PHOTO-IDENTIFICATION AND AERIAL SURVEYS OF FLORIDA MANATEES (*Trichechus manatus latirostris*) IN MANATEE COUNTY WATERS

2007-2008 FINAL REPORT

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Introduction:

The Florida manatee (*Trichechus manatus latirostris*) is an herbivorous marine mammal that inhabits the coastal waters of Florida and adjoining states (Reynolds and Odell 1991, Reynolds and Powell 2002). Manatees have inhabited Florida waters since the Pleistocene epoch, nearly 1.5 to 1.1 million years ago (Dawson 1967, Domning 2001). All of the four living species of Sirenia are vulnerable to extinction, mostly due to over-harvesting for food and other products, incidental mortality as a result of human activities, and loss of habitat. The Florida manatee is currently listed as an endangered species by the U.S. government (U.S. Fish and Wildlife Service [USFWS] 2001) and is protected under federal law by the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Manatees are also protected under the Florida Manatee Sanctuary Act of 1978.

Despite protective legislation, the loss of valuable habitat and increasing mortality from both human-related activities, notably watercraft collisions, and natural causes threaten the recovery of the Florida Manatee (Reynolds 1999, USFWS 2001). Manatees in southwestern Florida are particularly vulnerable, as they are impacted by *both* natural mortality due to red tides and human activities (e.g., intensive coastal development and boating). The manatee subpopulation in southwestern Florida is the only one, of four, in the state to possibly experience a decline in recent years (Runge et al. 2004).

Within Florida, the southwestern region has experienced the fastest growth in human population every decade since 1960 (Smith 2005). Managers are confronted with the difficult problem of accommodating human population growth, while preserving the natural resources that, in part, promote such growth. Conflicts between manatees and

human residents of coastal areas of Florida are common because humans enjoy recreational and commercial use of the same habitats that manatees need for feeding, resting, mating and traveling. The possibility of a balance between preservation and conservation has recently become clear, as the State of Florida found compelling reason to believe that the status of manatees statewide has improved sufficiently to propose downlisting the subspecies from endangered to threatened under state statutes.

Resolution of potential conflicts and achieving a balance between human population growth and maintenance of natural resources requires that informed decisions be made. Thus, the collection and rigorous analysis of scientific data can provide vital information to managers and policy makers. To promote informed decision making, Manatee County administrators provided funding to permit the conduct of aerial surveys and photo-identification (photo-ID) to establish baselines and to help monitor manatee populations in the county's coastal waters. Aerial surveys provide information on relative abundance and habitat preferences of manatees, whereas photo-identification and subsequent analysis permit assessments of population structure, site fidelity, movement and travel patterns, life history and reproductive traits, and adult survival rates (e.g. Ackerman 1995, Beck and Reid 1995, Langtimm et al. 2004, O'Shea and Ackerman 1995).

This report provides sighting data from a third year of aerial surveys over Manatee County waters and a summary of photo-identification efforts conducted at specific sites during the 2007-2008 contract year. Comparisons in data among the three study years are also discussed.

Methods:

Aerial-Surveys:

Mote Marine Laboratory's Manatee Research Program staff conducted standardized manatee surveys of the inshore and nearshore waters of Manatee County (Figure 1). A single engine, high-winged Cessna 172 aircraft was flown at an average altitude of 850 ft, and a speed of 90 knots. Flights generally lasted 4-5 hours. Surveys were only flown on days when wind and weather conditions were conducive to effective counting. An experienced primary observer occupied the front, right seat of the aircraft and surveyed with the right window open to reduce glare and increase visibility. Whenever possible, a second observer occupied the right rear seat to help verify counts and scan the water while the primary observer recorded data. All pilots had previous manatee aerial survey experience as well. On a few occasions surveys were flown using a Cessna 182, which had a sealed right window. Therefore, the primary and secondary observers occupied the left side of the aircraft (to survey through the open window) and the pilot operated from the right front seat. The direction of travel was reversed for these flights to accommodate left-side surveying; however the general survey route remained consistent across surveys.

The primary observer plotted manatee sightings on photocopied maps of the study area with shoreline, bathymetry and aids to navigation. Flight tracks were recorded using a GARMIN GPSMAP® 76. For each sighting, the observer recorded the number of manatee adults and calves, direction of travel (if any), time, and whenever possible, behavior and habitat. The information recorded on the maps was later transposed into a computerized Geographic Information System (GIS) database using ArcGIS v9.3.

Photo-Identification (Photo-ID):

Photo-ID crews conducted surveys from 6-7 meter outboard motorboats, shorelines, bridges, or docks. Vessels were equipped with observation towers, propeller guards and electric trolling motors to minimize disturbance to the manatees. The primary observer operated a Canon EOS 10D, EOS 20D, or EOS 40D digital camera with 6.3, 8.20, and 10.1 respective mega pixel resolution and fitted with a 75-300 mm zoom lens with a polarizing filter. All images were taken in RAW format with embedded jpegs.

A field day included one or more sites surveyed on a single day. A sighting was defined as all individuals at a geographically distinct location (*i.e.,* canal, bayou, harbor, boat basin) within an approximately 0.1 – 2.5 km^2 area at the same time. For each sighting, distinctive manatees were photographed to document scars and mutilations on the body and tail. Observers sketched scar patterns and other features on data sheets for each individual and recorded its location, habitat, size class, gender (noted when either the ventrum or a nursing calf was observed) and photographic exposures taken during the sighting. Crews also recorded environmental data, such as weather, water and air temperature, depth, salinity, wind direction and speed, and photo conditions.

Results:

Aerial Surveys:

Manatee Research Program staff conducted 19 aerial surveys between 11 October 2007 and 16 September 2008 (Table 1). Two of these surveys (2/28/2008 and 6/12/2008) had to be aborted before completion due to deteriorating weather conditions.

Counts of manatees were influenced by the time of year and survey conditions (i.e., cloud cover, sea-state, and visibility) during each flight. Total counts varied considerably over the course of a year, with the highest count occurring in spring (135 manatees, 21 April 2008) and the minimum counts occurring in winter (1 manatee, 15 January and 28 January 2008). Manatee sightings generally decreased from fall to winter as water temperatures dropped below 18 ^{o}C. By early April, water temperatures warmed to greater than 21^{o}C and total manatee counts rapidly increased through the spring. Counts remained high but variable from spring to summer.

Manatee sightings for all months combined show that manatees inhabit virtually all of Manatee County's waterways during some portion of the year (Figure 2). However, when sightings are compared among seasons, a shift in distribution is evident. Summer sightings in 2008 (June, July and August) were widely distributed throughout the county, with sightings in the Gulf of Mexico, the Manatee and Braden rivers, eastern Tampa Bay, Terra Ceia Bay, Palma Sola Bay, Anna Maria Sound and North Sarasota Bay (Figure 3). Fall distribution (October and November 2007 and September 2008) was also widespread, although sightings within the Manatee and Braden Rivers were fewer (Figures 4 and 5). Winter sightings were few but widespread, with sightings in Terra

Ceia Bay, the Manatee River, Palma Sola Bay, and a single sighting in the Braden River (Figure 6). Distribution was widespread once again during the spring (Figure 7).

Large groups of manatees (>12), possibly representing mating herds, were most often seen during the spring and summer months, particularly within Palma Sola Bay and the Manatee River. Sightings with calves occurred regularly, though least frequently during winter (Table 1). Inshore protected areas such as Terra Ceia Bay, Palma Sola Bay, Northern Sarasota Bay and the Manatee and Braden rivers appeared to provide important habitat for mother and calf pairs (Figures 8 – 12).

Photo-Identification:

Photo-identification (photo-ID) studies were conducted in fall 2007, suspended during the winter months when animals were less frequent, and resumed again in the spring of 2008. From 11 October 2007 to 16 September 2008, 48 surveys of over 20 sites were completed (Appendix A).

Over 1,700 digital images taken during these sightings are currently being sorted and analyzed. Preliminary sorting has shown that animals documented previously in Sarasota Bay, Tampa Bay, and Fort Myers were photographed in Manatee County waters again this year. There were also a number of unknown but distinctly marked individuals repeatedly sighted in Palma Sola Bay, Terra Ceia Bay, and north Sarasota Bay. Once all of the images have been sorted to determine if they are of known animals catalogued from other locations in previous years, sighting information will be entered into MIPS (Manatee Individual Photo-identification System), a state-wide computerized database for manatee photo-identification data. Distinctive animals that are not identified as being cataloged in previous years will either be cataloged and entered in MIPS, or classified as

"Distinct Unknown" (DU). The DU animals may then be matched to individual manatees in future field seasons.

Discussion:

Aerial Surveys:

The mean monthly counts for the 2007-2008 contract year are generally similar to those from the previous contract years (2005-2006, 2006-2007) with a few exceptions (Figure 13). For all years, mean counts rose steadily from early spring through summer. In 2005 and 2006, sightings peaked in October, and then decreased rapidly from November through January. Though there is a gap in late summer and early fall data for 2007, the trend for late fall through winter appears to be very similar. In each year, the winter low counts are followed by a sharp increase during February and March. As discussed in the 2005 - 2006 final report, the prolonged and re-occurring red tide events that plagued much of 2005 may have led to a reduction of animals using the area during the summer and fall. Although *Karenia brevis* blooms did occur during fall 2006, the red-tide event was much less intense and not as widespread as 2005; therefore fall counts for the second study year likely reflect more "normal" conditions. In 2007 and 2008, there were no red tide events that impacted the study area.

Few comparisons can be made among years of the study for late spring and summer, as mean counts from these months appear to be highly variable. During year three of the study, counts jumped in mid-spring, peaking at their greatest level over the entire three year survey period. The mean count from April 2008 (135 manatees) was more than two-fold greater than the 2007 average count (62). Surveys in May 2008 also

produced the highest mean count for that month (128 manatees) over the three year study. In 2008, as in 2007, the mean count of manatees decreased from May to June, as compared to an increase between these two months in 2006 (Figure 13). The mean counts from June 2008 were similar to those of previous years, slightly lower than 2007, but slightly higher than 2006. The mean counts from July and August of 2008 varied from those observed during the same period in 2006, higher and lower respectively. The variability in late spring and summer counts could be the result of variability in environmental conditions. Water clarity, turbidity, surface choppiness and surface glare, all affect the visibility of manatees (Reynolds and Wilcox 1994) and influence counts. This is particularly true during spring and summer months, when increased rainfall and extensive plankton blooms decrease water visibility. These environmental factors can mask the effect of other significant events, such as severe red-tide blooms or intense tropical storms. Long-term aerial surveys provide the best solution to identifying trends in relative abundance and distribution within a specific region, as well as in providing correlations between environmental conditions and counts.

Seasonal distribution results for the third year of the study are similar to those reported for the previous years. With the exception of winter months, manatees were widely distributed throughout Manatee County waters in relatively high numbers. Manatees likely sought warm-water refuges outside of the county during the coldest weeks of winter (January and February), but continued to use areas that serve as important feeding grounds within Manatee County sporadically during warm spells. The 2007-2008 winter season was particularly mild, with only a few cold fronts occurring in late January. This may account for slightly higher counts in late fall and early winter.

During the winter of 2007-2008 there were also many more sightings of manatees with calves (14 sightings) as compared to 2006-2007 (2 sightings) and 2005-2006 (9 sightings). The "peak" in total counts during fall and spring was likely due to the migration of animals through the area as they traveled between their summer feeding grounds and winter warm-water refuges. During summer months, total counts were moderate to high as manatees dispersed throughout the county to areas that provide forage, access to fresh water, and quiet for calving and resting.

Once again, the higher concentrations of sightings and/or larger group sizes in areas such as Palma Sola Bay, Terra Ceia Bay, and the Manatee and Braden rivers show a preference by manatees for these locations. Terra Ceia and Palma Sola bays have extensive sea grass beds and deep-water canals and basins that are ideal habitat for feeding and resting. Both Terra Ceia Bay and Palma Sola Bay have fresh water input from small streams and, therefore, provide manatees with access to lower-salinity waters for drinking. In fact, animals in the Palma Sola Yacht Club boat basin have been observed swimming upstream over the basin dam with their mouths open. Salinities in this basin reached as low as 8 ppt. The Manatee and Braden rivers are obviously a significant source of freshwater for manatees; however, these locations provide limited access to forage.

Photo-Identification:

Photo-ID surveys of manatees documented distinctly marked manatees, both cataloged and unknown, repeatedly in specific locations throughout the county. It is evident from these and aerial surveys that manatees prefer specific locations within Manatee County. For example, the Palma Sola Yacht Club boat basin remained a

constant destination for manatees during the non-winter months despite dredging activity conducted from September through November 2007.

Upon completion of slide analyses, data will be used to update, expand, and improve the collaborative statewide scar catalog (MIPS), and establish sighting histories for new, distinctive individuals. Such information will be useful for managers gaining a greater understanding of life-history parameters and critical habitat needs for manatees within southwest Florida.

Conclusions:

The research efforts supported by Manatee County over the last three years have allowed scientists to discern a seasonal trend in abundance of manatees and define high-use areas by manatees within county waters. This information is useful to managers who wish to guide development activities in a manner that minimizes impacts to manatees. However, given inter-annual variation in weather, environmental conditions, and manatee behavior, additional years of work are needed to confirm trends and establish norms. For example, recent analyses of twenty years of aerial survey data from Sarasota County have shown complicated trends in abundance of manatees spanning over periods of five or more years. Population survey and monitoring are necessary tools for understanding changes in size and distribution, which ultimately is the key to conservation. We commend Manatee County administrators for initiating research in an effort to provide information that facilitates an effective balance between human population growth and sustainability of manatees in county waters.

References:

Ackerman, B.B. 1995. Aerial surveys of manatees: A summary and progress report. Pages 13-33 in T.J. O'Shea, B.B. Ackerman and H.F. Percival, eds. Population biology of the Florida manatee. U.S. Department of the Interior, National Biological Service Information and Technology Report 1.

Beck, C.A. and J.P. Reid. 1995. An automated photo-identification catalog for studies of the life history of the Florida manatee. Pp. 120-134. *In* T.J. O'Shea, B.B. Ackerman, and H.F. Percival (eds.). Population Biology of the Florida Manatee. U.S. Fish and Wildlife Service, National Biological Service, Information and Technology Report 1. 289 pp.

Dawson, M.R. 1967. Fossil history of the families of recent mammals, order Sirenia. Page 45 in S. Anderson and J. K. Jones, Jr. (eds.). Recent Mammals of the World. A Synopsis of Families. Ronald Press Co., New York. 453 pp.

Domning, D.P. 2001. Sirenians, seagrasses and the Cenozoic ecological change in the Caribbean. Palaeogeography, Palaeoclimatology, Palaeoecology 166:27-50.

Gannon, J.G., K.M. Scolardi, J.E. Reynolds, III, J.K. Koelsch, and T.J. Kessenich. In press. Habitat selection by manatees in Sarasota Bay, Florida. Marine Mammal Science.

Langtimm, C.A., C.A. Beck, H.H. Edwards, K.J. Fick, B.B. Ackerman, S.L. Barton, and W.C. Hartley. 2004. Survival estimates for Florida manatees from the photo-identification of individuals. Marine Mammal Science 20:438-463.

O'Shea, T. J. and B. B. Ackerman. 1995. Population biology of the Florida manatee: an overview. Pp. 280-288. *In* T. J. O'Shea, B. B. Ackerman, and H. F. Percival (eds.). Population Biology of the Florida Manatee. National Biological Service Information and Technology Report 1. 289 pp.

Reynolds, J.E. III. 1999. Efforts to conserve the manatees. Pages 267-295 in: J.R. Twiss Jr. and R.R. Reeves, eds. Conservation and Management of Marine Mammals. Smithsonian Institute Press, Washington.

Reynolds, J.E. III, and D.K. Odell. 1991. Manatees and Dugongs. Facts on File, New York.

Reynolds, J.E., III and J.A. Powell, Jr. 2002. The manatees--Family Trichechidae (*Trichechus manatus, T. senegalensis, and T. inunguis*). Pp. 709-720. IN: W.F. Perrin, B. Würsig, and H. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA.

Reynolds, J.E. III., and J.R. Wilcox. 1994. Observations of Florida manatees (Trichechus manatus latirostris) around selected power plants in winter. Marine Mammal Science 10: 163-177.

Runge, M.C., C.A. Langtimm and W.L. Kendall. 2004. A stage-based model of manatee population dynamics. Marine Mammal Science 20:361-385

Smith, S.K. 2005. Florida Population Growth: Past, Present and Future. Bureau of Economic & Business Research. 02 December 2006: http:// www.bebr.ufl.edu.

U.S. Fish and Wildlife Service {USFWS}. 2001. Florida Manatee Recovery Plan, (*Trichechus manatus latirostris*), Third Revision. U.S. Fish and Wildlife Service. Atlanta, Georgia. 144 pp. + appendices.

Table 1: Total counts for each aerial survey conducted from 11 October 2007 through 16 September 2008. Surveys on 2/28/2008 and 6/12/2008 were aborted before completion due to inclement weather. Weather conditions and water visibility as noted by the primary observer are also shown for each survey date. Bodies of water such as rivers and boat basins typically have poor (<0.5m) visibility; therefore water visibility conditions listed below refer to the enclosed bays and Intracoastal Waterway only. NR: not reported.

SURVEY DATE	# ADULTS	# CALVES	TOTAL	WEATHER	WATER VISIBILITY (NON-RIVER)
10/11/2007	85	14	99	EXCELLENT	EXCELLENT
10/20/2007	63	8	71	GOOD	GOOD
11/9/2007	57	8	65	EXCELLENT	EXCELLENT
12/6/2007	26	2	28	EXCELLENT	GOOD
12/20/2007	19	5	24	EXCELLENT	EXCELLENT
1/15/2008	1	0	1	GOOD	GOOD
1/28/2008	1	0	1	GOOD	GOOD
2/15/2008	26	4	30	EXCELLENT	EXCELLENT
2/28/2008*	31	4	35	GOOD	POOR
3/12/2008	51	8	59	FAIR	FAIR
4/21/2008	121	14	135	GOOD	EXCELLENT
5/6/2008	115	13	127	EXCELLENT	GOOD
5/29/2008	120	9	129	GOOD	GOOD
6/12/2008*	50	5	55	EXCELLENT	GOOD
6/23/2008	115	11	126	EXCELLENT	EXCELLENT
7/7/2008	88	6	94	EXCELLENT	GOOD
7/21/2008	69	10	79	EXCELLENT	EXCELLENT
8/11/2008	57	7	64	EXCELLENT	EXCELLENT
9/16/2008	53	5	58	FAIR	FAIR

Figure 1. Survey area showing general flight path over Manatee County, FL.

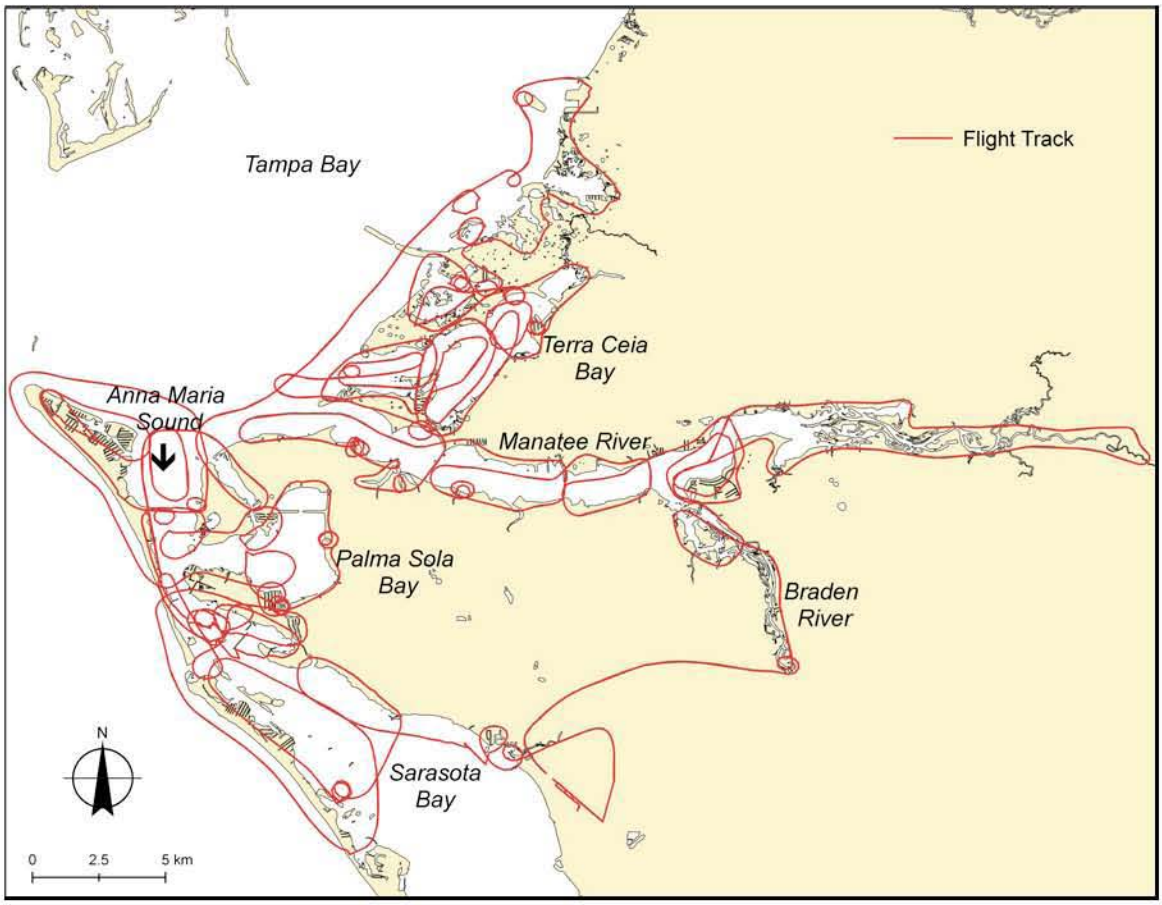


Figure 2. Cumulative manatee sightings from 19 aerial surveys conducted between 11 October 2007 and 16 September 2008 in Manatee County, FL.

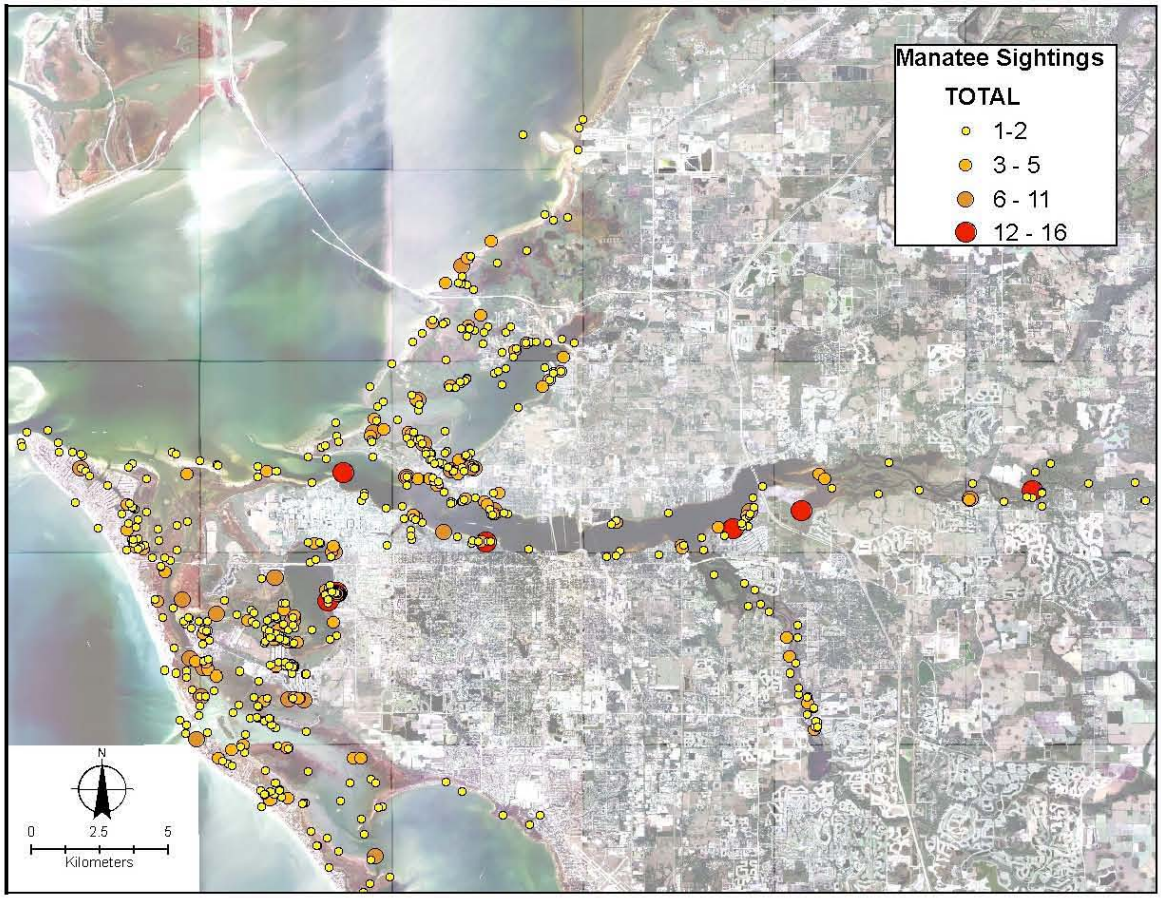


Figure 3. Distribution of manatee sightings during summer (July – August) 2008 in Manatee County, FL.

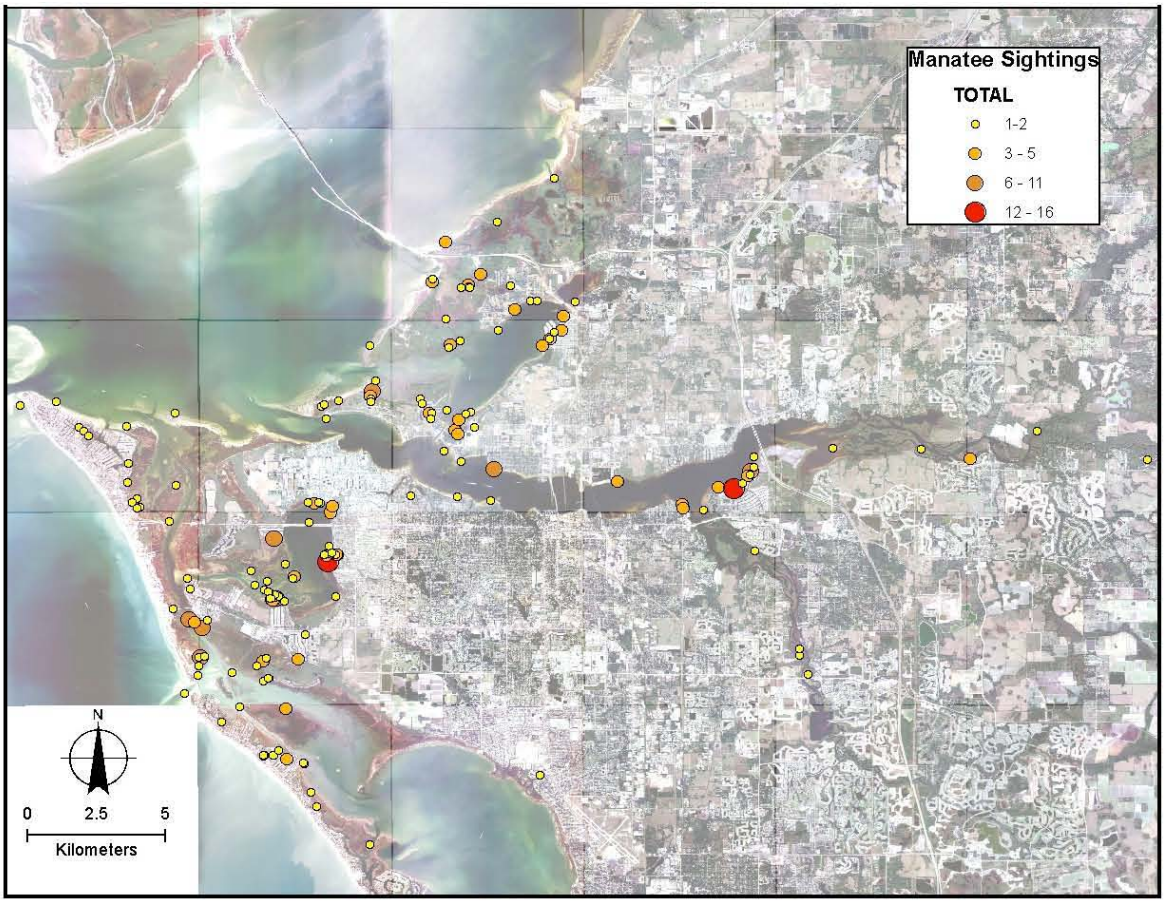


Figure 4. Distribution of manatee sightings during fall (October – November) 2007 in Manatee County, FL.

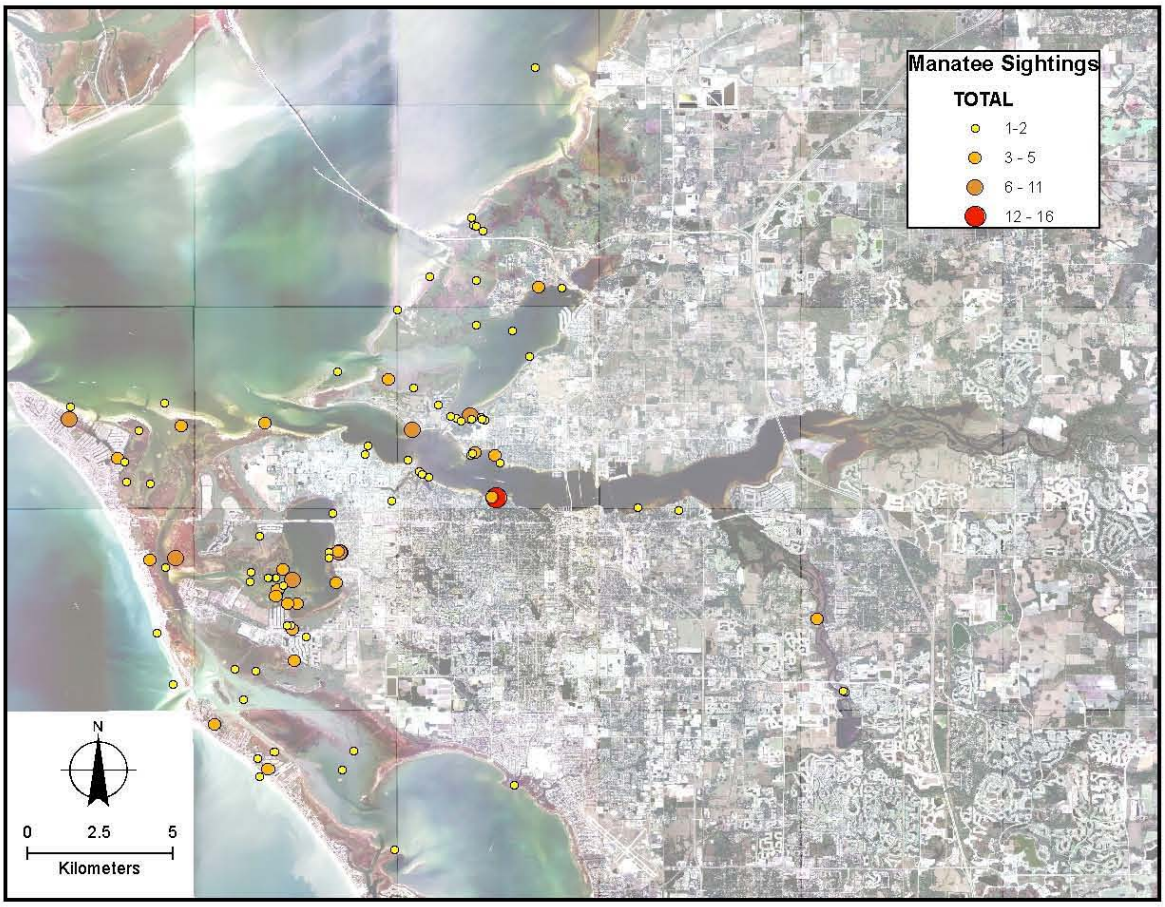


Figure 5. Distribution of manatee sightings during fall (September) 2008 in Manatee County, FL.

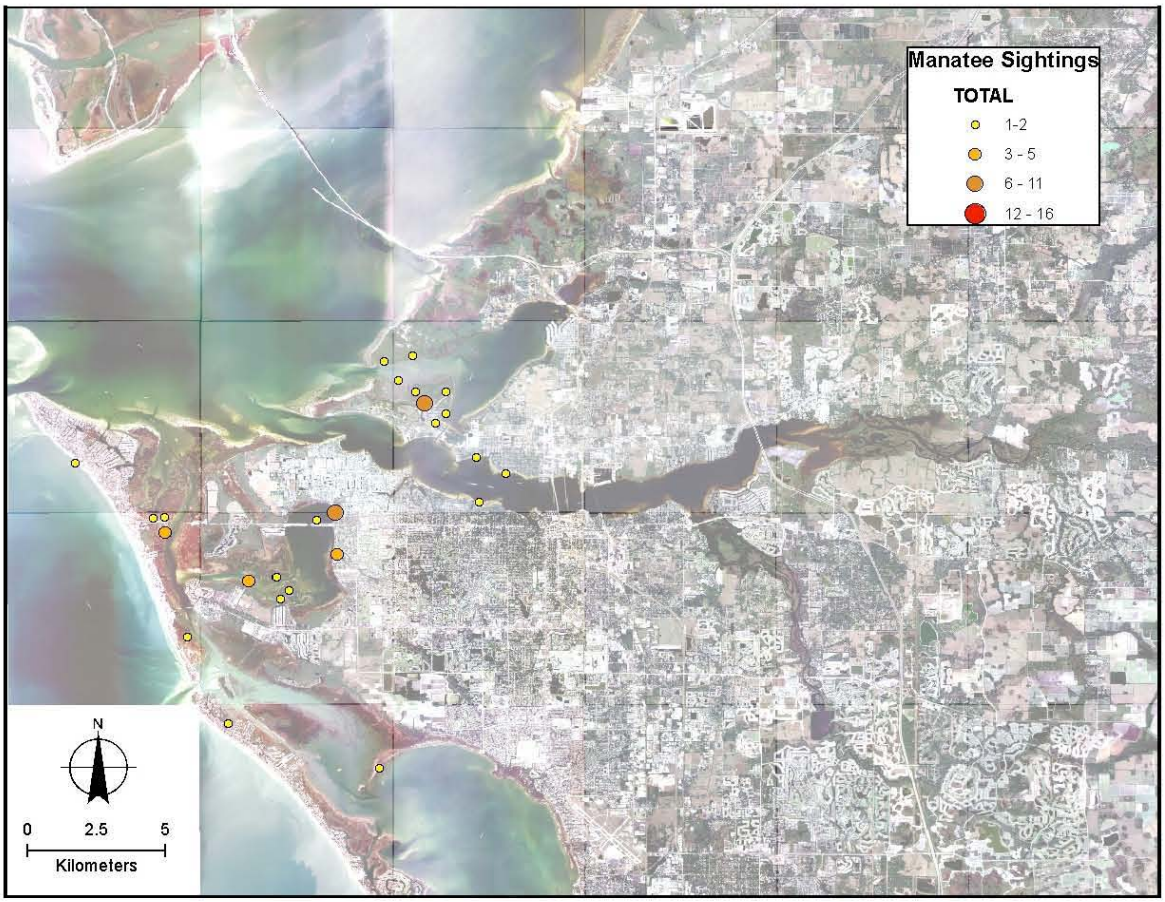


Figure 6. Distribution of manatee sightings during winter (December – February) 2007-2008 in Manatee County, FL.

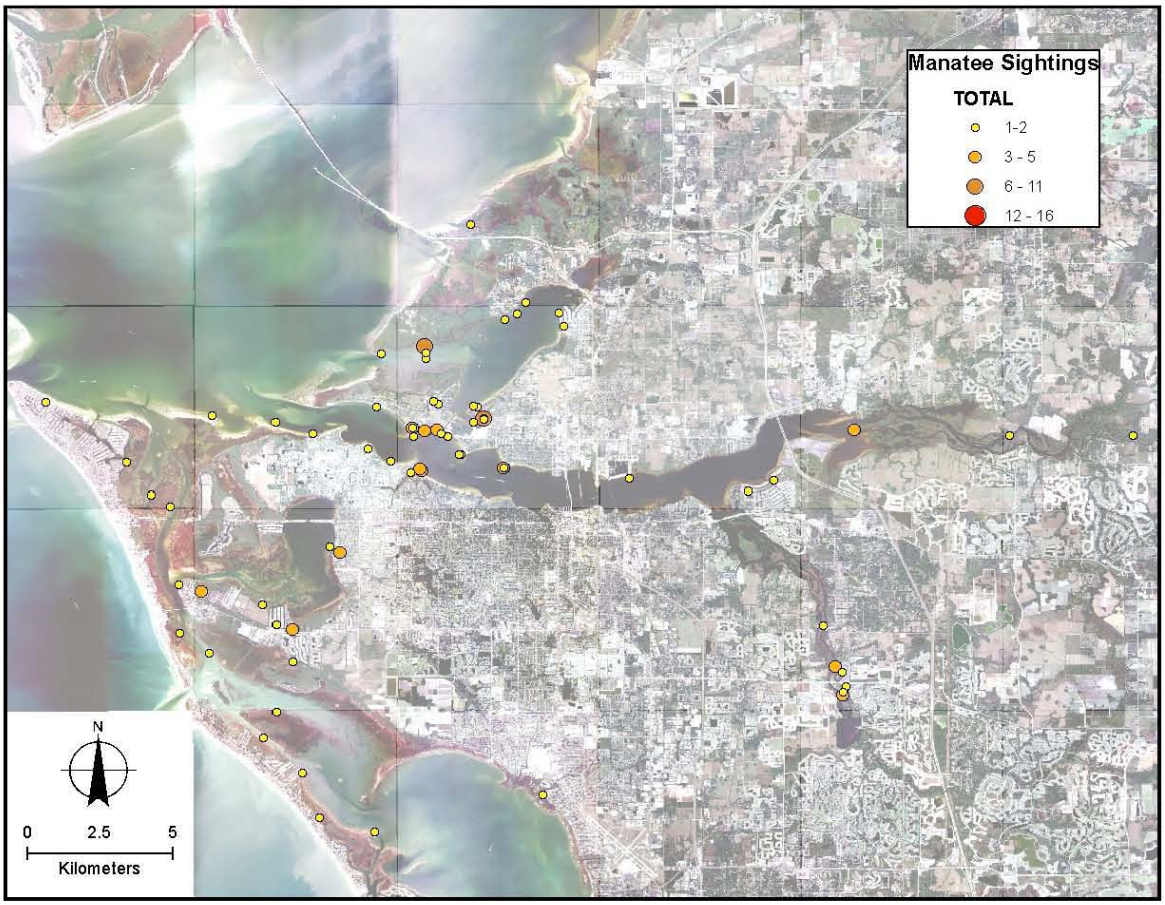


Figure 7. Distribution of manatee sightings during spring (March – May) 2008 in Manatee County, FL.

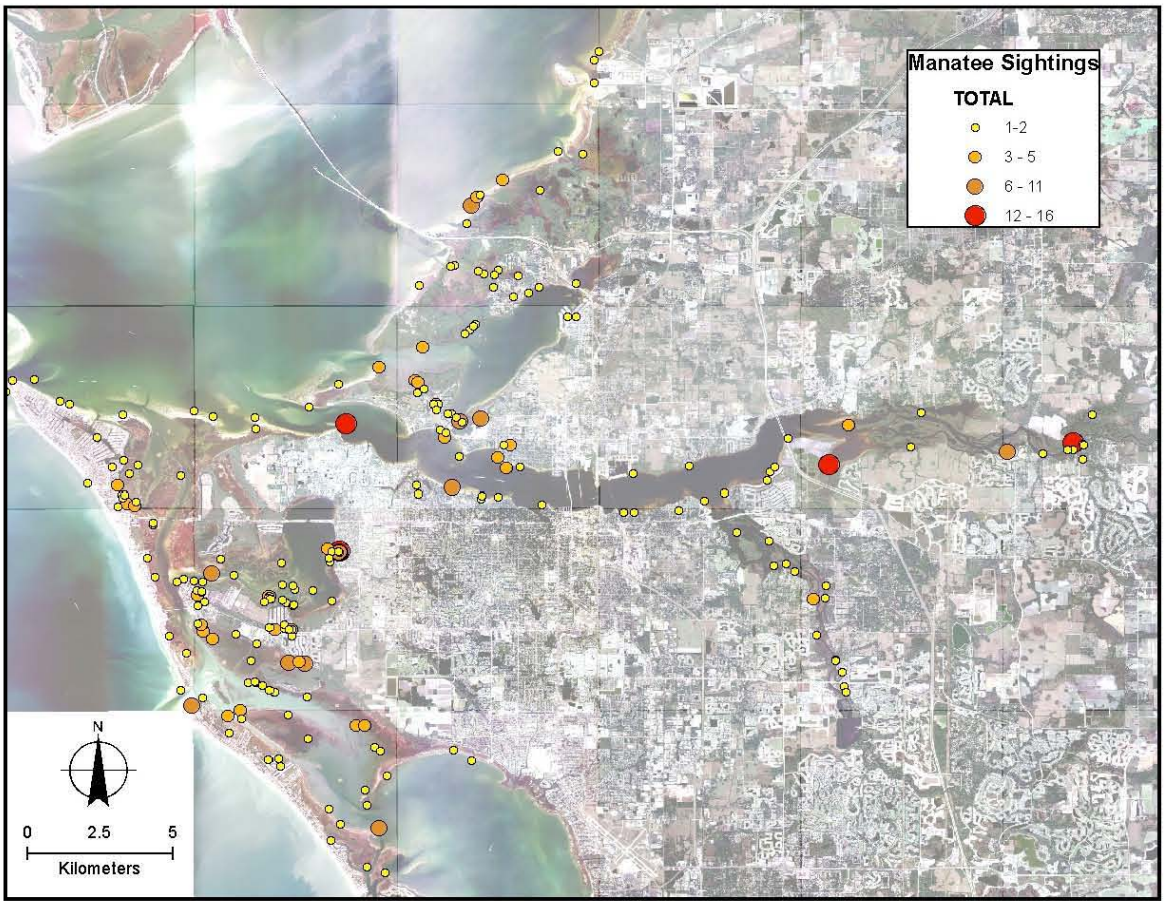


Figure 8. Distribution of manatee sightings with calves during summer (July – August) 2008 in Manatee County, FL.

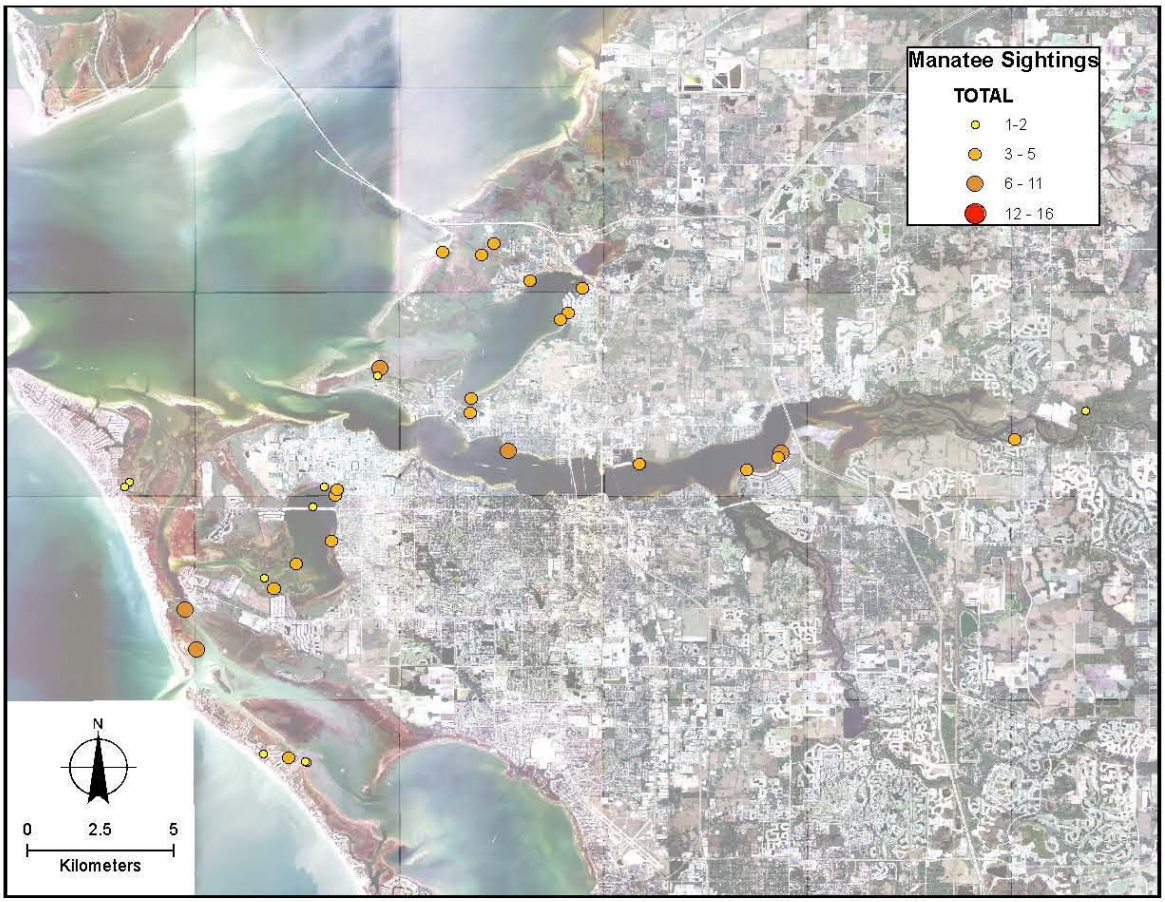


Figure 9. Distribution of manatee sightings with calves during fall (October-November) 2007 in Manatee County, FL.

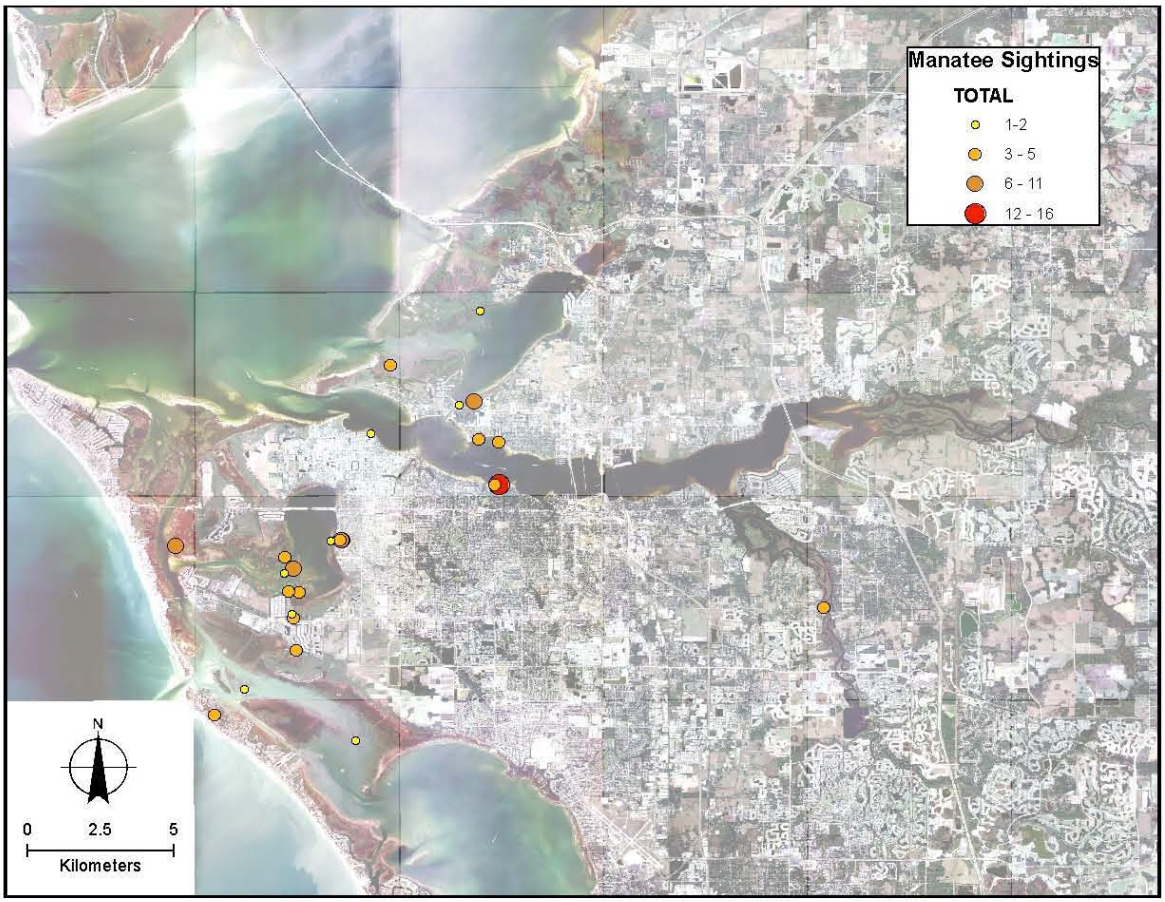


Figure 10. Distribution of manatee sightings with calves during fall (September) 2008 in Manatee County, FL.

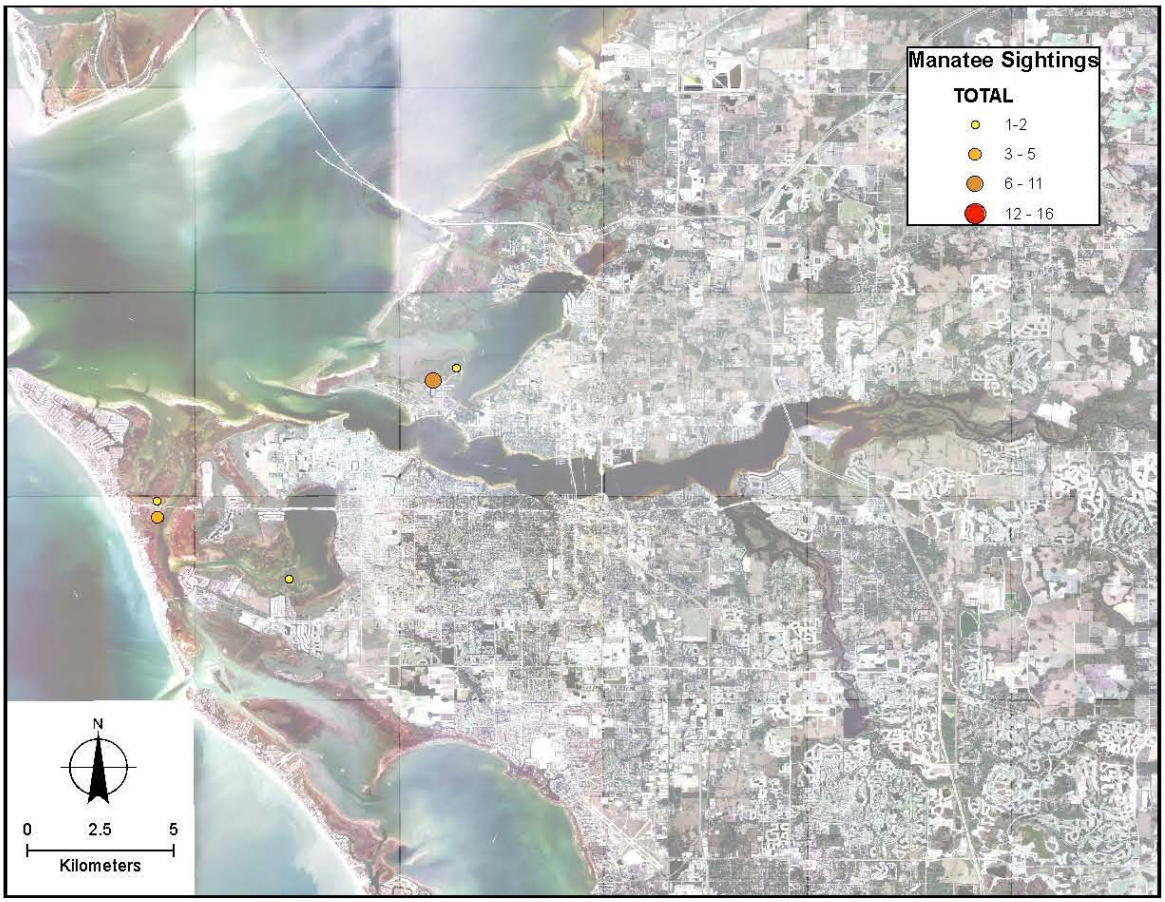


Figure 11. Distribution of manatee sightings with calves during winter (December – February) 2007-2008 in Manatee County, FL.

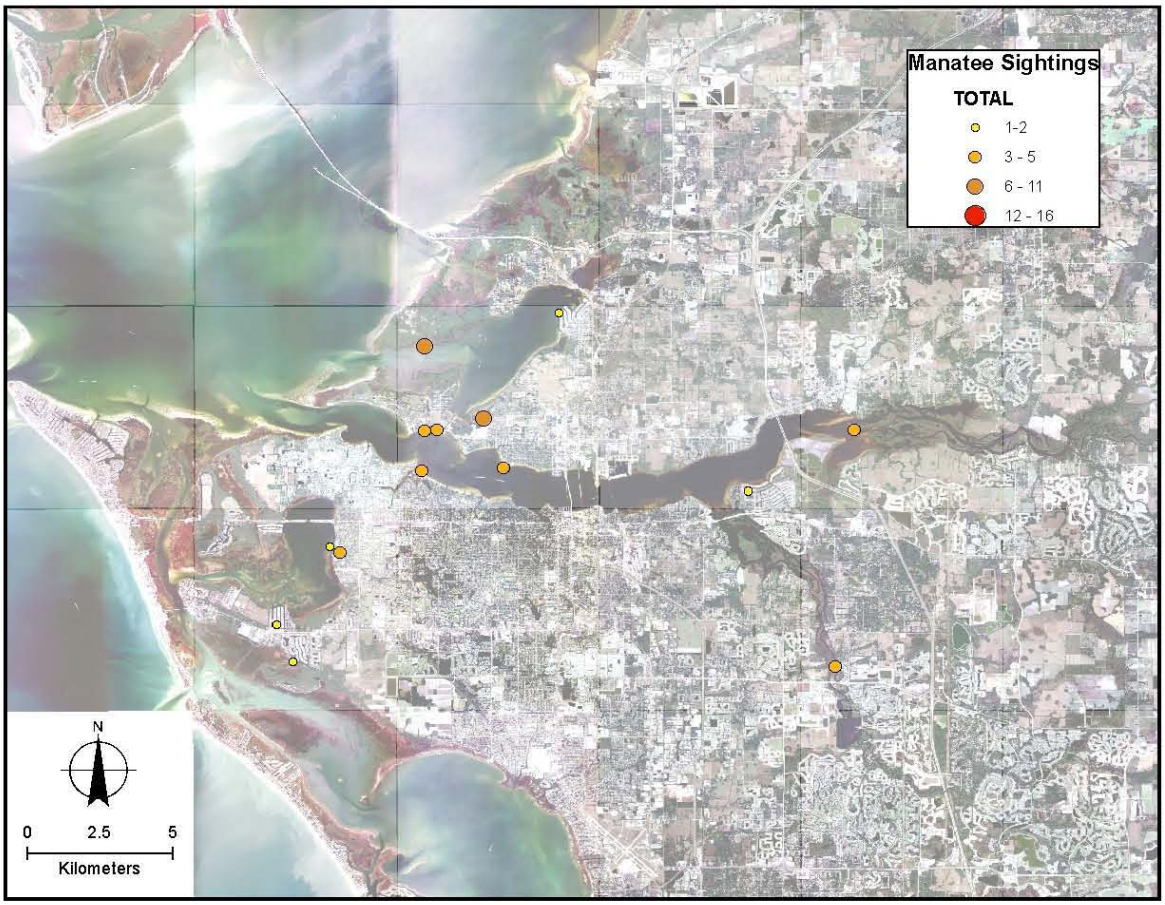


Figure 12. Distribution of manatee sightings with calves during spring (March – May) 2008 in Manatee County, FL.

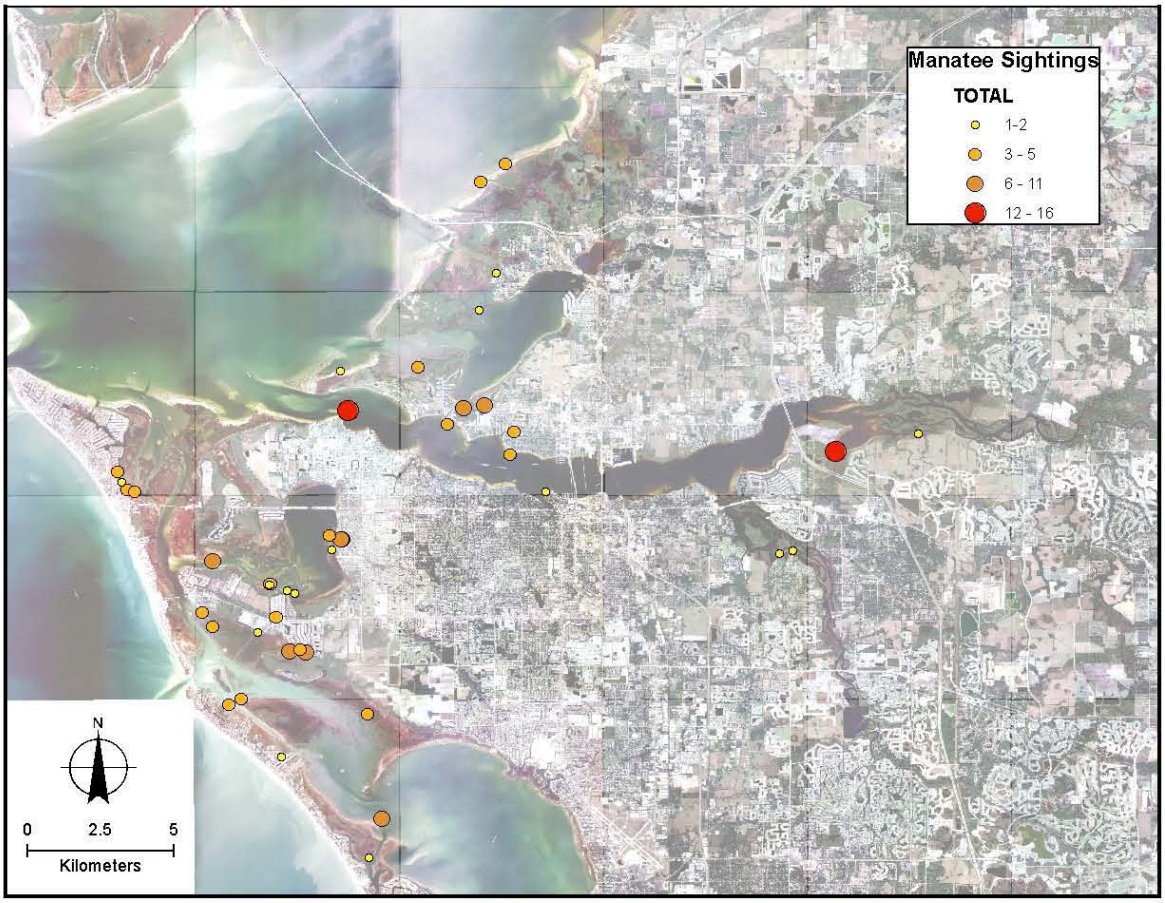
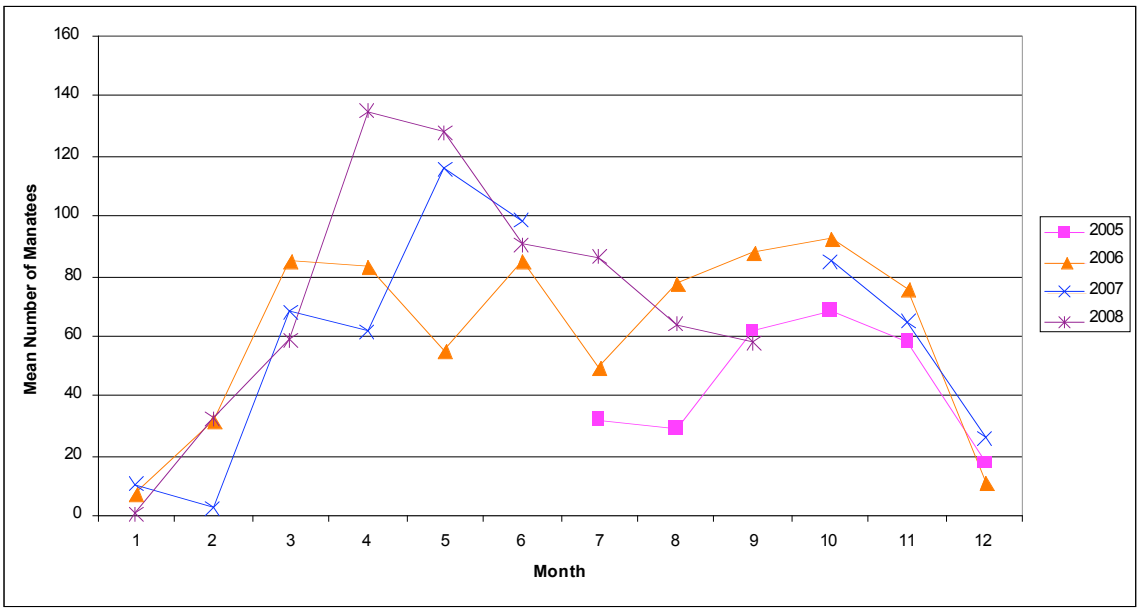


Figure 13. Mean number of manatees sighted monthly from aerial surveys conducted from July 2005 through September 2008.



Appendix A: Photographic identification effort in Manatee County from 11 October 2007 to 16 September 2008.

		On Survey Time		Obs Time		Total # manatees		# Photo'd		Air	Water		
Date	Location	Start	End	Start	End	Min	Max	Min	Max	(°C)	(°C)	Weather	Conditions
11-Oct-07	Terra Ceia Bay, S	9:45	9:50	-	-	0	0	0	0	-	-	C	G
11-Oct-07	Terra Ceia Bay, Cuts Edge Harbor	9:50	10:05	-	-	0	0	0	0	-	-	C	G
11-Oct-07	Terra Ceia Bay, S	10:05	10:14	-	-	0	0	0	0	-	-	C	G
11-Oct-07	Terra Ceia Bay, Tropic Isles	10:14	11:21	10:20	11:04	2	3	2	2	31.2	29.9	C	G
11-Oct-07	Terra Ceia Bay, S	11:21	12:10	11:54	12:09	1	1	0	0	33.5	30.5	C	G
11-Oct-07	Manatee River, W	12:29	13:18	12:29	13:18	8	10	4	4	31.9	30.6	PC	F
11-Oct-07	Palma Sola Bay, Palma Sola Yacht Club	14:26	15:07	14:26	15:07	4	5	2	2	31.9	30.8	PC	F
22-Oct-07	Palma Sola Bay, Palma Sola Yacht Club	10:36	12:14	10:37	12:10	16	18	13	13	30.8	29.1	PC	F
22-Oct-07	Palma Sola Bay	12:14	12:38	12:17	12:38	2	2	0	0	33.6	29.2	PC	F
22-Oct-07	Palma Sola Bay	13:04	13:40	13:05	13:40	5	6	2	2	33.0	29.5	PC	P
22-Oct-07	Sarasota Bay, Tidy Island Flats	14:11	14:51	14:11	14:51	3	3	1	1	32.8	29.8	PC	F
26-Oct-07	Palma Sola Bay, Palma Sola Yacht Club	10:05	10:58	10:05	10:58	6	7	3	4	30.1	27.1	PC	F
26-Oct-07	Terra Ceia Bay, Tropic Isles	11:46	12:01	-	-	0	0	0	0	-	-	-	-
26-Oct-07	Terra Ceia Bay, Tropic Isles	12:03	12:19	-	-	0	0	0	0	-	-	-	-
12-Nov-07	Sarasota Bay, Coral Shores Canals	11:11	11:26	-	-	0	0	0	0	-	-	C	G
12-Nov-07	Palma Sola Bay, Palma Sola Yacht Club	11:40	12:32	11:40	12:32	14	17	5	5	30.2	24.0	PC	G
20-Nov-07	Palma Sola Bay, Palma Sola Yacht Club	14:45	15:16	14:47	14:55	1	1	0	0	29.5	23.0	PC	F
21-Apr-08	Palma Sola Bay, San Remo Shores	12:48	13:09	-	-	0	0	0	0	26.8	24.6	C	G
21-Apr-08	Palma Sola Bay, San Remo Shores, Bank	13:09	13:33	13:09	13:33	6	7	5	6	25.3	25.2	C	G
21-Apr-08	Palma Sola Bay (outside of San Remo)	13:49	14:52	13:49	14:52	12	14	8	8	24.3	24.9	C	F
21-Apr-08	Palma Sola Bay (near red 10A marker)	15:04	15:12	15:07	15:12	1	1	1	1	25.7	24.9	C	F
5-May-08	Palma Sola Bay, Palma Sola Yacht Club	10:50	11:35	10:51	11:35	7	9	4	5	27.3	28.2	PC	G
5-May-08	Palma Sola Bay, San Remo Shores, Bank	11:50	12:05	-	-	0	0	0	0	27.1	29.2	PC	G
23-Jun-08	Sarasota Bay, Kitchen Key Flats	10:31	11:25	10:40	11:20	8	10	6	6	31.0	30.1	C	G
23-Jun-08	Palma Sola Bay (outside of San Remo)	11:50	13:06	11:50	13:06	11	12	9	10	32.4	31.2	C	G

Appendix A (continued): Photographic identification effort in Manatee County from 11 October 2007 to 16 September 2008.

		On Survey Time		Obs Time		Total # manatees		# Photo'd		Air	Water		
Date	Location	Start	End	Start	End	Min	Max	Min	Max	(°C)	(oC)	Weather	Conditions
23-Jun-08	Palma Sola Bay, Palma Sola Yacht Club	13:28	14:15	13:28	14:15	5	6	3	3	34.2	32.2	PC	G
23-Jun-08	Palma Sola Bay, SE	15:27	16:08	15:27	16:08	16	20	8	9	33.0	33.0	PC	F
24-Jun-08	Gulf, Longboat Key (Longboat Cove)	13:10	14:35	13:10	14:35	5	5	5	5	35.6	32.1	PC	E
21-Jul-08	Sarasota Bay, Cortez	9:36	9:53	-	-	0	0	0	0	32.4	32.5	C	G
21-Jul-08	Anna Maria Sound, SE	9:53	10:15	9:57	10:15	7	8	6	7	32.3	32.5	C	G
21-Jul-08	Palma Sola Bay, Smugglers Cove	10:15	11:13	10:15	11:03	8	10	8	9	33.6	32.3	C	G
21-Jul-08	Palma Sola Bay (S of entrance channel to PSYC)	11:35	12:39	11:35	12:11	9	11	4	4	34.9	33.0	PC	F
21-Jul-08	Palma Sola Bay, Palma Sola Yacht Club	14:39	14:54	-	-	0	0	0	0	32.8	33.4	C	G
11-Aug-08	Sarasota Bay, Leffis Key Flats	9:53	11:21	9:55	11:21	7	7	7	7	32.2	31.1	PC	G
11-Aug-08	Palma Sola Bay, Palma Sola Yacht Club	12:03	12:56	12:06	12:56	9	11	7	7	33.8	31.4	C	F
11-Aug-08	Palma Sola Bay (N of San Remo Shores)	13:11	13:26	-	-	0	0	0	0	-	-	PC	G
11-Aug-08	Palma Sola Bay, San Remo Shores	13:26	13:51	13:32	13:51	3	3	3	3	36.0	33.5	C	G/F
11-Aug-08	Palma Sola Bay, San Remo Shores, Bank	13:51	14:10	-	-	0	0	0	0	-	-	C	G/F
3-Sep-08	Palma Sola Bay, Smugglers Cove	10:09	10:30	-	-	0	0	0	0	30.9	30.7	PC	G/F
3-Sep-08	Palma Sola Bay, Palma Sola Yacht Club	10:45	12:18	10:47	12:18	17	20	11	13	31.1	30.7	PC	F
3-Sep-08	Palma Sola Bay (outside of San Remo)	12:32	12:47	-	-	0	0	0	0	-	-	PC	F
3-Sep-08	Palma Sola Bay, San Remo Shores	12:47	13:23	12:48	12:49	0	1	0	0	-	-	PC	F
12-Sep-08	Palma Sola Bay, Palma Sola Yacht Club	12:55	13:33	13:00	13:33	5	9	8	8	33.8	29.6	C	F
12-Sep-08	Palma Sola Bay, San Remo Shores, Bank	13:51	14:11	-	-	0	0	0	0	35.6	31.3	PC	F
16-Sep-08	Palma Sola Bay, Palma Sola Yacht Club	10:14	10:45	10:16	10:45	2	3	0	0	32.0	31.2	PC	G/F
16-Sep-08	Palma Sola Bay, N	10:55	12:09	11:02	11:47	5	10	4	4	33.3	31.7	PC	F
16-Sep-08	Palma Sola Bay, Parrot Cove	13:00	13:21	-	-	0	0	0	0	-	-	MC	F
16-Sep-08	Palma Sola Bay, SE	13:21	13:42	-	-	0	0	0	0	-	-	MC	F