Annual Update
2004-2005
Duval County Manatee Protection Plan
Population Inventory and Analysis

Prepared by
Jacksonville University
for the
Waterways Commission
of the
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EXECUTIVE SUMMARY

This document is the 2004-**05** annual update to the Duval County Manatee Protection Plan. It represents additional population inventory and analysis of data gathered between October 1, 2004 and September 30, **2005** by Jacksonville University.

In addition, the recommendation was made that the 1999 Duval County Manatee Protection Plan be updated in the form of a 2005 version. Data, figures and tables need to be brought up to date including changes in agencies names. The updating of such material amounts to an administrative update and does not affect the inner workings of the Duval Manatee Protection Plan itself.

***Aerial Sightings*: Single Highest Day Count (SHDC) for LSJR was 170 manatees per survey in June. This number represents the highest count to date (1994-2005). 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 29 manatees per survey in July.** 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 which was higher than the 13 reported in 2000. The count between 2001 to 2005 appear to be more consistent with counts prior to the period of drought for years 1994-1998.

General means for manatees/survey/yr. indicate gradual increase in LSJR numbers of animals since 2000 (16 manatees/survey/yr.) to 2002 (39 manatees/survey/yr.) to 2005 (40 manatees/survey/yr.). Recent numbers are similar to those prior to 1999. General means in the ICW have been consistent for the last five years 2000-2005 (5 manatees/survey/yr.)

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. 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, percent calves was higher than the general mean in both the LSJR and ICW but in 2005 the percentages are similar to the general mean in LSJR and below the general mean in the ICW (note however, that 2005 data is up to September).**

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 **2002-2005** 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 between 2002-**2005** was well spread throughout the County similar to the drought years 2000/2001. 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 tape grass.

***Manatee Mortality*:** **In 2004, there were 15 reported deaths total of which 5 were watercraft, 4 perinatal, 1 cold stress and 5 undetermined (FWC, FWRI 2005). 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.**

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 December 8th 2004:

1. **Law enforcement initiatives. The City is working with the Jacksonville Sheriff's Office (Marine Unit) to build a docking facility in the downtown area near Metropolitan Park. The Sheriff has already added one officer to the Marine Unit, and in December two more marine patrol officers will be added. These additions will help the County regulate boater activity, and keep the boating public informed about manatee protection and speed zones. This facility will also offer docking space to the FFWCC officers. JSO continues to work with FWC, USCG, and the FWS through a joint task force that evaluates enforcement on the river, and how we can continually improve.**

2. **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.**

3. **MPP reissuance. Dr. Quinton White, a consultant with the City, is working with the FWC, Jacksonville's Planning & Development Department and attorneys to update the MPP. This will provide up-to-date terminology as well as manatee counts. This group is also working to correct any perceived inconsistencies with the boating facilities siting plan.**

4. **Reducing Goodby's Creek speed zone to idle immediately. The Jacksonville City Council has already passed legislation to implement the idle speed zone in Goodby's Creek. While this is a condition of the boat ramp permit issued by the Corps of Engineers, the county has been proactive in creating the zone, and is now working to permit the signs to mark the zone. We will install regulatory signs as soon as FWC approves the speed reduction in this area and issues the necessary permits. This measure will enhance manatee protection in an area where one of the watercraft-related deaths occurred.**

5. **Enforcement of environmental permits. As we discussed, there may be a correlation between dredging projects or boat facilities construction and manatee deaths. We explored the connection between compliance with the**

manatee protection provisions of construction and dredging permits and manatee mortality. This is an issue that will be further discussed during the MPP update. Wally Esser with the SJRWMD volunteered to follow up on permits that were in place when the manatee deaths occurred near dredging and construction locations over the last year. He stated he would try to provide information such as the kind of barges that were in the water, etc.

6. **Additional protection zones. Duval County is also actively exploring the need for motorboat speed zones on Cedar Creek. We are working with the JSO to report to the Waterways Commission on the best placement for signage if the zone were adopted.**

7. **Ortega River anomalies. Discussion ensued concerning the possible existence of warm water springs in the Ortega River. FDEP's Jim Mather will report to the Jacksonville Waterways Commission on December 9, 2004, regarding his Department's preliminary study of the water temperature in the Ortega River near Timuquana Road.**

8. **Signage improvements. Duval County is working with FWC to update the signage on Florida Department of Transportation's bridges in the downtown area. The County is exploring simplifying and clarifying the language, and the possibility of lighting the signs.**

8. **Inspection trip. A boat trip will be scheduled in the near future on the ICW. Even though Duval County cannot regulate boat speeds and operation on the ICW, this part of our waterways is crucial. All agencies will be invited.**

(Above information from letter dated December 8, 2004 by Council Woman Lynette Self).

In 2005, there were a total of 12 reported deaths of that 3 were watercraft, 2 perinatal, 1 cold stress and 6 undetermined as of September 2005 (FWC, FWRI 2005).
In spite of these manatee deaths, the five-year running average from watercraft mortality is 3.45 (range 2-5) deaths since 1980 (Figure 7).

***Habitat*:** Indices for percent feeding indicated more animals feeding in 2002 than 2001, even more animals feeding in 2003 than 2002 **and more still feeding in 2004 than 2003. Numbers feeding remain similar to 2004 levels. This may be because the food supply has begun to level off in 2004/2005 and there were more total numbers of manatees. However, food supply still remains below 1998 levels in terms of the percentage of transacts without tape grass and the reduced depth on average that tape grass is now encountered (Jennifer Sagen 2005. LSJRB SAV Monitoring Project Coordinator, SJRWMD, 2004 Interim IV Report).** Feeding animals were for the most part located south of Buckman Bridge. Grass beds north of Buckman Bridge have regenerated significantly since late 2002. As a result, more manatees were observed in the area north of Buckman Bridge on the east bank of St. Johns River in **2004/2005** than in **2003/2002**.

***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** 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.**

Speed Zones imposed by USFWS: **New federal manatee protection slow speed zones announced by the U.S. Fish and Wildlife Service on April 28th in Duval, Clay and St. Johns are now official and are being enforced. The final rule amendment with a map is s available online at http://northflorida.fws.gov/. 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. This study was conducted by Dr. Ed Gerstein and funded by the City of Jacksonville. The preliminary report is under review.**

THIS REPORT CONTAINS THE FOLLOWING UPDATED SECTIONS TO THE 1999 DUVAL COUNTY MANATEE PROTECTION PLAN:

EXECUTIVE SUMMARY

1. INTRODUCTION, INVENTORY ANALYSIS SECTION (PAGES 7-13). Recommendations (PAGE 14).

2. TABLES SECTION (PAGES 15-23).

3. FIGURES SECTION (PAGES 24-33).

4. SERIES A – AERIAL SIGHTINGS (PAGES 34-40).

5. SERIES B – MANATEE MORTALITY 2002/2003 (PAGE 41-47).

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

Inventory and Analysis

Manatees

Distribution and Abundance: Aerial surveys by Jacksonville University (March, 1994 - **September**, 200**5**) 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 475 bimonthly surveys, a total 10,721 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 2004–2005** was not found to be significantly different from past years. ***Map Series A*, shows manatee distribution from Summer 2004 through Summer 2005.** 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 and 2005, the percentages seem to be higher in both the LSJR than the previous three years (note 2005 data is not a complete year). In the ICW percentages were lower in 2005 (4%) than 2004 (11%) (Table 1).**

Single Highest Day Count (SHDC) for LSJR was 170 manatees per survey in June. This number represents the highest count to date (1994-2005). 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. **SHDC has alternated between the months of May and June each year since 2000. Prior to 2000 SHDC were achieved during July, August and September (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 have been seen in 2003-**2005** (47, 51 and **57** manatees per survey year, respectively 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 28 manatees in 2002 (remains the highest since 1994) was similar to 23 manatees in the 2001 and higher than 13 reported in 2000. **From 2001-2005** count appears to be more consistent with counts prior to the period of drought for years 1994-1998 (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.); September 2005 (57 manatees/survey/yr.). Recent numbers are similar to those prior to 1999. Yearly means in the ICW have been consistent for the last three years 2000-2003 (5 manatees/survey/yr.); 2004 (6 manatees/survey/yr.); September 2005 (7 manatees/survey/yr.). (Table 1). This does not necessarily indicate increase in real population numbers for the Florida manatee. It is more likely that simply of more individuals are migrating into the northeast Florida region.

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.

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, however, ICW totals remain relatively stable over the past several years.**

Some of these animals came 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. Counts at Blue Springs were 114 manatees (89-1999), 132 (99-2000), 153 (00-2001), 141 (01-2002), 162 (02-2003) and 178 (03-2004) and **196 total manatees seen in 2004/05 (Richard Harris, Park Biologist; Wayne Hartley, Park Ranger, Blue Spring State Park, personal communication)**. 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 suggests 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.**

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 4)**. In winter it was difficult to find manatees feeding because manatee abundance was low. Also, no manatees were observed cavorting in winter. Winter variances for resting and traveling animals was larger because of fewer sightings and resting animals congregated at power plants. **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 in 2002 than 2001, even more animals feeding in 2003 than 2002 **and more still feeding in 2004 than 2003. This may be because the food supply continued to increase in 2003/2004 and there were more total numbers of manatees.**

The percentage of number of transects without Submerged Aquatic Vegetation (8%) decreased compared to a high of 20% in 2002 but has not returned to 1998 status (0%). The mean number of species per transect increased from 2 in previous years (2000–2002) to the 1998 average of 4. The distribution of most species was not as extensive as in 1998; the exceptions were charophytes and *Ruppia maritima* both of which had much higher distributions than in 1998 but have declined relative to their maximum distributions in 2003 and 2000, respectively. *Ceratophyllum demersum* was not present during 2000-2002 surveys; it appeared for the first time in 2003 and its distribution increased dramatically since then. Submerged Aquatic Vegetation was found at a mean maximum depth of 0.71 m in 2004 as compared to a mean maximum of 0.92 m in 1998. Food supply still remains below 1998 levels in terms of the percentage of transacts without tape grass and the reduced depth on average that tape grass is now encountered (Jennifer Sagen 2005. Project Coordinator, SJRWMD, Interim IV Report for the contract entitled *Lower St. Johns River Basin (LSJRB) Submerged Aquatic Vegetation (SAV) Monitoring, January 1, 2004 – December 31, 2004*).

Feeding animals were for the most part located south of Buckman Bridge. Grass beds north of Buckman Bridge have regenerated significantly since late 2002. Percent cavorting seems to have decreased in 2002 similar to 1999 levels. Also, the timing of cavorting seems to have shifted to slightly later in the year. **In spring 2004 we observed the highest numbers of manatees (375) since 2002 (330) and 1999 (286). In spring 2005 fewer numbers of manatees (187) were seen than last year probably because animals arrived in greater numbers later this year. Similar percentages of manatees engaged in traveling, resting and feeding behaviors. More manatees were engaged in resting and feeding and type behaviors than in 2004. Fewer animals were seen traveling than in past years. Similar percentages of manatees were engaged in traveling both years 2001-2004. In summer 2004 we observed less manatees (504) than in 2003 (725) probably because they arriver earlier in the year, hence higher than usual spring numbers. In 2005 we saw 626 manatees compared with 504 manatees in 2004 probably because animals arrived later. Manatees engaged in less traveling, more resting and similar feeding type behaviors than in 2004. Feeding percentage in 2004 was highest (52%) than in 2005 (41%) perhaps because more food was available. In 2003 feeding during the summer was 31% (Table 4).**

Fewer animals were seen cavorting in spring (decreasing trend 2000-2003) and more animals in summer and fall (increasing trend 2000-2003). **In 2004 the shift is reversed and more animals were seen cavorting in spring (increasing trend 2003-2004) and less animals in summer (decreasing trend 2003-2004). Cavorting percentages were generally lower in 2005 and 2003 (6%) than in 2004 (14%) and the years 1999-2002. Similar numbers were seen cavorting during the summers of 2004/2005 (Table 4).**

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 have remained low throughout the year favoring continued grass bed growth and regeneration (Figure 3).**

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 4 and 5 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-**2005,** the ICW continues to be a travel corridor. **In winter 1 manatee were observed resting near a basin south of JTB Bridge. In spring, we observed fewer animals (46) than last year (70), more of which were traveling than resting. Fifty nine percent of the animals were engaged in traveling, 37% in resting, no animals were observed feeding but 4% were cavorting. Feeding and cavorting percentages were below average for this time of year (Table 5). In summer, total number of manatees was higher (63) than previous years (1999-2004) and consisted of traveling animals (45%), resting animals (41%) and cavorting animals (14%). No animals were observed feeding. In past years more animals were also observed traveling than in 2005. Also, more animals were seen resting and cavorting than in past years (Table 5). Generally, no feeding or cavorting animals were seen in summer, which is consistent with past years except for summer 2002 (9% feeding) and 2005 (14% cavorting).**

Mortality Information: **The total of State-wide deaths documented for 2004 was 276, of which 69 were watercraft-related. Other causes included other human (4), perinatal (72), cold stress (50), other natural (24), flood gate (3), undetermined (51) and unrecovered (3). In 2005, watercraft deaths for the key counties totaled 46. Other causes of death for the key counties included other human (5), perinatal (58), cold stress (23), other natural (39), flood gate (1), undetermined (59) and unrecovered (2) (Table 6). Watercraft caused mortality of manatees in Florida compared for the years 1998 - 2002 indicated a decreasing trend (Figure 6). Watercraft, perinatal,**

natural, undetermined and cold stress causes of death were the most significant for 2005 (FWC, FWRI 2005).

Total mortality rates for manatees in Duval County decreased from 19 deaths per year in 1991 to 13 deaths per year in 1998 and have edged upwards to 14 deaths in 2002, 19 deaths 2003, 15 deaths in 2004 **and then decreased to 12 deaths as of September 2005 (Table 7, and Figure 7).** In 2001 there were a total of 6 reported deaths in Duval County of which, 2 were undetermined, 2 were cold stress, 1 perinatal and 1 watercraft. In 2002, there were a total of 14 reported deaths of which 10 were watercraft, 2 undetermined, 1 unrecovered and 1 perinatal (FWC, FWRI, 2004). This triggered Florida Fish and Wildlife Conservation Commission Manatee Protection Plan Standards to address the high increase in watercraft related mortality in Duval County. **In 2003, there were 19 reported deaths total of which 4 were watercraft, 4 perinatal, 3 cold stress, 2 other natural, 5 undetermined and 1 unrecovered. In 2004, there were a total of 15 reported deaths of which 5 were watercraft, 4 perinatal, 1 cold stress and 5 undetermined and in 2005 there were a total of 12 reported deaths of which 3 were from watercraft, 2 perinatal, 1 cold stress and 6 undetermined as of September 30th 2005 (FWC, FWRI 2005).**

Mortality due to watercraft impacts in 2004 (Table 8) was highest in, Lee County (13) and Brevard (11) . Intermediate numbers of watercraft-caused deaths were documented in Collier (5), Duval (5), Palm Beach (3) and Volusia (3); and lower numbers of deaths were documented in Dade (2), Sarasota (2), Broward (1), Citrus (1), Indian River (1), Martin (1), and St. Lucie (0). Table 8 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 September 30th 2005. Duval County experienced higher than usual watercraft deaths in 1991(9) and 2002 (10) than in other years. Watercraft-caused mortality in Duval County (5 year running average) has ranged from 2 to 5 deaths per year between 1980-September 30th 2005 (Figure 7). Watercraft deaths were 4 in 2000, 1 in 2001, 10 in 2002, 4 in 2003, 5 in 2004 and 3 as of September 30th 2005 (Table 8/9, Figure 7). Table 9. shows total manatee mortality/yr. and cause in Duval County from 1976 to September 30th 2005 (FWC, FWRI 2005). Figure 8 shows total and watercraft mortality as well as 5 year running average of watercraft deaths for the State of Florida (FWC, FWRI 2005).

Map Series B, Duval County Manatee Mortality 2004/2005 **shows locations of carcass recoveries.**

Acoustical Study; **For this study, underwater acoustical recordings of hopper dredging activities were conducted with the full cooperation and assistance of B&B Dredging. The noise from their 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. The following recommendations were made: Mitigation techniques suggested to abate noise radiation include; ship quieting technologies, reducing propeller cavitations, insulating and elevating the slurry pipeline, and minimizing the**

number and distance of transects back and forth to pump out stations. With respect to the effects on boat noise a direct mitigation would be to attach a low intensity, directional alarm (in a noise bandwidth above the masking frequencies) to the bows of slow and fast moving vessels (Edmund R. Gerstein and Joseph E. Blue, Leviathan Legacy Incorporated, Draft Final Report to Jacksonville Waterways Commission, Contract N0. 8548, September 2005).

***Warm-Water Attractants*: In winter 2004/05, manatees were not observed at the warm water source identified in Ortega River.**

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.

In winter of 2002/2003/2004/**2005**, 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**, 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.

Recommendations

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

Manatee Protection Plan Update

In the last update it was recommend that the 1999 Duval County Manatee Protection Plan be updated to a 2005 edition. Data, figures and tables are being brought up to date including changes in agencies names. The updating would not change the substance of the Duval County Manatee Protection Plan itself, but would modernize it relative to current terminology and agency names. A new time line has been established to complete the update by 2007 when the Comprehensive Plan is due to be updated. The Comprehensive Plan will continue to be amended to maintain consistency between the MPP and the Comp Plan documents until the complete revision of the Comprehensive Plan in 2007.

New Duval Manatee Protection Brochure

A new brochure will be produced and mailed to all registered boat owners in Duval County in late 2005. The brochures will include updated manatee protection zones mandated by the USFWS in April 2005.

TABLE 1. Summary of the total number of aerial surveys, adults and calves observed, and Single Highest Day Counts (SHDC) by year (1994-2005).

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 [2]	16	830	74	904	8.19	170	6/22/05	57
Total		249	8,992	756	9,748	7.64 [3]	120 [4]		39 [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 [2]	16	107	5	112	4.46	29	7/6/05	7
Total		226	909	64	973	6.80 [3]	21 [4]		4 [5]

SHDC=Single Highest Day Count

[1] March to the end of December

[2] January to September

[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-September 2005).

LOCATION	ADULTS*	CALVES*	TOTAL*
Nassau Sound	23	0	23
Sawpit Creek	41	0	41
ICW North of Fort George River	63	0	63
Sisters Creek	25	3	28
Fort George Inlet	6	0	6
Mayport	11	0	11
St. Johns Bluff	37	0	37
Blount Island	152	8	160
Mill Cove	60	2	62
Atlantic Blvd. Bridge to SJR confluence	46	1	47
Beach Blvd. Bridge to Atlantic Blvd.	74	5	79
JTB Bridge to Beach Blvd. Bridge	77	4	81
Palm Valley Bridge to JTB Bridge	159	11	170
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 2005.**

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-September 2005).

LOCATION	ADULTS*	CALVES*	TOTAL*
Quarantine Island	49	1	50
Dames Point	16	0	16
Trout River	218	17	235
Arlington River	35	2	37
Pottsburg Creek	31	1	32
Miller Creek	25	2	27
Downtown	77	9	86
San Marco	130	3	133
Ortega River	153	16	169
Sadler Point	146	13	159
Pirates Cove	46	3	49
NAS/JAX	195	12	207
Mulberry Cove	121	11	132
Rudder Club	554	60	614
Club Continental	997	91	1088
Doctors Lake	1675	159	1834
SJR south of Dr.Lake	1005	79	1084
Julington Creek	136	15	151
Durbin Creek	8	0	8
Mandarin Point	999	76	1075
Plummers Point	282	26	308
Beauclerc Bluff	289	20	309
Goodbys Creek	127	10	137
Christopher Point	761	68	829
Point La Vista	171	5	176
Lions Club Boat Ramp	9	0	9
JEA - Southside	56	8	64
Jefferson Smurfit	10	2	12

*** These numbers indicate total per survey counts of manatees.**
Individual manatees may migrate to other areas between flights.
Source Jacksonville University 2005.

TABLE 4. Number percent of manatees engaged in various activities between winter 1998-summer 2005 (LSJR).

Year/Season	Total	Percentage			
	No.	T	R	F	C
Fall '99	282	26	28	21	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	6
Fall '04	31	16	55	19	10
Falls Mean	126	24	43	19	15
SD	105	6	16	8	13
CI	84	5	12	6	11
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	2	0	100	0	0
Winter '04-05	5	40	60	0	0
Winters Mean	1	13	37	7	0
SD	2	22	48	19	0
CI	1	16	36	14	0
Spring '99	286	26	49	12	14
Spring '00	186	27	44	12	17
Spring '01	139	33	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
Springs Mean	238	29	36	23	12
SD	92	5	12	11	5
CI	68	4	9	8	4
Summer '99	321	19	58	16	7.2
Summer '00	102	36	35	16	13
Summer '01	287	26	37	8	29
Summer '02	324	43	24	22	11
Summer '03	725	26	23	31	20
Summer '04	504	21	18	52	9
Summer '05	100	18	31	41	10
Summers Mean	338	27	32	27	14
SD	221	9	13	16	8
CI	164	7	10	12	6

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

SD = Standard deviation

CI = 95% Confidence interval for the mean

Source Jacksonville University 2005.

TABLE 5. Number percent of manatees engaged in various activities between winter 1998-summer 2005 (ICW).

Year/Season	Total	Percentage			
	No.	T	R	F	C
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
Falls Mean	5	57	22	4	0
SD	4	37	23	6	0
CI	3	29	18	5	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	2	100	0	0	0
Winter '04-05	1	0	100	0	0
Winters Mean	1	57	14	0	0
SD	1	53	38	0	0
CI	1	40	28	0	0
Spring '99	16	63	0	0	37
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
Springs Mean	47	57	25	8	10
SD	18	15	19	7	14
CI	13	11	14	0	0
Summer '99	13	85	15	0	0
Summer '00	15	60	40	0	0
Summer '01	26	69	31	0	0
Summer '02	35	54	37	9	0
Summer '03	33	70	30	0	0
Summer '04	25	96	4	0	0
Summer '05	63	45	41	0	14
Summers Mean	30	68	28	1	2
SD	17	18	14	3	5
CI	12	13	10	0	0

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

SD = Standard deviation

CI = 95% Confidence interval for the mean

Source Jacksonville University 2005.

TABLE 6. Causes of manatee mortality for Florida's Key Counties, September 2005.

County	Watercraft	Flood Gate	Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
Brevard	4	0	2	21	6	4	10	0	47
Broward	1	0	0	1	0	2	3	0	7
Citrus	2	0	0	8	0	1	2	0	13
Collier	5	0	0	3	8	1	9	1	27
Dade	0	0	2	1	0	0	1	0	4
Duval	3	0	0	2	1	0	6	0	12
Indian River	5	0	1	3	0	2	3	0	14
Lee	8	1	0	8	3	16	13	1	50
Martin	0	0	0	2	2	1	2	0	7
Palm Beach	5	0	0	1	1	0	0	0	7
Sarasota	3	0	0	1	0	10	4	0	18
St.Lucie	2	0	0	0	1	0	3	0	6
Volusia	8	0	0	7	1	2	3	0	21
Total	46	1	5	58	23	39	59	2	233

Source: FWCC/FWRI 2005

TABLE 7. Florida manatee mortality, 1991- September 2005.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005*	# Total	% of Total
Brevard	38	31	30	42	40	57	62	47	46	49	52	50	42	65	47	698	23.80
Broward	3	9	4	4	5	6	3	7	15	4	9	10	8	6	7	100	3.41
Citrus	5	9	8	5	6	6	5	4	8	6	10	9	10	7	13	111	3.78
Collier	14	19	18	13	10	70	21	14	19	35	31	13	37	23	27	364	12.41
Dade	7	10	5	11	14	7	14	9	12	8	11	9	9	7	4	137	4.67
Duval	19	8	5	6	7	10	10	13	9	11	6	14	19	15	12	164	5.59
Indian R.	4	1	-	2	5	10	7	5	6	10	5	7	6	6	14	88	3.00
Lee	18	19	17	33	31	145	43	31	33	44	51	58	81	51	50	705	24.04
Martin	9	8	3	7	6	6	6	8	9	6	7	9	6	5	7	102	3.48
Palm Bch.	6	3	5	3	6	7	6	5	7	9	8	14	12	9	7	107	3.65
Sarasota	5	1	5	6	12	8	3	4	13	11	5	16	22	7	18	136	4.64
St. Lucie	1	4	4	2	2	4	2	1	2	2	4	4	0	1	6	39	1.33
Volusia	10	5	5	6	10	9	9	15	12	13	27	13	14	13	21	182	6.21
Total	139	127	109	140	154	345	191	163	191	208	226	226	266	215	233	2933	100.00

*** = September**

Source: FWCC/FWRI 2005.

TABLE 8. Watercraft caused mortality in Florida's Key Counties, 1991- September 2005.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005*	# Total	% of Total
Brevard	13	7	9	9	6	13	12	9	12	13	7	17	8	11	4	150	21.31
Broward	2	2	2	3	0	1	0	2	5	2	4	3	5	1	1	33	4.69
Citrus	0	3	1	2	0	2	1	2	4	1	1	3	3	1	2	26	3.69
Collier	5	4	5	4	4	5	4	7	10	5	8	6	7	5	5	84	11.93
Dade	0	4	0	1	2	0	5	2	1	2	5	1	2	2	0	27	3.84
Duval	9	2	2	2	3	3	2	3	2	4	1	10	4	5	3	55	7.81
Indian R.	1	0		0	1	4	1	3	1	4	1	2	1	1	5	25	3.55
Lee	7	2	5	10	8	14	9	9	10	13	23	13	9	13	8	153	21.73
Martin	2	1	0	1	1	2	3	1	2	1	1	2	1	1	0	19	2.70
Palm Bch.	1	0	3	2	2	3	1	2	2	3	3	6	5	3	5	41	5.82
Sarasota	1	0	2	2	0	1	2	0	4	5	2	4	1	2	3	29	4.12
St. Lucie	1	1	1	0	0	1	0	0	0	1	1	1	0	0	2	9	1.28
Volusia	3	1	0	1	1	2	1	8	5	4	11	3	2	3	8	53	7.53
Total	45	27	30	37	28	51	41	48	58	58	68	71	48	48	46	704	100.00

*** = September**

Source: FWCC/FWRI 2005.

TABLE 9. Causes of manatee mortality in Duval County, Florida. 1976 - September 2005.

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	7	1	0	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*	3	0	2	1	0	6	0	12
Total	105	8	37	30	25	102	9	316

Source FWCC/FWRI 2005.

*** = Untill September 2005.**

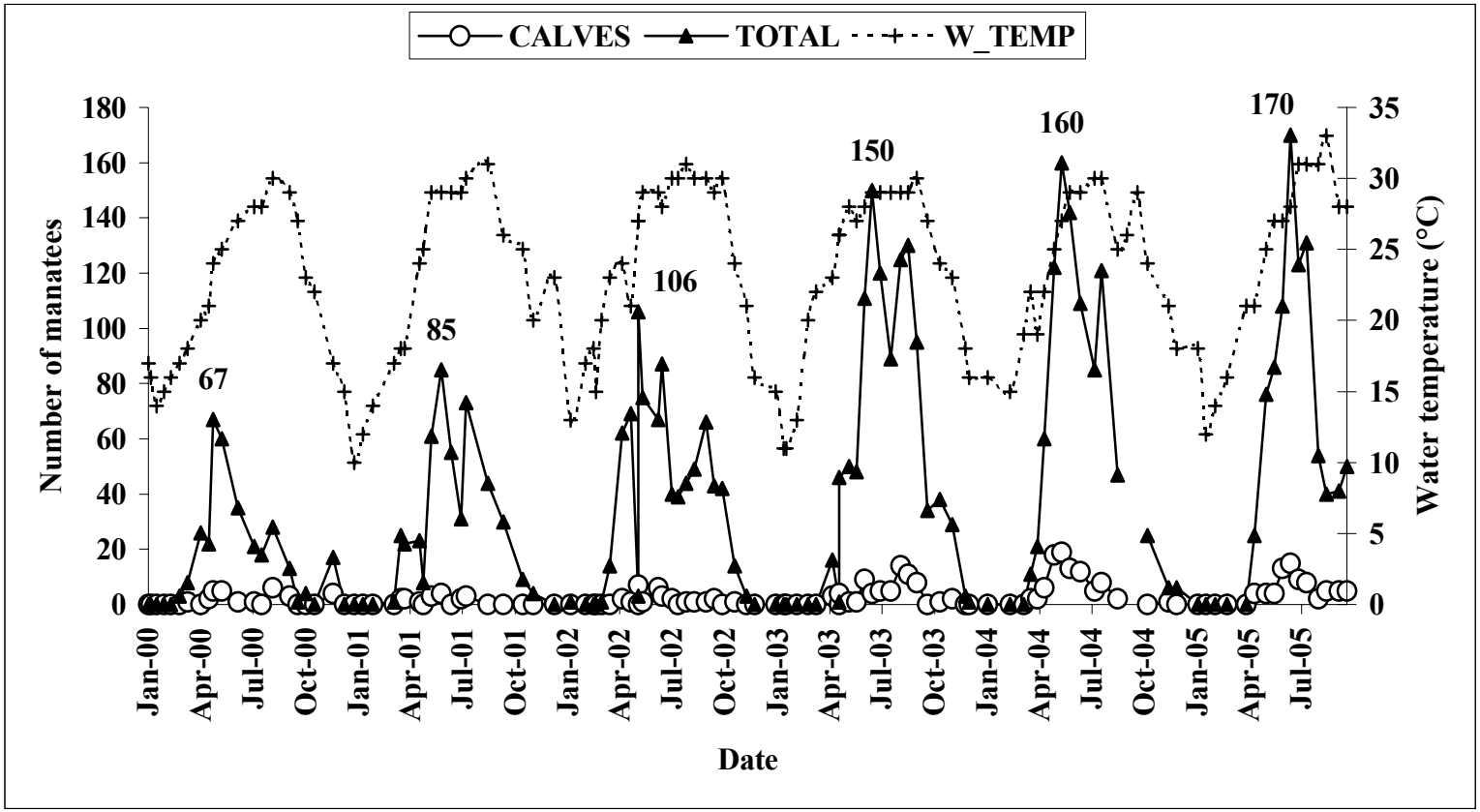


FIGURE 1. Aerial sightings of manatees and water temperature in the Saint Johns River 2000–September 2005.

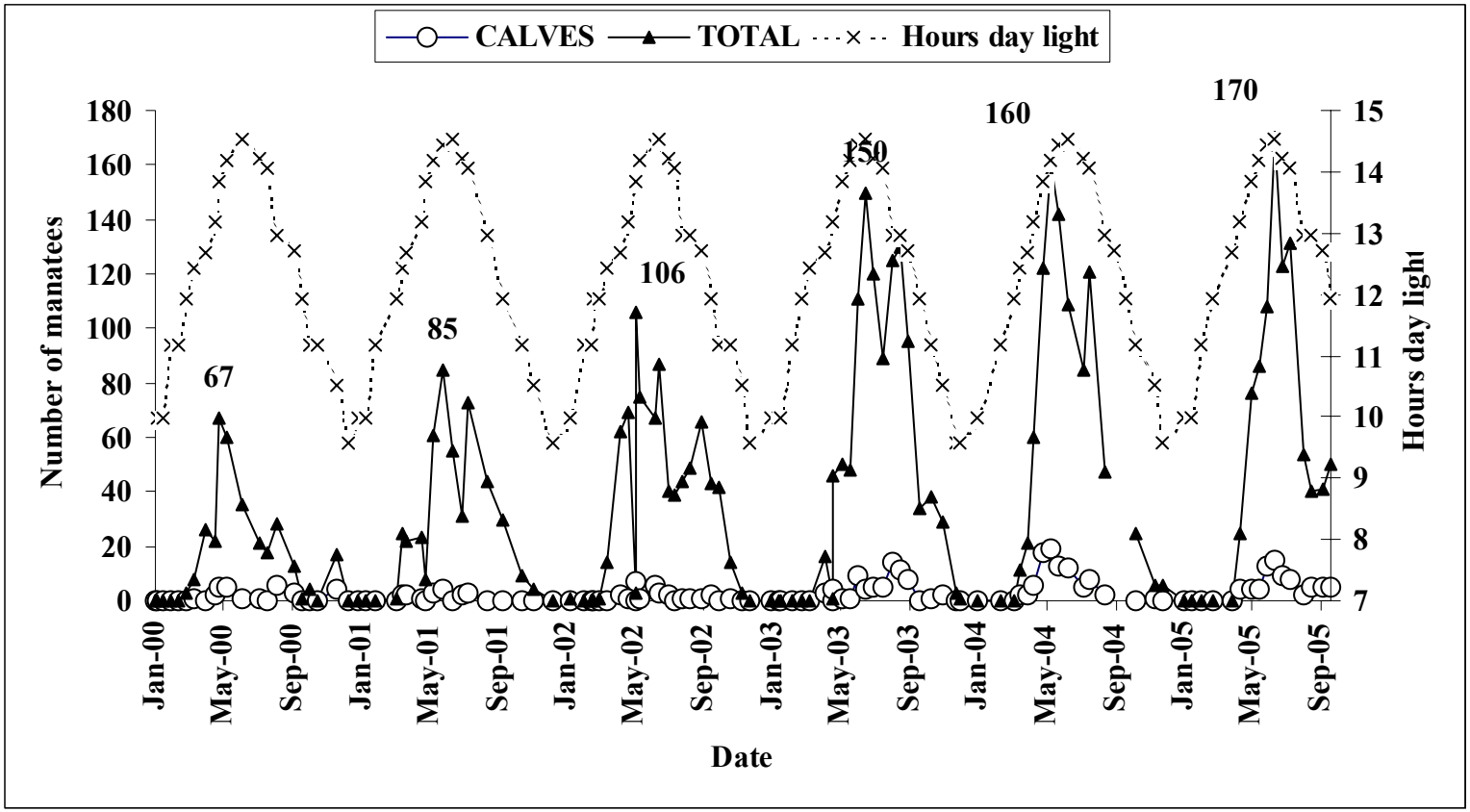


FIGURE 1a. Aerial sightings of manatees and hours daylight in St. Johns River 2000–September 2005.

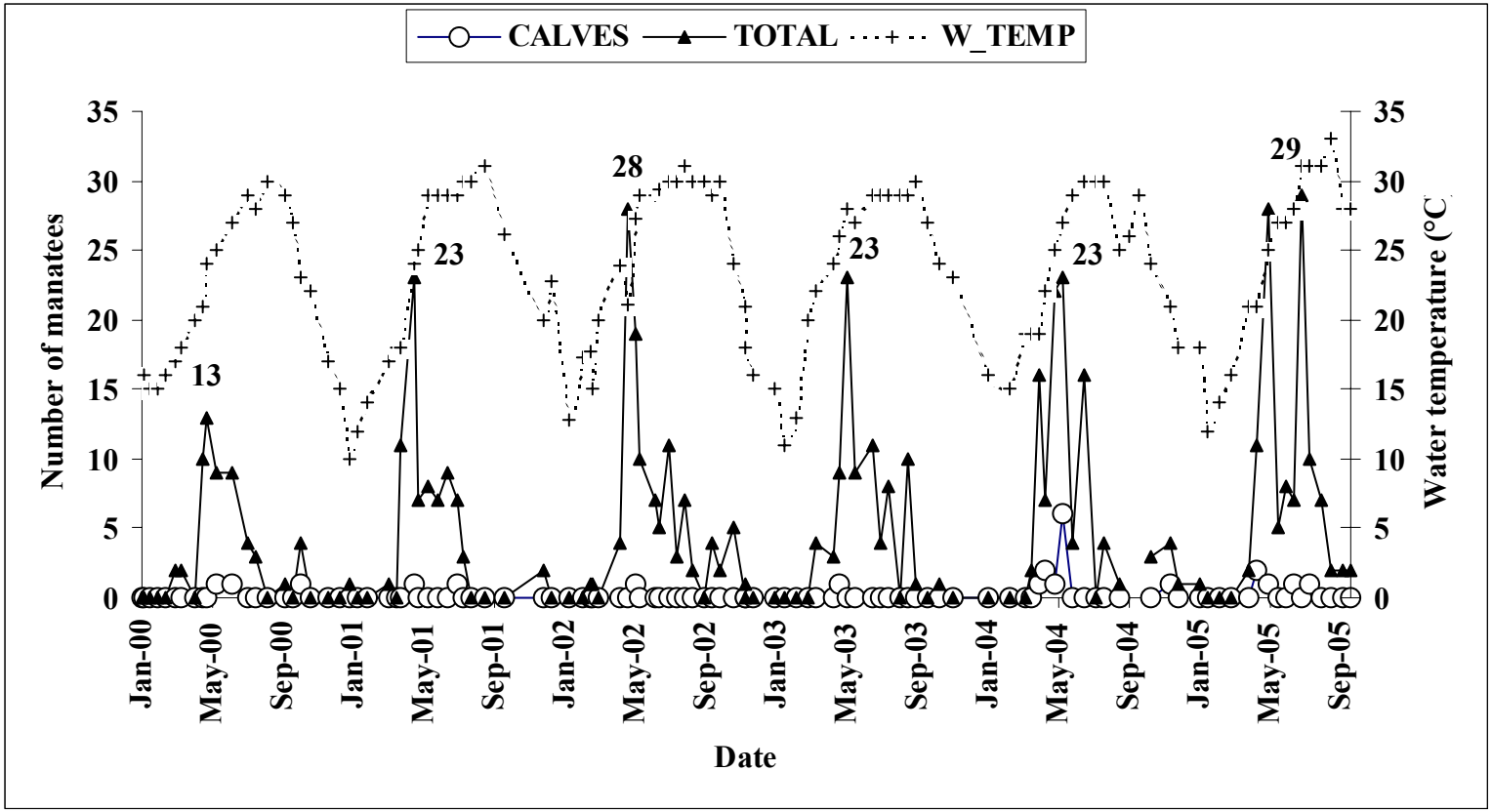


FIGURE 2. Aerial sightings of manatees and water temperature in the Intracoastal Waterway 2000–September 2005.

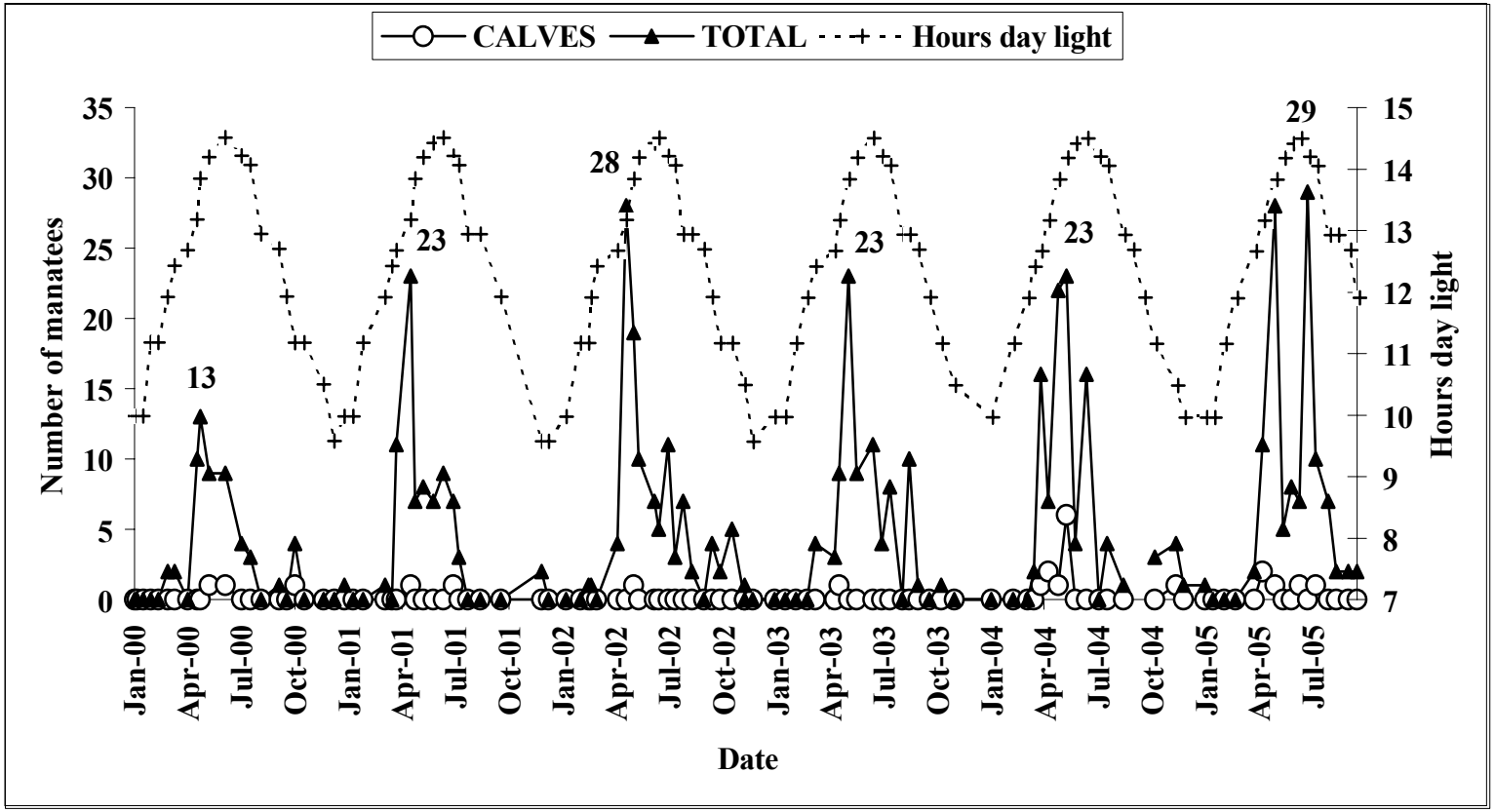


FIGURE 2a. Aerial sightings of manatees and hours daylight in The Intracoastal Waterway 2000-September 2005.

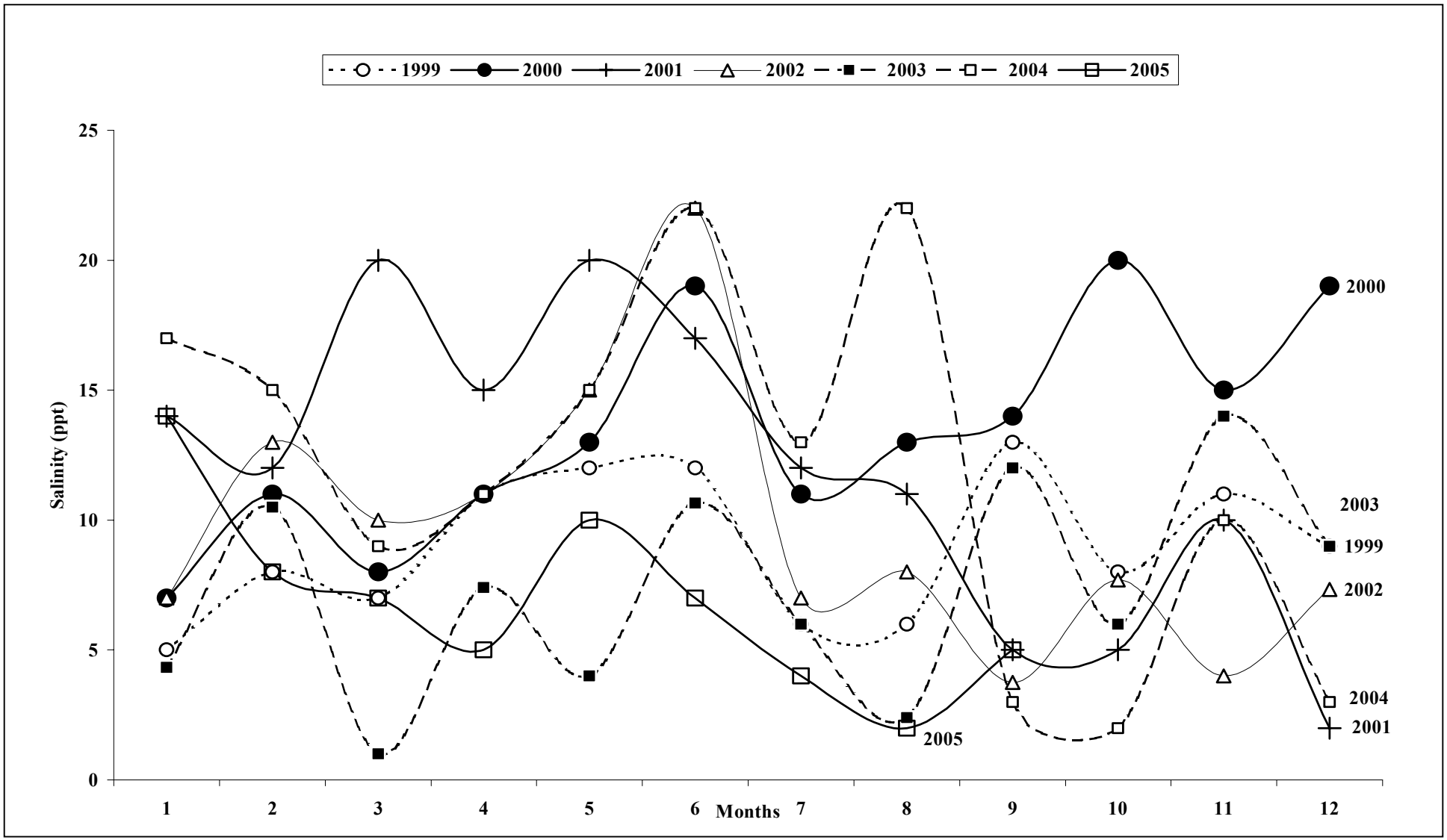


FIGURE 3. Mean monthly salinity recorded at the Jacksonville University dock, Duval Co., FL 1999-September 2005.

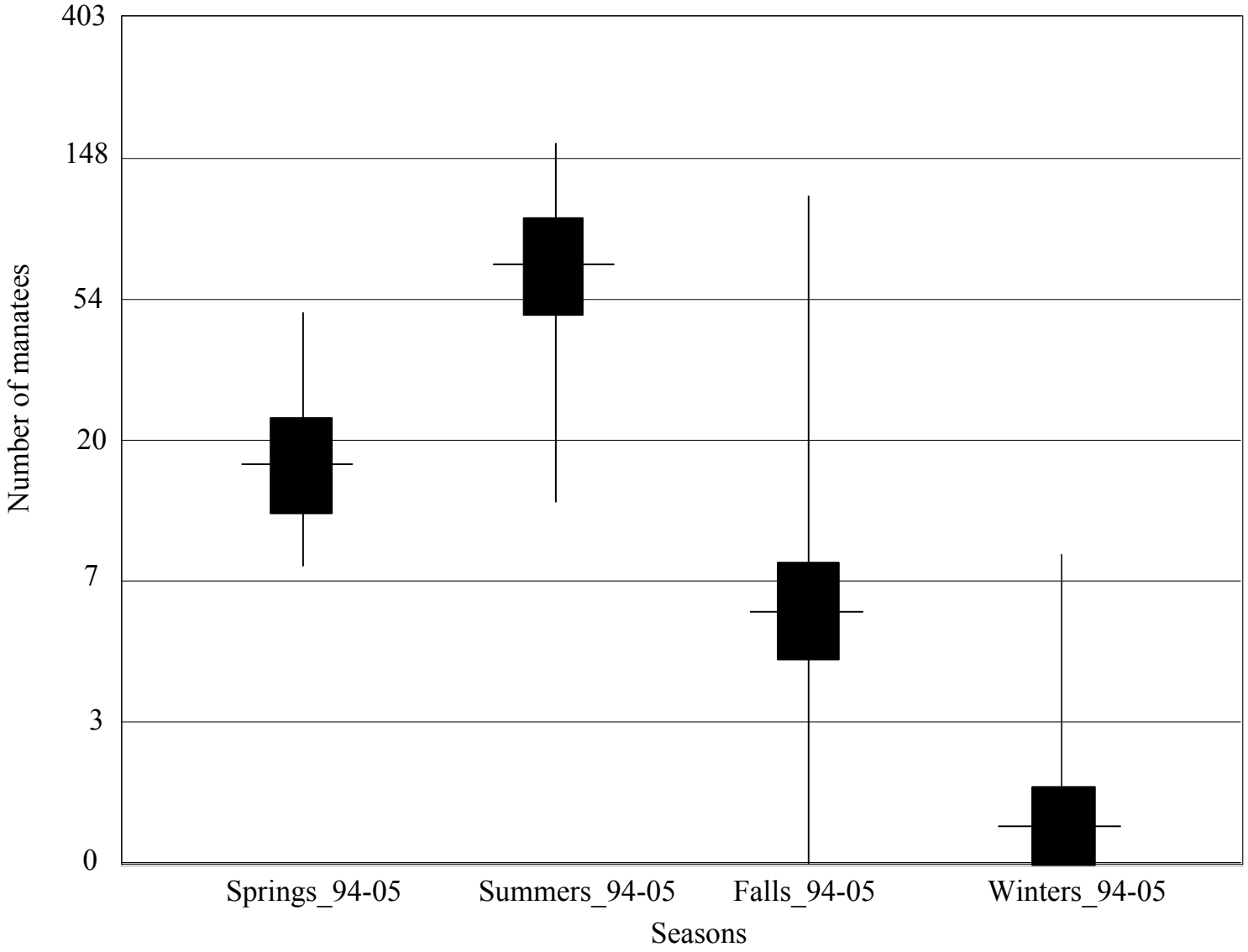


FIGURE 4. Mean counts of manatees in the LSJR by season (horizontal lines) 1994-2005. Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis converted from Ln (count + 1) scale.

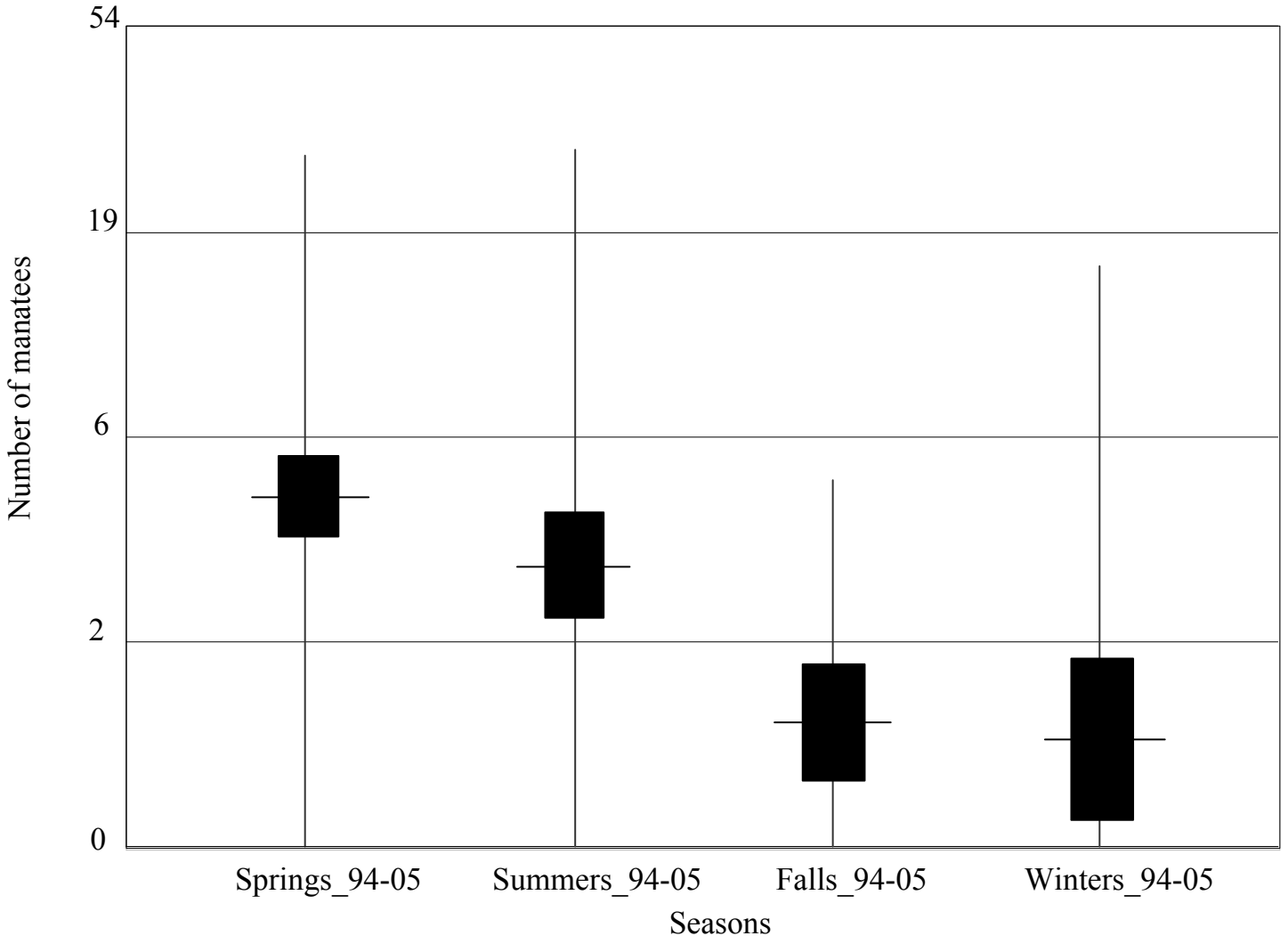
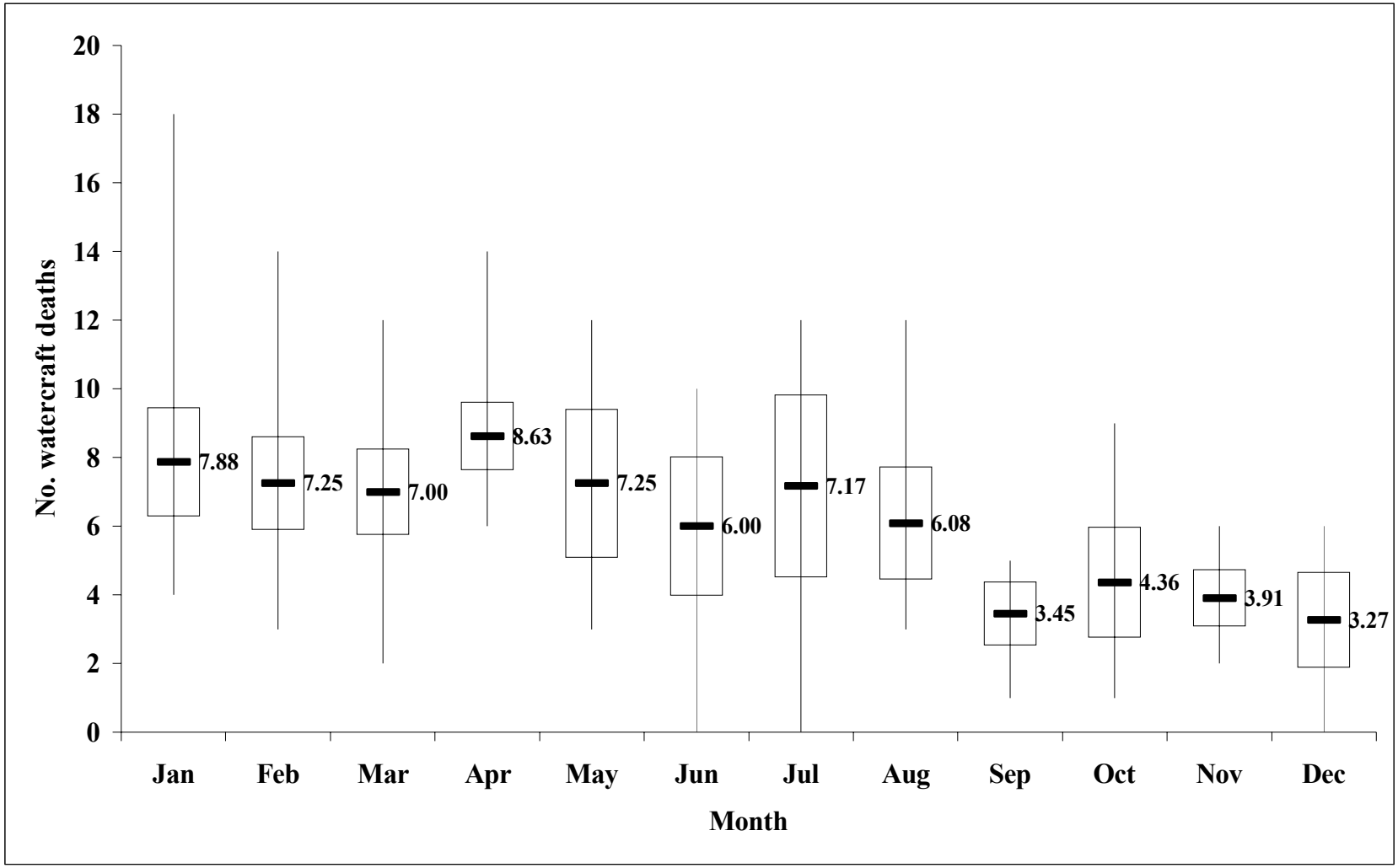
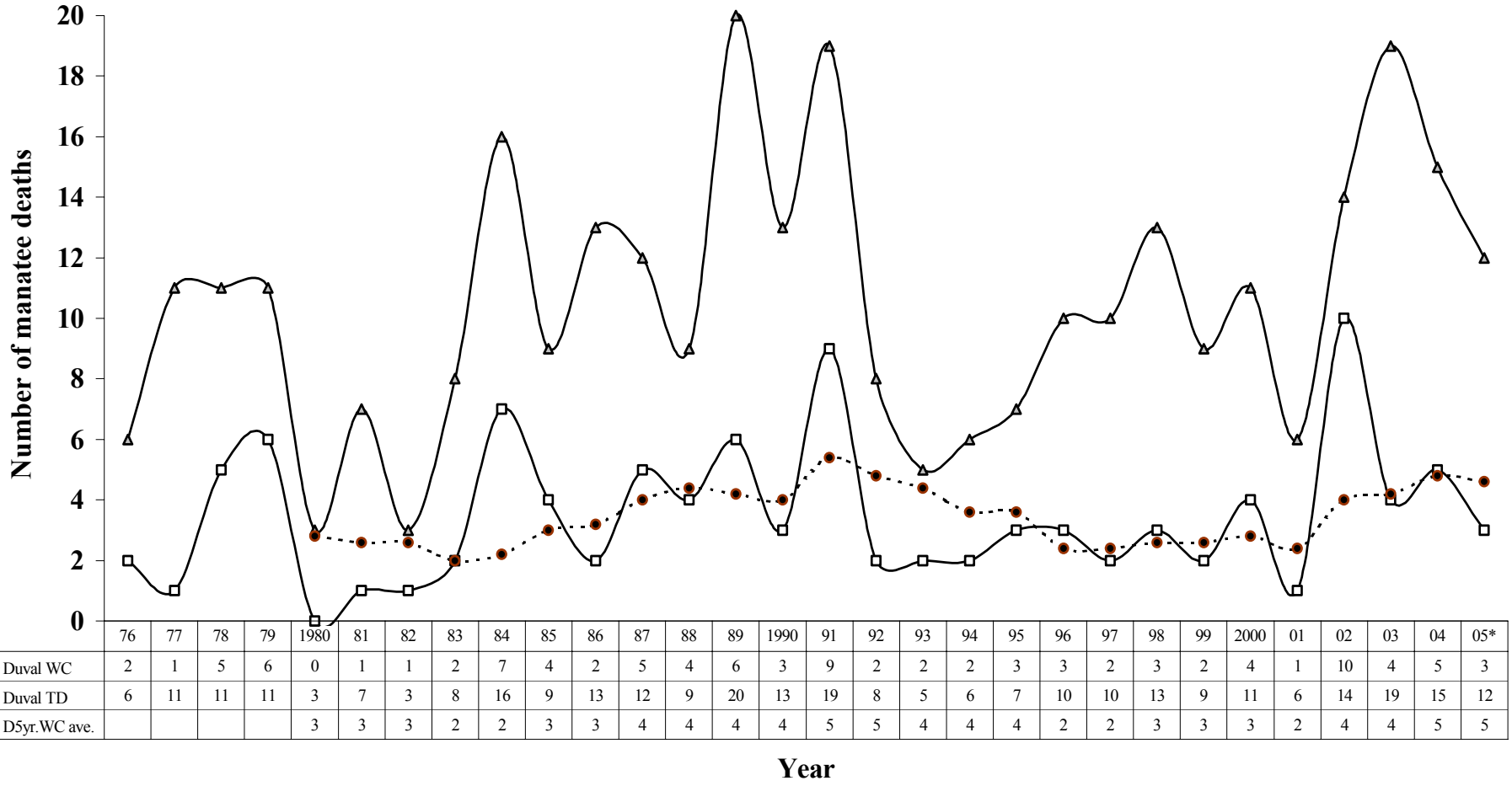


FIGURE 5. Mean counts of manatees by season in the ICW 1994 – 2005 (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals of the mean. Y-axis was converted from Ln (count + 1) scale.



Source data: FWRI 2005.

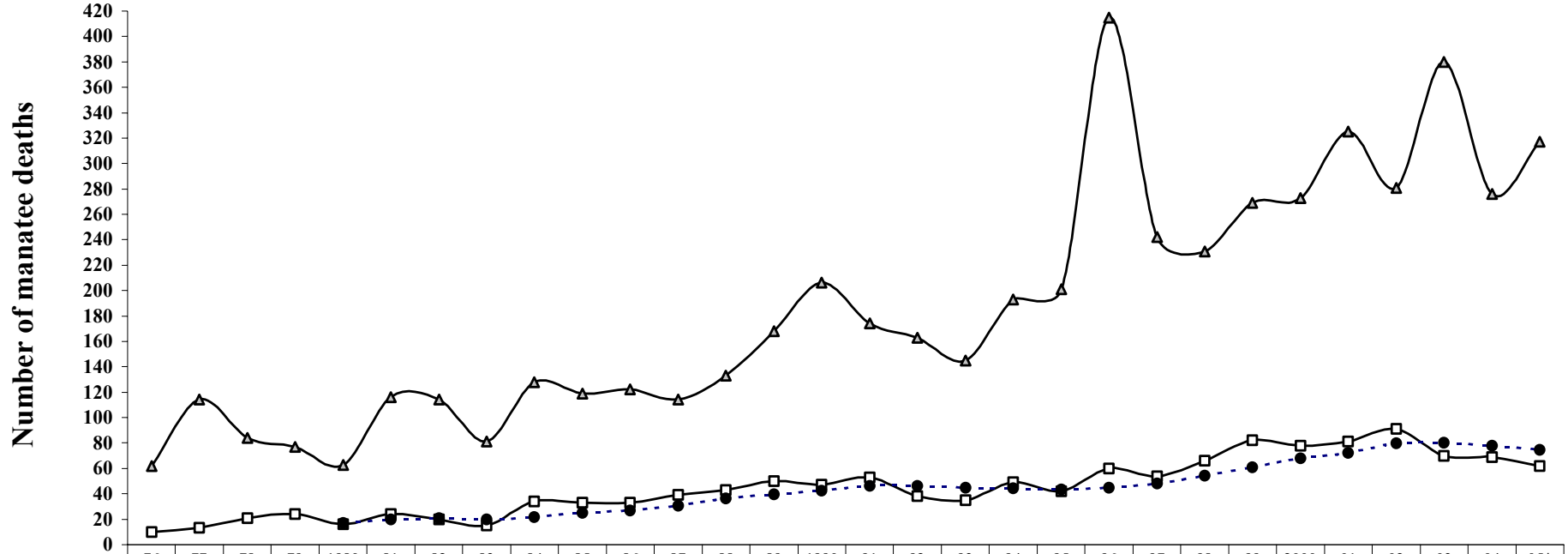
FIGURE 6. Watercraft caused mortality of manatees in Florida compared for the years 1994 – August 2005. Mean monthly counts of manatees (horizontal lines). Vertical lines show maximum and minimum counts. Boxes show 95% confidence intervals for the mean.



	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*
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	3
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	12
D5yr.WC ave.					3	3	3	2	2	3	3	4	4	4	4	5	5	4	4	4	2	2	3	3	3	2	4	4	5	5

05* = August 2005.
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 2005).

FIGURE 7. Watercraft and total manatee mortality in Duval County, Florida 1976–September 2005.



	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*
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	62
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	317
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	75

05* = August 2005.
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 2005).

FIGURE 8. Watercraft and total manatee mortality in Florida 1976–September 2005.

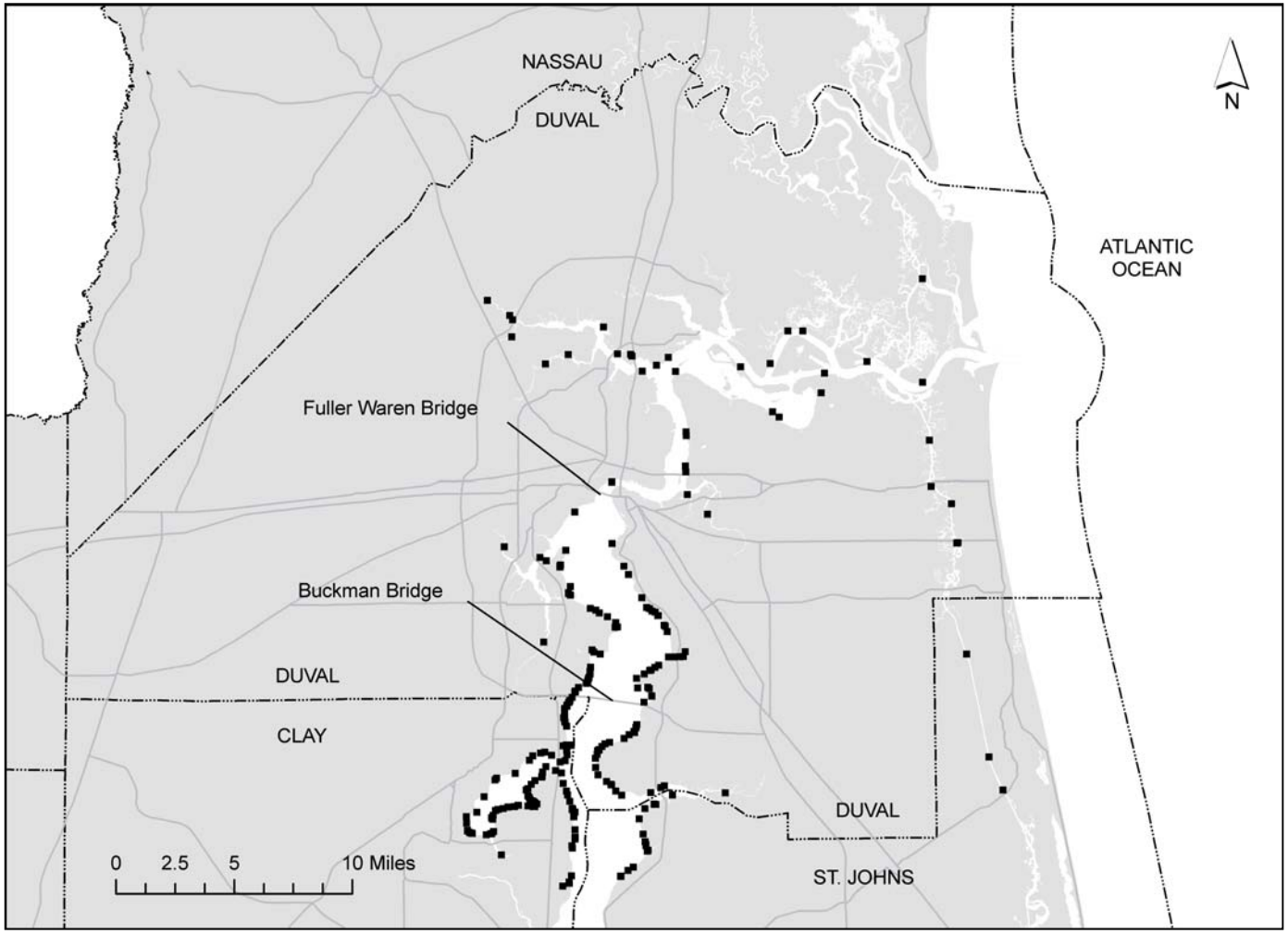
Aerial sightings of manatees

1. The following maps show manatee distribution from **Summer 2004–Summer 2005.**

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

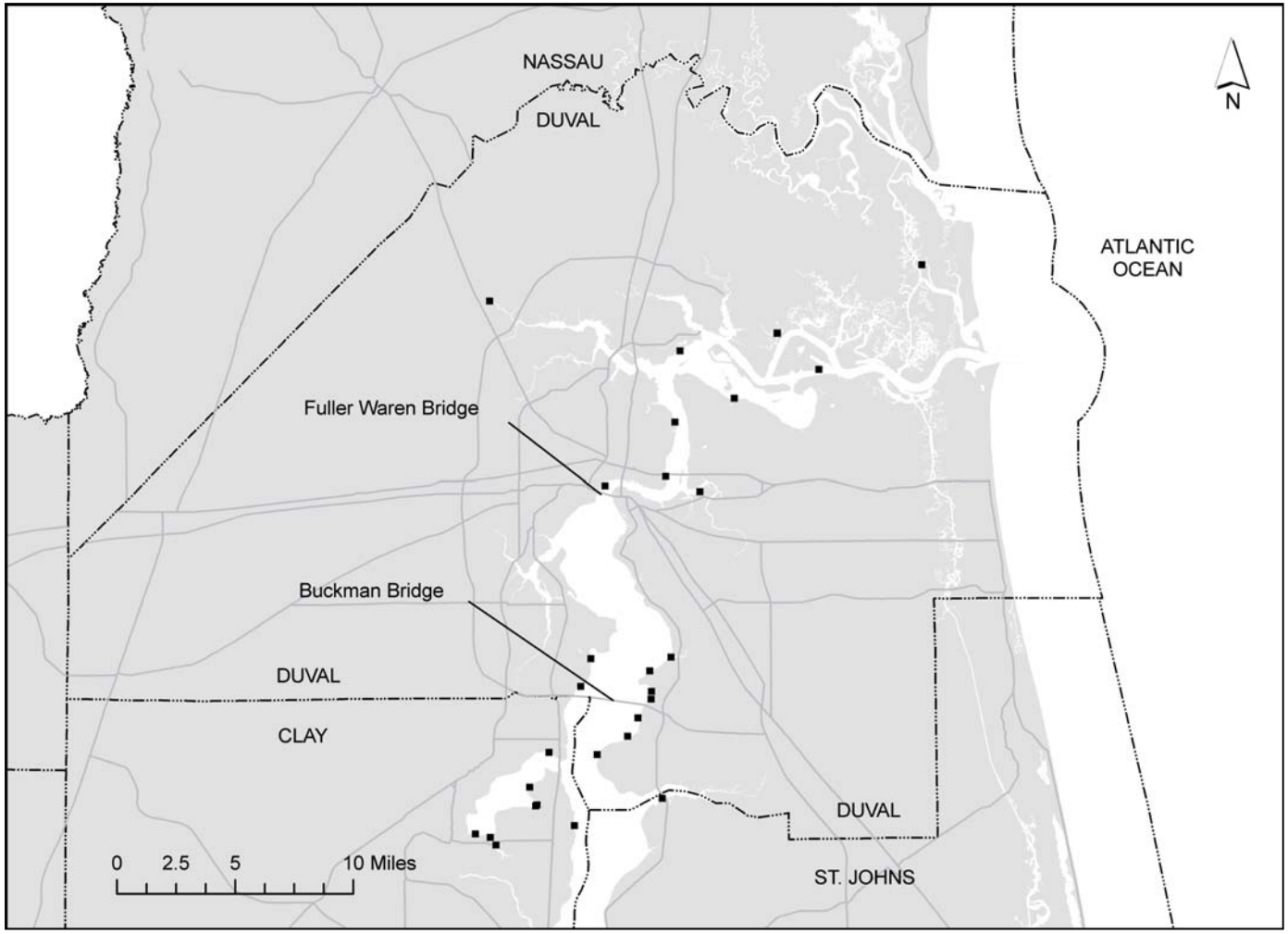
SERIES A - MANATEE AERIAL SIGHTINGS

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2004).



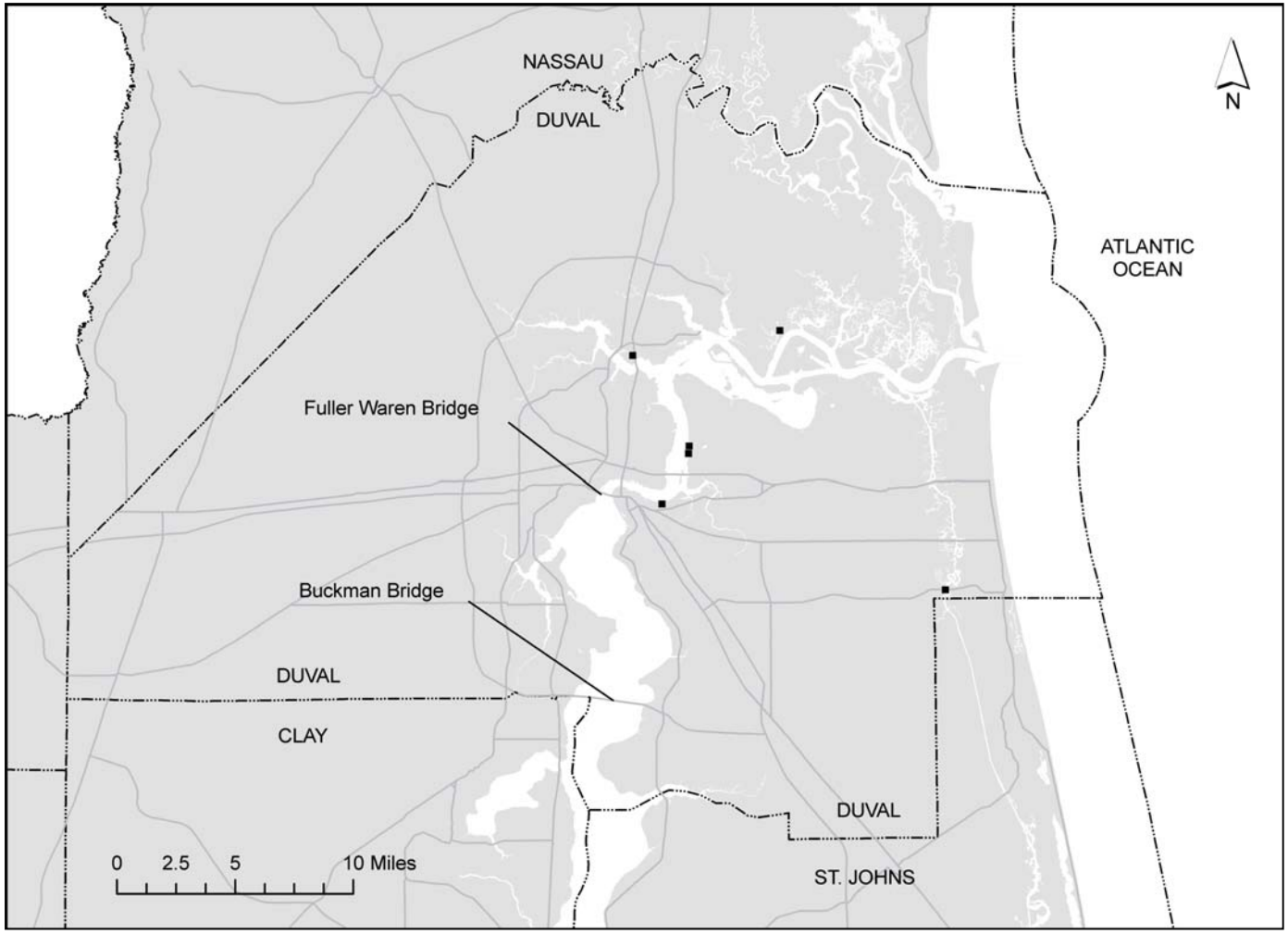
Source: Jacksonville University 2005.
Note: Each dot represents the location of a sighting, not the number of manatees sighted.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Fall, 2004).



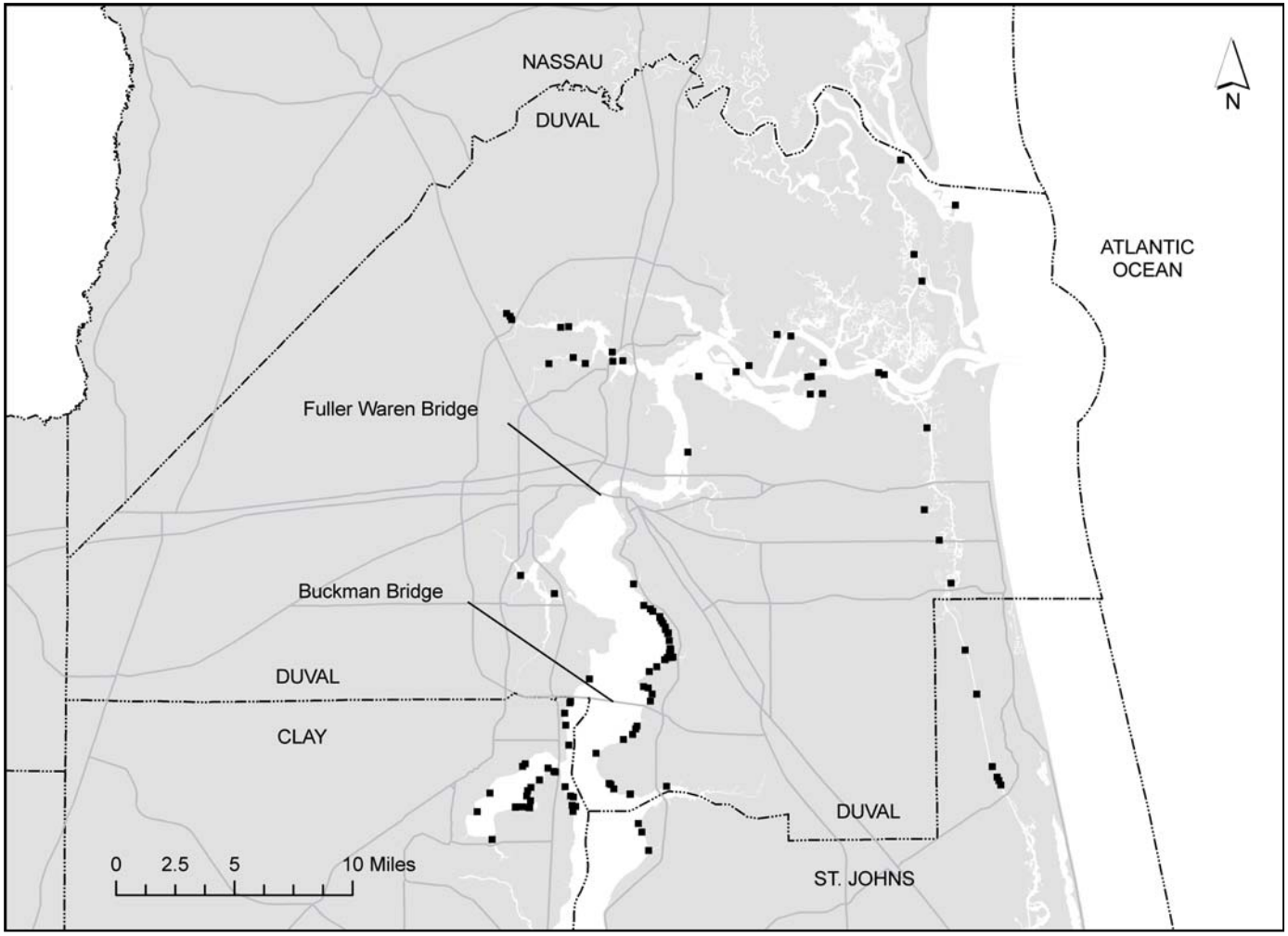
Source: Jacksonville University 2005.
Note: Each dot represents the location of a sighting, not the number of manatees sighted.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Winter, 2004).



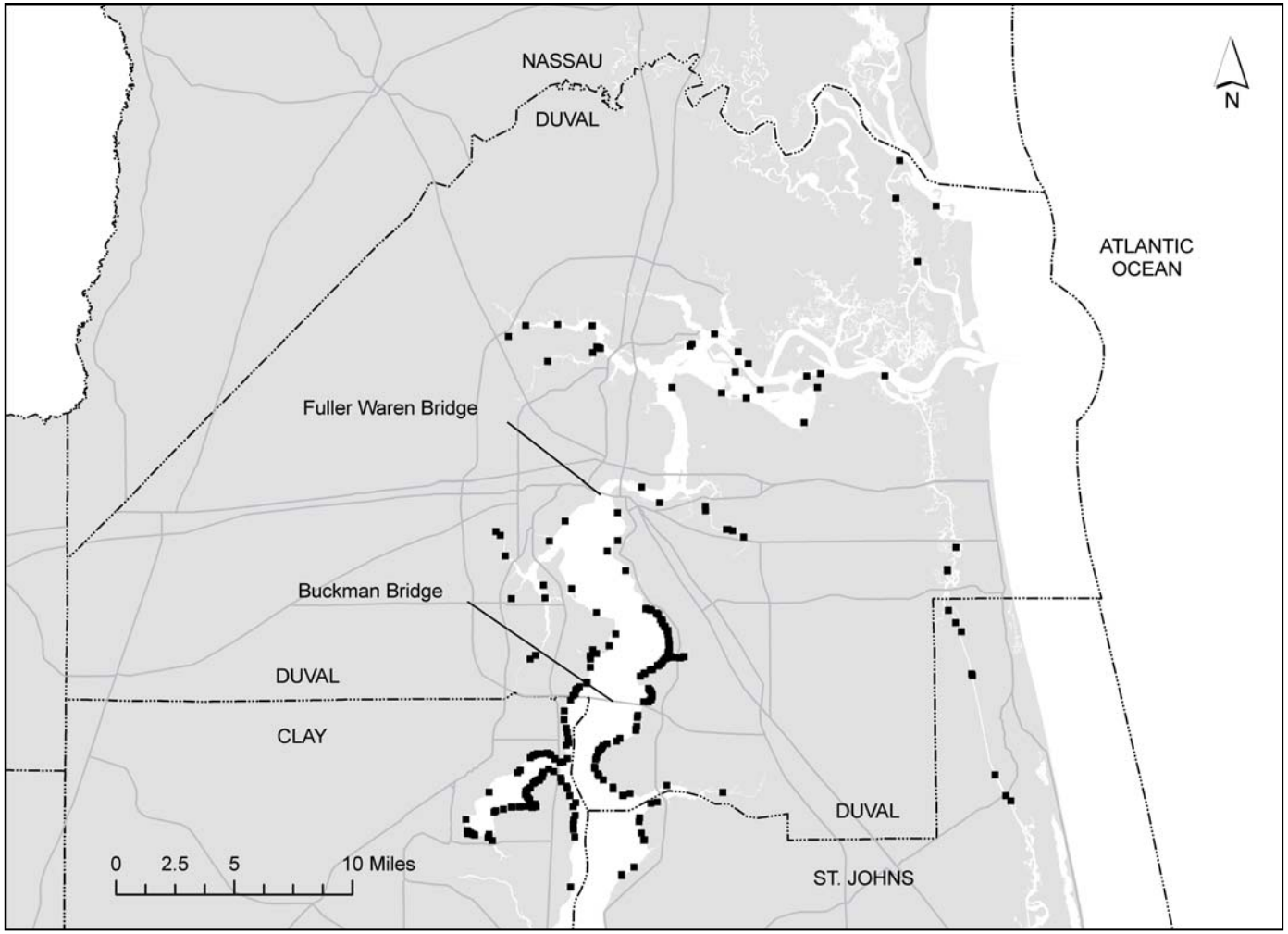
Source: Jacksonville University 2005.
Note: Each dot represents the location of a sighting, not the number of manatees sighted.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Spring, 2005).



Source: Jacksonville University 2005.
Note: Each dot represents the location of a sighting, not the number of manatees sighted.

SERIES A – Manatee aerial sightings, Duval Co., FL. (Summer, 2005).



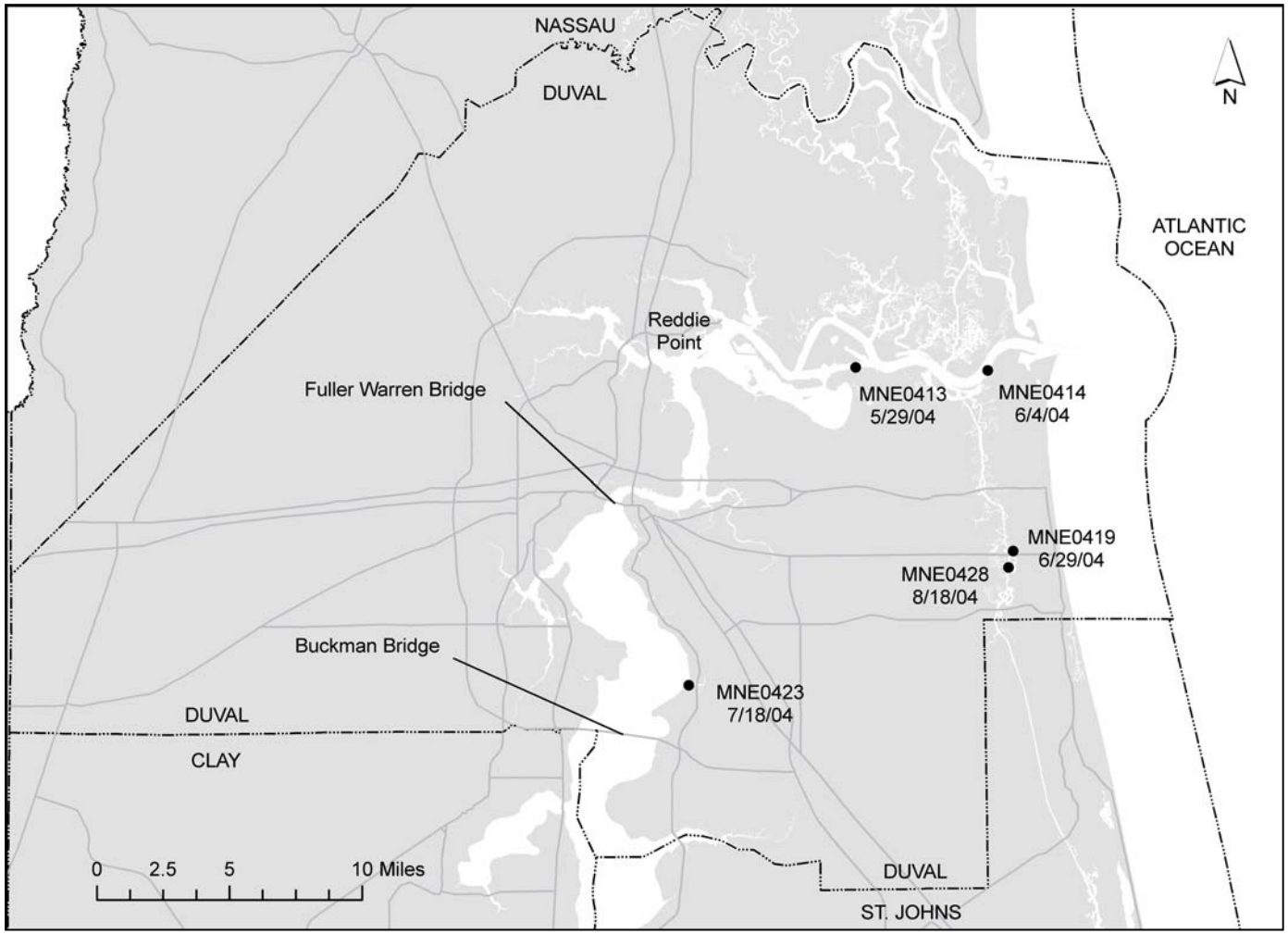
Source: Jacksonville University 2005.
Note: Each dot represents the location of a sighting, not the number of manatees sighted.

Manatee mortality

1. Watercraft manatee mortality 2004, Duval Co., FL. (Map).
2. Manatee deaths from all causes, Duval Co., FL. 2004. (Map).
3. Manatee deaths from all causes, Duval Co., FL. 2004. (Table).
4. Watercraft manatee mortality September 2005, Duval Co., FL. (Map).
5. Manatee deaths from all causes September 2005, Duval Co., FL. 2005 (Map).
6. Manatee deaths from all causes September 2005, Duval Co., FL. 2005 (Table).

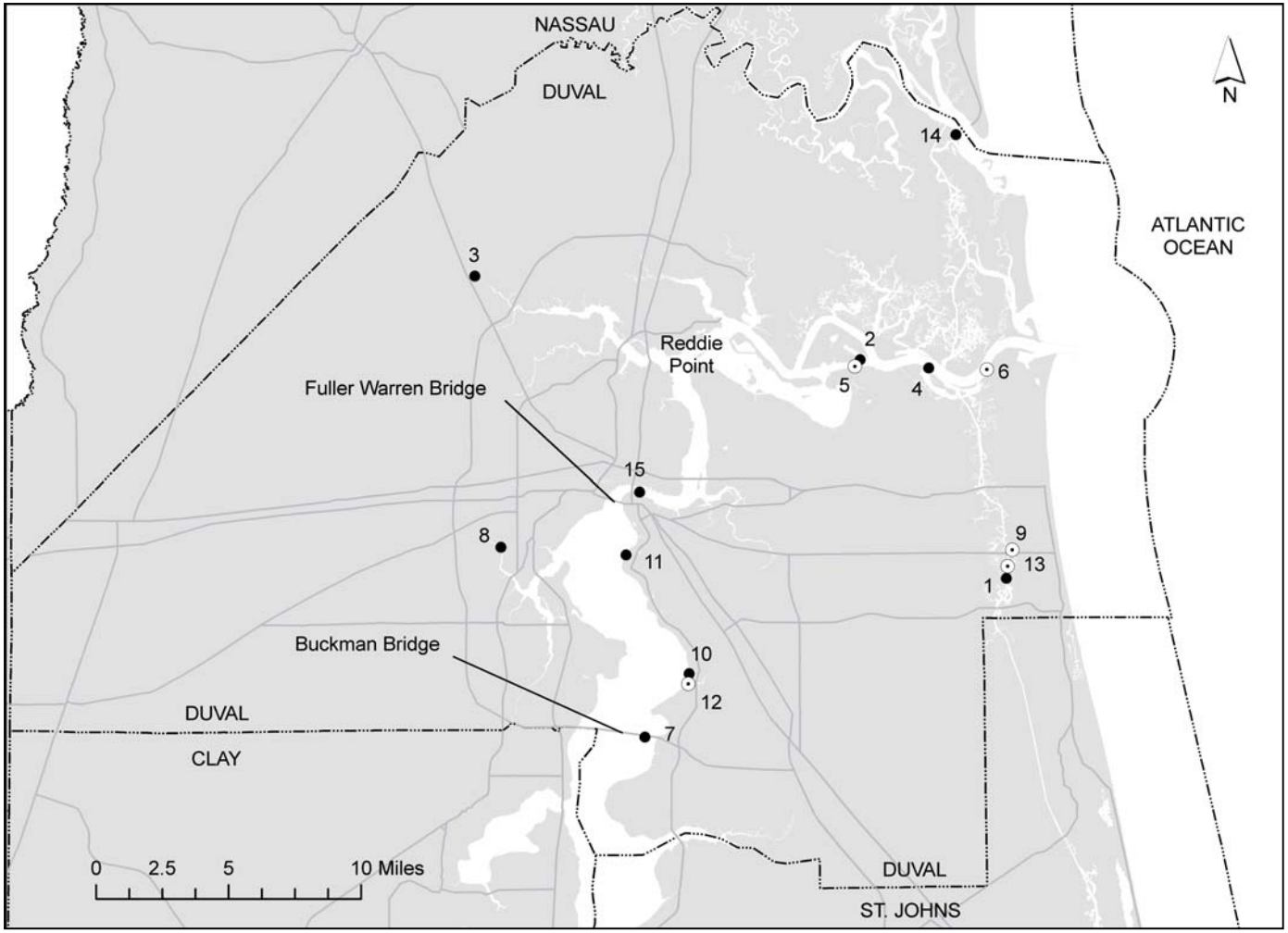
SERIES B – MANATEE MORTALITY

SERIES B – Watercraft manatee mortality, Duval Co., FL. 2004.



Source: FWRI 2005.

SERIES B – Manatee deaths from all causes, Duval Co., FL. 2004.



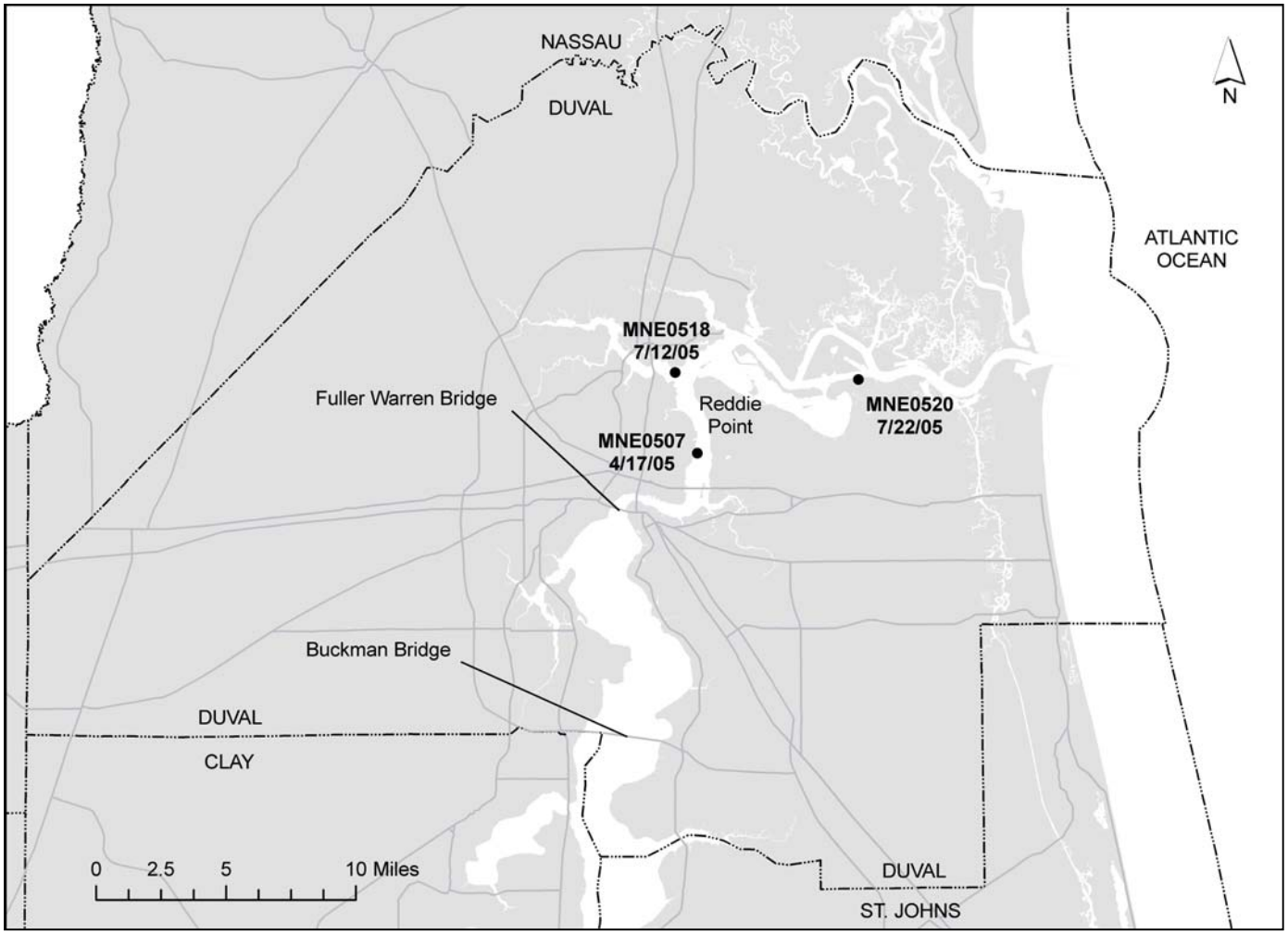
Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2005.

Table 10. Manatee deaths from all causes in 2004, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total length	Mortality category
1	1/6/2004	MNE0401	M	198	5-Natural-Cold Stress
2	1/14/2004	MNE0403	M	170	8-Undetermined
3	4/18/2004	MNE0408	M	127	4-Perinatal
4	5/9/2004	MNE0410	M	291.6	8-Undetermined
5	5/29/2004	MNE0413	F	307	1-Watercraft
6	6/4/2004	MNE0414	M	292	1-Watercraft
7	6/8/2004	MNE0415	F	330	8-Undetermined
8	6/27/2004	MNE0418	F	128	4-Perinatal
9	6/29/2004	MNE0419	F	301	1-Watercraft
10	7/7/2004	MNE0420	M	135	4-Perinatal
11	7/12/2004	MNE0421	F	137	4-Perinatal
12	7/18/2004	MNE0423	M	270	1-Watercraft
13	8/18/2004	MNE0428	M	295	1-Watercraft
14	9/7/2004	MNE0430	F	285	8-Undetermined
15	9/16/2004	MNE0431	F	337	8-Undetermined

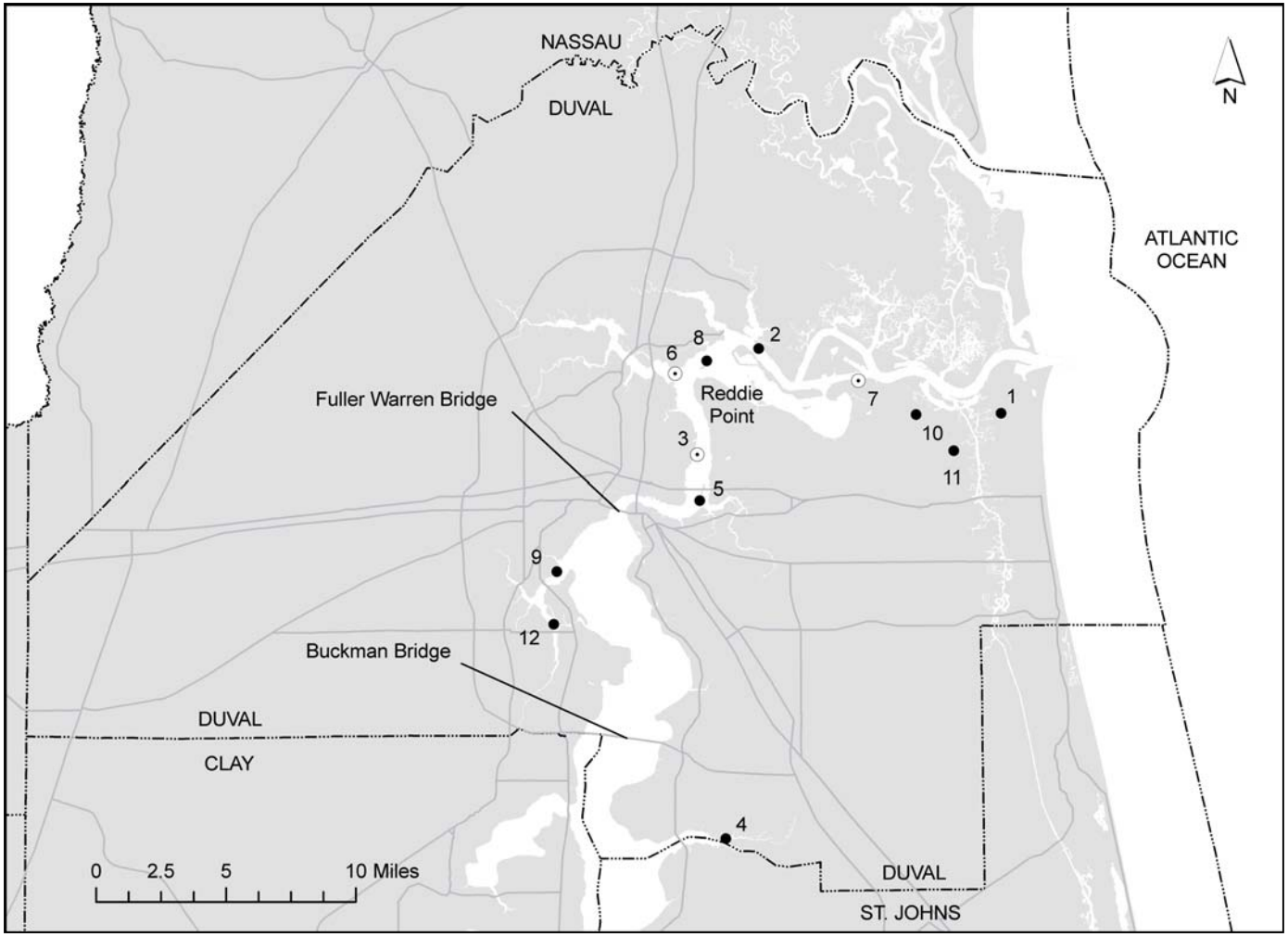
Source: FWRI 2005.

SERIES B – Watercraft manatee mortality, Duval Co., FL. 2005.



Source: FWRI 2005.

SERIES B – Manatee deaths from all causes, Duval Co., FL. 2005.



Dots surrounded with a white border are watercraft mortalities.
Source: FWRI 2005.

Table 11. Manatee deaths from all causes in 2005, Duval Co., FL.

Count	Date	Manatee field ID	Sex	Total length (cm)	Mortality category
1	1/20/2005	MNE0502	M	237	8-Undetermined
2	2/17/2005	MNE0504	F	240	5-Cold Stress
3	4/17/2005	MNE0507	F	314	1-Watercraft
4	5/8/2005	MNE0512	M	124	4-Perinatal
5	7/9/2005	MNE0517	M	318	8-Undetermined
6	7/12/2005	MNE0518	M	289	1-Watercraft
7	7/22/2005	MNE0520	M	312	1-Watercraft
8	8/8/2005	MNE0522	F	255	8-Undetermined
9	8/13/2005	MNE0524	M	301	8-Undetermined
10	8/14/2005	MNE0525	M	182	8-Undetermined
11	8/18/2005	MNE0523	M	152	4-Perinatal
12	8/22/2005	MNE0526	F	353	8-Undetermined

Source: FWRI 2005.