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Claire M. Pabody
Dauphin Island Sea Lab

Ruth H. Carmichael
Dauphin Island Sea Lab

Lauren Rice
Auburn University

Monica Ross
Wildlife Trust

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A New Sighting Network Adds to 20 Years of Historical Data on Fringe West Indian Manatee (*Trichechus manatus*) Populations in Alabama Waters

CLAIRE M. PABODY, RUTH H. CARMICHAEL, LAUREN RICE, AND MONICA ROSS

Recent findings suggest increased use of fringe habitats by the endangered West Indian manatee. To begin collecting fundamental data on population dynamics and ecology of fringe manatees in the northern Gulf of Mexico, we established the Mobile Manatees Sighting Network (MMSN), the first formal network to receive and track manatee sightings in Alabama waters. Comparison of MMSN data with compiled historical data indicated that West Indian manatees are regular seasonal visitors to Alabama waters. Historical (1985–2006) and newly collected data shared consistent distributions, seasonal patterns of abundance in sighting number, and group size frequencies. These data indicate that MMSN was as effective at capturing data as two decades of historical sighting reports and suggest consistent long-term patterns in habitat preference and seasonal movements of manatees in Alabama waters. A nearly fourfold increase in number of manatee sightings, with inception of the MMSN, made evident the success of community outreach efforts but also betrayed the potential influence of observers on data quality. The MMSN maintains a 24-hr toll-free phone line, website with interactive online sighting form, and E-mail address to receive citizen sighting reports and provide supporting educational materials. Our data demonstrate that this type of monitoring for manatees in fringe habitat is feasible, effective, and essential to guide local management and recovery efforts of this endangered species.

Distribution of the endangered West Indian manatee (*Trichechus manatus*) has changed through time as the population has declined throughout its range (Powell and Rathbun, 1984; Lefebvre et al., 2001). Once common along the Gulf of Mexico coast, manatee populations are now confined largely to peninsular Florida and southeastern Georgia in the winter, with poorly defined migrations north and east during summer (Powell and Rathbun, 1984; Fertl et al., 2005). In recent years, there have been a greater number of manatee sightings reported in areas west of Florida, suggesting a possible increase in use of fringe habitats (Fertl et al., 2005).

Knowledge of fringe populations and habitats may become increasingly important in coming years (USFWS, 2001; Fertl et al., 2005). Fringe habitats may experience more use if manatee recovery efforts increase populations in nearby peninsular Florida, or if habitat and food resources continue to decline (Rathbun et al., 1990; USFWS, 1993, 2001; Bonde and Lefebvre, 2001; Fertl et al., 2005). Manatees may rely more heavily on fringe habitats and food resources when influenced by large-scale change (such as climate change and sea level rise) and natural disasters (Marmontel et al., 1997; Langtimm and Beck, 2003; Langtimm et al., 2006). Manatees in fringe areas also may be more susceptible to loss because of greater variation in water temperature

and other resources (Marshall et al., 2000; Fertl et al., 2005). Determining how and why manatees frequent fringe locations is essential to understanding the fundamental ecology of this endangered species, but also will guide development of management and restoration programs throughout the range.

Despite knowledge of manatees as regular visitors to the northern Gulf of Mexico (nGOM) and demand for more data, manatees in the region have been understudied. Unlike Florida, Alabama and other states bordering the nGOM have lacked concerted sighting outlets and outreach organizations to collect and analyze sighting data, raise public awareness, and support research efforts. Hence, data on the number and frequency of manatees using fringe habitats, including areas from Alabama to Texas, are poorly understood and have relied primarily on opportunistic sightings (Fertl et al., 2005). Furthermore, the spatial and temporal extent of habitat and food resources used by fringe populations is unknown, as are genetic links to apex populations.

We established the Mobile Manatees Sighting Network (MMSN) to begin collecting fundamental data on population dynamics and ecology of West Indian manatees in fringe habitats in nGOM. This is the first formal network dedicated to receiving and tracking manatee sightings in Alabama waters. We compiled and compared our

data with available past sighting reports to provide a context for newly collected sighting data and gain a holistic view of manatee distributions and habitat use. We integrated our primary research into a comprehensive public education and outreach effort to enhance our data set, increase public awareness of the presence of manatees in the region, and increase public participation in conservation and management activities in the region. This manuscript describes and quantifies the basic function and outputs of the MMSN and its potential to provide rigorous scientific data to evaluate population dynamics and ecology of West Indian manatees in fringe habitat.

METHODS

Study site.—Alabama waters provide an excellent location in nGOM to begin directed studies on the use of fringe habitats by manatees. Alabama coastal waters are dominated by the Mobile Bay estuary, the sixth largest river basin in the United States. The Mobile Bay system and surrounding waters have a history of manatee sightings and support habitat and food resources known to attract manatees (Fertl et al., 2005; D. Ingram, USFWS, pers. comm.). Mobile Bay and associated waters are characterized by relatively shallow, warm water (mean depth 1.3 m), salinities below 20 parts per thousand, and substantial natural and anthropogenic freshwater inputs (Schroeder et al., 1992), which are favored by manatees (Ortiz et al., 1998; Fertl et al., 2005). Alabama waters also support several species, including seagrasses (Vittor, 2004; Byron and Heck, 2006; Valentine et al., 2006), that are known to be food for manatees (Powell, 1978; Smith, 1993; Lefebvre et al., 2000). The Mobile Bay estuary may be an important and undefined regional habitat for manatees since abundances of seagrasses, *Thalassia* and *Halodule*, are limited west of Mobile Bay (Handley, 1995; Vittor, 2004). Mobile Bay and the adjacent watershed support relatively intense anthropogenic activities that generate boat traffic and alter water quality (Schreiber and Pennock, 1995; Rabalais et al., 2001; Sturm et al., 2007), which are known threats to manatees and their habitat and food resources (Campbell and Powell, 1976; Wright et al., 1995; Reep and Bonde, 2006). Hence, Alabama waters attract and support manatees, and data are needed to inform local management and conservation efforts.

Data collection.—To initiate an enduring data collection program on manatee population ecology in nGOM and provide a historically

meaningful context for future data analyses, we sought to compile and compare current manatee sighting data (2007 to present) from a newly established sighting network to a composite of available past sighting reports (before 2007).

Historical sightings: To gather data on historical use of Alabama waters by manatees, we attempted to collate data from a broad range of sources. Sources included primary literature and groups known to receive sighting reports such as the Southeast Region Marine Mammal Stranding Network, local experts, the United States Fish and Wildlife Service (USFWS) in Daphne, AL and Jacksonville, FL (which have jurisdiction over manatees in Alabama waters), and the U.S. Geological Survey (USGS) Sirenia Project. Two primary sources provided sufficiently documented sighting information for compilation and comparison: 1) Fertl et al. (2005) contained data for sightings through 2004, and 2) data from 2005–2006 were obtained from the USFWS (these were redundant with reports on file at USGS). Each source provided (at least) location, site description, and date and number of manatees per sighting.

MMSN: To collect current data on manatee distributions and habitat use in Alabama waters, in collaboration with Wildlife Trust in Florida, we developed and launched (in May 2007) a formal sighting network, which provided the local community with a central location to report manatee sightings. The MMSN maintains a toll-free telephone number (1-866-493-5803), interactive online sighting form (http://manatee.disl.org/report_siting.cfm), and an E-mail address (manatee@disl.org) and was available 24 hr a day, 7 d a week to receive sighting reports. Observers were asked to provide contact information and detailed descriptions of each sighting, including location description, global positioning system (GPS) coordinates, date and time, waterway name, number and length of manatees, observed behaviors (on the basis of established behavior codes prepared by Wildlife Trust in Florida), condition of the animal (alive, carcass, injured, tagged), and other pertinent information. We acquired and carefully analyzed the specific physical and behavioral descriptions or photographs for each sighting to ensure that observers sighted manatees and not other common local species (e.g., bottlenose dolphin or garfish). To help assess network success, we also asked observers to indicate how they learned about the sighting network. The network is currently in operation. Data from phone, online, and E-mail reports were compiled, entered into a

master database, and each sighting was given a unique identification code for future reference. To expedite reporting to federal authorities and avoid duplication of efforts, our database automatically generated a companion form in the USFWS reporting format. For each sighting, the companion form and a geographic information system (GIS)-based map of the sighting location were sent to the USFWS in Daphne, AL.

Mapping and tracking sightings: To determine the locations most frequently used by manatees in Alabama waters, we plotted GPS coordinates of each historic and currently reported sighting to within 5 m, depending on available data. For any sightings that did not include GPS coordinates, we used physical descriptions or street addresses to identify sighting locations and assign coordinates. We did not have any sightings for which coordinates could not be reasonably assigned on the basis of site descriptions. We prepared GIS data layers using ArcGIS 9.2 software and publicly available USGS base maps (Alabama Comprehensive GIS Inventory of Coastal Resources, U.S. Geological Survey, 2006). To improve the accuracy of our data and glean as much information as possible from each sighting, we responded to reported sightings by phone or visiting locations (to the extent possible) within 24 hr. Habitat attributes at each sighting location, including weather conditions and temperature, salinity, and dissolved oxygen concentrations in surface and near-bottom waters, were measured (data on these habitat attributes will be presented elsewhere).

Outreach and data dissemination.—To engage the public's interest, encourage participation in the MMSN, and share project outputs, several outreach activities were conducted. Television and print media were utilized to inform the public of the network's launch and ongoing efforts. Fliers and business cards with MMSN contact information were created and distributed to private residences, businesses, local authorities, and other organizations to reach potential end users. A MMSN T-shirt was designed for donation or sale to support ongoing outreach efforts, and scientific and public presentations were given. The number of public presentations, distribution, and sale of these outreach products serendipitously provided an independent and tangible measure of outreach effort and success. To further educate the community about the sighting network and manatees in general, we created a publicly accessible webpage (<http://manatee.disl.org/>).

Through this site, end users may access sighting maps, view photographs from local sightings, and learn how to properly encounter a manatee in the wild and collect data to report to the network. To ensure widely accessible and enduring data, we created and published meta-data through the National Oceanic and Atmospheric Administration's National Coastal Data Development Center, a searchable archive that can be regularly updated with results of ongoing research.

To help determine the effect of outreach efforts on data acquisition, we tested whether intensity of media exposure (newspaper, television, and newsletter pieces) increased the number of reported sightings by comparing the number of media items throughout 2007 with the number of concurrent sighting reports. To normalize the results for effects of regular large-scale patterns in manatee movements through time, we also compared 2007 media items to historical sighting records. We opted to use media exposure (news items) for this assessment because other outreach activities were less tangible or quantifiable through time.

RESULTS

Historical sightings.—A total of 159 sighting records was compiled, providing data for years 1985–2006 (Fig. 1). The number of sightings increased through time ($F_{\text{reg}21} = 9.64, P < 0.01$) and showed substantial interannual variation (Fig. 1). Numbers of sightings ranged from zero in 1987–1990, 1992, and 2005 to a peak of 28 in 2006 (Fig. 1). The majority of historical sightings occurred in rivers and subembayments of Mobile Bay and in the Mobile–Tensaw Delta (Fig. 2, Table 1). Over the 21-yr period of available historical records, manatees were sighted in all months except March, with most sightings reported in June (35) and July (24). Group sizes of one to 11 manatees were reported, and nearly 75% of all historical sightings were of single manatees (Fig. 3). Among sightings of multiple manatees, 96% reported groups of two to six (Fig. 3). The largest groups were observed in June (8), Aug. (11), and Oct. (5). Fourteen percent of sightings included calf manatees. Historical records did not include standard behavioral observations.

MMSN.—One hundred four manatee sightings were reported to the MMSN in 2007 (Fig. 1, open symbol), nearly four times the number of sightings reported in any preceding year. As observed among historical sightings, the majority of 2007 sightings occurred in rivers and sub-

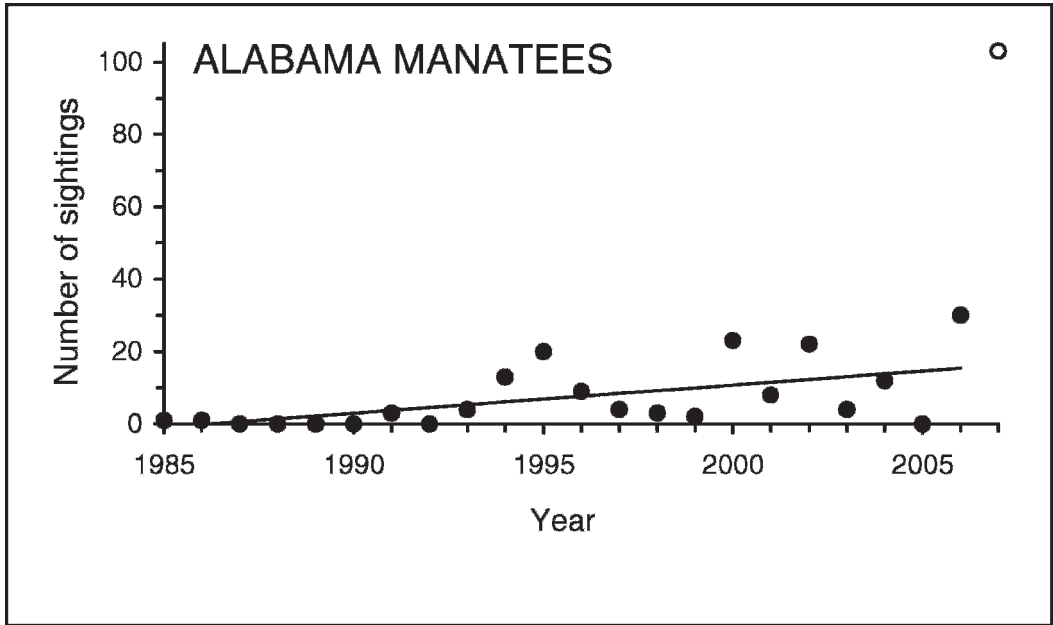


Fig. 1. Number of reported manatee sightings in Alabama waters from 1985 to 2007. The increase in number of sightings in 2007 (open symbol) corresponds to establishment of MMSN and is not included in the regression ($y = 0.78x - 1546.60$, $r^2 = 0.32$).

embayments of Mobile Bay and in the Mobile-Tensaw Delta (Fig. 2; Table 1). In 2007, manatees were observed from May through Nov., and most sightings were reported in May (22) and June (21). Reported group sizes ranged from one to 15, and the majority of sightings were of single manatees (Fig. 3). Ninety five percent of group manatee sightings reported two to six manatees. The largest groups were observed in May (10), July (10), and Sep. (7). Twenty percent of sightings included calf manatees. Traveling and socializing were the behaviors most often observed, and human interactions were rarely reported. Photographs accompanied 10 sightings in 2007 (~ 10%), all of which accurately corroborated the sighting.

Outreach efforts.—With the launch of the MMSN in spring 2007, multiple outreach activities were conducted to alert the public. Eighteen stories appeared in local and regional press between May and Sep., four of which were television news pieces (Table 2). Five hundred business cards were printed and distributed as a quick reference for MMSN contact information. One hundred twenty-five MMSN T-shirts were sold and 30 were otherwise distributed to the public and network volunteers. More than 1,000 MMSN educational fliers were printed and distributed to local residents, businesses, and other organizations in the community. These

efforts yielded more sightings in 2007 than in any preceding year (Fig. 1), the majority of which were reported by phone (13 were reported using the online form). In fact, MMSN outreach efforts elicited manatee sighting reports from all southeastern states from North Carolina to Louisiana (as with in-state sightings, all reports from outside Alabama were subsequently shared with authorities at USFWS). On the basis of data provided by MMSN regarding the frequency and regularity of manatee visits to local waters, Alabama Natural Heritage Program (ALNHP) recognized manatees as regular seasonal residents and changed their subnational rank from accidental to priority in 2007.

We used intensity of media exposure as a proxy for outreach effort to help determine the effect of outreach efforts on data acquisition. We found a significant positive correlation between the number of news items and number of reported sightings through time (May–Sep.) in 2007 (Table 2; $r = 0.85$, $Z = 2.54$, $P = 0.01$). We, however, found a similar correlation between 2007 media exposure and historical sighting frequency (Table 2; $r = 0.76$, $Z = 2.01$, $P = 0.04$), which could not have been affected by this publicity. The press release indicated in Table 2 is shown to indicate the initiation of media exposure but was not included in the correlation analysis (only the number of resulting media items was included).

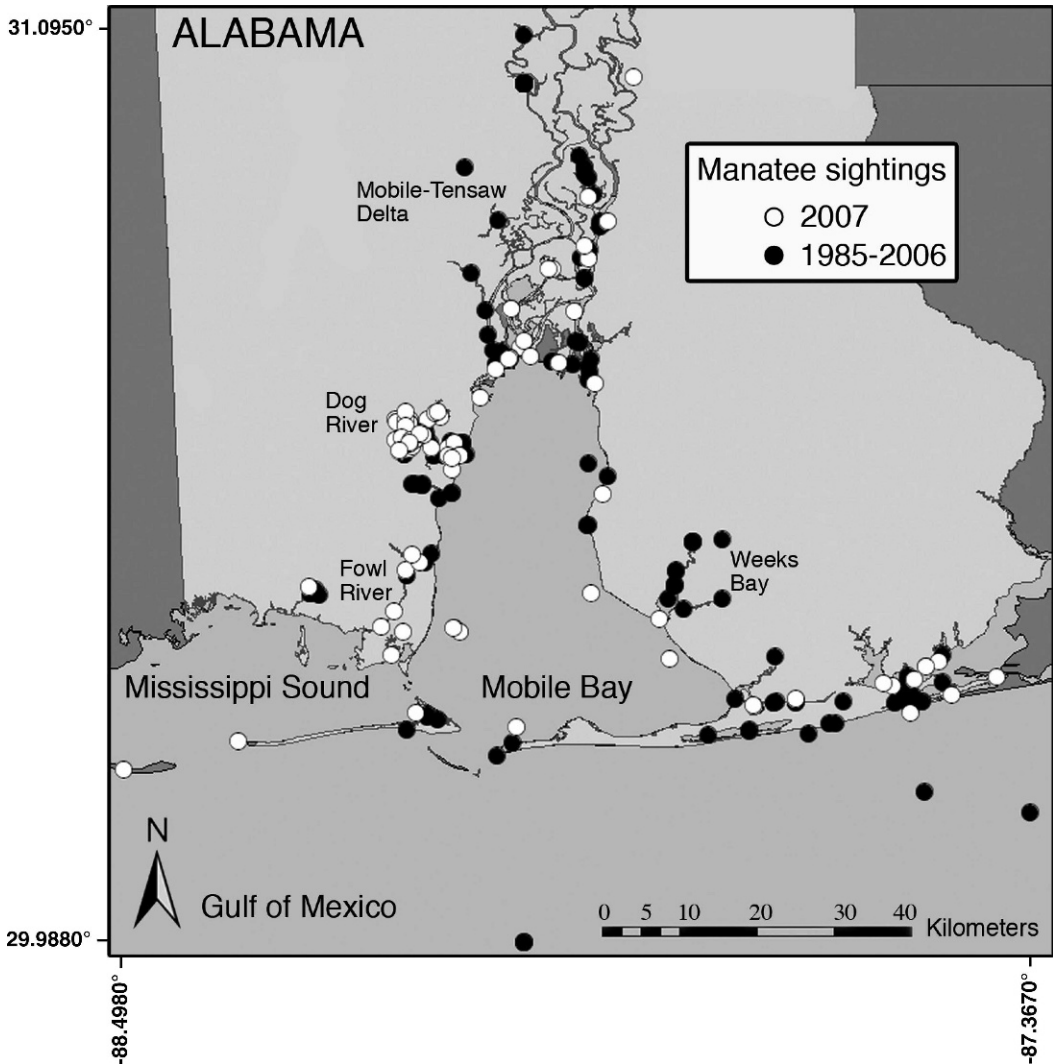


Fig. 2. Locations of manatee sightings in Alabama waters from 1985 to 2006 (historical data) and reported to the Mobile Manatees Sighting Network (MMSN) in 2007.

DISCUSSION

Number of sightings.—Florida manatee populations (*T. manatus latirostris*) are estimated to have increased at an annual rate of 1–6% through the early 2000s (Langtimm et al., 2004; Runge et al., 2004; Craig and Reynolds, 2004), a time period largely concurrent with available historical data for manatees in Alabama waters. An increase in the number of manatees in Florida waters accompanied by an ongoing decrease in available habitat and food resources may encourage these animals to take advantage of fringe habitats, including Alabama waters (Rathbun et al., 1990; Bonde and Lefebvre, 2001; Fertl et al., 2005). Accordingly, the significant increase in

manatee sightings in Alabama waters through 21 yr of historical data (Fig. 1, black symbols) suggests an increase in number of manatees frequenting the region. Given the lack of consistent prior monitoring or data validation, however, it is unclear whether past increases reflect increasing numbers of manatees or variation in reporting (Fig. 1). Coincidentally, populations of coastal counties in Alabama (Mobile and Baldwin) have increased considerably since the mid-1980s, spurring an explosion of coastal waterfront urbanization (Sturm et al., 2007; censusscope.org). An increase in the number of people living near the water and in a position to observe manatees, heavier use of Alabama waters as habitat by manatees, or a

TABLE 1. Percentage of manatee sightings at different locations in Alabama waters from historical sighting reports and reports to the Mobile Manatees Sighting Network (MMSN) in 2007. Locations include rivers and subembayments of Mobile Bay (Rivers and subembayments); Mobile–Tensaw Delta (Delta); open waters in Mobile Bay, Gulf of Mexico, and Mississippi Sound (Open waters); and the Intracoastal Waterway (ICW).

Location	Percentage of sightings	
	Historical sightings (1985–2006)	MMSN (2007)
Rivers and subembayments	54	62
Delta	23	17
Open waters	17	15
ICW	6	6

combination of these factors may explain the apparent increase in number of sightings through time in historical data (Fig. 1). The sudden and more extreme increase in number of sightings in 2007 seems most likely due to launch of the MMSN and ancillary public outreach activities (Fig. 1 and Table 2). This result suggests that, if maintained, MMSN has potential to provide a more consistent and abundant baseline of sighting data than was possible without this directed network.

Spatial and temporal patterns.—Sighting data independently collected by MMSN in 2007 were highly consistent with the composite of historical data. This finding is particularly remarkable considering that historical data were not subject to the same standards of evaluation and corroboration as data more recently collected by MMSN. Viewed in concert, these data suggest

consistent long-term patterns in manatee habitat preferences and seasonal movement. First, on the basis of the frequency of sightings in different locations (Fig. 2 and Table 2), manatees showed preference for the relatively calm, shallow waters of the rivers and subembayments of Mobile Bay and the Mobile–Tensaw Delta. These findings are consistent with known preferences of manatees in apex habitats (Hartman, 1979; Reep and Bonde, 2006). Second, both data sets reported manatees most frequently from mid-April to mid-Oct. (Table 2), when Alabama coastal water temperatures are typically above 20°C (Mobile Bay National Estuary Program, Environmental Monitoring data, <http://www.mobilebaynep.com/mondata>). Manatees are known to avoid water temperatures below 20°C and can experience cold stress and death from either prolonged or sudden extreme exposure to cold waters (Reynolds and Odell, 1991). This pattern of sightings suggests: a) use of Alabama waters by manatees depends on seasonal temperature variation, and b) large-scale changes in temperature (such as global climate change) may significantly alter these patterns. Third, manatees were consistently observed alone or in small groups in Alabama waters (Fig. 3). Although manatees will form large aggregations, particularly at warm-water refuges during winter in Florida, they are not usually gregarious, and smaller group sizes are common (Reep and Bonde, 2006). Manatees in Alabama waters demonstrated basic patterns in population dynamics that are consistent with observations among apex populations, but showed greater variation with the greater variation in seasonal air and water temperatures in the nGOM region.

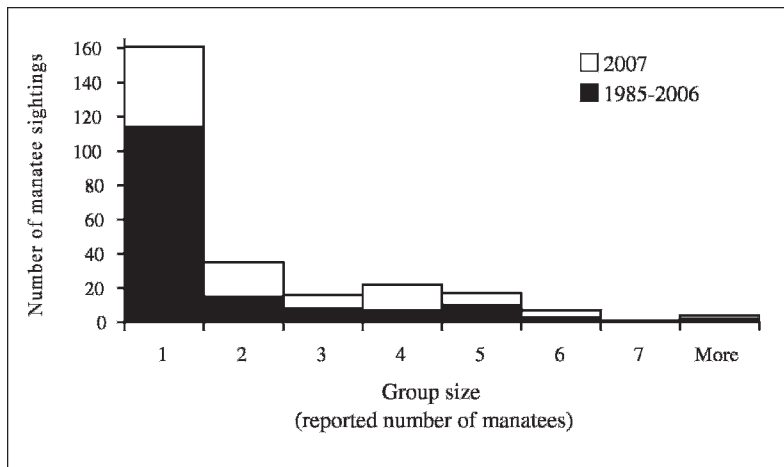


Fig. 3. Group size frequency distributions for manatee sightings reported in Alabama waters historically (1985–2006) and to the Mobile Manatees Sighting Network (2007).

TABLE 2. Press release and subsequent monthly media exposure within Alabama for the Mobile Manatees Sighting Network (MMSN) in 2007 compared with number of sightings each month in 2007 and historically (1985–2006).

Month	Media	Number of items	Location (municipality)	Number of sightings	
				1985–2006	2007
May	Press release	1	Mobile, northern Gulf of Mexico ^a	12	22
	Television	2			
	Newspaper	1			
	Newsletter ^a	1			
June	Newspaper	7	Bay Minette, Daphne, Elberta, Fairhope, Foley, Gulf Shores, Robertsedale	35	21
July	Newspaper	4	Birmingham, Grand Bay, Scottsboro, Tuscaloosa	24	18
Aug.	Television	2	Mobile	18	19
Sep.	Newspaper	1	Mobile	18	11
Oct.	—	0	—	13	7
Nov.	—	0	—	7	6

^a National Oceanic and Atmospheric Administration Ocean Service, Office of Ocean & Coastal Resource Management Gulf of Mexico News, regional newsletter.

Since it is likely that the accuracy of reporting decreases with manatee group size and not all reports have been equivalently validated, the consistency among historical and current data in Alabama waters and elsewhere is impressive. These data demonstrate that, in a single season, MMSN was at least as effective at capturing data on local manatees as two decades of historical data. Continued consistent reporting will allow more accurate interpretation of data among years to define local manatee distributions, movements, and habitat use.

When assessing manatee coastal distributions on the basis of sighting data, it is important to consider the potential influence of human distributions as well. Alabama's coastal waterfront is not evenly populated. There is considerably greater urbanization along rivers and sub-embayments of Mobile Bay compared with areas adjacent to the Mobile–Tensaw Delta. Accordingly, sightings were concentrated in heavily populated areas such as Dog River and Fowl River (Fig. 1), where the presence of abundant riverfront neighborhoods may provide more opportunities to encounter manatees. Given that the Mobile–Tensaw Delta is characteristic of known preferred manatee habitat, it is possible that sighting numbers would be higher in this area if it were urbanized.

Public outreach and influence on data acquisition.—The success of MMSN's outreach efforts was clear and had several positive effects on data collection and dissemination efforts. This increased participation enhanced our data set (Fig. 1), allowing collection of data comparable with a historical 21-yr data set and demonstrating

the importance and effectiveness of a concerted, consistent, and publicized monitoring effort. Other benefits included ongoing interest of regional media outlets (Table 2), which further increased participation, and additional research and outreach funds generated by manatee T-shirt sales. Outreach efforts also generated many “hot calls” (those received while manatees were still in the immediate sighting area) and increased use of the online sighting form, which enhanced data quality, processing, and reporting efficiency. Furthermore, ALNHP's use of data generated by MMSN demonstrated that outreach and data dissemination efforts were effective as well as immediately useful to guide management and conservation efforts.

Along with their success, outreach efforts must be assessed for potentially negative effects on data quality. The positive correlation between intensity of media exposure and number of sightings through time suggests that outreach efforts may have biased the timing of sighting reports to MMSN (Table 2). If true, the apparent spatial and temporal patterns of manatee distribution or movements on the basis of MMSN sighting data may also be biased. A similar correlation with historical data, which could not have been affected by 2007 outreach efforts and during a time of little or no publicity regarding manatees in the region, however, suggests that this correlation is coincidental. Outreach efforts were targeted to warmer months when manatees were expected to be frequenting the area (May–Sep., Table 2). Although impossible to distinguish with certainty, the overall similarity between MMSN (seasonal publicity) and historical (no focused publicity)

data sets strongly suggests that the pattern of sightings through time is more reflective of typical seasonal patterns of manatee movements than media exposure. Hence, although media exposure and other outreach activities likely increased the number of sightings in 2007, these efforts did not have a clear effect on the spatial and temporal aspects of the data. As future data are acquired and analyzed, this potential source of bias will require further investigation.

Future study.—More data are needed to define how manatees use fringe habitats and subsequently contribute to local ecosystem function. The MMSN has potential to provide an abundance of consistent sighting data to support such future research efforts in Alabama waters and regionally, from western Florida through Mississippi. Ongoing and planned companion activities include aerial surveys, photo-identification, habitat characterization and mapping, tagging and GPS tracking of individual manatees, and stable isotope analysis of manatees and their foods to define local diets. Aerial surveys are widely used to estimate abundance and map distribution of manatees over large areas and have been implemented successfully in habitats similar to Alabama's coastal waters. Characterizing habitat and food resources available to manatees at sighting locations will aid interpretation of their habitat use in local waters. Coupled with tagging studies, these data will allow researchers to relate resource use to manatee movements in Alabama waters and track movements as local waters cool. Comparison of tracking data to sighting reports and year-round publicity efforts will help normalize for potential human influences on sighting data.

Application to management and conservation in Alabama.—Data and outreach efforts provided through MMSN will inform manatee management and recovery efforts in Alabama and other fringe habitats. In addition to providing data that may guide management-related decisions, such as the change in designation by ALNHP, MMSN has provided practical data to immediately and positively guide reactions to manatees in local waters. On the basis of our observations, the primary threats to manatees in Alabama waters are most likely cold stress and boat strikes. The presence of manatees in Alabama waters year-round, for example, suggests increased probability of loss from cold-related stress and potential for overwintering in local waters, which has not been previously suggested. Two cases of possible cold-related death were reported in Alabama waters during winter 2008–2009 (MMSN, pers.

obs.), whereas only two similar cases were suggested for the preceding 20 yr (Fertl et al., 2005). It is unclear why manatees may remain in fringe habitats late in the season (or overwinter) and whether this behavior may be increasing in frequency. This information is significant in the context of potential global climate change and sea level rise. Numerous possible thermal refuges (e.g., wastewater or industrial outfalls) exist throughout Alabama waters (AL Comprehensive GIS Inventory of Coastal Resources, Geological Survey of Alabama, 2006), which may allow manatees to reside locally for longer periods, but these areas have not been thoroughly examined or related to manatee distributions in the region. Furthermore, nearshore areas favored by manatees in Alabama waters are often popular boating sites. Although boat strikes are the leading cause of human-related mortality among manatee populations in nearby Florida (Reep and Bonde, 2006), we are aware of no boat-related manatee deaths in Alabama waters. It is important to note, however, that many Alabama residents are unaware of manatee presence in local waters. Increased occurrence of manatees in fringe areas for any reason, without knowledge of where manatees go and how they use local waters, could lead to habitat and manatee loss. MMSN is the primary group responsible for locating and responding to manatees reported in distress, stranded, or dead. Sighting data provided to MMSN have allowed us to begin making comparisons between environmental attributes and manatee distributions through time to support rescue functions. Ongoing and year-round publicity efforts initiated by MMSN also will raise public awareness, reducing the likelihood of negative interactions between people and manatees and increasing our ability to identify and respond to manatees in distress.

CONCLUSIONS

West Indian manatees are at least seasonal visitors to Alabama waters, but the timing and duration of their visits varied from year to year, presumably due to interannual variation in air and water temperature. Historical and newly collected data reported similar distributions, seasonal patterns of abundance in sighting number, and group size frequencies for manatees in Alabama waters. The majority of manatees were reported from spring through fall months, a pattern that has persisted for decades. Recent sightings suggest that manatees preferred the rivers and subembayments of Mobile Bay and the Mobile–Tensaw Delta, where freshwater sources

and aquatic vegetation are common features. These results indicate that data collected by MMSN in one season was as effective at capturing population data as two decades of historical sighting reports. Data collected by MMSN also reflect a level of evaluation and validation not previously applied to data for this fringe habitat. Viewed in concert, these data identify consistent long-term patterns in seasonal movements and habitat preference of manatees in Alabama waters.

Outreach efforts were highly successful and had two distinct benefits: 1) enabling data collection on a broader spatial and temporal scale than would have been feasible without public participation, and 2) increasing public education about when and where to expect manatees in Alabama waters. The latter benefit will necessarily help reduce the likelihood of negative interactions between manatees and local residents and aid restoration and management efforts. These benefits should have a positive feedback on sighting reports, in turn, increasing future data sets. Although we did not find a significant effect of publicity or public participation on the major patterns in our data set, our findings emphasize that any data collection dependent on public participation is sensitive to bias. Potential biases must be considered and normalized as future data are collected and analyzed. Overall, our data demonstrate that monitoring of manatees in fringe habitat is feasible, effective, and essential to guide local management and recovery efforts of this endangered species.

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regulatory systems. S. Johnston prepared initial GIS maps and R. Nowlin created meta-data for the project. We are grateful to coastal residents and watermen of Alabama, Mississippi, and western Florida for participation in the network.

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- (CMP, RHC) DAUPHIN ISLAND SEA LAB, 101 BIENVILLE BOULEVARD, DAUPHIN ISLAND, ALABAMA 36528; (LR) AUBURN UNIVERSITY, AUBURN, ALABAMA 36849; AND (MR) WILDLIFE TRUST, 1601 3RD STREET S #F, SAINT PETERSBURG, FLORIDA 33701. Send reprint requests to RHC. Date accepted: July 13, 2009.