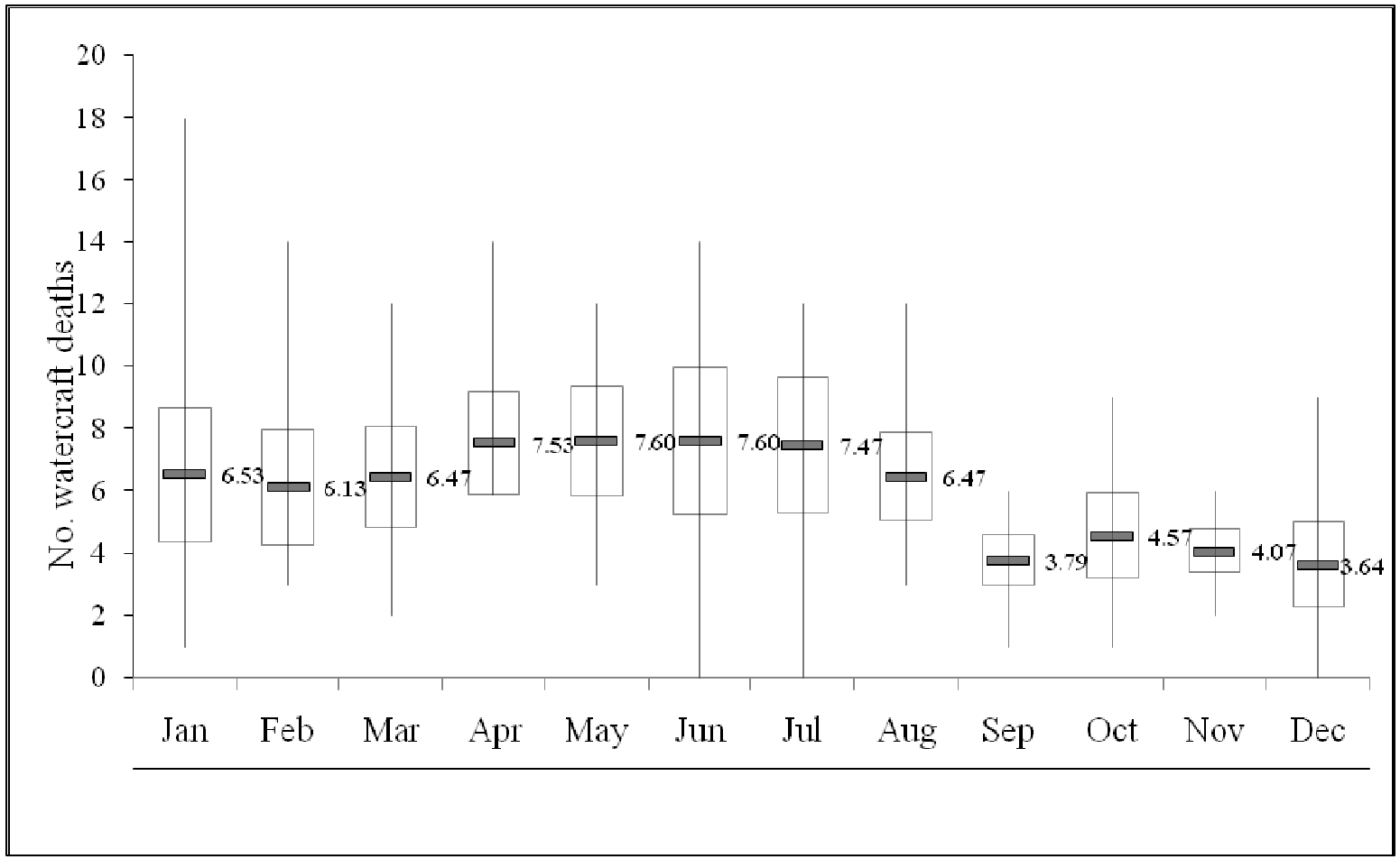
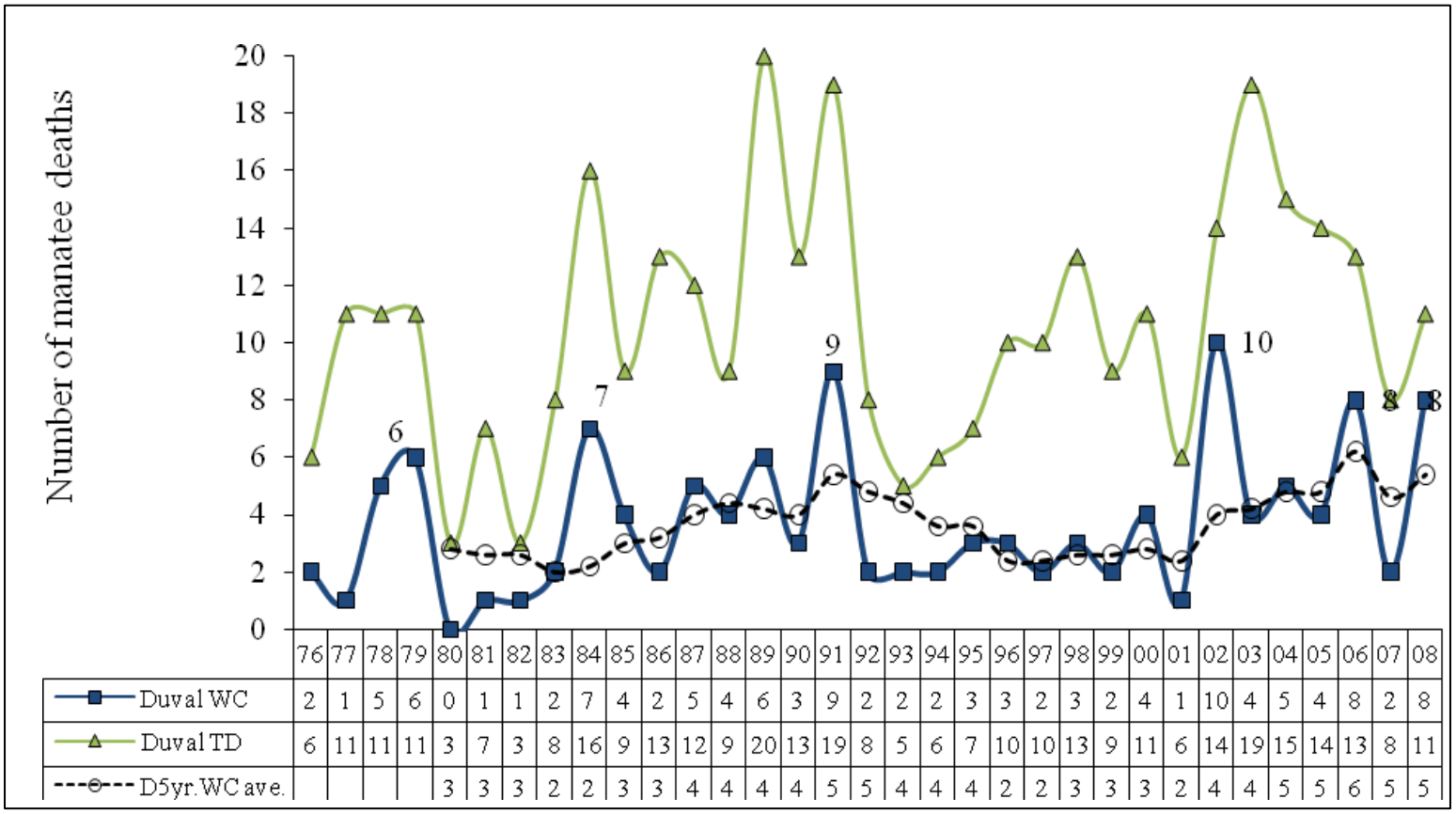


FIGURE 6. Mean counts of manatees by season in the ICW 1994 – 2008 (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).



Source data: FWRI 2008.

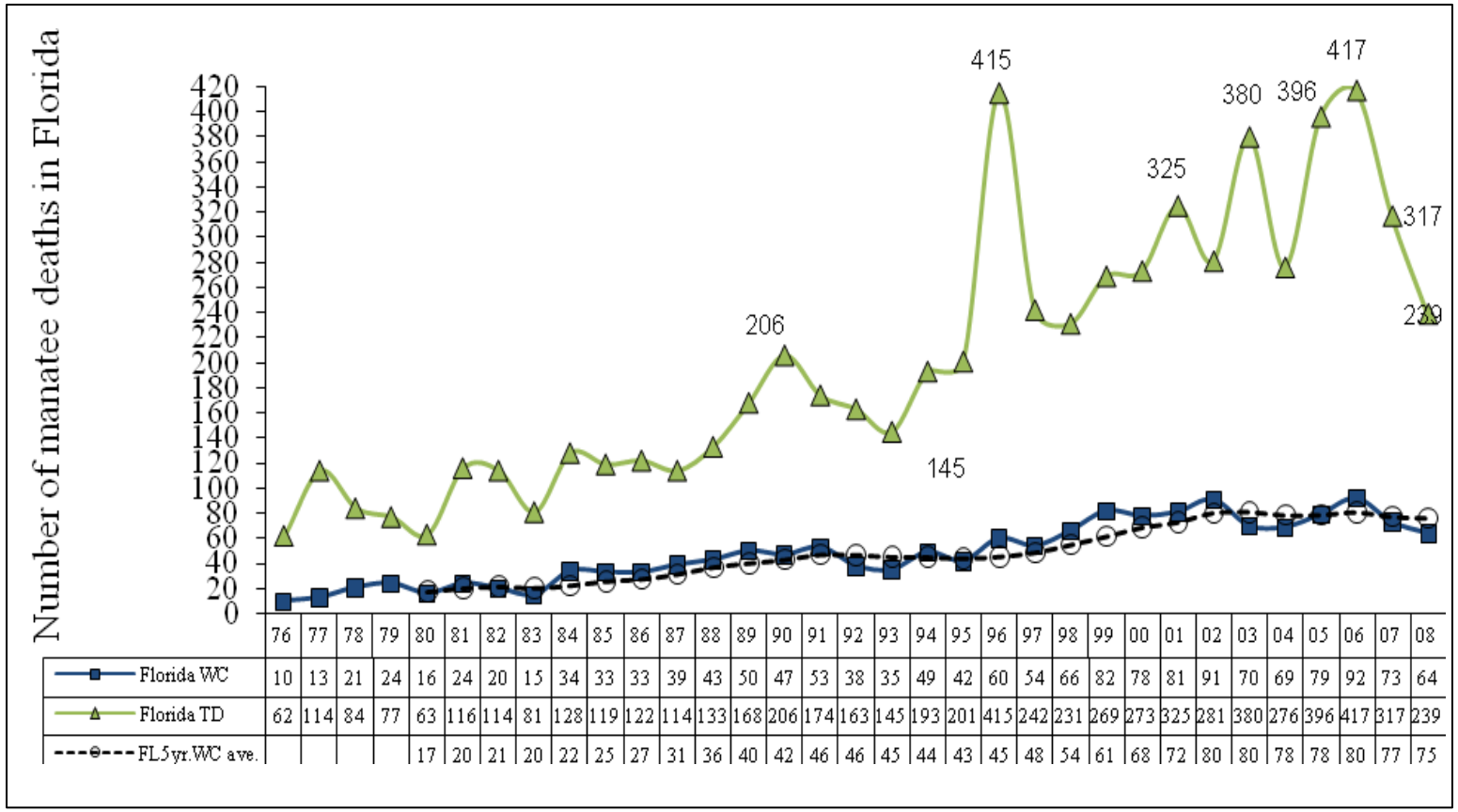
FIGURE 7. Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2008. Mean monthly counts of manatees (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals for the mean.



	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
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	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	11
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	5

08 = September 2008
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 2008).

FIGURE 8. Watercraft and total manatee mortality in Duval County, Florida (1976–September 2008).



08 = August 2008.
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.
(Source: FWRI 2007).

FIGURE 9. Watercraft and total manatee mortality in Florida 1976–August 2008.

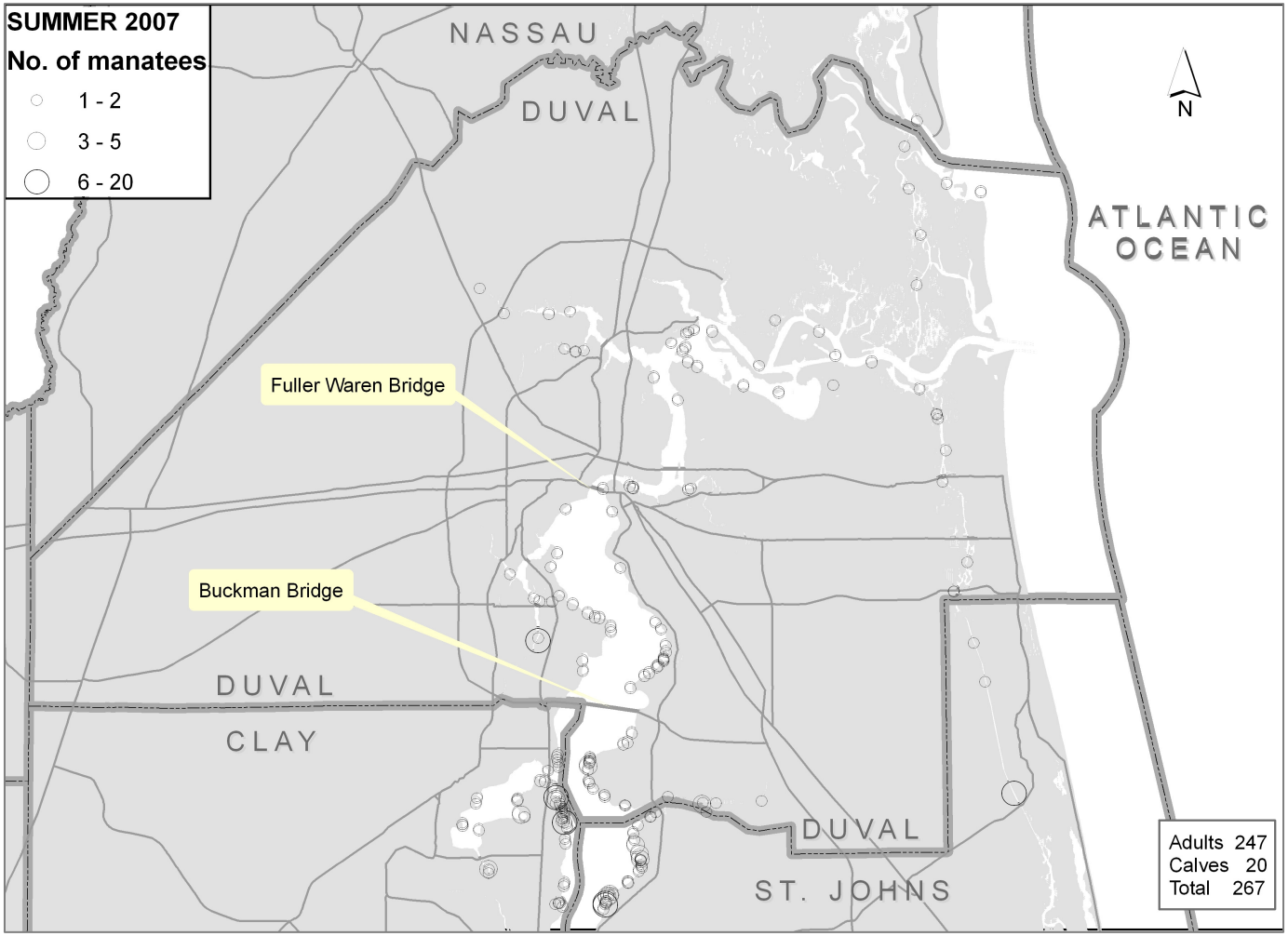
Aerial sightings of manatees

1. The following maps show manatee distribution from **Summer 2007–Summer 2008.**

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

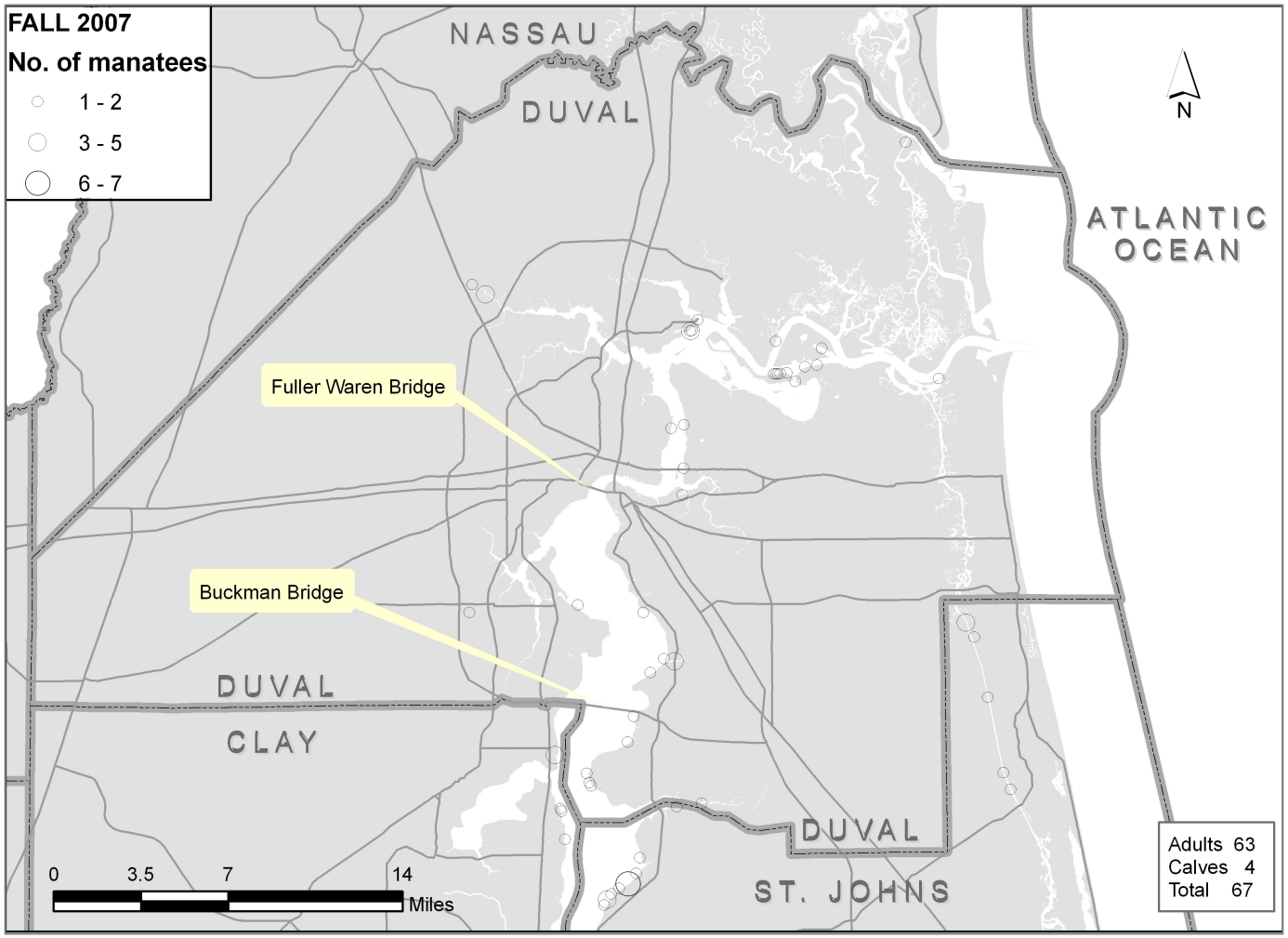
SERIES A - MANATEE AERIAL SIGHTINGS

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2007).



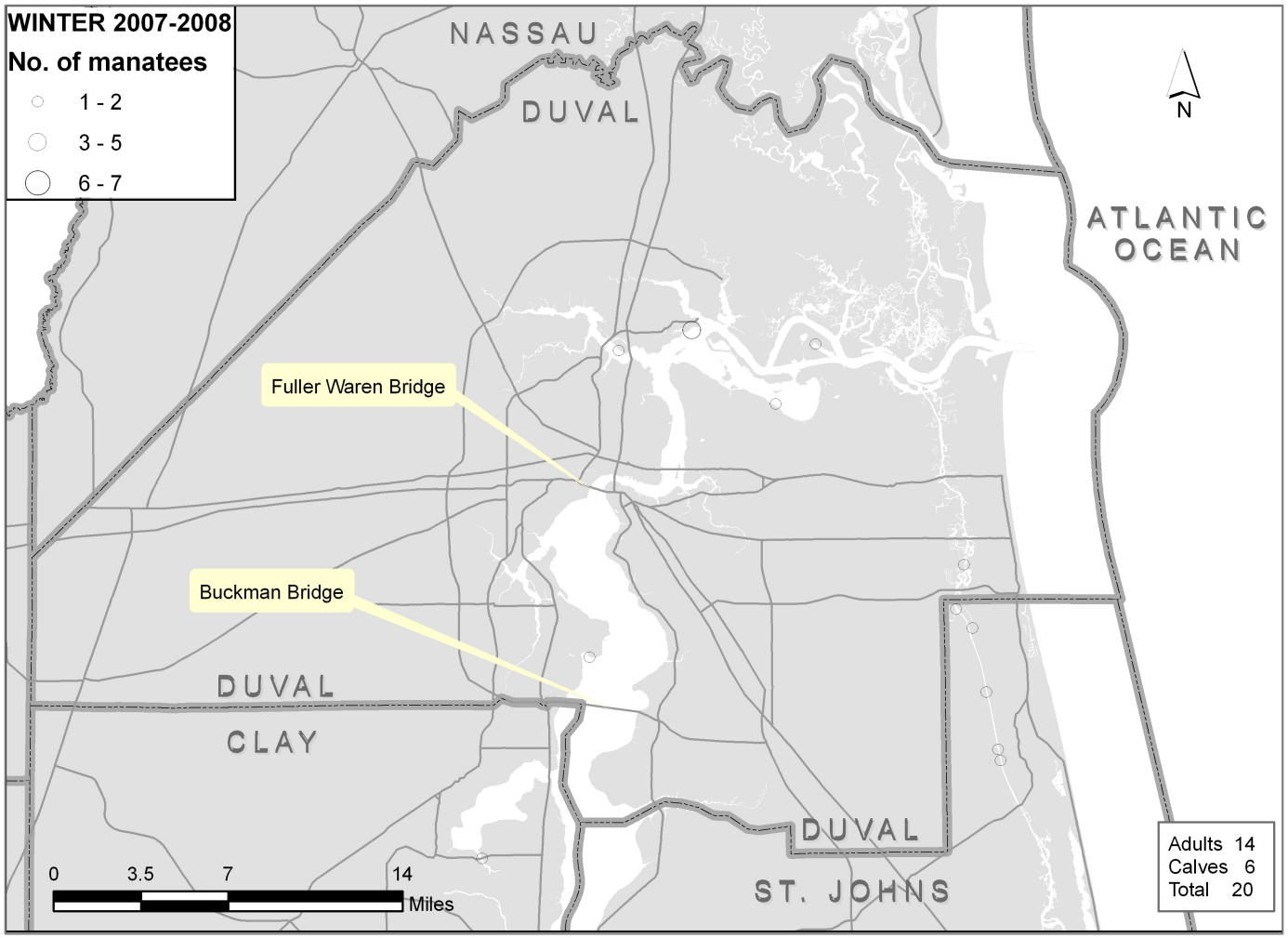
Source: Jacksonville University 2008.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Fall, 2007).



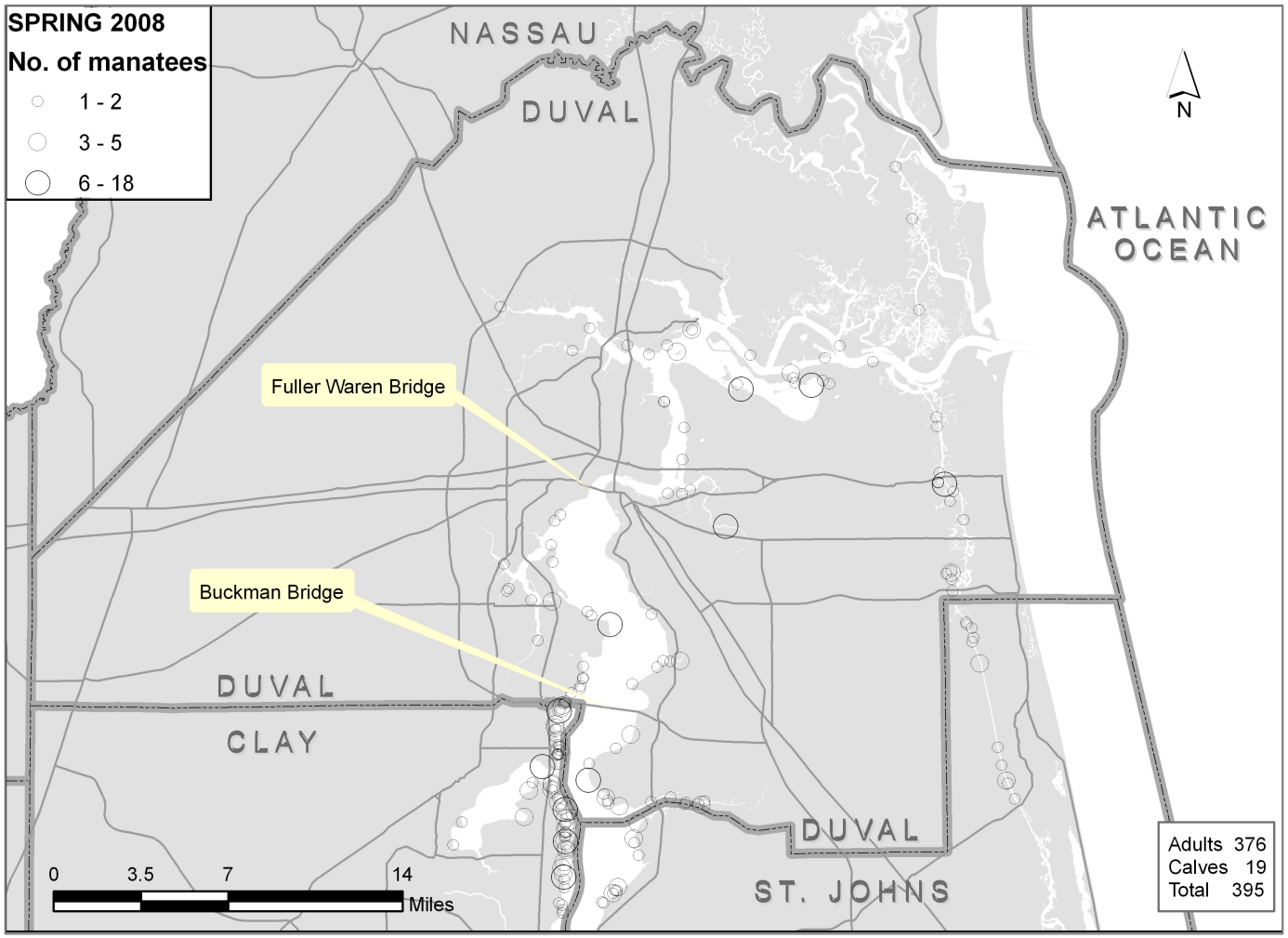
Source: Jacksonville University 2008.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Winter, 2007-2008).



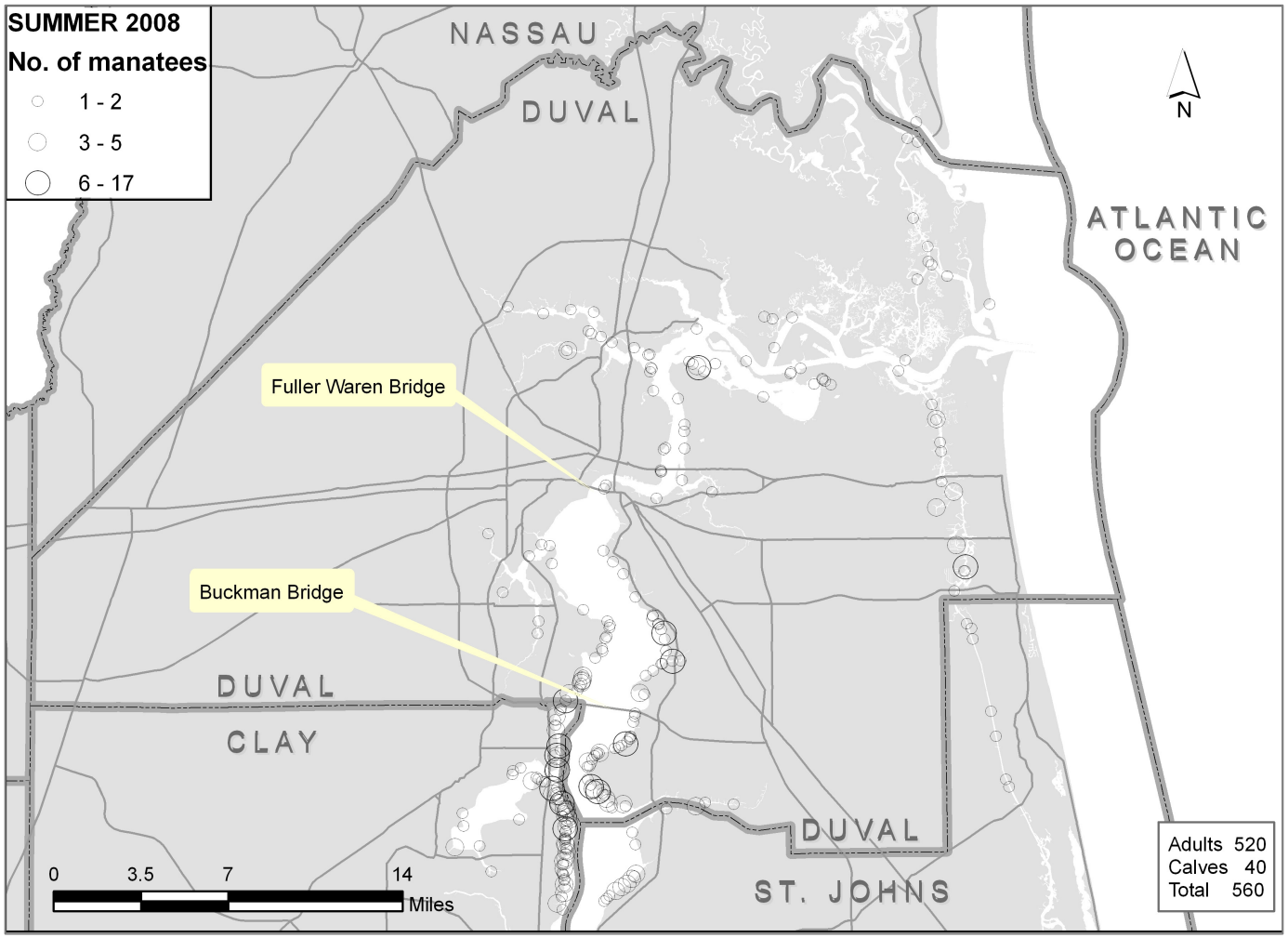
Source: Jacksonville University 2008.

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



Source: Jacksonville University 2008.

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



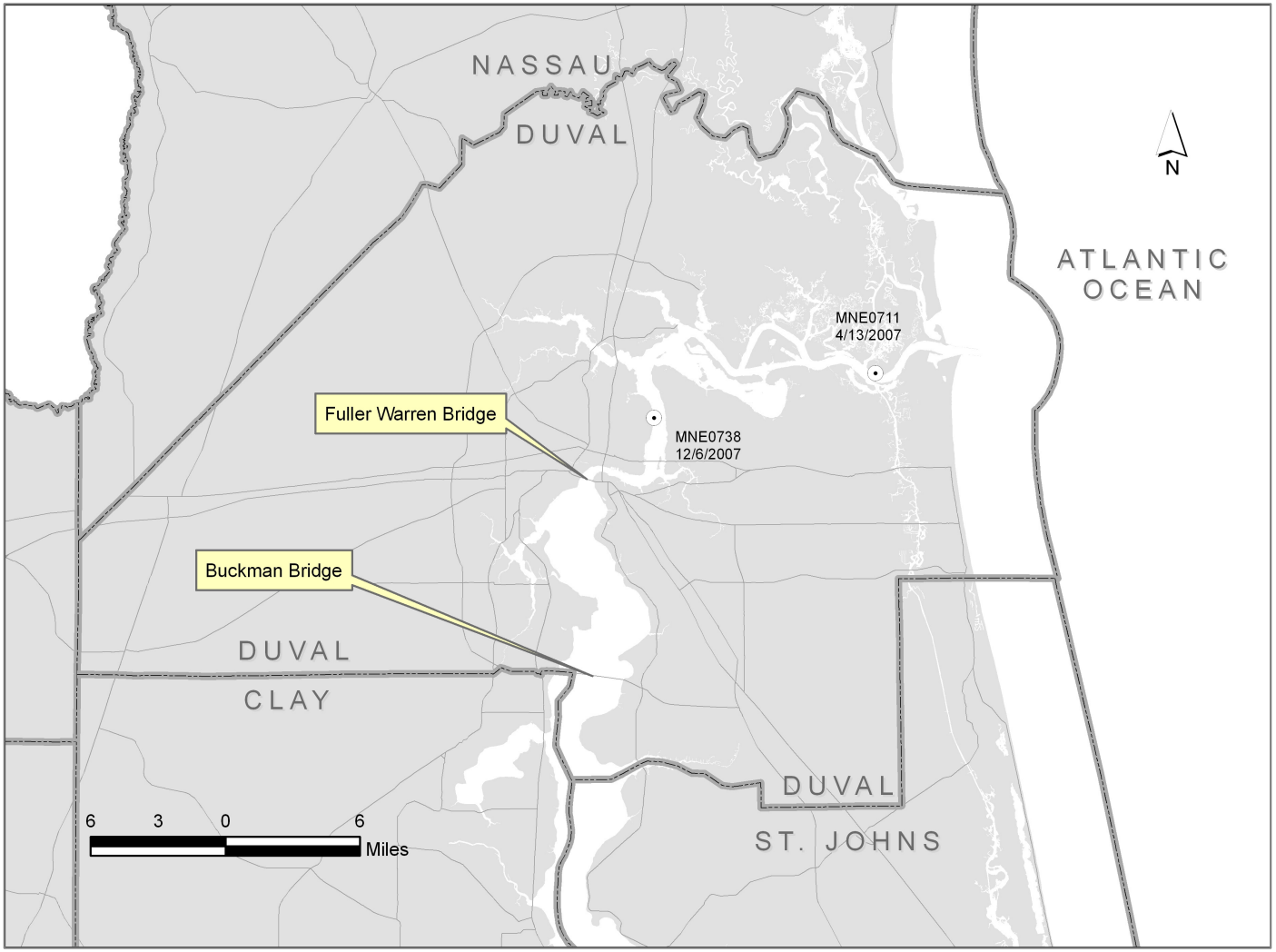
Source: Jacksonville University 2008.

Manatee mortality

1. Map of watercraft manatee mortality 2007, Duval Co., FL.
2. Map of manatee deaths from all causes, Duval Co., FL. 2007, Duval Co., FL.
3. Table of manatee deaths from all causes, Duval Co., FL. 2007.
4. Map of watercraft manatee mortality (August 2008) Duval Co., FL.
5. Map of manatee deaths from all causes (August 2008) Duval Co., FL.
6. Table of manatee deaths from all causes (August 2008) Duval Co., FL.

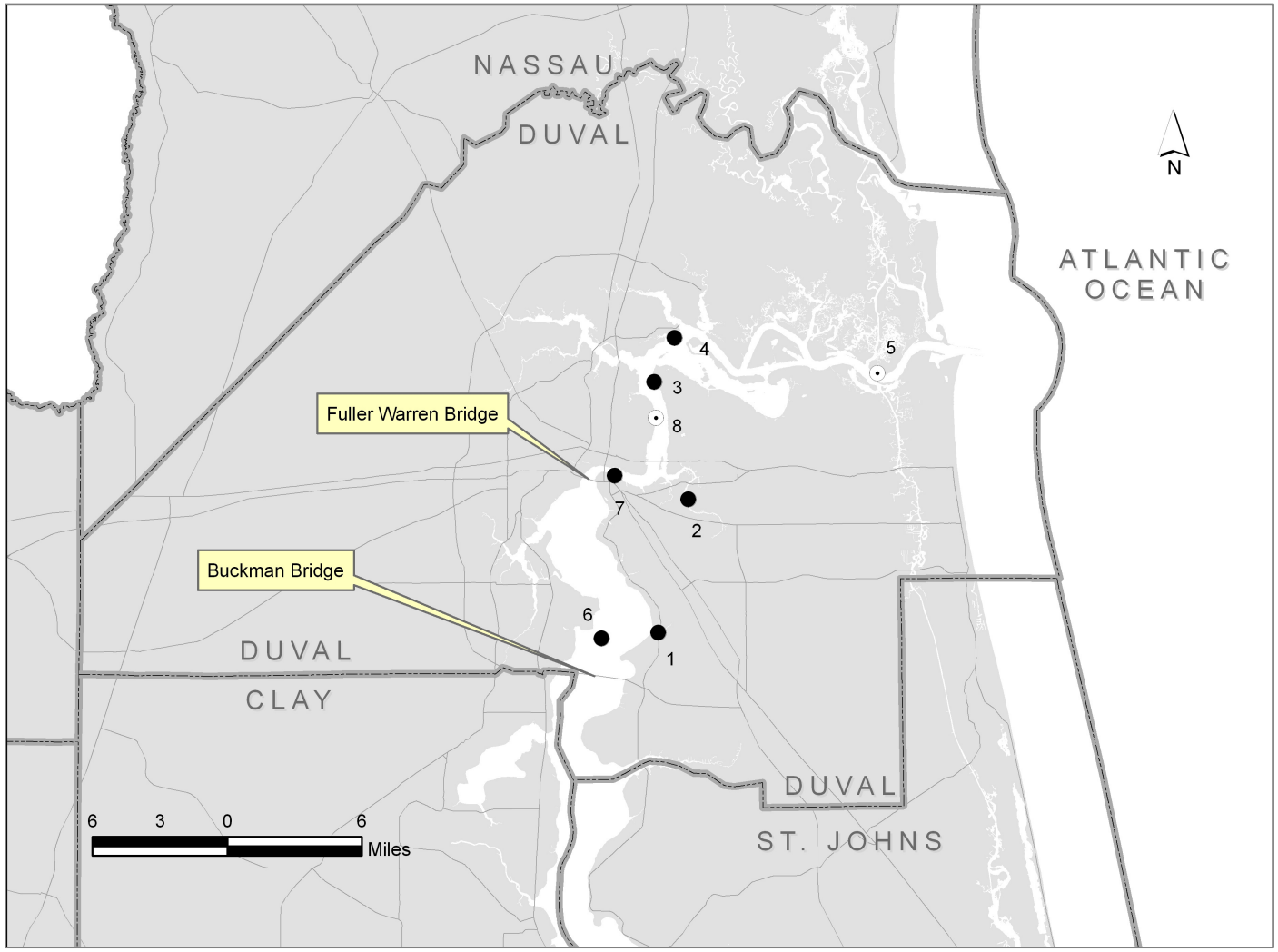
SERIES B – MANATEE MORTALITY

SERIES B – Watercraft manatee mortality, Duval Co., FL. 2007.



Source: FWRI 2008.

SERIES B – Manatee deaths from all causes, Duval Co., FL. 2007.



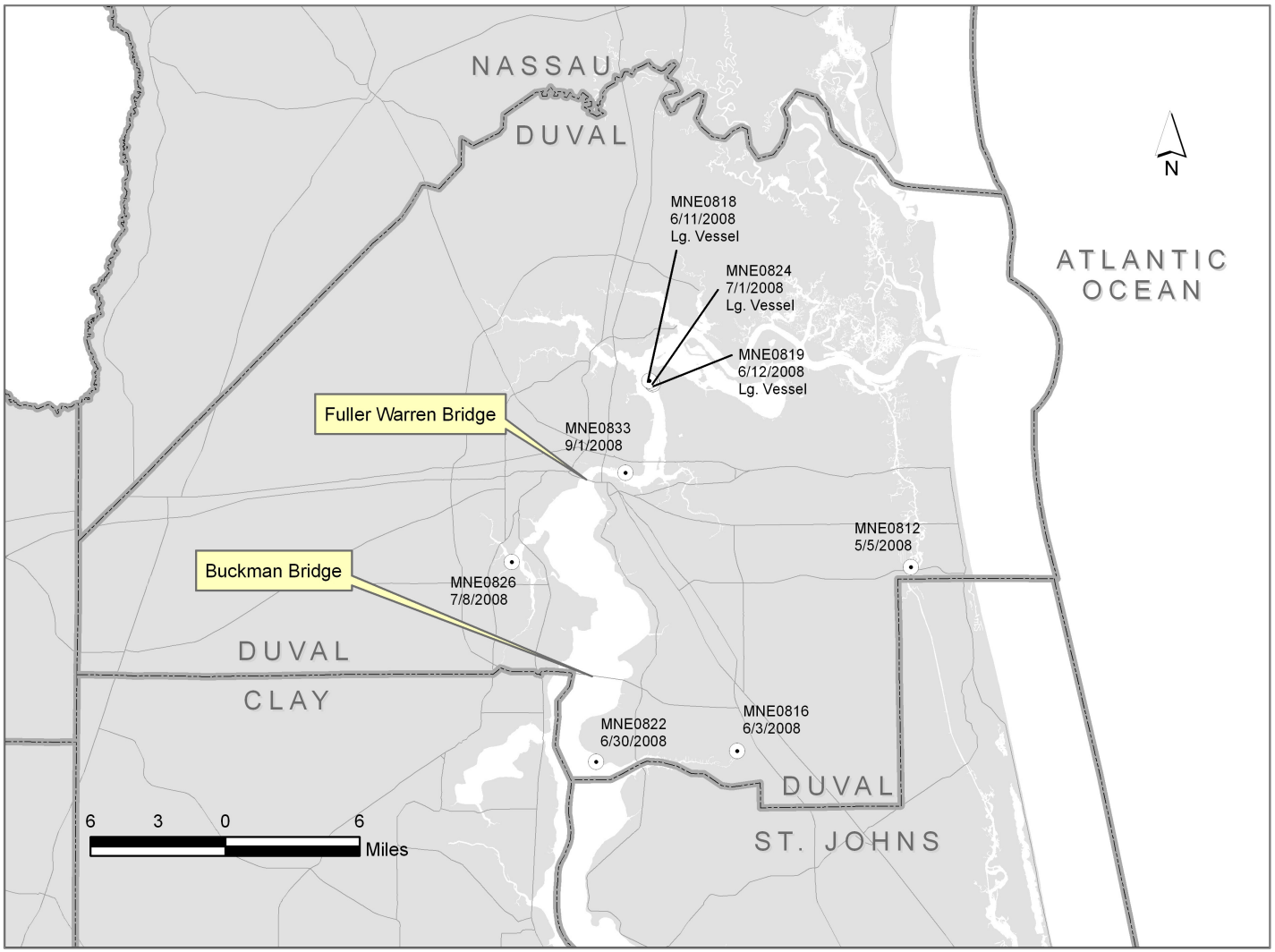
Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2008.

Table 11. Manatee deaths from all causes in 2007, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total length (cm)	DCODE	Mortality category
1	1/14/2007	SWFTm0701b	M	204.0	5	5-Natural-Cold Stress
2	2/10/2007	MNE0702	F	219.0	5	5-Natural-Cold Stress
3	2/13/2007	MNE0703	F	211.0	5	5-Natural-Cold Stress
4	2/15/2007	MNE0704	U		9	9-Undetermined. Other
5	4/13/2007	MNE0711	M	330.0	1	1-Watercraft
6	5/12/2007	MNE0714	F	336.0	8	8-Undetermined
7	9/29/2007	MNE0735	M	204.0	8	8-Undetermined
8	12/6/2007	MNE0738	M	295.0	1	1-Watercraft

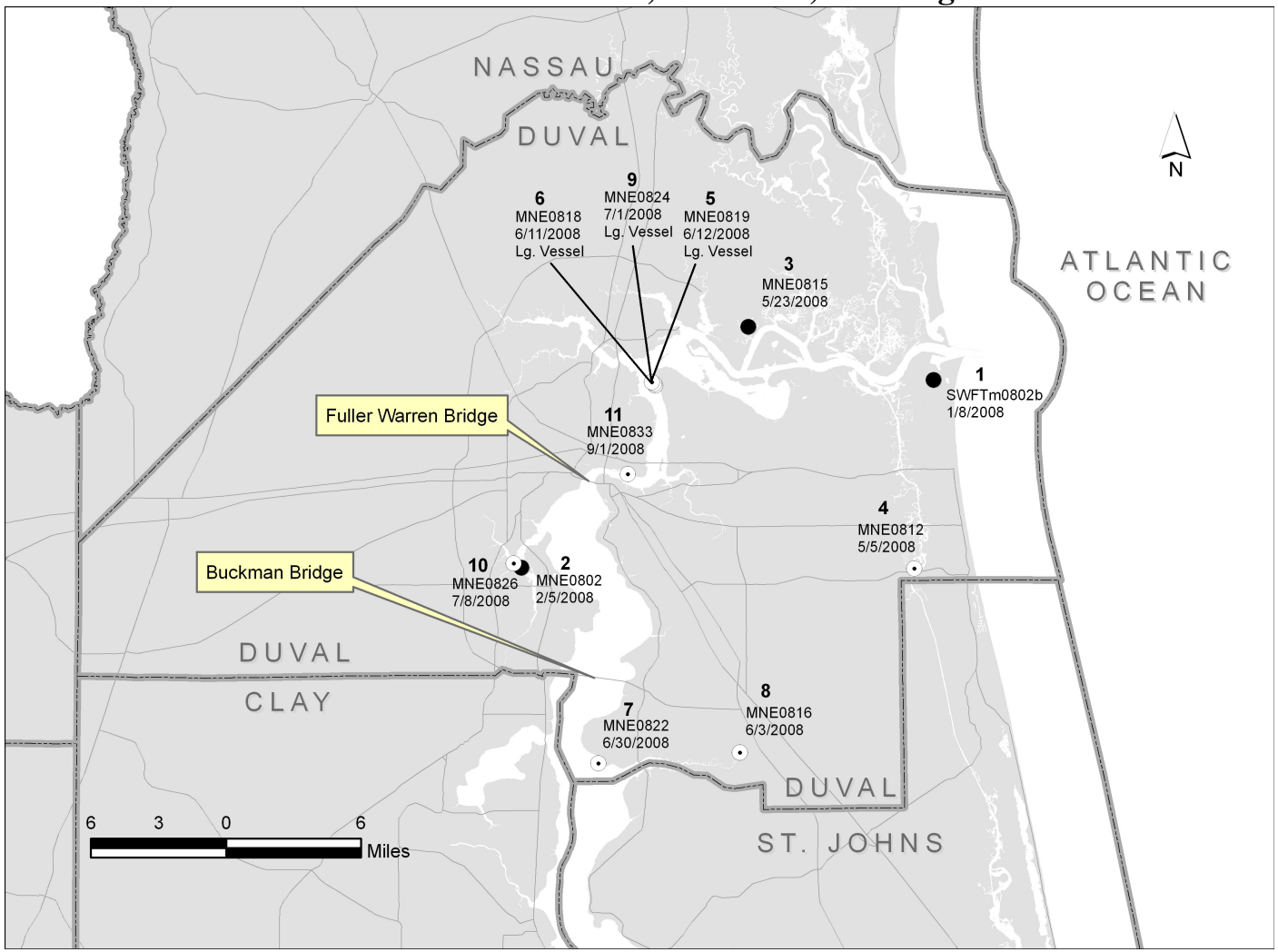
Source: FWC, FWRI 2008

SERIES B – Watercraft manatee mortality, Duval Co., FL. August 2008.



Source: FWRI 2008.

SERIES B – Manatee deaths from all causes, Duval Co., FL. August 2008.



Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2008.

Table 12. Manatee deaths from all causes untill August 2008, Duval Co., FL.

Count	Date	Manatee field ID	Sex	TLENGTH	Mortality category
1	1/8/2008	SWFTm0802b	M	213.0	5-Natural-Cold Stress
2	2/5/2008	MNE0802	F	217.0	5-Natural-Cold Stress
3	5/23/2008	MNE0815	M	285.0	8-Undetermined
4	5/5/2008	MNE0812	M	312.0	1-Watercraft
5	6/12/2008	MNE0819	M	303.0	1-Watercraft
6	6/10/2008	MNE0818	M	326.0	1-Watercraft
7	6/26/2008	MNE0822	M	265.0	1-Watercraft
8	6/3/2008	MNE0816	F	124.0	1-Watercraft
9	7/1/2008	MNE0824	M	325.0	1-Watercraft
10	7/5/2008	MNE0826	M	272.0	1-Watercraft
11	9/1/2008	MNE0833	F	222.0	1-Watercraft

Source: FWC, FWRI 2008.