Annual Update
2006-2007
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 2006-**07** annual update to the Duval County Manatee Protection Plan. It represents additional population inventory and analysis of data gathered between October 1, 2006 and August 31st, **2007** 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 Data, figures, tables and agency names were outdated or no longer appropriate.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*: Single Highest Day Count (SHDC) for LSJR was 151 manatees per survey in April and represents the highest number of animals sighted this early in the season. Combined with the ICW count of 21 animals that same day, the county wide count came to 171 animals. The SHDC for LSJR was 153 manatees per survey in September 2006 and 170 manatees per survey in June 2005**. In May 2004 SHDC was 160 manatees per survey. In 2003 SHDC was 150 manatees per survey in June and in 2002 it was 106 manatees per survey in May. Dry weather (1999–2000) 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 highest day counts have gradually increased. Increased counts may be attributed to observers having gained a better knowledge of the survey area and where manatees are likely to occur. **In the ICW the SHDC was 21 manatees per survey in April 2007 and 19 manatees per survey in 2006.** In the ICW the SHDC was 29 manatees per survey in July 2005. SHDC was 23 manatees per survey (2003 and 2004). In 2002, SHDC of 28 manatees 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.

General means for manatees/survey/yr. indicated a gradual increase in LSJR numbers of animals since 2000 (16 manatees/survey/yr.) to 2002 (36 manatees/survey/yr.) to 2004/2006 (51 manatees/survey/yr.) to 2005/2007 (45 manatees/survey/yr.). Recent numbers are similar to those prior to 1999. 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 7.94 % (LSJR); and 0.91 % to 12.05 % with a mean of 6.74 % (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 the past couple of years. 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*: In 2007, there was a total of 6 reported deaths, of which 1 was watercraft related, 3 cold stress and 2 undetermined (FWRI 2007). In 2006, the county again surpassed the "unacceptable" level of watercraft related mortality as stipulated in the MPP (1st in 2002, 2nd in 2004). 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 January 31st, 2007 to discuss the 8 watercraft deaths in Duval County during 2006 and how Duval County should respond to these incidents. It was agreed that there was no identifiable pattern of activity that caused the mortalities.**

As a result of the meeting, the following is a list of Duval County's continuing efforts to protect the manatee contained in a letter outlining actions by Council Woman Lynette Self on February 9th 2007:

1. **Build the JSO boat facility near Reddie Point to increase response times. This project was delayed pending funding that is now available and must be spent within the next two years. However, while the facility is under construction the number of Marine Unit boats has been increased and two personal watercraft have been purchased. Comprehensive Plan improvements. Duval County updated the comprehensive plan with text changes in regards to our MPP. Our comprehensive plan now mirrors our MPP regarding manatee protection.**

2. **Distributing to all registered boat owners a new brochure depicting the new Federal/Sate manatee speed zones and which will be handed out by law enforcement during encounters with boaters on the river.**

3. **Coordinating with JAXPORT to obtain manatee observation data from commercial vessels and pilots, and providing both with manatee information.**

4. **Integrating manatee protection efforts into DEP Northeast District Office's Environmental Crimes Task Force.**

5. **Contacting Sea Grant and FIND for assistance to conduct a boat traffic study to determining where the greatest boat traffic meets the greatest number of manatees.**

6. **U.S. Fish & Wildlife Service would try to expedite installing of the manatee signs marking its new speed zones.**

7. **The City would review the Manatee Protection Plan and the Comprehensive Plan possibly reworking the marina siting zones.**

8. **FWC and the City would consider changing the manatee protection speed zones from year-round to seasonal would be considered.**

Since the meeting steps have already been taken to implement some of the commitments. I have spoken to the Mayor and obtained his commitment to look for money within the City budget to fund the boat traffic study with the Sea Grant program. He has also agreed to provide more press releases, and garner more coverage about manatee protection in the Duval County waterways.

Jim Maher at DEP's Northeast District Office tells me that DEP will host a meeting on February 14th with the Sheriff's Marine Unit, the City Waterfront Coordinator, our Environmental Quality Division, and possibly representatives from U.S. Fish & Wildlife Service to see how manatee protection can be strengthened through the 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.

(Above information from letter dated February 9, 2007 by Council Woman Lynette Self to Mr. Kipp Frohlich of FWC).

In 2005, there were a total of 14 reported deaths of that 4 were watercraft, 2 perinatal, 2 cold stress and 6 undetermined (FWRI 2007). In spite of these manatee deaths, the five-year running average from watercraft mortality is 3.57 (range 2-6) deaths since 1980 (Figure 8).

***Habitat*: Grass beds north of Buckman Bridge regenerated significantly since late 2002-2006 and then declined again 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.** 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) (Dean Dobberfuhl. SJRWMD 2007).**

***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 are located within a 7 mile radius of Downtown. Currently these facilities do not discharge warm water and ever decreasing numbers of animals have been observed at these locations. **In winter of 2002/2003/2004/2005** JEA undertook monitoring for manatees themselves using their own personnel. In spite of the plant being shut down in October 2002, manatees congregated at the site but did not remain. Also, JEA installed a retaining gate to prevent manatees moving into the old discharge pipes. No animals were seen at JEASS 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. In winter 2004/2005 no manatees were reported at the site. In winter 2004/05, manatees were not observed at the warm water source identified in Ortega River. The SSJEA plant has now been completely dismantled and the site proposed for redevelopment. **In 2006/2007, no manatees were observed at the warm water source in Ortega River. However, a few animals were seen at the JEA district #2 out-fall near north Bartram Island. Rescue attempts were made and one animal was relocated by Sea World of Florida and FWC.**

Speed Zones imposed by USFWS:

Duval County manatee protection rule (68C-22.027, FAC): Amendments to this rule were adopted on January 10, 2007. See Maps.

New federal manatee protection slow speed zones announced by the U.S. Fish and Wildlife Service on April 28th 2005 in Duval, Clay and St. Johns are now official and are being enforced. 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 compliment existing state and local governmental manatee protection measures. These regulations were made effective on September 5th 2003. A signage plan was implemented in May 2005.

Acoustical Study: Underwater acoustical recordings of hopper dredging activities were conducted with the full cooperation and assistance of B&B Dredging. Noise from the 100 m long hopper dredge, "*Columbia*" was recorded while it performed maintenance dredging in the St. Johns River during August, September and October 2004. Jacksonville University researchers assisted in recording dredging activities in the vicinities of Dames Point Bridge, Talleyrand, Hart Bridge and Bartram Island, recommendations were provided in the preliminary report **September 2005**. This study was conducted by Dr. Ed Gerstein and funded by the City of Jacksonville. **The final report was accepted by the Waterways Commission April 2006.**

THIS REPORT CONTAINS THE FOLLOWING UPDATED SECTIONS TO THE 2006 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.

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

Inventory and Analysis

Manatees

Distribution and Abundance: Aerial surveys by Jacksonville University (March, 1994 – **August**, 200**7**) conform to current FDEP Manatee Aerial Survey Protocol. Intensive bimonthly surveys were conducted in areas manatees frequent - the St. Johns River, its tributaries and the Atlantic Intracoastal Waterway (Nassau Sound to Palm Valley). During winter months, industrial warm water sources in Northeast Florida were also monitored. **During 548 bimonthly surveys, a total 11,614 manatee sightings were recorded, 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 2006–2007** was not found to be significantly different from past years **except that the highest daily count was recorded earlier (in spring) than in previous years. *Map Series A,* shows manatee distribution from Summer 2006 through Summer 2007.** 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 % (LSJR) and 0.91 % to 12.05 % (ICW) over the duration of the study (Table 1). When averaged 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**. In 2004 (10 %) and 2005 (8 %), the percentages seem to be higher in both the LSJR than the previous three years (range 4-6 %) and in 2006 (10 %) and 2007 (9 %) calf percentages remained stable on the previous two years. In the ICW percentages were lower in 2005 (5%) than 2004 (11%) but continued to increase to 8 % by 2007 (Table 1).**

Single Highest Day Count (SHDC) for LSJR seems to be stable at 151 manatees in April 2007 and 153 in September 2006, which was lower than 170 manatees per survey in June 2005. The latter number represents the highest count to date (1994-2007). In 2004 SHDC was 160 animals in May, and in 2003 SHDC was 150 manatees per survey in June. In 2002, it was 106 May. SHDC for 2001, 85 manatees per survey (June) and 2000, 67 manatees per survey (May) was considerable lower than previous years. **The SHDC seems to have alternated between the months of May and June each year since 2000. Prior to 2000 SHDC were achieved during July, August and September. However, more recently 2006/2007 the season seems to have expanded from April to September because of a particularly mild winter (Table 1).** Dry weather caused higher salinity in the LSJR that lead to poor or no regeneration of tape grass beds that manatees primarily rely on for food. As a result, over all per survey counts were generally lower than expected. A part from the year 2000/2001 data, it appears that highest day counts have increased but they are not statistically different from the 99 manatees per survey reported by Valade (1991). Increased counts may be attributed to observers having gained a better knowledge of the survey area and where manatees are likely to occur. **Higher than average numbers of manatees were seen in the period 2003-2007 (range 44-51 manatees per survey year) than the general mean for all years (40 manatees per survey).** In the ICW the SHDC was 29 manatees per survey (2005) up slightly from 23 manatees per survey observed in 2003 and again in 2004. **SHDC of 29 manatees (2005) and 28 manatees (2002) represent the highest counts since 1994. Excluding the highest counts from 2001-2007 count appears to be more consistent with counts prior to the period of drought for years 1994-1998 (range 19-23 manatees) (Table 1).**

Yearly means for manatees/survey indicate gradual increase in LSJR numbers of animals since 2000 (16 manatees/survey/yr.); 2003 (47 manatees/survey/yr.); 2004 (51 manatees/survey/yr.); 2005 (44 manatees/survey/yr.); 2006 (51 manatees/survey/yr.) and August 2007 (46 manatees/survey/yr.). Recent numbers are similar to those prior to 1999. Yearly means in the ICW have also slightly increased over time 1995, 1996 (4 manatees per survey /yr.) and 1997-2000 (3 manatees/survey/yr) to 2000-2003 (5 manatees/survey/yr.); 2004, 2005 (6 manatees/survey/yr.); 2006 (4 manatees/survey/yr.) and 2007 (8 manatees/survey/yr.)(Table 1). 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).

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 2006-2007 numbers indicate slight increase 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. Also, 2007 data does not represent a complete 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 stabilizing 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 population has continued to grow at a slightly faster rate during 2000-2007 (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. This was perhaps because tributary waters became too warm and uncomfortable for them. 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. **During the spring of 2007, we observed the highest manatee count to date for any spring. There were 369 manatees sighted and they were more spread out throughout county waters than the 218 manatees seen during spring 2006. In summer 2006/2007 manatees were similarly spread out throughout the county, however, there were 441 animals (2006) verses 247 (2007) 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.**

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 and 6a-d)**. In winter it was difficult to find manatees feeding because manatee abundance was low. 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.

Grass Beds: **Following is information supplied by Dean Dobberfuhl of the 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. Toxic algae blooms were again observed in 2007. 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 (Figure 4).**

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-**2007,** the ICW continues to be a travel corridor. **No manatees were observed in winter (Table 6a). In spring, we observed 55 manatees which was higher than 42 (2006) and 46 animals (2005) but lower than 70 animals (2004). No feeding behavior was observed in the last 3 years which is unlike prior years. Most animals were resting and traveling. We observed 36 % of the animals traveling, 64 % resting, no animals were observed feeding or cavorting. Feeding and cavorting percentages were below average for this time of year (Table 6b). In the summer, total number of manatees was lower (29 animals) than 32 (2006) and 63 animals (2005) but not unlike 25 animals (2004). Behaviors consisted of traveling animals (52 %), resting animals (21 %) and cavorting animals (28 %). No animals were observed feeding. More animals were seen cavorting in the past three years with the exception of 1998 (Table 6b).**

Mortality Information: **The total of State-wide deaths documented for 2007 (August) was 247, of which 59 were watercraft-related. Other causes included other human (4), perinatal (50), cold stress (17), other natural (57), flood gate (2), undetermined (48) and unrecovered (10). In 2007, watercraft deaths for the key counties totaled 40. Other causes of death for the key counties included other human (4), perinatal (40), cold stress (13), other natural (55), flood gate (0), undetermined (35) and unrecovered (5) (Table 7). Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2007 indicated a decreasing trend (Figure 7). Watercraft, perinatal, natural, undetermined and cold stress causes of death were the most significant for 2007 (FWRI 2007).**

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 6 by August, 2007. (Table 8, and Figure 8).

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).

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. It was noted that two of the deaths occurred in the Intracoastal Waterway where Duval County does not have jurisdiction to regulate boat speed or operations. Rules in the ICW are made by the state, not the county (see September 2004 update for details regarding actions taken by waterways to address the issue).

In 2005, there were a total of 14 reported deaths, of which, 4 were from watercraft, 2 perinatal, 2 cold stress and 6 undetermined. In 2006, there were 13 total deaths, of which, 8 were watercraft, 1 perinatal, 1 cold stress, 1 other human, 1 undetermined and 1 unrecovered. The mortality threshold in the MPP was triggered again and that led to a moratorium on permits issued by the state for marine construction (see executive summary for actions taken to address the issue).

Mortality due to watercraft impacts in 2006 (Table 9) was highest in, Brevard County (22) and Lee (21). Intermediate numbers of watercraft-caused deaths were documented in Duval (8), Broward (6), Sarasota (6) and Martin (5); and lower numbers of deaths were documented in Volusia (3), Citrus (2), Indian River (2), Collier (1), Dade (1), Palm Beach (0) 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 2007. Duval County experienced higher than usual watercraft deaths in 1991(9), 2002 (10) and 2004 (5) and 2006 (8) than in other years. Watercraft-caused mortality in Duval County (5 year running average) has ranged from 2 to 6 deaths per year between 1980-August 31st 2007 (Figure 8). Watercraft deaths were 4 in 2000, 1 in 2001, 10 in 2002, 4 in 2003, 5 in 2004, 4 in 2005, 8 in 2006 and 1 as of August 31st 2007 (Table 9/10, Figure 8). Table 10 shows total manatee mortality/yr. and cause in Duval County from 1976 to August 31st 2007 (FWRI 2007). Figure 9 shows total and watercraft mortality as well as 5 year running average of watercraft deaths for the State of Florida (FWRI 2007).

Map Series B, Duval County Manatee Mortality 2006/2007 **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, 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.**

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.

2006-2007 Updates

Manatee Protection Plan 2006.

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.

http://www.coj.net/City+Council/Jacksonville+Waterways+Commission/JWC+MPP.htm

Manatee Protection Plan 1999 and Annual Updates.

http://www.coj.net/Departments/Parks+and+Recreation/Recreation+Activities/Waterways+and+Boating/Manatee+Protection+Plan.htm

Duval Manatee Protection Outreach

The MARCO web site at JU has been updated to show the latest manatee sightings aerial survey maps so that the public 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).

Duval County manatee protection rule (68C-22.027, FAC): Amendments to this rule were adopted on January 10, 2007. See Maps.

Recommendations

No recommendations regarding speed zones or signage are made at this time.

TABLE 1. Summary of the total number of aerial surveys, adults and calves observed, and Single Highest Day Counts (SHDC) by year (1994-August 2007).

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 [2]	13	541	54	595	9.08	151	4/23/07	46
Total		289	10,547	927	11,474	7.94 [3]	125 [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 [2]	10	77	7	84	8.33	21	4/23/07	8
Total		259	1,067	75	1,142	6.74 [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 2007).

LOCATION	ADULTS*	CALVES*	TOTAL*
Nassau Sound	27	0	27
Sawpit Creek	46	0	46
ICW North of Fort George River	72	1	73
Sisters Creek	27	3	30
Fort George Inlet	6	0	6
Mayport	16	0	16
St. Johns Bluff	42	0	42
Blount Island	91	9	100
Mill Cove	73	3	76
Atlantic Blvd. Bridge to SJR confluence	55	1	56
Beach Blvd. Bridge to Atlantic Blvd.	92	6	98
JTB Bridge to Beach Blvd. Bridge	100	6	106
Palm Valley Bridge to JTB Bridge	211	17	228
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 2007.**

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 2007).

LOCATION	ADULTS*	CALVES*	TOTAL*
Quarantine Island	75	3	78
Dames Point	19	1	20
Trout River	245	19	264
Arlington River	40	3	43
Pottsburg Creek	40	2	42
Miller Creek	25	2	27
Downtown	110	9	119
San Marco	135	3	138
Ortega River	166	16	182
Sadler Point	150	13	163
Pirates Cove	54	3	57
NAS/JAX	214	12	226
Mulberry Cove	145	12	157
Rudder Club	634	63	697
Club Continental	1083	103	1186
Doctors Lake	1811	168	1979
SJR south of Dr.Lake	1241	114	1355
Julington Creek	196	23	219
Durbin Creek	13	0	13
Mandarin Point	1203	105	1308
Plummers Point	335	31	366
Beauclerc Bluff	312	21	333
Goodbys Creek	155	12	167
Christopher Point	864	80	944
Point La Vista	189	5	194
Lions Club Boat Ramp	17	0	17
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 2007.

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

Source: Wayne Hartley, Park Service Specialist, Blue Spring State Park 2007.

TABLE 5a. Number percent of manatees engaged in various activities between fall 1994-winter 2007 (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
Mean	181	22	46	21	10
SD	109	8	21	14	10
CI	62	5	12	8	6
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
Mean	3	28	30	4	0
SD	4	37	42	14	0
CI	2	20	23	8	0

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

SD = Standard deviation

CI = 95% Confidence interval for the mean

Source Jacksonville University 2007.

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
Mean	227	30	36	20	14
SD	94	10	15	15	6
CI	49	5	8	8	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
Mean	427	24	41	22	13
SD	175	10	16	14	7
CI	92	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 2007.

TABLE 6a. Number percent of manatees engaged in various activities between spring 1994-summer 2007 (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
Mean	5	57	33	2	0
SD	3	36	32	4	0
CI	2	19	17	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
Mean	9	28	26	0	0
SD	16	43	42	1	0
CI	9	24	23	1	0

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

SD = Standard deviation

CI = 95% Confidence interval for the mean

Source Jacksonville University 2007.

TABLE 6b. Number percent of manatees engaged in various activities between spring 1994-summer 2007 (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
Mean	44	51	31	10	9
SD	17	14	19	10	11
CI	9	8	10	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
Mean	25	67	26	2	5
SD	15	20	18	5	9
CI	8	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 2007.

TABLE 7. Causes of manatee mortality for Florida's Key Counties, August 2007.

County	Watercraft	Flood Gate	Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
Brevard	6	0	0	16	2	7	3	0	34
Broward	1	0	1	0	0	0	2	0	4
Citrus	5	0	0	3	0	0	2	0	10
Collier	5	0	1	2	0	2	3	0	13
Dade	2	0	2	1	0	3	1	0	9
Duval	1	0	0	0	3	0	2	0	6
Indian River	0	0	0	3	0	0	3	0	6
Lee	12	0	0	4	4	39	13	4	76
Martin	2	0	0	0	0	1	2	0	5
Palm Beach	0	0	0	0	2	1	1	0	4
Sarasota	0	0	0	2	2	0	0	0	4
St.Lucie	0	0	0	1	0	0	0	0	1
Volusia	6	0	0	8	0	2	3	1	20
Total	40	0	4	40	13	55	35	5	192

Source: FWCC/FWRI 2007

TABLE 8. Florida manatee mortality, 1991- August 2007.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	# Total	% of Total
Brevard	38	31	30	42	40	57	62	47	46	49	52	50	42	65	57	87	34	829	23.74
Broward	3	9	4	4	5	6	3	7	15	4	9	10	8	6	9	15	4	121	3.47
Citrus	5	9	8	5	6	6	5	4	8	6	10	9	10	7	18	10	10	136	3.89
Collier	14	19	18	13	10	70	21	14	19	35	31	13	37	23	34	14	13	398	11.40
Dade	7	10	5	11	14	7	14	9	12	8	11	9	9	7	5	7	9	154	4.41
Duval	19	8	5	6	7	10	10	13	9	11	6	14	19	15	14	13	6	185	5.30
Indian R.	4	1	-	2	5	10	7	5	6	10	5	7	6	6	16	6	6	102	2.92
Lee	18	19	17	33	31	145	43	31	33	44	51	58	81	51	75	82	76	888	25.43
Martin	9	8	3	7	6	6	6	8	9	6	7	9	6	5	9	17	5	126	3.61
Palm Bch.	6	3	5	3	6	7	6	5	7	9	8	14	12	9	8	7	4	119	3.41
Sarasota	5	1	5	6	12	8	3	4	13	11	5	16	22	7	20	20	4	162	4.64
St. Lucie	1	4	4	2	2	4	2	1	2	2	4	4	0	1	8	5	1	47	1.35
Volusia	10	5	5	6	10	9	9	15	12	13	27	13	14	13	22	22	20	225	6.44
Total	139	127	109	140	154	345	191	163	191	208	226	226	266	215	295	305	192	3,492	100

*** = August**

Source: FWCC/FWRI 2007.

TABLE 9. Watercraft caused mortality in Florida's Key Counties, 1991- August 2007.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	# Total	% of Total
Brevard	13	7	9	9	6	13	12	9	12	13	7	17	8	11	6	22	6	180	21.61
Broward	2	2	2	3	0	1	0	2	5	2	4	3	5	1	2	6	1	41	4.92
Citrus	0	3	1	2	0	2	1	2	4	1	1	3	3	1	6	2	5	37	4.44
Collier	5	4	5	4	4	5	4	7	10	5	8	6	7	5	4	1	5	89	10.68
Dade	0	4	0	1	2	0	5	2	1	2	5	1	2	2	1	1	2	31	3.72
Duval	9	2	2	2	3	3	2	3	2	4	1	10	4	5	4	8	1	65	7.80
Indian R.	1	0		0	1	4	1	3	1	4	1	2	1	1	5	2	0	27	3.24
Lee	7	2	5	10	8	14	9	9	10	13	23	13	9	13	12	21	12	190	22.81
Martin	2	1	0	1	1	2	3	1	2	1	1	2	1	1	0	5	2	26	3.12
Palm Bch.	1	0	3	2	2	3	1	2	2	3	3	6	5	3	6	0	0	42	5.04
Sarasota	1	0	2	2	0	1	2	0	4	5	2	4	1	2	3	6	0	35	4.20
St. Lucie	1	1	1	0	0	1	0	0	0	1	1	1	0	0	1	0	0	8	0.96
Volusia	3	1	0	1	1	2	1	8	5	4	11	3	2	3	8	3	6	62	7.44
Total	45	27	30	37	28	51	41	48	58	58	68	71	48	48	58	77	40	833	100.00

*** = August**

Source: FWCC/FWRI 2007.

TABLE 10. Causes of manatee mortality in Duval County, Florida. 1976 - August 2007.

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*	1	0	0	3	0	2	0	6
Total	114	8	39	35	26	105	10	337

*** = August 2007.**

Source FWCC/FWRI 2007.

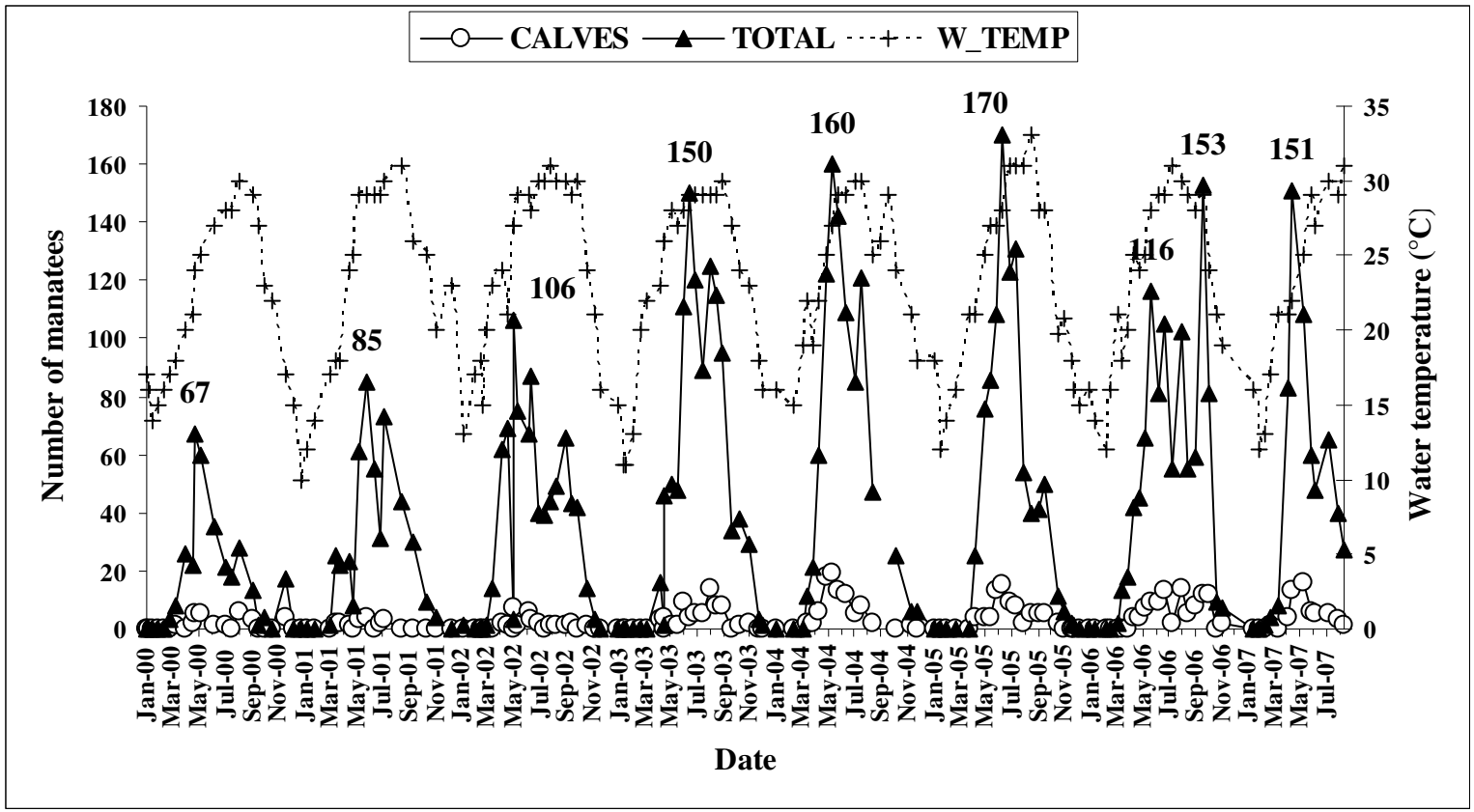


FIGURE 1. Aerial sightings of manatees and water temperature in the St. Johns River 2000–August 2007.

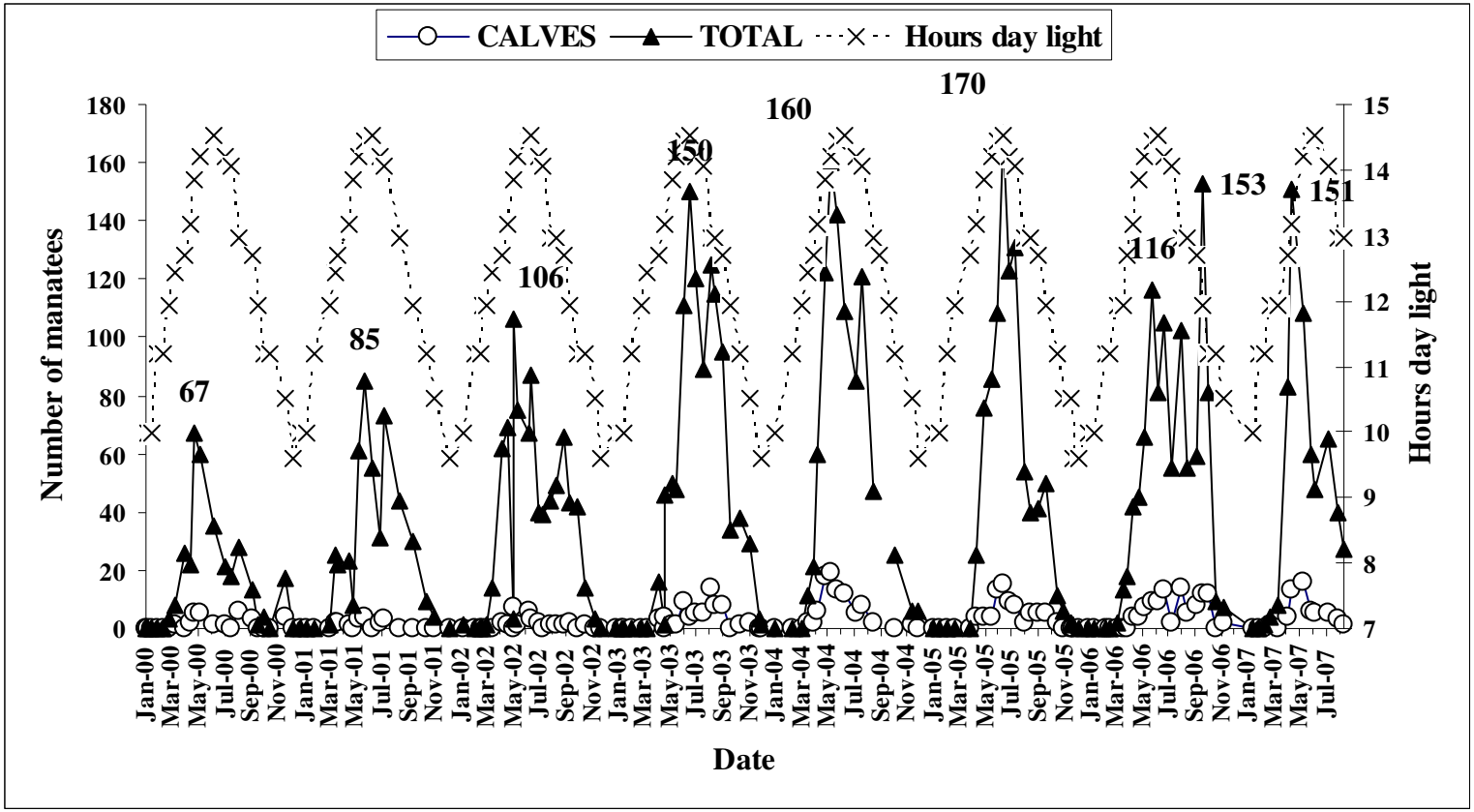


FIGURE 1a. Aerial sightings of manatees and hours daylight in St. Johns River 2000–August 2007.

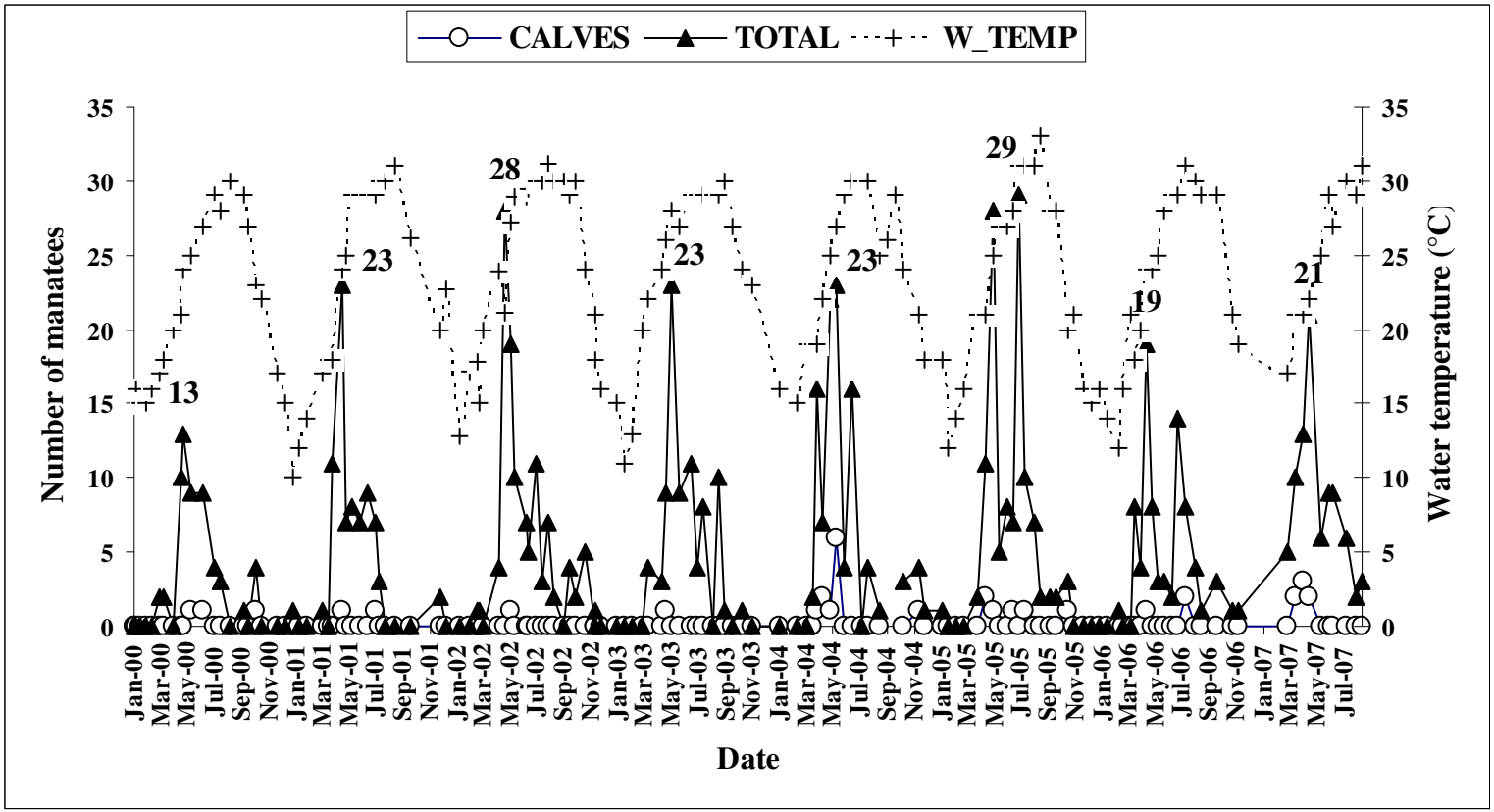


FIGURE 2. Aerial sightings of manatees and water temperature in the Intracoastal Waterway 2000–August 2007.

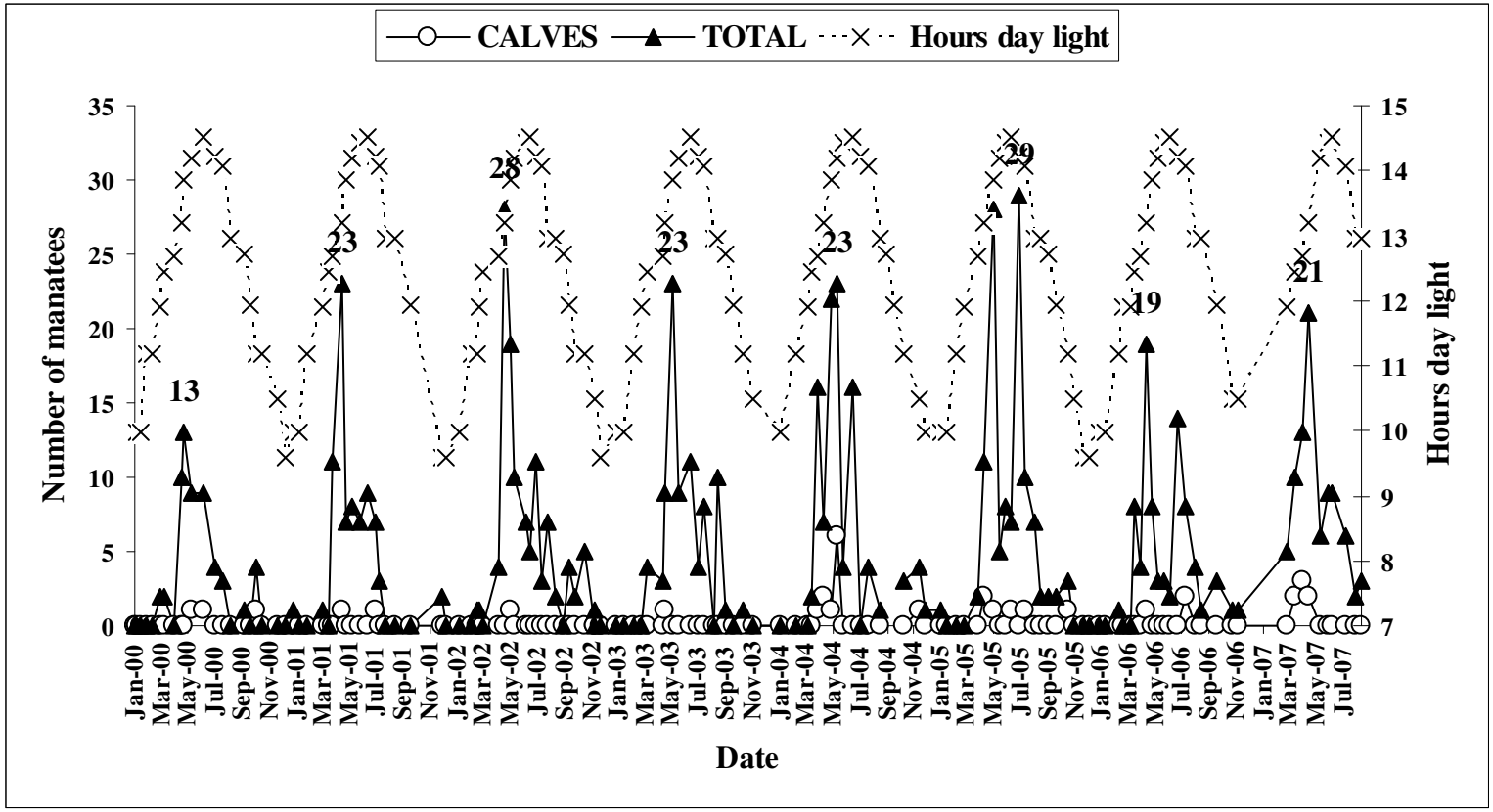
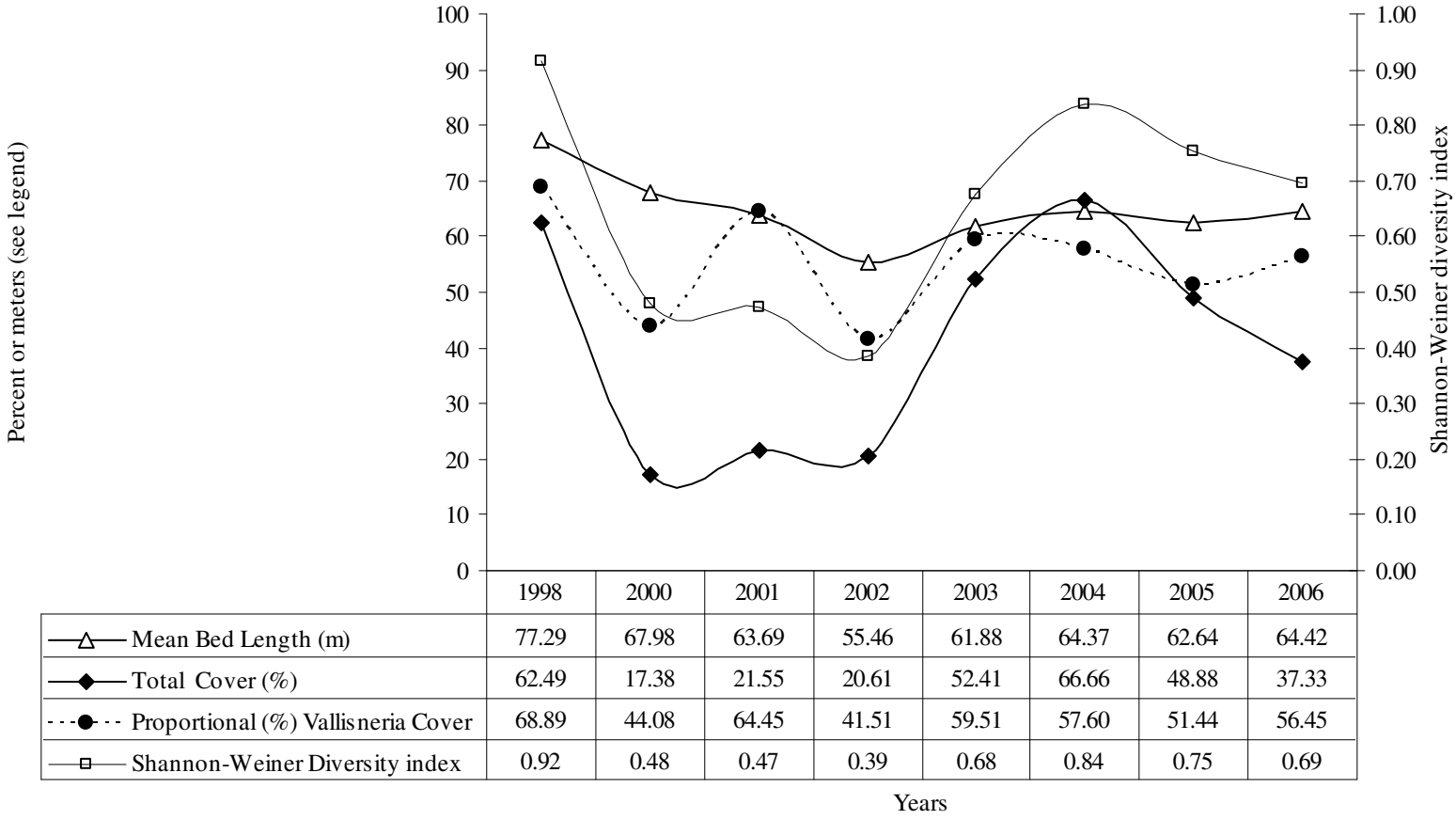


FIGURE 2a. Aerial sightings of manatees and hours daylight in The Intracoastal Waterway 2000-August 2007.



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

Source: Dean Dobberfuhl. SJRWMD. Lower St. Johns River Basin Submerged Aquatic Vegetation Monitoring 2007.

FIGURE 3. Submerged aquatic vegetation data for Duval County from SJRWMD 2007.

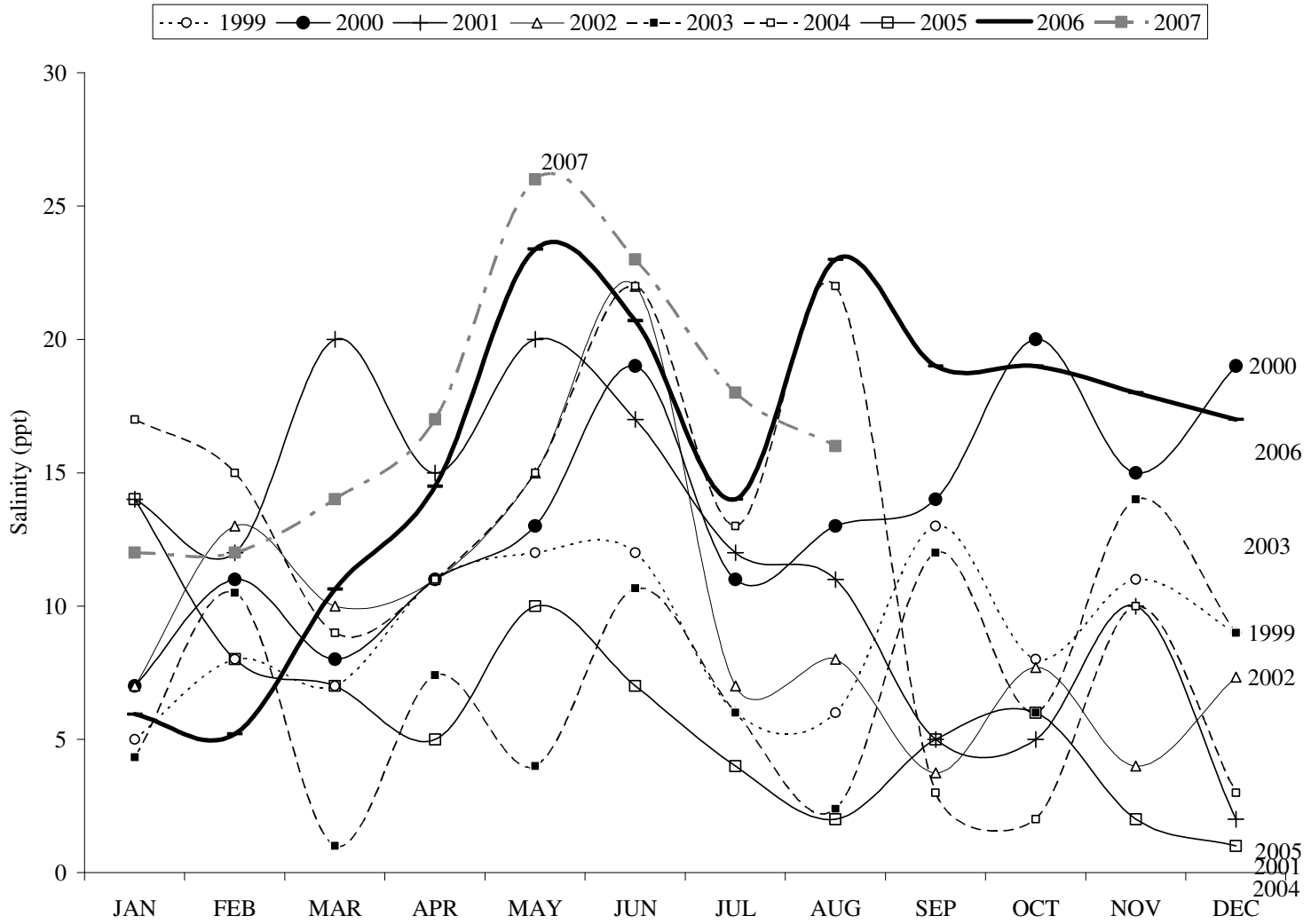


FIGURE 4. Mean monthly salinity recorded at the Jacksonville University dock, 1999-August 2007.

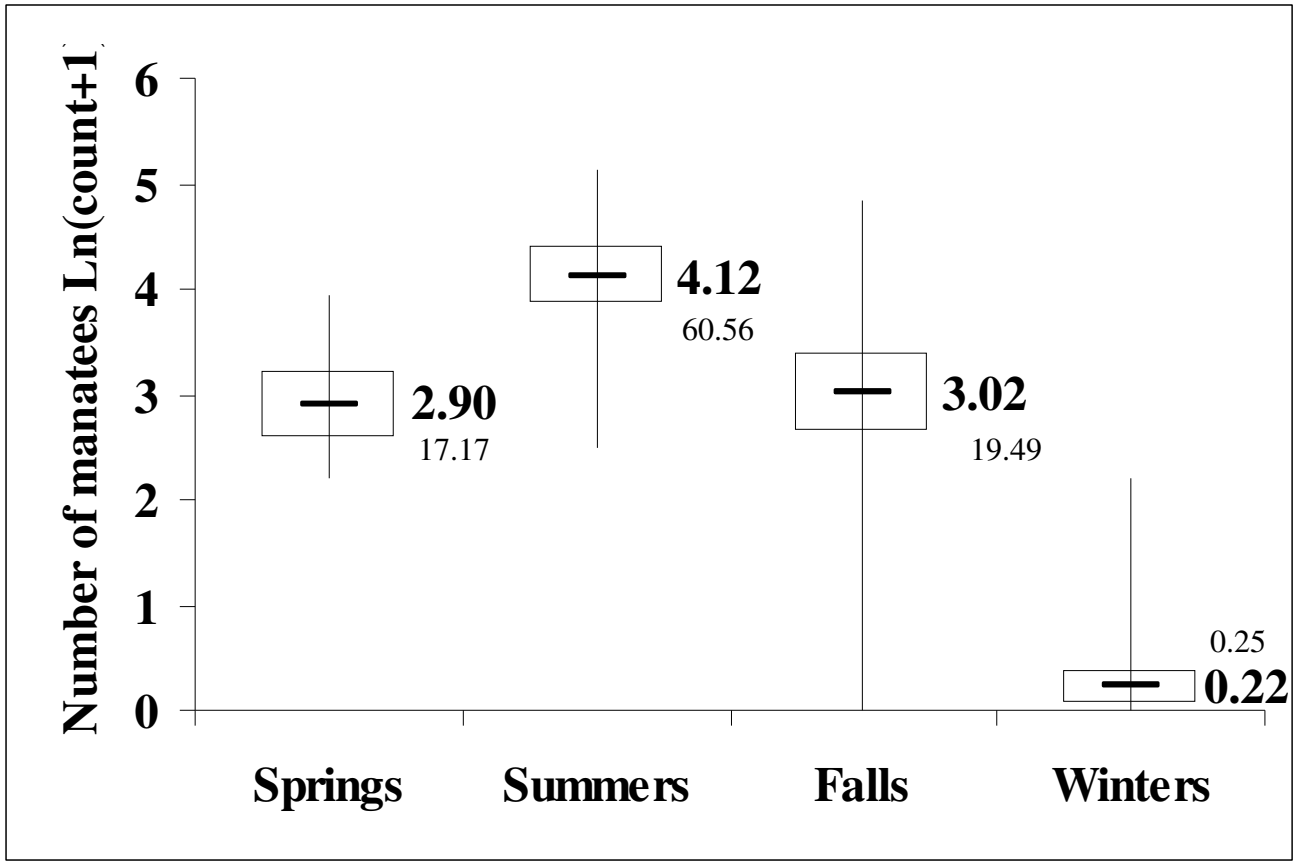


FIGURE 5. Mean counts of manatees in the LSJR by season (horizontal lines) 1994-2007. Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).

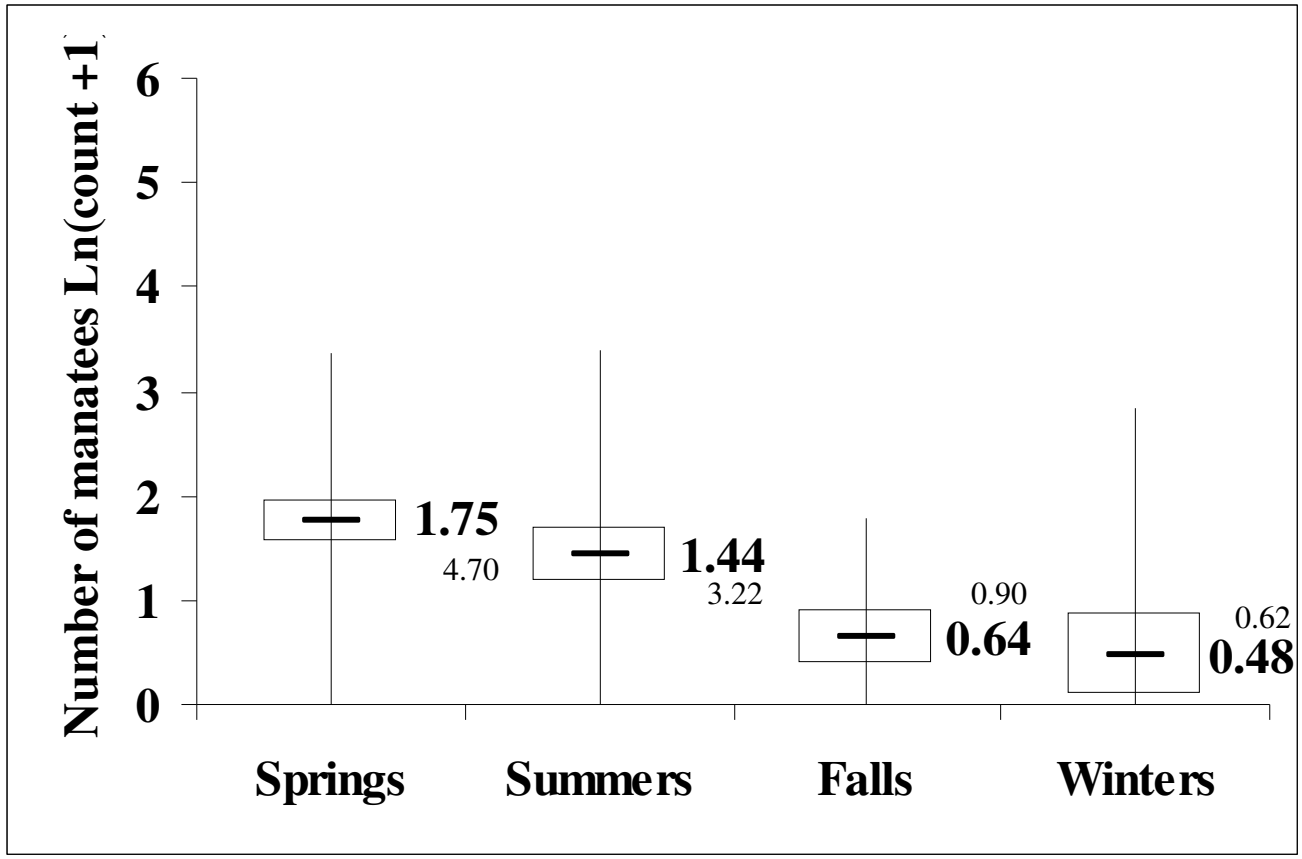
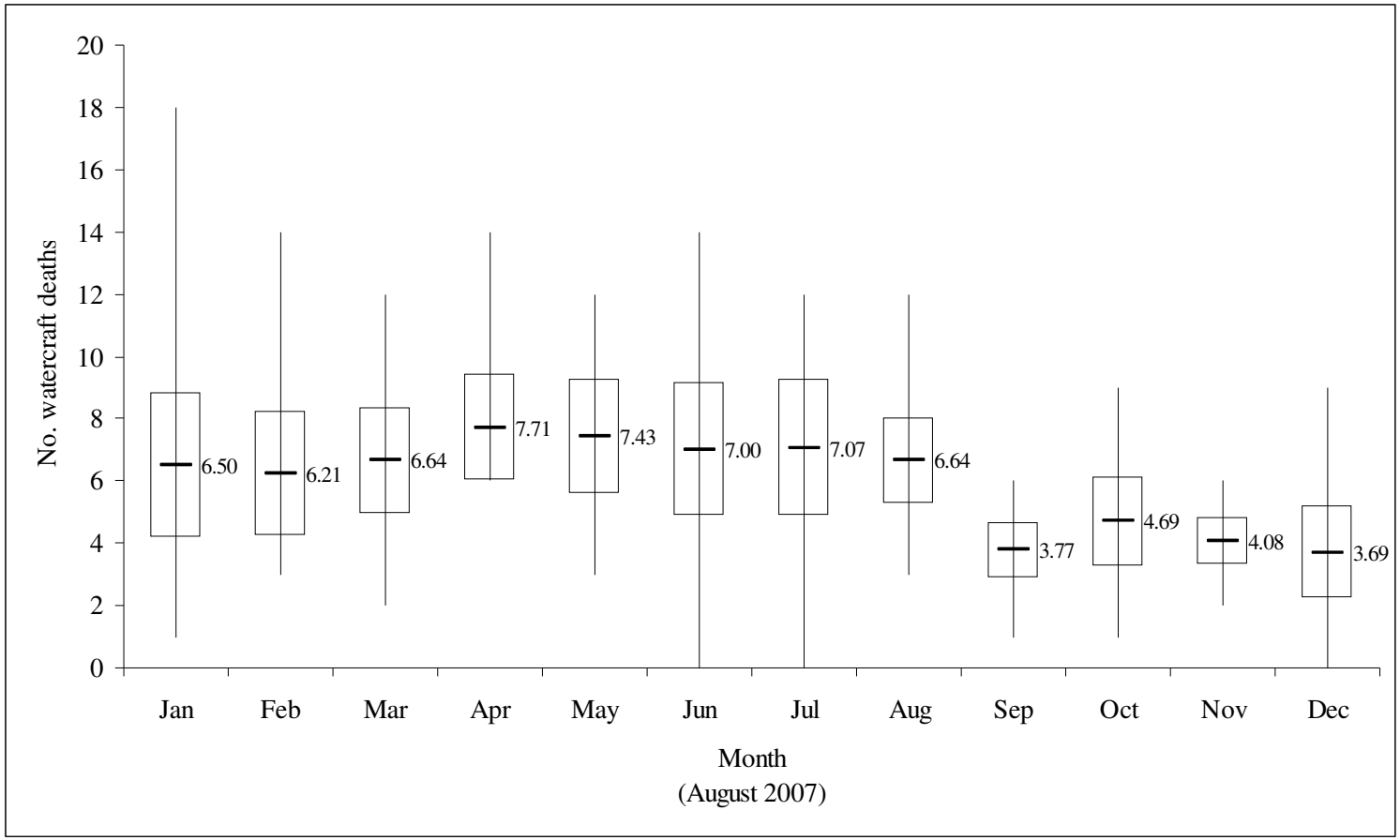
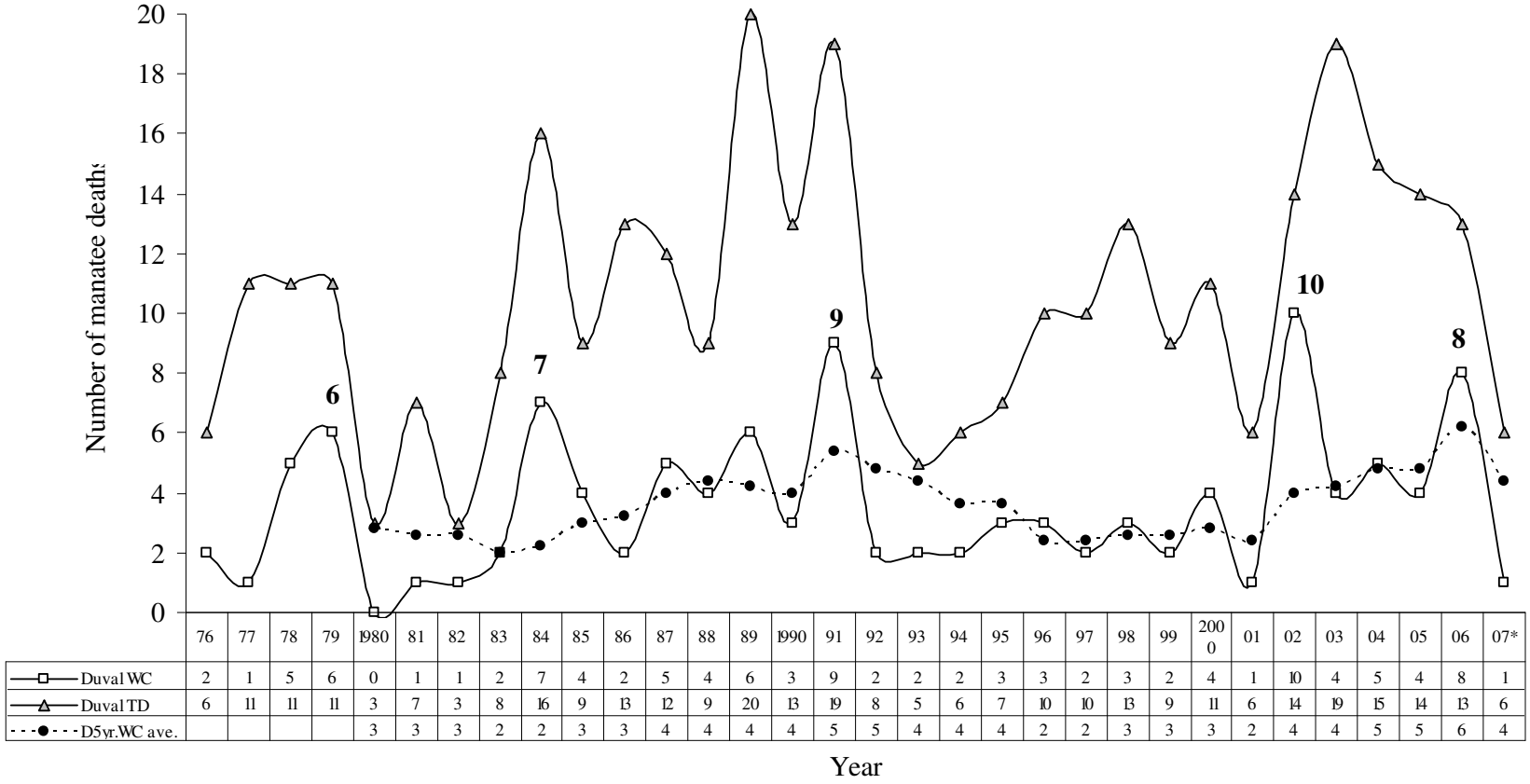


FIGURE 6. Mean counts of manatees by season in the ICW 1994 – 2007 (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis indicates the natural log of the number of manatees counted + 1 (Unbolded numbers are converted to actual numbers).



Source data: FWRI 2007.

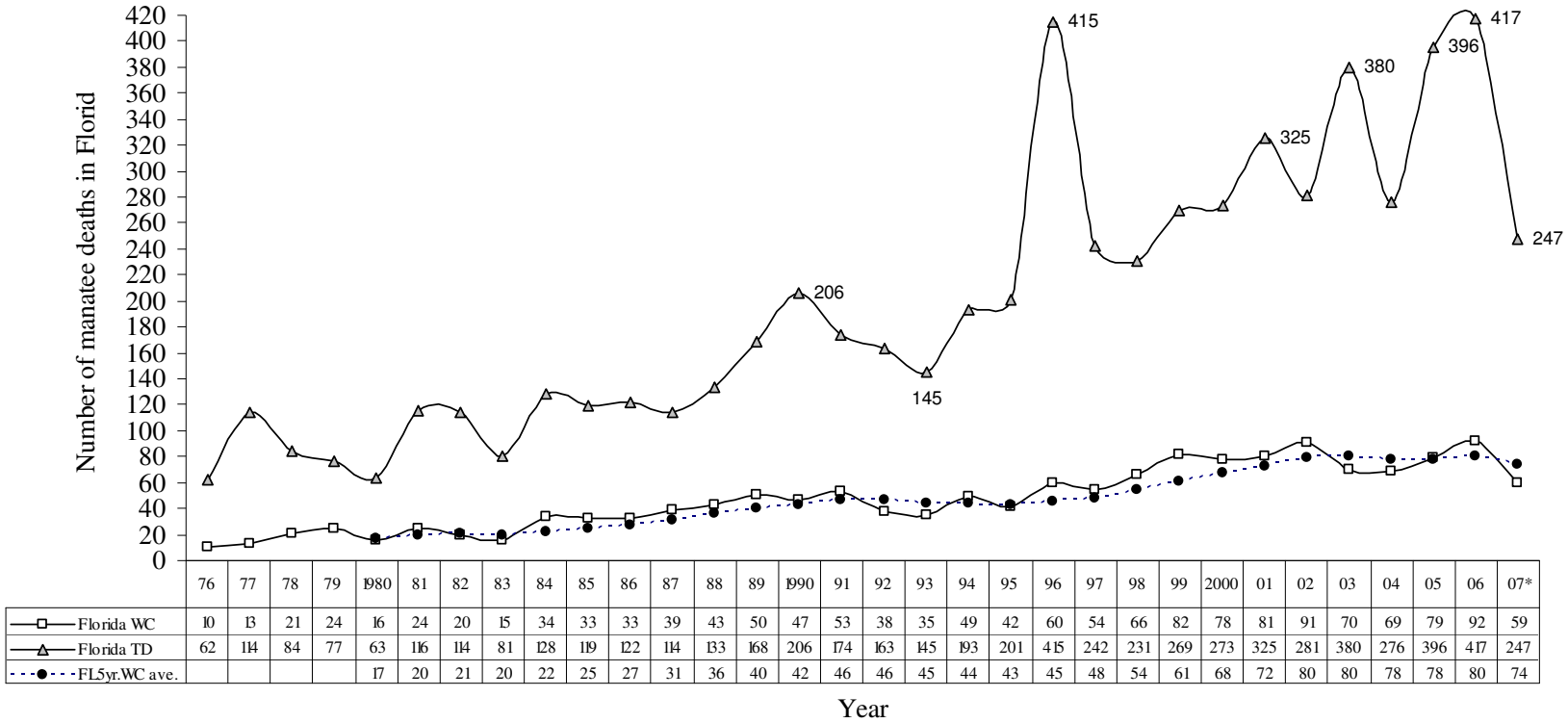
FIGURE 7. Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2007. Mean monthly counts of manatees (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals for the mean.



	76	77	78	79	1980	81	82	83	84	85	86	87	88	89	1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07*
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	1
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	6
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	4

07* = August 2007
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 2007).

FIGURE 8. Watercraft and total manatee mortality in Duval County, Florida 1976–August 2007.



	76	77	78	79	1980	81	82	83	84	85	86	87	88	89	1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07*
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	59
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	247
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	74

07* = August 2007.
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 2007.

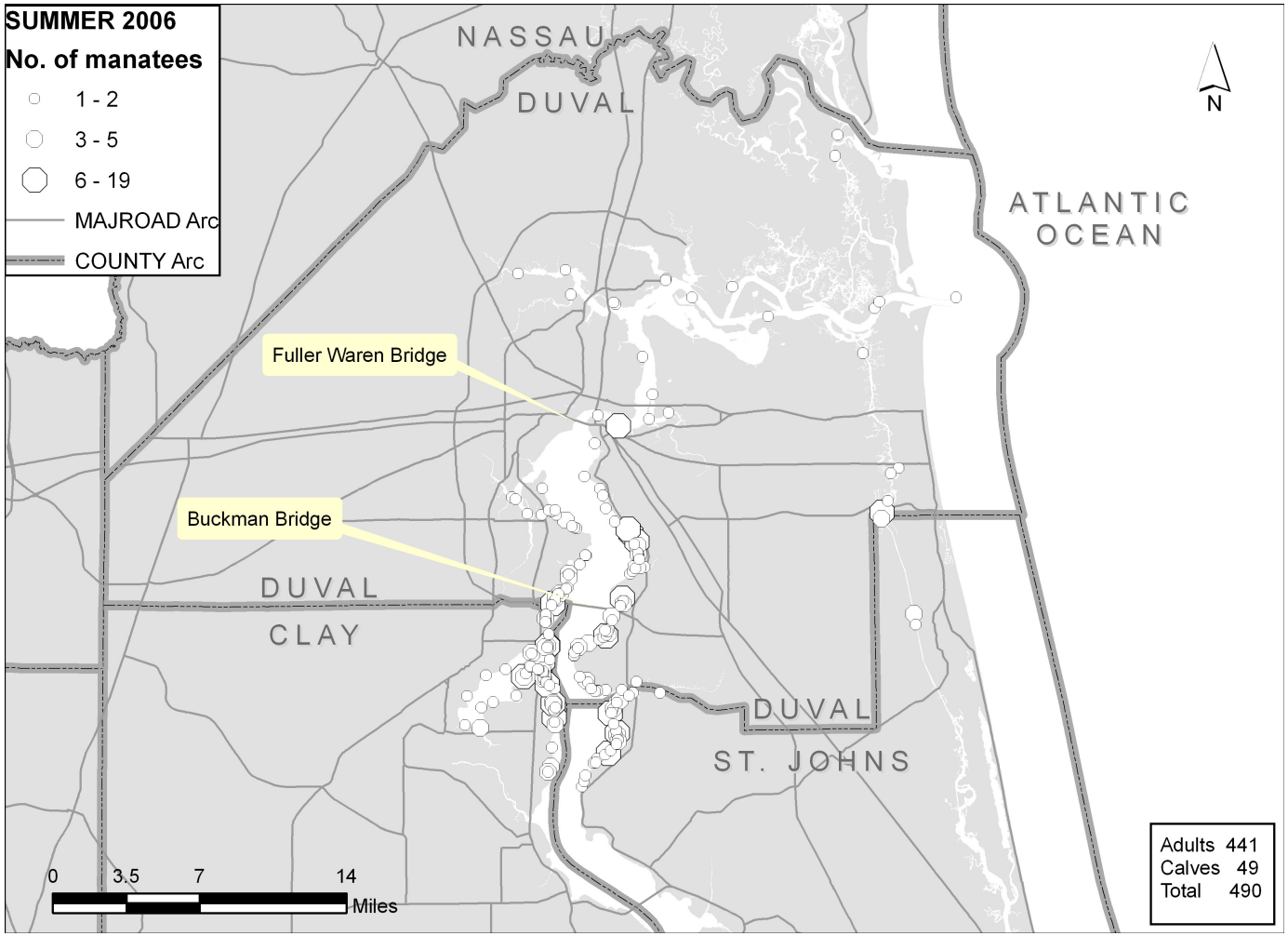
Aerial sightings of manatees

1. The following maps show manatee distribution from **Summer 2006–Summer 2007.**

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

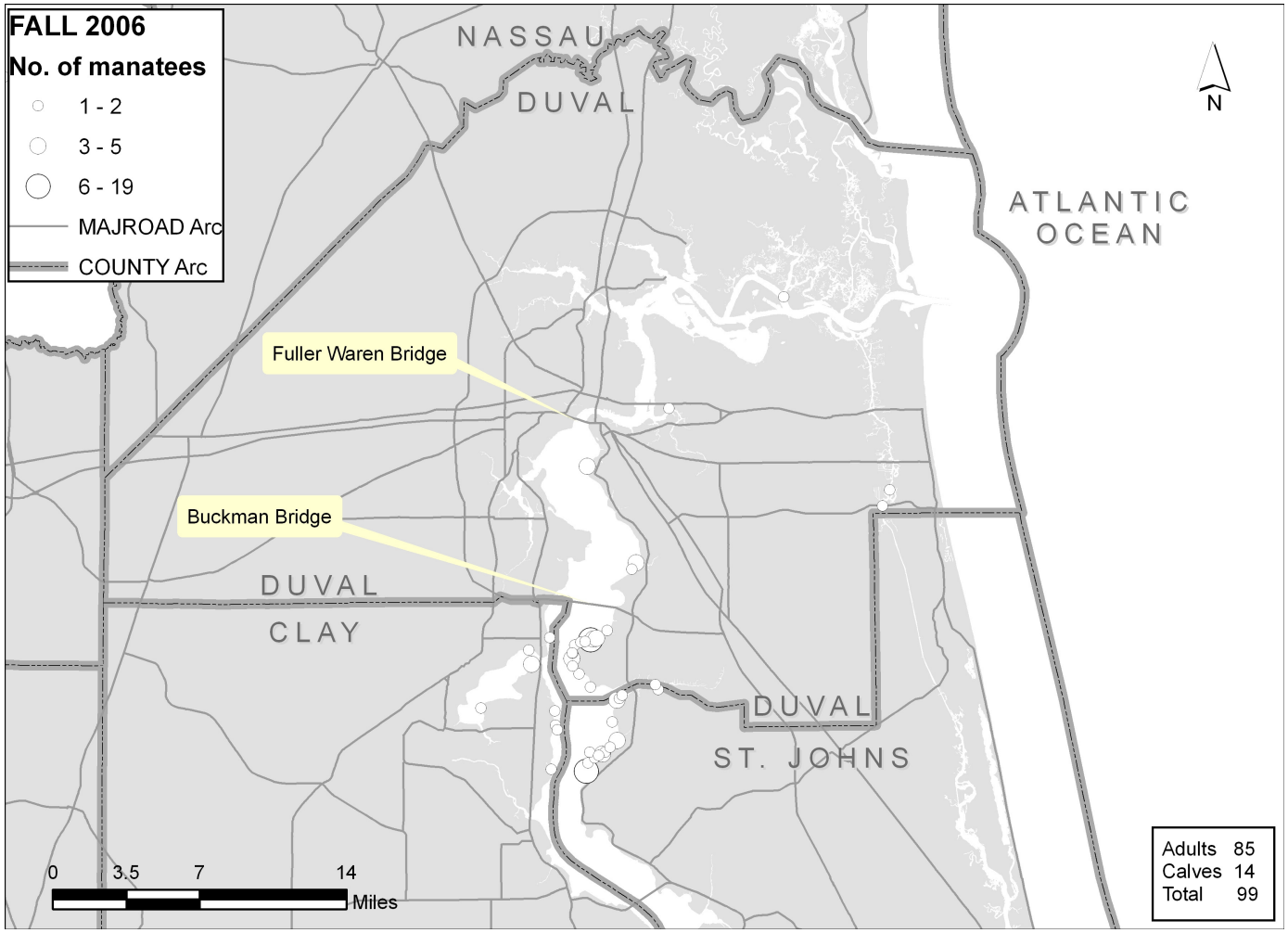
SERIES A - MANATEE AERIAL SIGHTINGS

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2006).



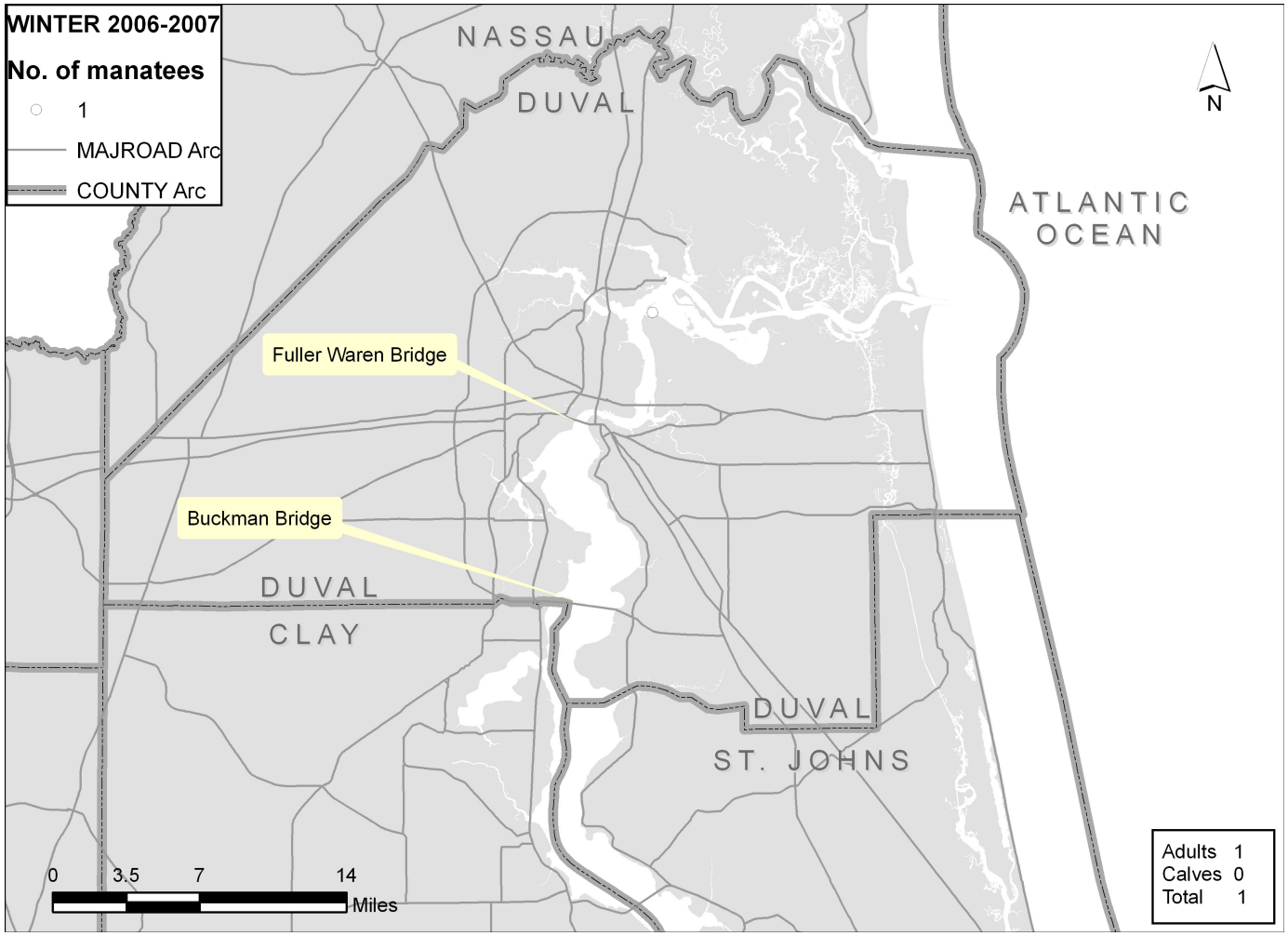
Source: Jacksonville University 2007.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Fall, 2006).



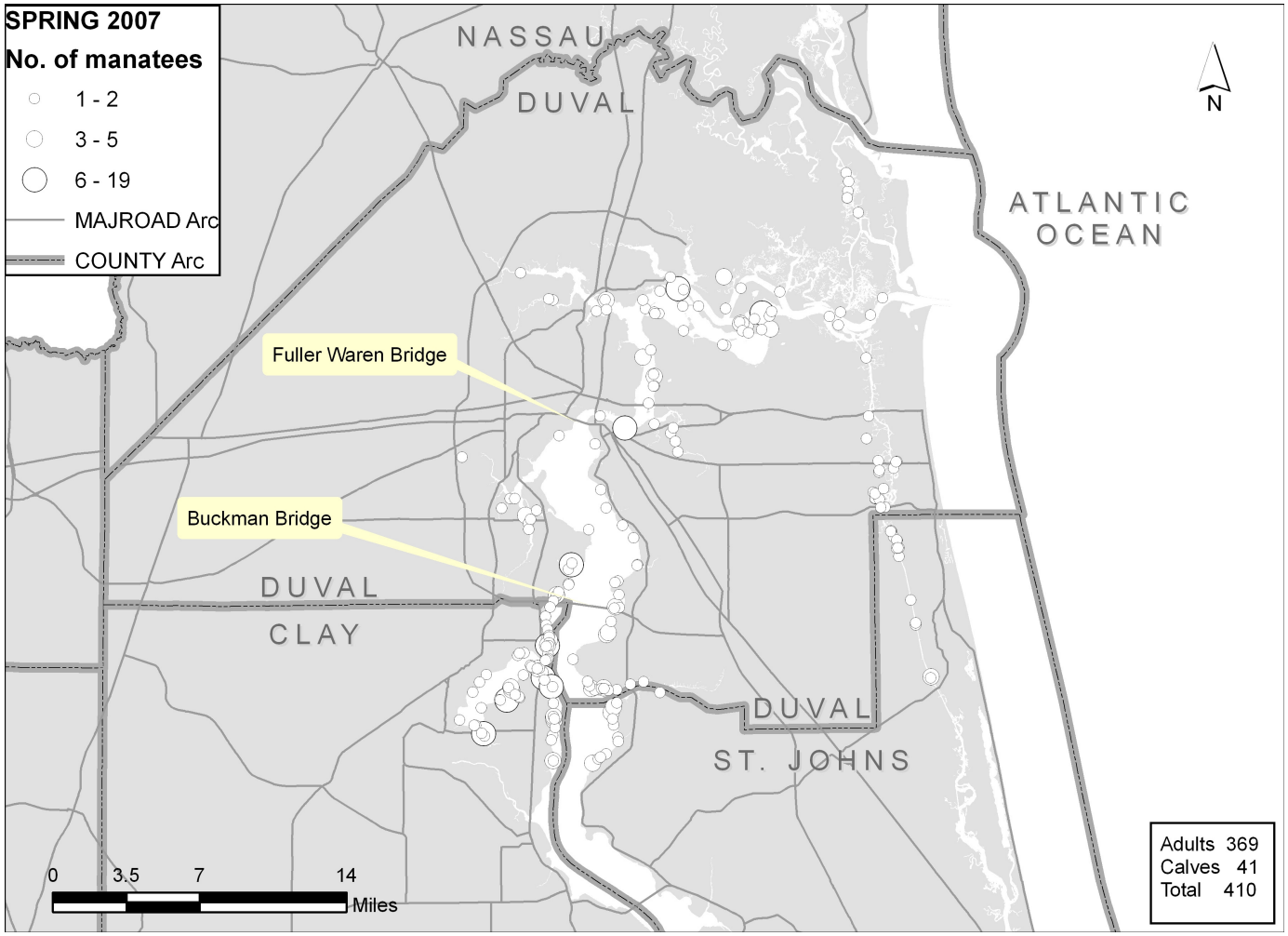
Source: Jacksonville University 2007.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Winter, 2006-2007).



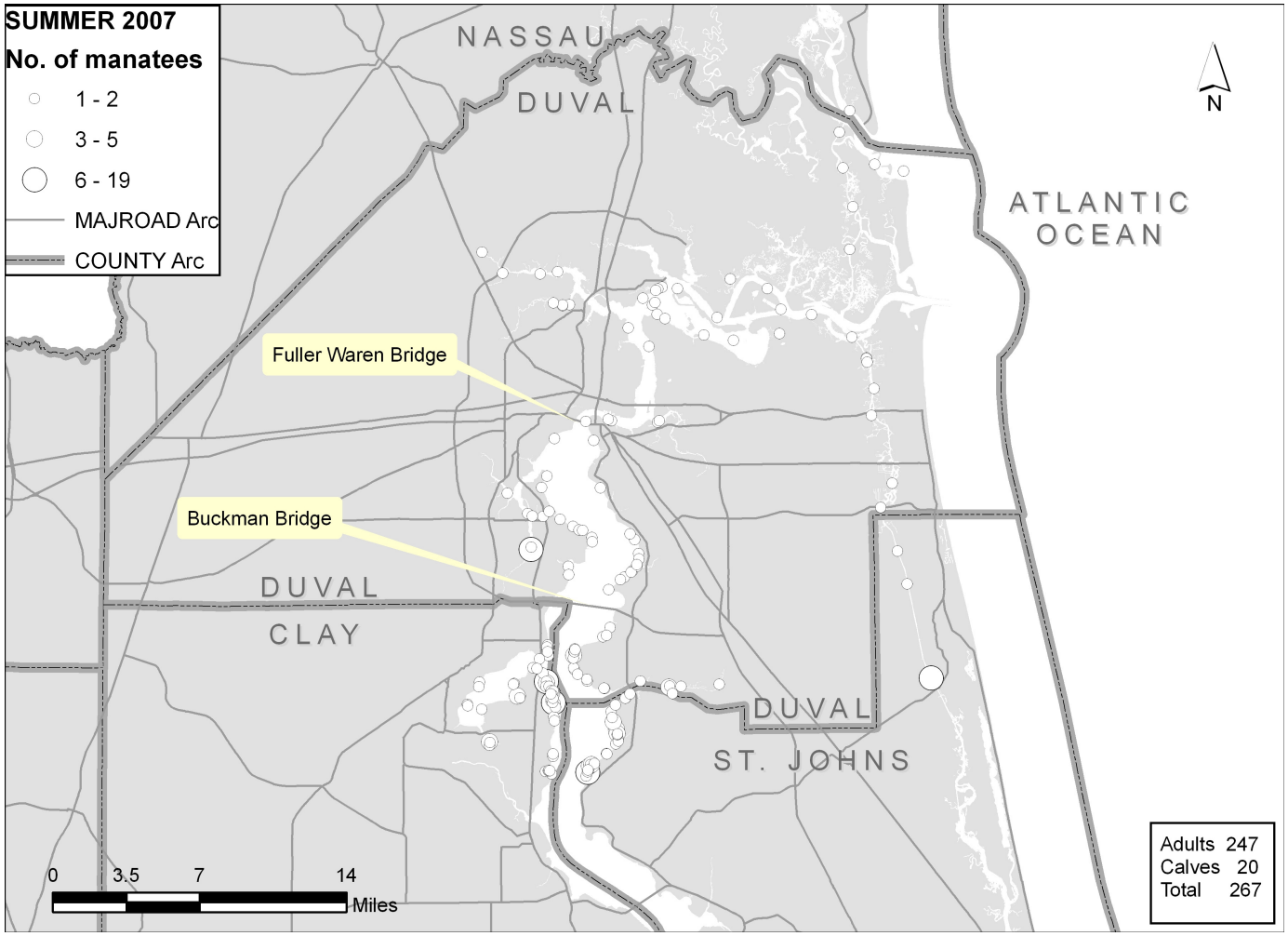
Source: Jacksonville University 2007.

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



Source: Jacksonville University 2007.

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



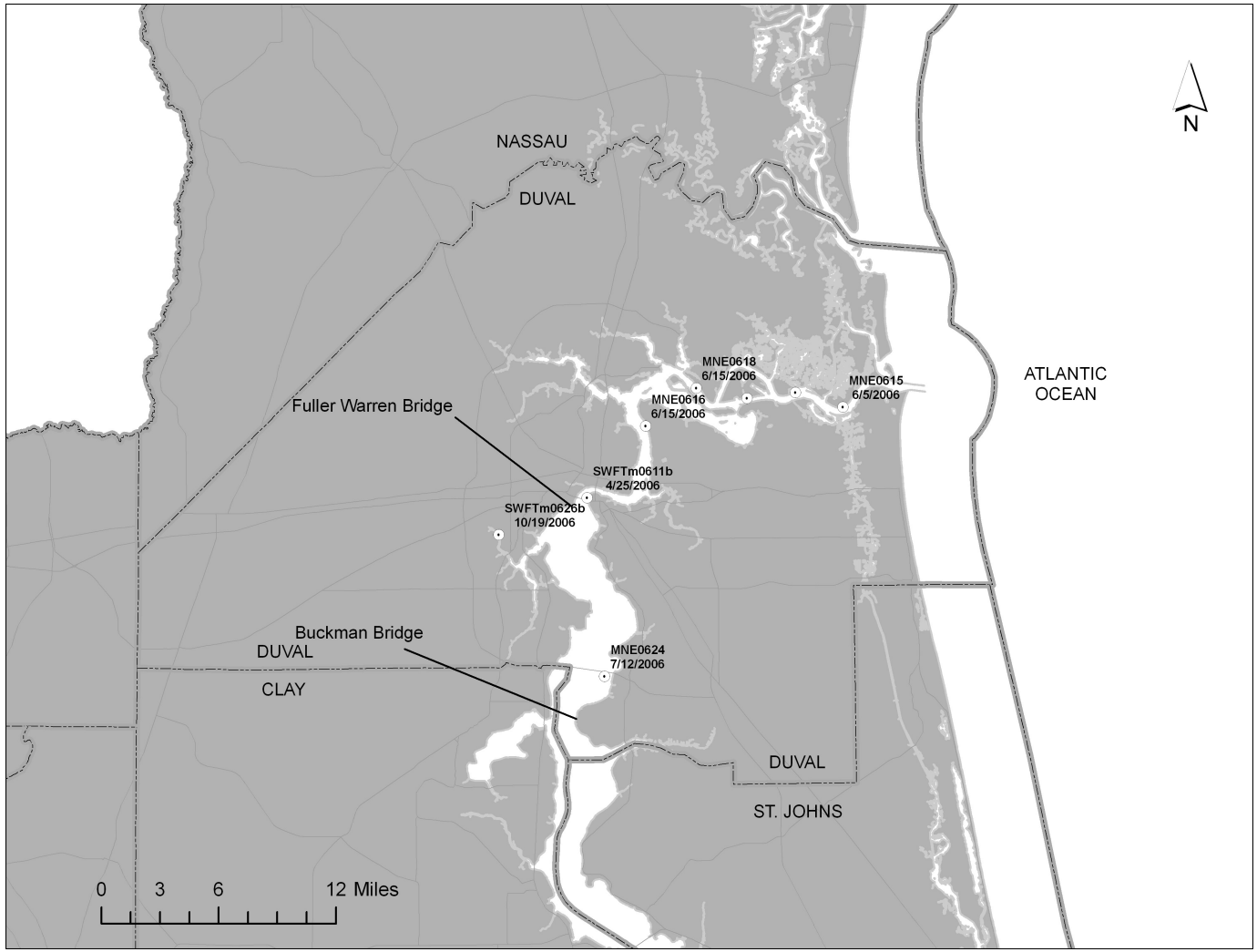
Source: Jacksonville University 2007.

Manatee mortality

1. Watercraft manatee mortality 2006, Duval Co., FL. (Map).
2. Manatee deaths from all causes, Duval Co., FL. 2006. (Map).
3. Manatee deaths from all causes, Duval Co., FL. 2006. (Table).
4. Watercraft manatee mortality August 2007, Duval Co., FL. (Map).
5. Manatee deaths from all causes August 2007, Duval Co., FL. 2007 (Map).
6. Manatee deaths from all causes August 2007, Duval Co., FL. 2007 (Table).

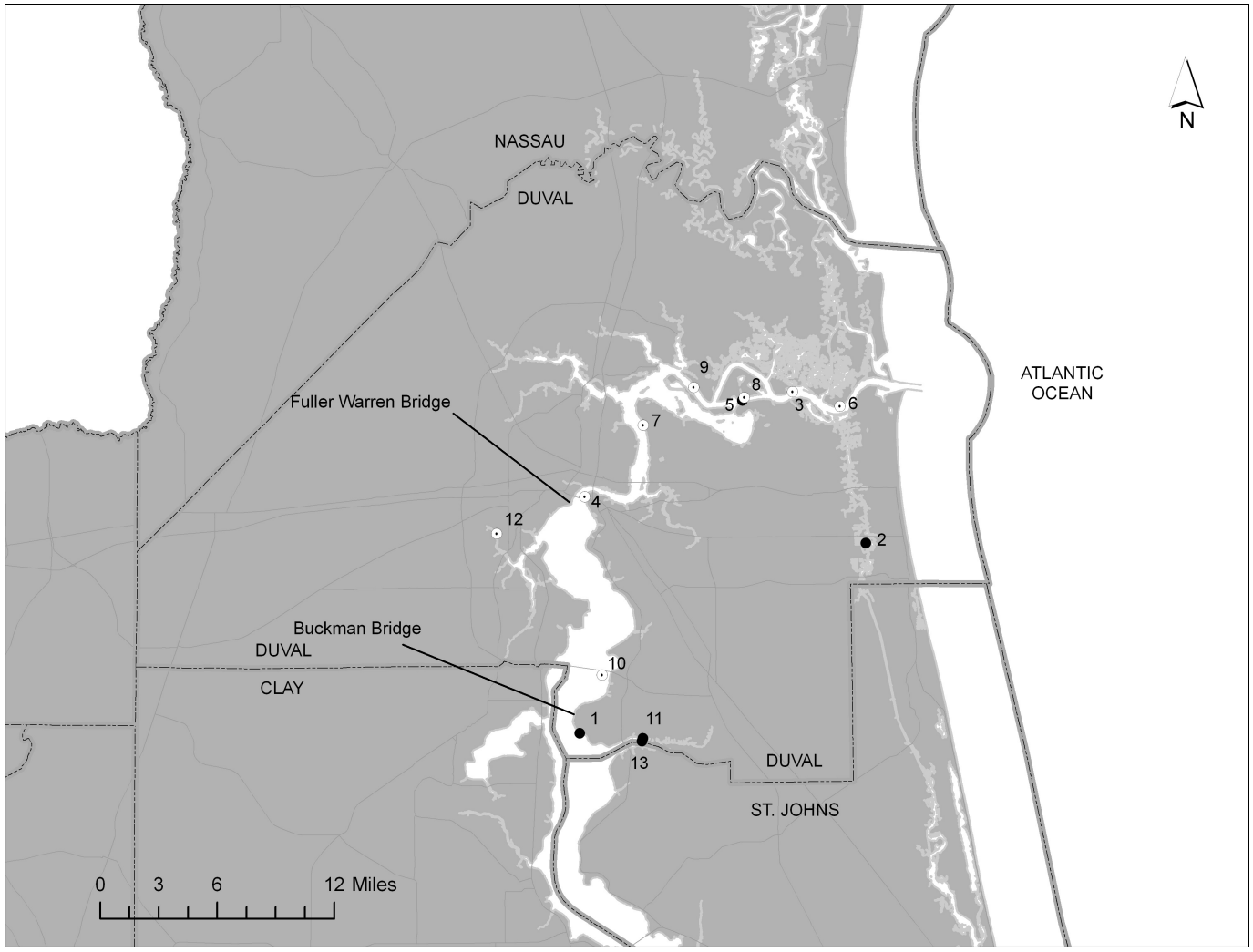
SERIES B – MANATEE MORTALITY

SERIES B – Watercraft manatee mortality, Duval Co., FL. 2006.



Source: FWRI 2007.

SERIES B – Manatee deaths from all causes, Duval Co., FL. 2006.



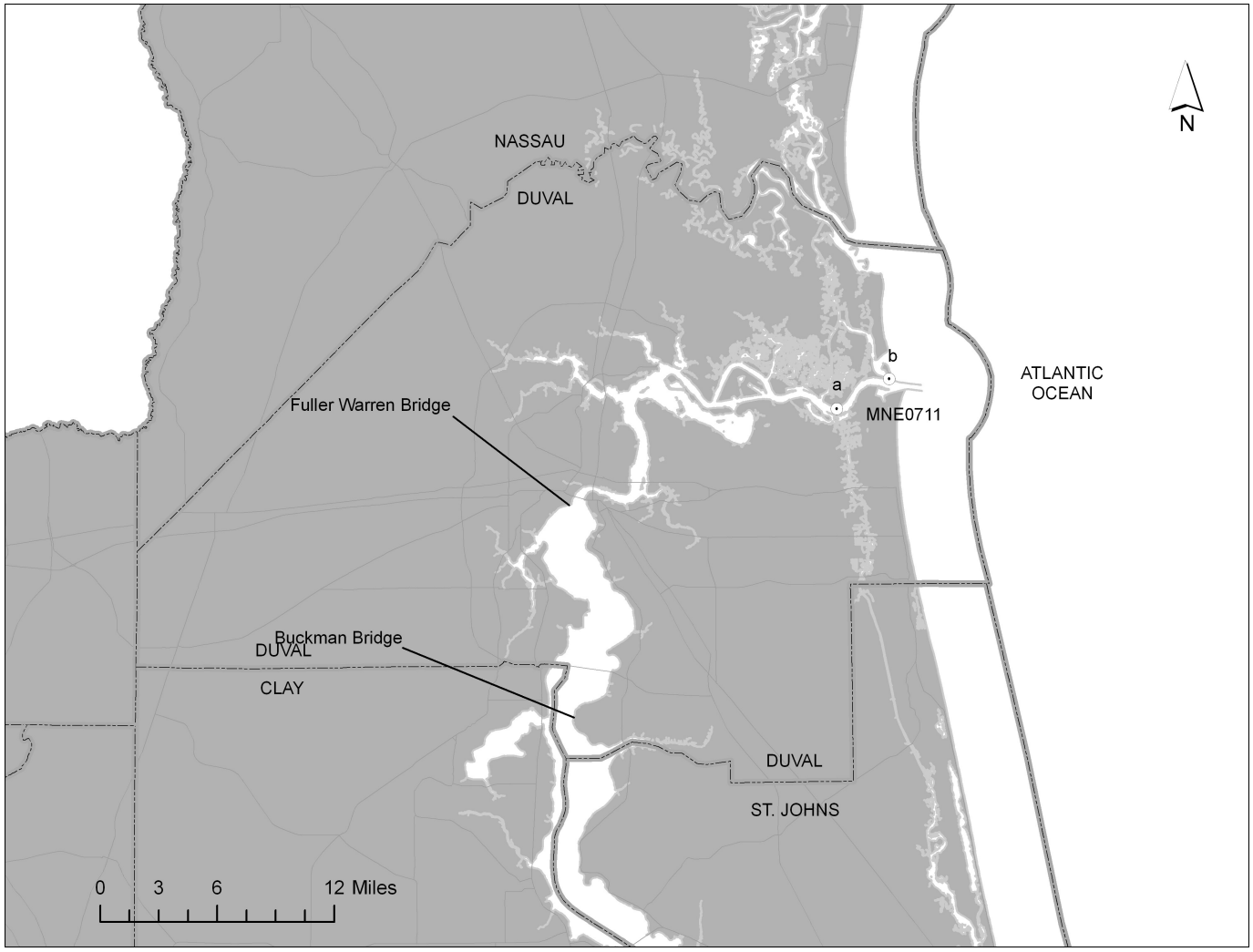
Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2007.

Table 11. Manatee deaths from all causes in 2006, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total length (cm)	Mortality category
1	2/14/2006	MNE0605	M	280	8-Undetermined
2	2/21/2006	MNE0606	M	238	5-Natural-Cold Stress
3	4/17/2006	MNE0610	M	283	1-Watercraft
4	4/25/2006	SWFTm0611b	M	335	1-Watercraft
5	4/28/2006	MNE0612	U	290	7-Verified Not Recovered
6	6/5/2006	MNE0615	M	311	1-Watercraft
7	6/15/2006	MNE0616	M	312	1-Watercraft
8	6/15/2006	MNE0617	F	310	1-Watercraft
9	6/15/2006	MNE0618	M	310	1-Watercraft
10	7/12/2006	MNE0624	F	311	1-Watercraft
11	7/15/2006	MNE0626	M	113	4-Perinatal
12	10/19/2006	SWFTm0626b	M	267	1-Watercraft
13	12/4/2006	MNE0636	F	191	6-Natural-Other

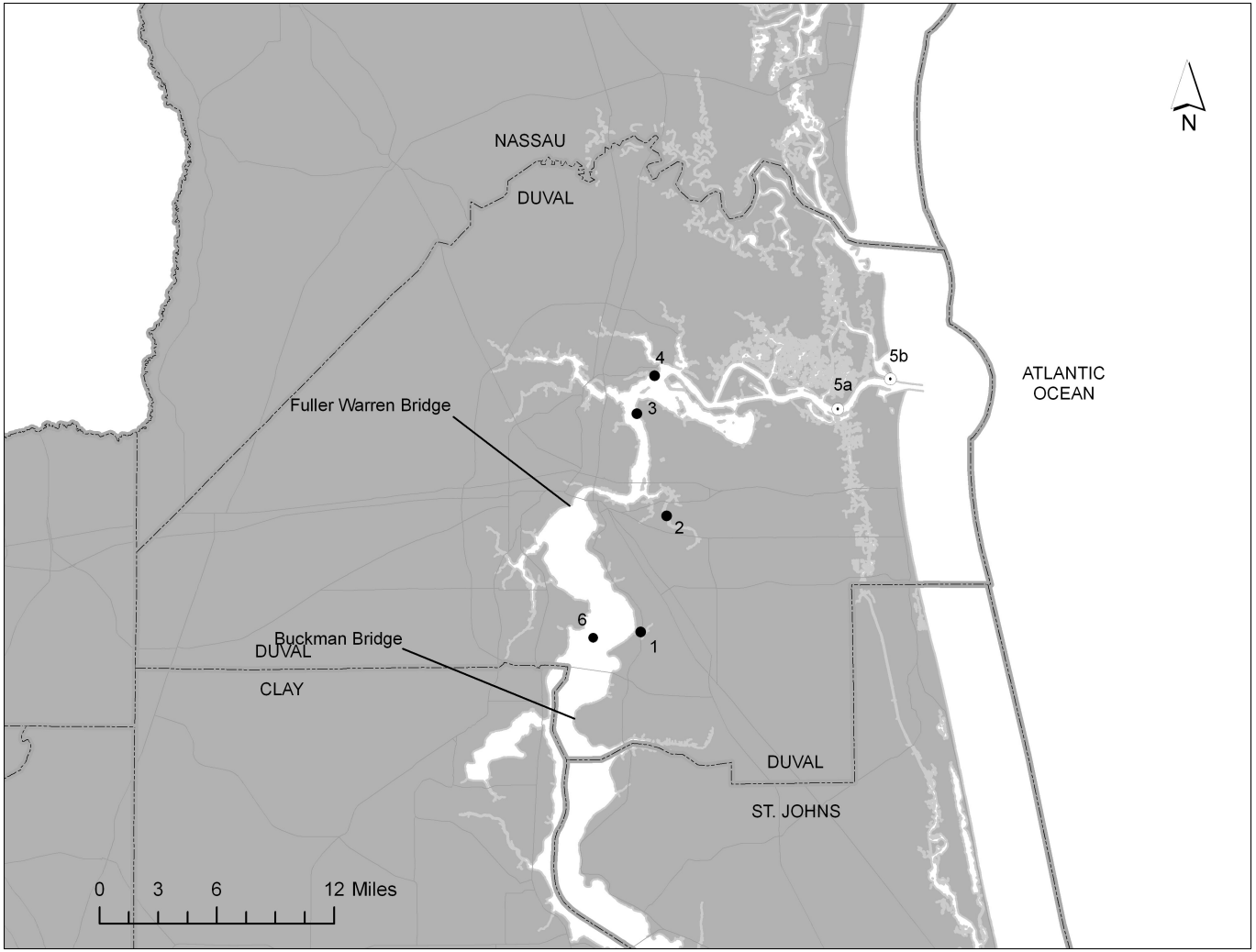
Source: FWC, FWRI 2007.

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



Source: FWRI 2007.

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



Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2007.

Table 12. Manatee deaths from all causes untill August 2006, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total length (cm)	Mortality category
1	1/14/2007	SWFTm0701b	M	204	5-Natural-Cold Stress
2	2/10/2007	MNE0702	F	219	5-Natural-Cold Stress
3	2/13/2007	MNE0703	F	211	5-Natural-Cold Stress
4	2/15/2007	MNE0704	U	0	9-Undetermined
5a, b	4/13/2007	MNE0711	M	330	1-Watercraft (severed in half)
6	5/12/2007	MNE0714	F	336	8-Undetermined

Source: FWC, FWRI 2007.