# MANATEE USE OF MATLACHA ISLES, AN ALTERNATE WINTER AGGREGATION SITE IN SOUTHWEST FLORIDA

## FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION CONTRACT 00127 FINAL REPORT

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**Project Title:** Manatee Use of Matlacha Isles, a Secondary Winter Refuge Site in Southwestern Florida (Year 2)

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**Project Goals:** The goal of this study is to assess the importance of the Matlacha Isles canal system as a secondary winter refuge site in southwestern Florida by investigating: 1) seasonal patterns of manatee use of Matlacha Isles, 2) daily patterns of manatee use of Matlacha Isles, 3) physical and chemical characteristics of the Matlacha Isles canal system and two apparently similar nearby canal systems that are not used by manatees.

**Introduction:**

One of the major threats facing Florida manatees is the loss of warm-water refuge sites (U.S. Fish and Wildlife Service 2001). Manatees have a metabolic rate 15-20% below that expected for an animal their size (Irvine 1983) and a high rate of thermal conductance (O'Shea 1988), causing them to be vulnerable to cold. Water temperatures of 15-20°C prompt physiological and behavioral changes in manatees, such as an increase in metabolic rate and migrations to warmer water (Irvine 1983; Worthy et al. 2000). When exposed to water temperatures between 18-20°C for several days, captive manatees feed erratically or may cease feeding altogether at temperatures below 15-18°C (Campbell and Irvine 1981).

To survive periods of cold weather, manatees need to seek refuge in areas with warm water. Generally, when water temperatures fall below 20°C, manatees migrate to winter refuge sites (Lefebvre et al. 1989; O'Shea 1988). Since the introduction of industrial warm-water effluents, such as those from power plants, many manatees have come to rely on artificial sources of warm water. Many of the primary winter refuge sites (defined as those typically having 100+ individuals) for manatees are now at the effluents of power plants. The warm-water flows of these and some natural refuge sites however, may not be stable. Effluents from power plants can be unreliable due to routine maintenance and equipment failure. A more serious situation would be the complete shutdown of a plant, which is likely to occur at some locations if

the deregulation of the power industry in Florida takes place. Some of the natural springs providing warm-water refugia for manatees may also become unreliable (Reynolds 2000; U.S. Fish and Wildlife Service 2001). The continuous depletion of the aquifer due to increased human demands for water and long periods of drought has lowered some spring flow rates and resulted in less warm-water output (Vergara 1994; Sucsy et al. 1998). As flows continue to decrease, springs on which manatees have learned to rely for refuge may be insufficient at warming the surrounding water to the level at which manatees can survive. Manatees relying on sites impacted by these alterations may succumb to cold stress or even death if they are unable to find a suitable alternative site (Reynolds 2000).

Whereas most of the primary winter refuge sites for manatees have been well documented, many lesser known secondary sites (defined as those typically having aggregations up to 100 manatees) also exist and require further investigation (U.S. Fish and Wildlife Service 2001). Many of these sites are not influenced by industrial discharges and are primarily dredged boat basins and canal systems, apparently capable of retaining water temperatures above those in adjacent waterways. Possible explanations for the heat retention at these sites include presence of ground water seeps or springs that may be a few degrees above ambient and/or the structure and configuration of the particular boat basins or canal system, which may be able to maintain warmer water temperatures through limited tidal flushing and solar heating of the water held within them (U.S. Fish and Wildlife Service 2001). Another possibility that requires further investigation is heat retention of certain sediments. The Florida Manatee Recovery Plan (U.S. Fish and Wildlife Service 2001) has identified the "protection, enhancement, and investigation" of these sites as Objective 3.2.3; and the role that winter refuge sites play in the survival of the species is considered extremely important for managers and researchers to understand. Data on physical and chemical characteristics of secondary or alternate winter refuge sites, in conjunction with site use patterns, may facilitate the understanding of manatee use of these sites during cold weather, as well as their importance as winter refugia and/or alternate sites in the event that warm water at a primary site ceases.

In southwestern Florida, a secondary winter refuge site exists at Matlacha Isles in Lee County, near Ft. Myers. Aerial surveys of Lee County have documented manatees using this site year-round and especially during the winter (Florida Department of Environmental Protection, Florida Marine Research Institute 1998). Photographic identification (photo-ID)

studies have further shown that manatees consistently use the site throughout the winter and spring, that a high proportion of individuals return to the site annually, and many of these individuals travel between this site and the regional primary warm-water refuge at the Florida Power & Light Company power plant in Ft. Myers throughout the winter (Koelsch and Webb 1997; Koelsch 1998; Koelsch and Barton 1999).

Photo-ID and focal animal studies in Matlacha Isles have provided information on site fidelity, life history, and movement and travel patterns (Koelsch and Webb 1997; Koelsch 1998; Koelsch and Barton 1999). During the first year of this study, seasonal and daily manatee use of Matlacha Isles appeared to be influenced by water temperatures (Koelsch et al. 2000). Daily use of Matlacha Isles also followed a distinctive pattern. Manatees came into the canal system in the morning, spent most of the day resting, and left in the afternoon/evening to forage in Matlacha Pass. The objectives of the second year of this study were to continue data collection and further document patterns observed during the first year, as well as detect any new patterns.

**Methods:**

Study Area

The study area centers around the Matlacha Isles canal system and encompasses Matlacha Pass, from its northernmost boundary to the power lines south of Little Pine Island (Figure 1). The Matlacha Isles canal system is an approximately 5-$km^2$ series of brackish residential canals located in western Cape Coral, FL. Although dredged in the 1970s as part of the northern Cape Coral canal system, Matlacha Isles remains separated from the rest of this larger system by a small dam and boatlift, and it is the only section that has open water access. Matlacha Pass is the 65-$km^2$ body of water between Pine Island and the city of Cape Coral. It contains abundant sea grass beds, and consists of numerous small bays, mangrove islands, backwater areas and shallows. The Matlacha Isles canal system is accessed by a dredged channel, which runs along the northeastern side of the Matlacha Bridge and continues east, through a small shallow bay, located between Matlacha Pass and Matlacha Isles (Figure 2). The canal system begins in the southeastern corner of this bay as one 1.5 m deep and 8-10 m wide

entrance/exit canal. The entrance/exit canal then branches into multiple finger canals, with a "lake" in the easternmost end.

Two additional canal systems are included in the study area and are used for comparison with Matlacha Isles. The comparison canal systems, located in northern Pine Island and West Island, were chosen for their proximity to Matlacha Isles, low occurrence of manatee use, and general similarity in structure. The canals located at the far northeastern corner of the northern Pine Island canal system are physically the most similar to those of Matlacha Isles. A small shallow "bay" is located to the north of the entrance to the canals. The canals are branched, forming multiple finger canals, with similar shorelines to Matlacha Isles. The canals in West Island are located directly across Matlacha Pass from Matlacha Isles. The canals on West Island that are used as comparisons open directly to Matlacha Pass, are much shorter and have less branching than those in Matlacha Isles, and the shorelines are almost entirely sea walled.

Photographic Identification of Individual Manatees

Photographic identification (photo-ID) data were collected during 46 days between October 16, 2000 and July 25, 2001 (Table 1). A field day included one or more sites surveyed on a single day. Survey teams worked from 6-7 meter outboard motorboats with observation towers and propeller guards. Electric trolling motors are used to minimize disturbance of the manatees. The primary observer photographed manatees with a Nikon or Canon 35mm camera, fitted with a 70-300 mm zoom lens and a high-quality polarizing filter, using 100 or 200 ISO Ektachrome or Fujichrome slide film. For each sighting, we photographed individual manatees and sketched scars and other features on data sheets compatible with those used by the U.S. Geological Survey Sirenia Project (USGSSP). A sighting was defined as all individuals at a geographically distinctive location (*i.e.*, creek, bayou, harbor, boat basin) within an approximately 0.1 - 0.2 $km^2$ area at the same time. The term "observation" refers to individual animals. We noted sex of individuals when possible. We also recorded environmental data, such as weather, water and air temperature, salinity, wind direction and speed, and photo conditions. Locations of all sightings were plotted in a Geographic Information System (GIS), ArcView 3.1.

Data and slides were processed and analyzed using methods established by USGSSP, Manatee Individual Photo-Identification System (MIPS), and similar photo-identification research projects (Beck and Reid, 1995; Koelsch, 1997; Koelsch and Barton, 1999). Slides of distinctive manatees analyzed to date have been compared to cataloged individuals in MIPS, as well as to distinctive but unknown individuals observed previously in southwestern Florida. Individuals not recognized as being previously identified were grouped into one of three categories:

- Indistinct - Manatees with no readily identifiable scars or natural markings;
- Distinct Unknown (DU) - Manatees with visible scars or natural markings, but the animals were either not photographed in their entirety or photographs were not of adequate quality to allow for verifiable resightings. These distinct unknowns may represent incomplete photographs of previously sighted animals, but others may be unique individuals;
- Distinct Known - Manatees with readily recognizable, permanent scars or natural markings. These animals have adequate photographic documentation to be considered for inclusion in MIPS.

Sighting records and all other data were entered into Paradox, Q&E, MS Excel, and ArcView computer databases and analyzed. We continued to maintain a dedicated staff person to manage the MIPS databases.

Manatee Travels Past a Fixed Point

Daily patterns of manatee use of the Matlacha Isles canal system were documented through observations conducted at the entrance of the canal system. During this year's field season, we conducted four 24-hour observations from a resident's dock and/or balcony at the canal entrance (Table 2). Data were collected each time a manatee passed the entrance and at half-hour intervals. These data included: time of day, tide height, tide direction, sighting conditions, weather, wind speed and direction, number of manatees sighted, travel direction of the manatee(s), air and water temperature, and salinity.

Focal Animal Observations of Tagged Manatees

Manatees were captured and tagged within Matlacha Isles by FWC and MML staff, interns, and volunteers January 30-31, 2001 (Table 3) under FWC permit PRT-773494. A target

list of individual manatees, known to return to the study area annually during the winter, was compiled at the beginning of the field season. The number of manatees within the canals however made it difficult to safely capture only selected individuals. The method of capture within this site used a 400-ft long, 30-foot deep net with 4-inch mesh that was stretched across the mouth of one of the canals known to have high manatee use during the winter. The net was positioned so that one end was kept on the net boat at one side of the canal, while the other was stationary at the sandy bank where the captured manatees were hauled. When a manatee (or multiple manatees) approached the net, the net boat circled around to the capture bank and enclosed the manatee(s) in the net. The net was then used to secure the manatees and haul them onto the bank. The captured manatees were photographed, had blood collected from them, received passive integrated transponder (PIT) tags, and had physical data collected on them, including routine morphometrics, fat depths and thicknesses, and sex determination. Weights were obtained for five of the manatees captured on January 30, 2001; however due to logistic problems, weights could not be obtained on the last individual captured that day or the three caught the following day.

We caught and collected data on six manatees on January 30 (TSW031-033 and CSW034-036) and three on January 31 (TSW034-035 and CSW037). Individuals recognized as target animals were fitted with a standard manatee peduncle belt, tether of appropriate strength, and a tag with either a single very high frequency (VHF) radio-transmitter or a platform transmitter terminal (PTT) with VHF and ultrasonic transmitters, as described in Reid et al. (1995). Four manatees received PTT tags (TSW031 and TSW033-035) and 1 received a VHF tag (TSW032, CH040).

Focal animal observations were conducted on tagged individuals for 24-hour sampling periods to obtain behavioral data and investigate temporal activity patterns. Since we are only interested in behaviors of manatees in general, the focal manatee was randomly selected among the tagged individuals present within the study area prior to the onset of each sampling period. Instantaneous sampling methods were used to collect data on the focal individual's activity at four-minute intervals (Altmann 1974).

We conducted 10 focal observations from February 7 through March 13, 2001; however three of the sampling periods were less than 8 hours long due to inclement weather or the focal manatee leaving the study area (Table 4). The data collected at each sample point included time

of day, activity, confidence level, location, habitat type, minimum number in subgroup, and sighting conditions (following Koelsch 1997). The activities recorded include rest, travel, mill, feed, rest/feed, and socialize (from Hartman 1979; Urian and Wells 1996). The "rest/feed" activity was recorded when the focal manatee was in a sea grass bed but conditions made it difficult to distinguish between rest and feed. "Confidence level" is a measure of the observer's certainty of the manatee's activity at the sample point. The range is from 1 to 4, with 1 being the highest level of confidence and 4 being the lowest. Habitat type is based on those defined by Culter and Leverone (1993) and include the following: sea grass bed (GB), dredged basin (DB, >50% altered shoreline), dredged channel (DC, <50% altered shoreline), shoal/sandy bottom (SB, unvegetated, <1.5 m deep), open bay (>1.5 m deep), and grass bed/shoal-sandy bottom (GB/SB; used in areas <1.5 m deep and bottom composition, *i.e.*, vegetated vs. unvegetated, could not be determined, or in areas where sea grass cover is very sparse). Focal observations were not conducted after March 13, 2001 because water temperatures had increased and the tagged manatees were no longer using Matlacha Isles.

Movements of Tagged Manatees Within and Beyond the Matlacha Study Area

We monitored the tagged manatees throughout the winter, while they were both within and outside of the study area, and as they dispersed during the spring and summer. Daily and monthly location data transmitted by the PTT tags were acquired via System Argos, Inc. We also attempted to obtain semimonthly visual observations on each tagged individual via radio tracking by boat or truck (Table 5). Telemetric tracking of the tagged manatees ended August 30, 2001. At this time, most of the individuals had lost their tags. The USGS Sirenia Project staff assumed responsibility for the two remaining manatees with tags (FM281 and CH040) after the animals had traveled to the Ten Thousand Islands area where Sirenia Project is conducting a telemetry study.

Habitat Characterization

This field season we collected data on two habitat variables within the study area: surface and bottom water temperatures throughout the entire study area and surface and bottom water temperature and salinity at sampling stations within Matlacha Isles and comparison canal systems in West Island and northern Pine Island (Table 6).

Surface and bottom water temperatures (°C) throughout the study area (Figures 1, 3, and 4) were collected at 40-minute intervals using Optic StowAway Temp loggers. The loggers were deployed during the fall, cleaned and downloaded at least once per month, and retrieved in late spring. Loggers within canal systems were attached to the end of residential docks. Loggers within Matlacha Pass were attached to channel markers in three different sections of the pass: northern, mid, and southern. Water temperature data were entered into MS Excel and graphed.

Surface and bottom water temperature and salinity were collected one to four times per month at stations, established the first year of the study, within Matlacha Isles and the West Island and northern Pine Island canals (Table 6; Figures 4-5). Temperature and salinity were measured with YSI 30 handheld SCT (salinity/conductivity/temperature) meter with a 25-foot cord. Data collected at each station also included time, air temperature (°C), and depth (ft). Data were entered into MS Access and graphed.

**Results:**

As this is the second year of a three-year study, we will wait until the final year of data collection to run rigorous statistical analyses on the data. Results are given as general trends in the data sets.

Photographic Identification of Individual Manatees

We completed 95 sightings during 46 field days. Most of the effort occurred from October 16, 2000 to April 26, 2001, with 72 sightings during 34 field days within the primary study area. Other areas in which manatees were photographically documented include Orange River and Manatee Park (2 sightings), near Pirate Harbor (5 sightings), Burnt Store Marina (6 sightings), Turtle Bay (3 sightings), Peace River (1 sighting), Tampa Bay/Boca Ciega Bay (3 sightings), and Ten Thousand Islands (2 sightings).

We photographically documented 56 cataloged individuals 145 times. Thirty of the cataloged manatees were observed on multiple occasions (range: 1-14 observations/individual). All 56 of the cataloged individuals had been previously identified in southwest Florida or elsewhere along Florida's west coast prior to this study. Sighting histories of these previously documented manatees date back 1-18 years; two individuals (ID #s FM007 and FM029) were

first observed in 1983. Sighting records of all cataloged manatees have been sent to FMRI and have been prepared for inclusion into the MIPS sighting database.

Manatee Travels Past a Fixed Point

We conducted four 24-hour observation periods of manatee movements into and out of the Matlacha Isles canal system. Fewer observation periods were conducted this year than last due to lower recruitment of observers for this portion of the study. Data from the first two years of the study were combined to detect trends. The number of manatees observed varied throughout the winters and appears to be related to water temperatures (Figures 6-8). When water temperatures in Matlacha Pass were below 18°C for multiple days in a row, few (<50) manatees were observed traveling into or out of Matlacha Isles. As water temperatures warmed above 18°C, many (>100) manatees were observed. When water temperatures remained above 20°C and continued to warm over multiple days, the number of manatees observed began to gradually decrease. Manatees also displayed a strong daily pattern in their use of Matlacha Isles, with most entering the canal system in the morning and leaving in the afternoon/evening. This pattern exhibits a distinct bimodal distribution when graphed (Figure 9).

Focal Animal Observations of Tagged Manatees

Five tagged manatees were observed during ten focal animal sampling periods. Data from the first two years of the study were combined and graphed to detect trends. Reported data includes only those activities with confidence levels of 1 or 2. Cold and warm days were defined as those having bottom water temperatures within Matlacha Pass of $\leq$18°C and >18°C, respectively. These definitions were based on previous studies of manatee behavioral and physiological responses to various water temperatures (Campbell and Irvine 1981; Irvine 1983; Worthy et al. 2000).

Manatee activities were compared among times (Figure 10A-D). More activities were recorded during the day (0800-1800 hours) when it was easier to locate the focal individuals and observe behaviors. Rest was the most frequently observed activity (n = 1,678 intervals; 43% of recorded activities), followed by rest/feed (n = 818), mill (n = 637), travel (n = 592), feed (n = 202), and socialize (n = 11). Socialize was not included in the analyses due to the low number of observations.

On cold days, manatees spent the majority of their time resting, with rest and mill being the primary daytime activities (Figure 10C). Manatees were more active from evening to morning (1700-0800). Rest/feed was observed only between 1900 and 0600 hours. Confirmed feeding occurred at 1900, 2200, and 0600 hours. The majority of milling occurred during the day (0700-1700 hours). Travel was recorded primarily during the morning (0600-0800 hours) and evening (1700-1900). On warm days, manatees spent proportionately less time resting throughout the 24-hour period Figure 10D). The proportion of rest/feed and feed increased on warm days, with the largest percentages at night and morning (2000-0500 and 0800-1100 hours). Travel and mill occurred throughout the 24-hour period, with peaks in the proportion of travel around dawn and dusk (0600-0700 and 1600-1800 hours).

Manatee habitat use was also compared among times (Figure 11A-D), as well as among activities (Figure 12A-D). The only dredged basins that were used by manatees were within the Matlacha Isles canal system. Dredged basins (n = 1,734 intervals; 39% of observed habitat use), grass beds (n = 1,723; 38%), and GB/SB (n = 746; 17%) were the most frequently used habitats. For all observations, the number of observations within dredged basins was highest during the day, between 0800-1800 hours (Figure 11A-B). Grass beds (GB) and grass beds/shoal-sandy bottoms (GB/SB) were used throughout the 24-hour period, however GB/SB was used more frequently between 1900 and 0700 hours than during the rest of the day. Use of dredged channels (DC) occurred most frequently at 0100, 0400-0800, and 1800-1900 hours. Shoal/sandy bottom and open bay habitats were only used occasionally. On cold days, manatees primarily used dredged basins, which were also the only habitat used between 0900 and 1700 (Figure 11C). Dredged channels were used in the morning (0600-0800 hours) and evening (1800-1900 hours). Grass beds and GB/SB were used between 1800 and 0700 hours. On warm days, dredged basins were used less than other habitat types, with a peak in use at 1400-1500 hours (Figure 11D). Manatees were observed primarily throughout the 24-hour period in grass beds and GB/SB.

Manatees used certain habitat types for specific activities (Figure 12A-D). Most observations occurred in dredged basins, grass beds, and GB/SB, respectively, with few observations in dredged channels, shoal-sandy bottoms, and open bays. Dredged basins were used most frequently and in higher proportions for resting. Mill and travel were also observed in dredged basins. Not surprisingly, dredged channels were used primarily for travel and milling.

Rest was also observed in dredged channels on warm days. Grass beds and GB/SB were used mainly for rest/feed, resting, and feeding. Some travel and milling also occurred within grass beds and GB/SB. Open bays were used in higher proportions for milling and resting on cold days. In contrast, open bays were used exclusively for travel on warm days. Shoal/sandy bottoms were used exclusively for resting on cold days, whereas they were also used for milling and travel on warm days.

Movements of Tagged Manatees Within and Beyond the Matlacha Study Area

Five manatees were tagged and monitored during the second year of this study. Manatees included in the target list of individuals for tagging were ranked according to total number of sightings and/or sightings over multiple years in Matlacha Isles. Documented sightings averaged 6.8 per target individual, with a range of 2 to 19. The individual with 19 previous sightings in Matlacha Isles ranked highest on the target list, whereas those having only 2 previous sightings ranked lowest.

We received and plotted daily and monthly locations based on satellite data from the PTT tags. Visual observations of each tagged manatee were attempted 1-2 times per month. Location data were processed and plotted in ArcView GIS. Movements of each tagged manatee are summarized below:

CH106 (TSW031), a known adult female who ranked lowest on our list of target animals, was tagged (PTT #3054) on January 30, 2001. She primarily remained within the study area through March 6, with occasional visits to the area north of Pine Island and Bokeelia (Figure 13a). On March 7, she traveled into the Caloosahatchee River and the south Cape Coral canal system, where she remained for a few days during a period of colder water temperatures. By March 12, water temperatures had warmed above 20°C (Figure 8) and she returned to the study area for several days before heading north into Charlotte Harbor and west to Pine Island Sound. She then started heading north into Lemon Bay (March 19), Venice By-Pass canal (March 20), Sarasota Bay (March 21), and ended up in Tampa Bay/Boca Ciega Bay on March 23 (Figure 13b-c). She primarily remained within Boca Ciega Bay throughout the rest of the period she was tagged, except for two brief periods in April, and a period of approximately 1 month in late May through late June when she visited Old Tampa Bay/Safety Harbor. We estimate that it was during this latter period that she gave birth to a calf. Between July 31 and August 2, she lost her

tag near Mullet Key in the mouth of Tampa Bay. The tag continued to update its location as it floated further and further offshore into the Gulf of Mexico during Tropical Storm Barry. The MML staff recovered the tag on August 8 approximately 18 miles west of St. Pete Beach. After inspecting the tag, it was concluded that the eyebolt on the nosecone of the tag had rusted through and broken. Further inspection of our tags revealed that this was true for several others. The manufacturer of the tag housings was notified and has replaced the faulty eyebolts.

CH040 (TSW032), a known subadult male who was one of our top target animals (17 sightings between 1997 and 2001), was tagged (VHF 619) on January 30, 2001. He remained in the study area until the latter part of February when he traveled to the area outside Pirate Harbor, on the east side of Charlotte Harbor (Figure 14a). He remained in the Pirate Harbor and Burnt Store Marina area until April 26, when he was last seen. Multiple attempts to locate him were unsuccessful until June 28, when he was found in the Ten Thousand Islands area, east of Kice Island (Figure 14b). He remained in this general area throughout the rest of the time he was tagged. Staff from USGS Sirenia Project switched out his VHF tag for a PTT (#14609) on July 19 and assumed monitoring responsibilities, as they were interested in him for a study they are presently conducting. On September 10 he lost his tag, tether, and belt, which were later recovered in a residential canal in Marco Island. The belt appears to have broken free at the weak link.

FM007 ("Bandito", TSW033), a known adult female who was first documented in the Orange River in 1983, has been documented on multiple occasions in recent years within Matlacha Isles, and was on our list of target animals. She was tagged (PTT #14609) on January 30, 2001. She and her calf remained within the study area until February 15 (Figure 15). She then traveled north into Charlotte Harbor and visited Burnt Store Marina. On February 18, her tag became entangled within the marina and the tether broke free at the weak link. Her tag and tether were recovered a few days later by residents and returned to MML. Bandito and her calf were later documented in Matlacha Isles on March 8, when ambient water temperatures had decreased to approximately 18°C (Figure 8).

FM281 ("Pipe", TSW034), a known adult female who ranked fairly high on our target list of animals, was tagged (PTT #1883) on January 31, 2001. Upon capture, it was apparent that her left pectoral flipper had previously been entangled in monofilament line. She had scar tissue around the entire flipper and it was suspected that the line was still embedded within the flipper.

The FWC staff would have taken her to a rehab facility for treatment; however it was known that she had a dependent calf, and that calf had not been caught when she was. When her condition was reassessed in August, FWC staff decided not to rescue and bring her in for treatment.

A few days after being tagged, Pipe and her calf traveled to Manatee Park on the Orange River, where they remained through February 8 (Figure 16a). By February 9 they had returned to Matlacha Pass. For the following month, they traveled back and forth between the south Cape Coral canal system and southern Matlacha Pass/Matlacha Isles. By March 12, they started using the northern part of Matlacha Pass and Matlacha Isles. Pipe and her calf remained in this area until May 4, when they began to travel north into Charlotte Harbor. In the spring and early summer months, Pipe frequently used the areas on the western "wall" of Charlotte Harbor, Punta Gorda, Alligator Bay, and the Myakka River. On June 25, Pipe started traveling south to the Ten Thousand Islands area, which she reached by June 28 (Figure 16b). Chokoloskee Bay is the area she most frequents and where she is at present. USGS Sirenia Project staff switched out her tag on August 31 and has assumed monitoring responsibilities for her.

FM316 ("Moo-nar", TSW035), an adult female with no known sighting history in Matlacha Isles, was not a target animal. She was later identified as a Distinct Unknown (U1733) from the Orange River. She was tagged (PTT #5192) on January 31, 2001. A few days after being tagged, Moo-nar left the study area and traveled to the Caloosahatchee River (Figure 17). She was in the Orange River on February 8; however she returned to Matlacha Pass by February 10, where she stayed briefly until reaching the Peace River by February 14. Throughout the rest of the time she was tagged, Moo-nar alternated between Turtle Bay, the west "wall" of Charlotte Harbor, and the Peace River. After updating on June 17 in Shell Creek off the Peace River, her tag began having problems transmitting updates. MML staff located the signal from her tag on June 21 and followed it from Shell Creek into the Peace River. She was located near the I-75 bridge, traveled west under the bridge, then headed east back under the bridge. As she maneuvered through the pilings, she broke free of her tag and tether. We immediately tried to pick up a sonic signal from her belt, searching the entire area, but never heard one. It was determined that her PTT had stopped transmitting after becoming entangled in a crab trap and was probably partially submersed. We think that after several days, she dragged the crab trap from Shell Creek to the location where we found her. As she maneuvered between the pilings of

the bridge, the crab trap became trapped on one side of a piling and as she pulled, the tether broke free at the weak link, allowing her to escape.

Habitat Characterization

Bottom water temperatures in the three canals (sites 1, 2, and 6) used most frequently by manatees within Matlacha Isles remained 2-5 °C warmer than in Matlacha Pass, West Island, and northern Pine Island (Figures 8 and 18). Bottom water temperatures in Matlacha Isles site 6 tended to have the highest temperatures of all locations, however they also fluctuated by time of day, increasing during daylight hours and decreasing at night. Site 2 had slightly lower temperatures and followed this same pattern. Temperatures within site 1 were more stable, with little fluctuation between time of day, and most times retained warmth at night when temperatures in sites 1 and 6 decreased. Water temperatures within West Island and northern Pine Island tended to be 1-2°C higher than those in Matlacha Pass, however they were occasionally equal.

Surface and bottom salinities varied among Matlacha Isles, West Island and northern Pine Island. Differences between mean surface salinities were unremarkable, however the upper limits of the range of surface salinities at the Matlacha Isles stations were up to 10 ppt higher than those in West Island and northern Pine Island (Figure 19). Mean bottom salinities at the Matlacha Isles stations tended to be a few ppt higher than those in the comparison canal systems (Figure 20). As with surface salinities, the upper limits of the range of bottom salinities were up to 10 ppt higher than those in the comparison canal systems.

**Discussion:**

During the first two years of this project, we initiated the characterization of manatee use of the secondary manatee winter refuge site, Matlacha Isles, and the nearby waters of Matlacha Pass. We have collected information on habitat, temperature, movements, activities, counts, and individual use. After the final year of data collection, we will use this information to better understand and predict manatee use of the Matlacha Isles canal system, as well as specific sites within the canal system, to determine its importance as a winter refuge. This report represents the first two years of a multi-year study, so many of the findings will be discussed in greater detail at the conclusion of the final year of research. Due to the late timing of captures and

tagging during the first two years of the study, focal observations were only conducted during the latter part of each winter, resulting in few observations during colder periods. A full winter of focal observations would give a better picture of manatee activity and site use, while also providing much needed additional observations during the colder periods.

To fully understand why and how manatees use Matlacha Isles, a thorough characterization of the habitat is needed. Water temperatures are perhaps the primary factor known to influence manatee winter distribution (Hartman 1979; Irvine 1983; Lefebvre et al. 1989). Comparing water temperatures within the three different canal systems further revealed differences between Matlacha Isles and the comparison canals. The warmer water temperatures in Matlacha Isles compared to Matlacha Pass, West Island, and northern Pine Island, likely served as the primary attractant for manatees to Matlacha Isles. In Matlacha Pass (where the fewest manatees were observed during periods of cold weather), shallower water quickly cooled when air temperatures dropped. The warmer temperatures in Matlacha Isles might be attributed to the deeper water at some sites and the higher degree of canal branching compared to the comparison canals. The deeper waters in Matlacha Isles retained warmer temperatures and experience less fluctuation. The comparison canals, which initially appeared to share similar physical characteristics with Matlacha Isles, were much cooler and did not retain warm water. A possible explanation for this may be that the canals in West Island and northern Pine Island experience more tidal flushing than the Matlacha Isles canals. Further sampling of each canal system is needed however to determine this.

Overall, water temperatures affected manatee distribution. When water temperatures were cold, few manatees moved in and out of the canals. Low to moderate numbers remained in the canals, favoring particular sites (Sites 1, 2, and 6). When water temperatures in the canals remained below their thermal tolerance for several successive days, some individuals left the study area and traveled to the Orange River, likely in search of warmer water. Although some manatees fled to the Orange River, many individuals of all size classes remained in Matlacha Isles throughout the cold periods. In December 2000 and January 2001 however, multiple cold fronts in a row kept temperatures low for several weeks. Water temperatures in Matlacha Pass got as low as 10°C and rarely reached 18°C, while water temperatures within Matlacha Isles remained much warmer. At one point during this period however, water temperatures within Matlacha Isles did drop as low as 15°C and few manatees (<20) were seen.

Temperatures in Site 1 were more uniform than in other sites, as were counts of manatees themselves. Unlike most other sites, Site 1 bottom temperatures were often warmer than the surface. This is probably due to the deeper water at this site (up to 16 feet in some areas). In previous years, higher numbers of manatees may have been observed in Site 1 than during the past two winters (MML unpublished data). Although Site 1 appears to continue to offer favorable habitat and was consistently used by manatees during both cold and warm days, manatees may have shifted their use to other sites within Matlacha Isles. Air temperatures and radiational heating appear to have more influence on water temperatures in Sites 2 and 6 than Site 1. The high number of manatees documented in Sites 2 and 6 may be due to the higher daytime water temperatures in these sites. The highest manatee counts for the season were on January 19, when between seventy and one hundred manatees were observed in Site 2.

During the first year of the study (Koelsch et al. 2000), it was evident by the dramatic increase in aerial counts that large numbers of manatees migrated into Matlacha Pass during warmer periods between cold fronts. This happened again this winter following the extended cold period in December and January. For a few days during this period, water temperatures in Matlacha Pass increased above 18°C. This warmer period was also a time when we had high manatee counts during photo-ID surveys, with 79-111 manatees recorded on January 19, 2001 in Matlacha Isles. The primary refuge at the Florida Power & Light Ft. Myers power plant on the Orange River has little forage for manatees. Individuals aggregated at this site throughout the cold period may have traveled to Matlacha Pass during the warmer spell to forage in its abundant sea grass beds. Matlacha Pass may also be a favorable site to forage because Matlacha Isles provides a proximate, immediate refuge if temperatures were to drop again suddenly.

Another important habitat factor is food availability. During the first field season, very little vegetation was available within Matlacha Isles, with only algae and overhanging vegetation being found. The only evidence of sea grass was in Site 3, the small bay at the mouth of the canal system. This small amount of forage is not enough to support the dozens of manatees that use the canals during the winter; therefore, manatees must leave the canal system to feed.

With a baseline understanding of the characteristics of Matlacha Isles canals, manatee use patterns can be investigated. Photographic identification studies provided one means of evaluating manatee use. Photo-identification surveys in Matlacha Isles, Matlacha Pass, and elsewhere in southwest Florida documented many previously recognized as well as several new,

formerly unidentified individuals. Observations of these individuals have updated and expanded the MIPS scar catalog and sighting databases for southwest Florida. Studies of distinctly marked manatees have established sighting histories for numerous formerly unknown individuals, collected information on reproductive histories of several adult females, documented inter- and intra-seasonal movement among several sites in southwestern and west central Florida, and identified winter locations for manatees previously observed in the non-winter.

Whereas some individuals appeared faithful to winter aggregations sites, even after several years, other manatees have moved among sites between and within winter seasons (Reid et al. 1991; Koelsch and Barton 1999; Koelsch et al. 1999). Several manatees (based on photo-identification as well as telemetry studies) moved between relatively near-by primary and secondary winter sites in southwest Florida: Orange River and Matlacha Isles, respectively. Within-season movements among southwestern Florida sites were not surprising because of the relatively close proximity of these sites and the short amount of time required for the travel, as telemetry data has shown that manatees can make the journey in less than one day. Findings of movements among winter sites suggest that although intra-seasonal movement may be constrained by water temperature, some limited exchange occurs. Also, whereas some individuals appear faithful to winter sites, others do not.

In addition to using resightings of individuals to study movement patterns and site fidelity, this investigation also provided baseline information on reproductive and life history parameters and created sighting histories of manatees in southwest Florida. If these individuals are later recovered as carcasses, we now possess baseline data on their distribution and movements. With continued photo-identification studies, we can build upon these findings and gain additional insight into the ecology of manatees in the region.

By observing manatee movements into and out of Matlacha Isles, as well as monitoring their activities while in the canals or Matlacha Pass, additional patterns of manatee use were revealed. Manatees entered the canals in the morning and left the canals in the afternoon/early evening. Data from both fixed point observations and aerial surveys support this finding. Manatee movements into and out of the canals were related to daily fluctuations in water temperature: they entered the canals as temperatures began to increase and departed when temperatures began to decrease. These daily fluctuations in water temperatures also correspond with the daily rise (during daylight hours) and fall (during nighttime hours) of air temperatures.

Manatees appeared to be taking advantage of Matlacha Isles during the warmest periods of the day, presumably to maximize energy conservation. When temperatures in Matlacha Pass remained below manatees' thermal tolerance, most manatees remained in the canals. When temperatures in Matlacha Pass were at or slightly above the threshold, manatees would move into the pass in the afternoon and early evening, even though temperatures in Matlacha Pass were still lower than the canals. Although the cooler temperatures may have made it energetically more demanding, manatees could feed in Matlacha Pass grass beds and increase their energy intake.

The consistent numbers of manatees present in Matlacha Isles throughout the winter support the fact that it is used as a winter refuge site. Drops in water temperatures below manatees' thermal tolerance make Matlacha Isles an unfavorable site during periods of extreme cold. Matlacha Isles should be considered an important winter refuge site, nonetheless. Another year of data will further elucidate patterns detected during the first two years. A better understanding of manatee use of secondary winter aggregation sites may better prepare regulators in the event of a cessation of warm water at a primary site.

In addition to the extensive studies focused on Matlacha Isles, another component of this contract encompassed the management of the MIPS databases. Collaborative efforts between the contractor and staff from FMRI, USGS Sirenia Project, and U.S.F.W.S. facilitated management of the databases. Over the last few years, the team of MIPS administrators has been planning and preparing an MS Access compatible upgraded MIPS. New manatees being cataloged from this field season will be included in MIPS. In addition, sighting records for both regions and study periods were entered and verified and are ready for inclusion in MIPS. New records cannot be appended to the existing system however, because the upgrade is still in process.

**Conservation benefits:**

The Matlacha Isles canal system is a non-industrial, secondary winter refuge site for manatees in southwestern Florida. The Florida Manatee Recovery Plan (U.S. Fish and Wildlife Service 2001) has identified the "protection, enhancement, and investigation" of secondary winter refuge sites as Objective 3.2.3; and the role that winter refuge sites play in the survival of the species is considered extremely important for managers and researchers to understand. Data

on physical and chemical characteristics of secondary or alternate winter refuge sites, in conjunction with site use patterns, may facilitate the understanding of manatee use of these sites during cold weather, as well as their importance as winter refugia and/or alternate sites in the event that warm water at a primary site ceases.

Through photographic identification, this investigation also provided information on movement patterns, site fidelity, reproductive and life history parameters, and created sighting histories of manatees in southwest Florida. If these individuals are later recovered as carcasses, we now possess baseline data on their distribution and movements. With continued photo-identification studies, we can build upon these findings and gain additional insight into the ecology of manatees in the region.

**Acknowledgements:**

Mote Marine Laboratory (MML) staff R. Nostrom and T. Kessenich provided invaluable assistance with fieldwork, data analysis, and report preparation. K. Scolardi (MML) and numerous interns and volunteers provided instrumental assistance with fieldwork and data entry. M. and P. Gadient and Burnt Store Marina provided logistical assistance. D. Fagone, A. Garrett, and T. Pitchford (FWC) coordinated the capture event. L. Keith and M. Barlas (FWC) provided additional sightings of tagged manatees and recovery of tags. A. Smith (FWC) provided technical assistance with processing and plotting of Argos data. J. Reid and S. Butler (USGS Sirenia Project) provided technical support, additional sightings, and extra telemetry supplies, as well as answered numerous questions.

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**List of Tables:**



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Table 1. Manatee photographic identification activities in southwestern Florida, October 16, 2000 - July 25, 2001

| Date | Obs. | Stg# | Location | Counts: Min | Max | MIPS status | ID's | IN GIS |
|---|---|---|---|---|---|---|---|---|
| 16-Oct-00 | SB | 1 | Matlacha Isles, Site 1 | 7 | 7 | P | | Y |
| 16-Oct-00 | TK | 2 | Matlacha Isles, Site 2 | 2 | 3 | P | | Y |
| 30-Oct-00 | SB | 1 | Matlacha Pass, Marker 71-72 | 3 | 4 | L | | Y |
| 30-Oct-00 | SB | 2 | Matlacha Isles, Site 1 | 3 | 4 | V | CH109, FM306 | Y |
| 6-Nov-00 | SB | 1 | Matlacha Isles, Site 2 | 10 | 12 | L | | Y |
| 6-Nov-00 | SB | 2 | Matlacha Isles, Site 1 | 6 | 8 | L | FM200 | Y |
| 1-Dec-00 | SB | 1 | Matlacha Isles, Site 1 | 22 | 30 | L | FM306, TB135, U1147, U1856 | Y |
| 1-Dec-00 | SB | 2 | Matlacha Isles, Site 6 | 15 | 25 | L | FM281 | Y |
| 1-Dec-00 | SB | 3 | Matlacha Isles, Site 2 | 20 | 30 | V | | Y |
| 4-Dec-00 | SB | 1 | Matlacha Isles, Site 1 | 12 | 14 | V | FM306, SB113, CH113, CH 88, U1066, U1147, U1845 | Y |
| 4-Dec-00 | SB | 2 | Matlacha Isles, Site 2 | 15 | 20 | V | CH 76, CH 70 | Y |
| 21-Dec-00 | SB | 1 | Matlacha Isles, Site 1 | 10 | 15 | L | | Y |
| 21-Dec-00 | SB | 2 | Matlacha Isles, Site 7B | 10 | 12 | V | SB 79 | Y |
| 21-Dec-00 | KS | 3 | Matlacha Isles, Site 2 | 7 | 10 | L | | Y |
| 27-Dec-00 | KS | 1 | Matlacha Isles, Site 3 | 3 | 3 | L | CH 74 | Y |
| 27-Dec-00 | SB | 2 | Matlacha Pass, NE of bridge | 3 | 3 | L | | Y |
| 27-Dec-00 | SB | 3 | Matlacha Isles, Site 2 | 25 | 40 | L | TB135, FM 29, CH 61, CH 80, U1757 | Y |
| 27-Dec-00 | SB | 4 | Matlacha Isles, Site 8 | 2 | 3 | V | | Y |
| 2-Jan-01 | SB | 1 | Matlacha Isles, Site 7B | 4 | 5 | L | | Y |
| 2-Jan-01 | SB | 2 | Matlacha Isles, Site 6 | 8 | 10 | L | | Y |
| 2-Jan-01 | SB | 3 | Matlacha Isles, Site 1 | 2 | 3 | L | CH 80 | Y |
| 5-Jan-01 | SB | 1 | Manatee Park | 35 | 50 | L | FM279, FM281, SB 93, FM292, FM294, FM244, U1227, U1347 | Y |
| 5-Jan-01 | SB | 2 | Orange River | 50 | 100 | L | CH 87, FM211, FM100, FM266 | Y |
| 9-Jan-01 | SB | 1 | Matlacha Isles, Site 6 | 1 | 2 | P | | Y |
| 9-Jan-01 | SB | 2 | Matlacha Isles, Site 7B | 1 | 1 | P | | Y |
| 9-Jan-01 | SB | 3 | Matlacha Isles, Site 2 | 35 | 40 | L | CH 78, CH 70, CH 47, U1197 | Y |
| 9-Jan-01 | SB | 4 | Matlacha Isles, Site 1 | 2 | 3 | P | | Y |

| Date | Obs. | Stg# | Location | Counts: Min | Max | MIPS status | ID's | IN GIS |
|---|---|---|---|---|---|---|---|---|
| 11-Jan-01 | SB | 1 | Matlacha Isles, Site 2 | 15 | 20 | L | CH 47 | Y |
| 11-Jan-01 | SB | 2 | Matlacha Isles, Site 1 | 3 | 5 | L | CH 78 | Y |
| 16-Jan-01 | SB | 1 | Matlacha Isles, Site 7B | 2 | 2 | L | | Y |
| 16-Jan-01 | SB | 2 | Matlacha Isles, Site 2 | 25 | 35 | L | CH120, CH 74, FM266 | Y |
| 16-Jan-01 | SB | 3 | Matlacha Isles, Site 6 | 10 | 12 | L | | Y |
| 17-Jan-01 | MG | 1 | Matlacha Isles, Site 1 | 5 | 8 | L | | Y |
| 19-Jan-01 | TK | 1 | Matlacha Isles, Site 6 | 4 | 6 | V | CH104 | Y |
| 19-Jan-01 | TK | 2 | Matlacha Isles, Site 8 | 3 | 3 | L | CH104 | Y |
| 19-Jan-01 | RN | 3 | Matlacha Isles, Site 7B | 2 | 2 | L | | Y |
| 19-Jan-01 | RN | 4 | Matlacha Isles, Site 2 | 70 | 100 | L | FM181, SB 38, SB126, CH 40, FM280, FM 29, SB131, CH 42, CH 47, SB141, CH 80, SB 94, FM100, CH120, U1147 | Y |
| 26-Jan-01 | RN | 1 | Matlacha Isles, Site 6 | 15 | 20 | L | CH 47, FM241, SB 98 | Y |
| 29-Jan-01 | MG | 1 | Matlacha Isles, Site 1 | 8 | 11 | L | | Y |
| 30-Jan-01 | SB | 1 | Matlacha Isles, Site 1 | 15 | 20 | L | U1147 | Y |
| 30-Jan-01 | RN | 2 | Matlacha Isles, Site 2 | 25 | 35 | L | FM281, FM7 | Y |
| 6-Feb-01 | MG | 1 | Matlacha Isles, Site 1 | 16 | 20 | V | SB154 | Y |
| 7-Feb-01 | KS | 1 | Matlacha Isles, Site 1 | 30 | 40 | L | SB 90, CH 42, CH120, FM277, SB 77, SB132 | Y |
| 7-Feb-01 | TK | 2 | Matlacha Isles, Site 6 | 10 | 14 | L | FM 7, CH 47, SB 24, CH 91, CH115, U1708 | Y |
| 8-Feb-01 | SB | 1 | Matlacha Isles, Site 1 | 30 | 40 | L | SB 90, FM 7, CH 94, CH120 | Y |
| 8-Feb-01 | SB | 2 | Matlacha Isles, Site 1 | 60 | 70 | L | SB 90, FM 7, CH 42, SB113, FM286, CH 94, FM124, CH107, CH 80, CH 78, FM100, U1605, U1708 | Y |
| 10-Feb-01 | KS | 1 | Matlacha Pass, Marker 81 | 1 | 2 | V | CH 88 | Y |
| 15-Feb-01 | SB | 1 | Matlacha Isles, Site 2 | 25 | 30 | L | FM100, FM281 | Y |
| 15-Feb-01 | SB | 2 | Matlacha Isles, Site 7B | 3 | 3 | V | FM 7 | Y |
| 16-Feb-01 | SB | 1 | Matlacha Pass, W of Marker 44 | 6 | 8 | L | FM281 | Y |
| 17-Feb-01 | SB | 1 | Matlacha Pass, E of 30 | 2 | 2 | V | Blinky | Y |
| 22-Feb-01 | TK | 1 | Matlacha Isles, Site 2 | 16 | 25 | L | CH 42 | Y |
| 22-Feb-01 | SB | 2 | Pirate Harbor, NW of channel into | 8 | 10 | L | CH 40 | Y |
| 23-Feb-01 | SB | 1 | Matlacha Isles, Site 1 | 6 | 8 | V | CH115 | Y |

| Date | Obs. | Stg# | Location | Counts: Min | Max | MIPS status | ID's | IN GIS |
|---|---|---|---|---|---|---|---|---|
| 23-Feb-01 | SB | 2 | Matlacha Isles, Site 2 | 30 | 35 | L | CH 47, CH115, FM280 | Y |
| 1-Mar-01 | RN | 1 | Matlacha Pass, E of Marker 38 | 2 | 3 | V | FM281 | Y |
| 1-Mar-01 | SB | 2 | Pirate Harbor, S of channel | 6 | 10 | L | CH 40 | Y |
| 2-Mar-01 | SB | 1 | Burnt Store Marina | 20 | 25 | L | FM211, CH 74 | Y |
| 2-Mar-01 | SB | 2 | Turtle Bay | 2 | 2 | V | FM316 | Y |
| 2-Mar-01 | SB | 3 | Matlacha Isles, Site 3 | 10 | 11 | L | | Y |
| 8-Mar-01 | TK | 1 | Matlacha Isles, Site 1 | 50 | 60 | L | CH 42, CH 80, CH109, CH 94, CH111, FM 7, FM280, FM286 | Y |
| 8-Mar-01 | TK | 2 | Matlacha Isles, Site 2 | 30 | 35 | L | | Y |
| 8-Mar-01 | KS | 3 | Matlacha Isles, Site 6 | 10 | 13 | L | FM280 | Y |
| 8-Mar-01 | TK | 4 | Matlacha Isles, Site 1 | 14 | 16 | L | CH 42, FM 7, CH111, CH 94 | Y |
| 8-Mar-01 | SB | 11 | Matlacha Pass, E of Marker 20 | 2 | 2 | V | FM281 | Y |
| 9-Mar-01 | SB | 1 | Matlacha Isles, Site 2 | 6 | 8 | L | CH101, FM281, CH109 | Y |
| 9-Mar-01 | SB | 2 | Matlacha Isles, Site 1 | 20 | 25 | L | CH 42, CH115 | Y |
| 9-Mar-01 | SB | 3 | Matlacha Isles, Site 2 | 20 | 30 | L | CH109, CH111, FM281 | Y |
| 10-Mar-01 | SB | 1 | Burnt Store Marina | 5 | 10 | V | CH 40 | Y |
| 13-Mar-01 | SB | 11 | Matlacha Isles, Site 2 | 20 | 22 | L | SB154, FM281 | Y |
| 22-Mar-01 | KS | 11 | Matlacha Isles, Site 3 | 6 | 7 | V | Blinky | Y |
| 22-Mar-01 | KS | 12 | Matlacha Pass, SW of Marker 81 | 2 | 2 | V | FM281 | Y |
| 22-Mar-01 | SB | 1 | Matlacha Isles, Site 3A | 7 | 8 | L | Blinky | Y |
| 22-Mar-01 | SB | 2 | Matlacha Isles, Site 1 | 15 | 20 | L | CH 42 | Y |
| 22-Mar-01 | SB | 3 | Matlacha Isles, Site 2 | 1 | 2 | L | | Y |
| 26-Mar-01 | RN | 1 | Pirate Harbor, N of | 1 | 1 | V | CH 40 | Y |
| 26-Mar-01 | SB | 2 | Turtle Bay | 3 | 5 | V | FM316 | Y |
| 5-Apr-01 | RN | 11 | Burnt Store Marina | 20 | 25 | L | CH 40 | Y |
| 5-Apr-01 | TK | 1 | Matlacha Isles, Site 1 | 10 | 15 | L | FM281 | Y |
| 5-Apr-01 | TK | 2 | Matlacha Isles, Site 2 | 4 | 5 | L | | Y |
| 10-Apr-01 | SB | 1 | Matlacha Pass, S of Marker 81 | 7 | 13 | L | FM281 | Y |
| 10-Apr-01 | SB | 2 | Burnt Store Marina | 5 | 7 | L | | Y |
| 10-Apr-01 | SB | 3 | Pirate Harbor, N of | 1 | 1 | L | CH 40 | Y |

| Date | Obs. | Stg# | Location | Counts: Min | Max | MIPS status | ID's | IN GIS |
|---|---|---|---|---|---|---|---|---|
| 20-Apr-01 | SB | 1 | Burnt Store Marina | 20 | 30 | L | CH 40 | Y |
| 26-Apr-01 | SB | 1 | Burnt Store Marina | 6 | 8 | P | | Y |
| 26-Apr-01 | SB | 2 | Pirate Harbor, NW of | 7 | 10 | L | CH 40 | Y |
| 26-Apr-01 | SB | 3 | Matlacha Pass, NE along shoal | 2 | 4 | L | FM281 | Y |
| 17-May-01 | SB | 1 | Turtle Bay | 7 | 8 | L | FM316, FM294 | Y |
| 25-May-01 | RN | 1 | Boca Ciega Bay, W of Bird Key | 5 | 6 | L | CH106 | Y |
| 30-May-01 | SB | 1 | Alligator Bay | 4 | 4 | L | FM281 | Y |
| 7-Jun-01 | SB | 1 | Peace River | 1 | 1 | L | FM316 | Y |
| 28-Jun-01 | SB | 1 | Ten Thousand Islands,Coon Key Pass | 10 | 20 | L | CH 40 | Y |
| 6-Jul-01 | SB | 1 | Tampa Bay, S of Little Bird Key | 3 | 3 | L | CH106 | Y |
| 12-Jul-01 | SB | 1 | Ten Thousand Islands, Goodland Marina | 2 | 2 | L | CH 40 | Y |
| 25-Jul-01 | SB | 1 | Boca Ciega Bay, SE of Bird Key | 2 | 2 | L | CH106 | Y |

**Observers**: SB - Sheri Barton, TK - Teresa Kessenich, RN - Rachel Nostrom, KS - Kerri Scolardi MG - Maija Gadient (Volunteer)

**MIPS Status codes**: P - No photos, L - Slides labeled, S- Slides sorted but not verified, V - Verified, C - Analysis complete

Table 2. Observations of manatees moving past a fixed point located at the entrance to Matlacha Isles, February 7 - 17, 2001. For additonal information on manatee movement patterns past a fixed point, see Figure 6.

| | | | | | # Manatees | | |
|---|---|---|---|---|---|---|---|
| Obs # | Start Date | Start Time | End Date | End Time | In | Out | Comments |
| 1 | 7-Feb-01 | 9:50 | 8-Feb-01 | 9:50 | 118 | 85 | cool at night, many manatees entering and leaving canals |
| 2 | 8-Feb-01 | 9:50 | 9-Feb-01 | 10:00 | 83 | 231 | many manatees observed entering and leaving canals |
| 3 | 15-Feb-01 | 9:15 | 16-Feb-01 | 9:30 | 52 | 69 | moderate number of manatees entering and leaving canals |
| 4 | 16-Feb-01 | 9:30 | 17-Feb-01 | 9:15 | 67 | 35 | moderate number of manatees entering and leaving canals |

Table 3. Summary of manatees captured and tagged in Matlacha Isles, January 30 - 31, 2001.

| Date tagged | Capture ID | Name | MIPS ID | Sex | Total Length | PTT | VHF | Sonic | Tag color | Antenna | Belt | End date tagged (approx) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30-Jan-01 | TSW031 | CH106 | CH106 | F | 308 cm | 3054 | 703 MHz | 77.5 kHz | Orange | Yellow | Purple | 30-Jul-01 |
| 30-Jan-01 | TSW032 | CH040 | CH040 | M | 277 cm | N/A | 619 MHz | N/A | Or/Rd/Yell | Yellow | Green | 10-Sep-01 |
| 30-Jan-01 | TSW033 | Bandito | FM 7 | F | 334 cm | 14609 | 669 MHz | 77 kHz | Yell/Wht | Yellow | Blue | 18-Feb-01 |
| 31-Jan-01 | TSW034 | Pipe | FM281 | F | 290 cm | 1883 | 637 MHz | 76 kHz | Red/Yell | Black | Red | 31-Aug-01 |
| 31-Jan-01 | TSW035 | Moo-Nar | FM316 | F | 272 cm | 5192 | 535 MHz | 76 kHz | Red/Green | Yellow | Red | 21-Jun-01 |
| 30-Jan-01 | CSW034 | | | M | 202 cm | | | | | | | |
| 30-Jan-01 | CSW035 | | | M | 204 cm | | | | | | | |
| 30-Jan-01 | CSW036 | | | M | 234 cm | | | | | | | |
| 31-Jan-01 | CSW037 | | | F | 310 cm | | | | | | | |

Table 4. Focal observations of tagged manatees, February 7 - March 14, 2001

| Start Date | Start Time | End Date | End Time | Animal ID | General Area | Comments |
|---|---|---|---|---|---|---|
| 7-Feb-01 | 1038 | 8-Feb-01 | 1034 | FM007 | Matlacha Isles to S. Matlacha Pass to Matlacha Isles | left canals at ~1900, returned at ~800 |
| 8-Feb-01 | 1227 | 9-Feb-01 | 1227 | FM007 | Matlacha Isles to N. Matlacha Pass | exited canals at ~2130 |
| 9-Feb-01 | 1027 | 10-Feb-01 | 1039 | CH040 | N. Matlacha Pass | moved north during focal |
| 15-Feb-01 | 1152 | 16-Feb-01 | 1156 | FM281 | Matlacha Isles to S. Matlacha Pass | exited canals at ~1800 |
| 16-Feb-01 | 1158 | 17-Feb-01 | 1113 | FM281 | S. Matlacha Pass to southern border of study area | manatee left study area |
| 22-Feb-01 | 1051 | 23-Feb-01 | 859 | CH106 | Matlacha Isles to N. Matlacha Pass | manatee left study area |
| 1-Mar-01 | 1112 | 1-Mar-01 | 1804 | FM281 | S. Matlacha Pass to southern border of study area | mantee left study area |
| 1-Mar-01 | 1958 | 1-Mar-01 | 2058 | Blinky | N. Matlacha Pass | ended focal due to foul weather |
| 9-Mar-01 | 824 | 10-Mar-01 | 852 | FM281 | Matlacha Isles to S. Matlacha Pass to Matlacha Isles | exited canals at ~1800, returned at ~800 |
| 13-Mar-01 | 1110 | 13-Mar-01 | 1838 | Blinky | N. Matlacha Pass | ended focal due to foul weather |

Table 5. Tracking history of tagged manatees in southwestern Florida, January 05 - August 22, 2001

| Animal ID | Date | Time | Observer | Mode | Location | Weather | Water Temp. (C) | Salinity (ppt) | Seagrass | Depth (ft) | Activity | PTT | Freq |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leech | 5-Jan-01 | 13:00 | Barton | Boat | Orange River | Clear | 24 | 16 | None | | Rest/Mill | 1881 | 473 |
| Leech | 17-Jan-01 | 11:12 | Public | Truck | Matlacha Isles, site 1 | PC | | | None | 10 | | 1881 | 473 |
| Benny | 19-Jan-01 | 12:43 | Barton | Boat | Matlacha Isles, site 2 | Clear | 23.4 | 24 | None | 6 | | | |
| CH106 | 30-Jan-01 | 12:42 | Public | Land | Matlacha Pass | | | | | | | 3054 | 703 |
| Pipe | 5-Feb-01 | 15:43 | Public | Land | Orange River | | | | | | | | |
| Benny | 7-Feb-01 | 9:45 | Scolardi | Boat | Matlacha Isles, site 1 | PC | 21.7 | 10.6 | None | 10 | | | |
| Bandito | 7-Feb-01 | 10:38 | Nostrom | Boat | Matlacha Isles, site 6 | Clear | | 26 | None | 10 | Rest | 14609 | 669 |
| Benny | 8-Feb-01 | 10:10 | Barton | Boat | Matlacha Isles, site 1 | Clear | | 30 | None | 9 | | | |
| Bandito | 8-Feb-01 | 10:34 | Nostrom | Boat | Matlacha Isles, site 1 | Clear | | 30 | None | 10 | Rest | 14609 | 669 |
| Bandito | 8-Feb-01 | 12:27 | Barton | Boat | Matlacha Isles, site 1 | Clear | | | None | 10 | Rest | 14609 | 669 |
| Ch040 | 9-Feb-01 | 10:27 | Kessenich | Boat | Matlacha Pass, Indian Field, W of 69/71 | PC | | | | 4 | Feed | | 619 |
| Bandito | 9-Feb-01 | 12:27 | Barton | Boat | Matlacha Pass, WSW of marker 79 | PC | | | | 3 | Feed | 14609 | 669 |
| Ch040 | 10-Feb-01 | 10:39 | Scolardi | Boat | Matlacha Pass, E of marker 79 | OC | | | | 5 | Travel | | 619 |
| CH106 | 11-Feb-01 | 8:57 | Public | Land | Burnt Store Marina | | | | None | 7 | | 3054 | 703 |
| Pipe | 15-Feb-01 | 11:52 | Barton | Boat | Matlacha Isles, site 2 | PC | 25.6 | 26 | None | 6 | Travel | 1883 | 637 |
| Bandito | 15-Feb-01 | 13:25 | Nostrom | Boat | Matlacha Isles, site 7B | PC | 26.3 | 24 | None | 9 | | 14609 | 669 |
| Pipe | 16-Feb-01 | 11:56 | Nostrom | Boat | Matlacha Pass, NW of of marker 44 | PC | | | | 3 | Rest,Feed | 1883 | 637 |
| Pipe | 17-Feb-01 | 11:41 | Barton | Boat | Matlacha Pass, just S of power lines | | | | | 4 | Travel | 1883 | 637 |
| Blinky | 17-Feb-01 | 11:30 | Barton | Boat | Matlacha Pass, E of marker 30, N of power lines | Clear | 25.1 | | | 3 | | 5193 | 589 |
| Pipe | 21-Feb-01 | 22:00 | Public | Land | Chiquita Canal | | | | | | | 1883 | 637 |
| CH106 | 22-Feb-01 | 9:40 | Public | Land | Matlacha Pass | | | | | | | 3054 | 703 |
| CH106 | 22-Feb-01 | 10:51 | Kessenich | Boat | Matlacha Isles, site 2 | PC | | | | 6 | Mill | 3054 | 703 |
| Ch040 | 22-Feb-01 | 11:30 | Barton | Boat | Charlotte Harbor, NW of Pirate Harbor | Clear | | 32 | | 13 | Feed | | 619 |
| CH106 | 23-Feb-01 | 8:59 | Kessenich | Boat | Matlacha Pass, NW of marker 85 | PC | | | | 5 | Travel | 3054 | 703 |
| Pipe | 24-Feb-01 | 13:13 | Public | Land | Tarpon Pt. Marina | | | | | | | 1883 | 637 |
| CH040 | 26-Feb-01 | 12:33 | Public | Land | Shell Creek | | | | | | | | 619 |
| Pipe | 1-Mar-01 | 11:12 | Nostrom | Boat | Matlacha Pass, E of marker 38 | PC | 25 | 37 | | 3 | Mill | 1883 | 637 |
| Ch040 | 1-Mar-01 | 12:54 | Barton | Boat | Pirate Harbor,S of entrance | PC | 25.1 | 17.8 | | 3 | Mill | | 619 |
| Pipe | 1-Mar-01 | 18:08 | Nostrom | Boat | Matlacha Pass, N of power lines | PC | | | | 4 | Travel | 1883 | 637 |
| Blinky | 1-Mar-01 | 19:58 | Kessenich | Boat | Matlacha Pass, SW of marker 55 | PC | | | | 8 | Rest,Feed | 5193 | 589 |
| Moo-nar | 2-Mar-01 | 13:09 | Barton | Boat | Turtle Bay | PC | 25.5 | 35 | | 4 | Mill | 5192 | 535 |
| Pipe | 7-Mar-01 | 15:35 | Public | Land | Matlacha Pass | | | | | | | 1883 | 637 |
| CH106 | 7-Mar-01 | 15:56 | Public | Land | Lake Louise | | | | | | | 3054 | 703 |
| Bandito | 8-Mar-01 | 12:00 | Kessenich | Boat | Matlacha Isles, site 1 | Clear | 20.9 | 33.5 | None | 10 | | | |
| Bandito | 8-Mar-01 | 16:00 | Kessenich | Boat | Matlacha Isles, site 1 | | 22.7 | | None | 10 | | | |
| Pipe | 8-Mar-01 | 14:06 | Barton | Boat | Matlacha Pass, E of marker 19/20 | Clear | | 38 | | 4 | | 1883 | 637 |
| Pipe | 9-Mar-01 | 8:24 | Barton | Boat | Matlacha Isles, site 2 | PC | | | None | 6 | Rest | 1883 | 637 |
| Pipe | 10-Mar-01 | 8:48 | Barton | Boat | Matlacha Isles, site 1 | PC | | | None | 10 | Travel | 1883 | 637 |

| Animal ID | Date | Time | Observer | Mode | Location | Weather | Water Temp. (C) | Salinity (ppt) | Seagrass | Depth (ft) | Activity | PTT | Freq |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch040 | 10-Mar-01 | 9:35 | Barton | Boat | Burnt Store Marina | PC | | | None | 5.5 | Rest | | 619 |
| Blinky | 13-Mar-01 | 11:10 | Scolardi | Boat | Matlacha Pass, marker 69 | OC | | | | 6 | Mill | 5193 | 589 |
| Pipe | 13-Mar-01 | 14:45 | Barton | Boat | Matlacha Isles, site 2 | OC | 26.1 | 21 | None | 6 | Rest | 1883 | 637 |
| Blinky | 14-Mar-01 | 18:38 | Scolardi | Boat | Matlacha Pass, E of markers 79/81 | OC | 25.3 | 38 | | 3 | Travel | 5193 | 589 |
| CH106 | 17-Mar-01 | 13:10 | Public | Land | Gasparilla Sound | | | | | | | 3054 | 703 |
| CH106 | 20-Mar-01 | 16:30 | Public | Land | Stickney Pt. Bridge | | | | | | | 3054 | 703 |
| Pipe | 22-Mar-01 | 11:40 | Scolardi | Boat | Matlacha Pass, SW of marker 81 | PC | 19.2 | 40 | | 5 | Mill | 1883 | 637 |
| Blinky | 22-Mar-01 | 13:45 | Barton | Boat | Matlacha Isles, site 1 | Clear | | 30 | None | 10 | Rest | 5193 | 589 |
| Ch040 | 26-Mar-01 | 11:45 | Nostrom | Boat | Pirate Harbor, N of | Overcast | 22.7 | 16.2 | Halo,Thala | 4.3 | Feed | | 619 |
| Moo-nar | 26-Mar-01 | 14:05 | Barton | Boat | Turtle Bay | Overcast | 23.1 | 25.6 | Halo,Thala | 6.1 | Feed | 5192 | 535 |
| CH106 | 1-Apr-01 | 10:23 | Public | Land | Tampa Bay, E of Sunshine Skyway | | | | | | | 3054 | 703 |
| Pipe | 5-Apr-01 | 11:15 | Kessenich | Boat | Matlacha Isles, site 1 | Clear | 25.2 | 24.2 | None | 8 | | 1883 | 637 |
| Ch040 | 5-Apr-01 | 13:35 | Barton | Boat | Burnt Store Marina | PC | | 33 | None | 6 | Rest | | 619 |
| Pipe | 8-Apr-01 | 21:00 | Public | Land | Charlotte Harbor, S of Burnt Store Marina | | | | | | | 1883 | 637 |
| Blinky | 8-Apr-01 | 0:00 | Public | Land | Charlotte Harbor, S of Burnt Store Marina | | | | | | | 5193 | 589 |
| Pipe | 10-Apr-01 | 12:15 | Barton | Boat | Matlacha Pass, N of marker 81 | PC | 26.5 | 35 | Halo,Thala,Syrin | 7 | Feed | 1883 | 637 |
| CH040 | 10-Apr-01 | 15:05 | Barton | Boat | N of Pirate Harbor, W of Fines Key | MC | 27.1 | 31.3 | | 7 | | | 619 |
| Blinky | 15-Apr-01 | 9:00 | Public | Land | Malacha Isles, site 1 | | | | | | | 5193 | 589 |
| Moo-nar | 20-Apr-01 | 15:00 | Barton | Boat | Peace River | PC | 24.2 | 9.2 | | | Rest | 5192 | 535 |
| CH040 | 20-Apr-01 | 10:30 | Barton | Boat | Burnt Store Marina | Clear | 22 | 33 | None | 7 | Mill,Rest | | 619 |
| CH040 | 26-Apr-01 | 11:34 | Barton | Boat | NW of Pirate Harbor | MC | 25.3 | 32.4 | Halo,Thala | 4 | Feed | | 619 |
| Pipe | 26-Apr-01 | 14:01 | Barton | Boat | Matlacha Pass, E of marker 81 | PC | 25.9 | 32.6 | Halo,Thala,Syrin | 5.5 | Feed,Mill | 1883 | 637 |
| CH106 | 27-Apr-01 | 16:14 | Public | Land | Tampa Bay, E of Tierra Verde | | | | | | | 3054 | 703 |
| Moo-nar | 9-May-01 | 12:22 | Barton | Boat | Turtle Bay | PC | 29.7 | | | | Travel | 5192 | 535 |
| CH040 | 9-May-01 | 13:50 | Barton | Boat | No signal heard | PC | | | | | | | 619 |
| Blinky | 10-May-01 | 10:08 | Kessenich | Boat | C.I.G.F, N | Clear | 22.8 | 30 | Thalassia | | Rest,Feed | 5193 | 589 |
| Pipe | 11-May-01 | 19:30 | Public | Land | Port Charlotte, W of Little Alligator Creek | | | | | | Socialize | 1883 | 637 |
| Moo-nar | 17-May-01 | 14:28 | Barton | Boat | Turtle Bay | Clear | 28 | 29 | Thala,Syrin | 7 | Feed | 5192 | 535 |
| CH106 | 25-May-01 | 10:30 | Barton | Boat | Tampa Bay, Bird Key | PC | 27.6 | 20.9 | Halo,Thala | 5.5 | Feed | 3054 | 703 |
| Pipe | 30-May-01 | 12:01 | Barton | Boat | Peace River, Alligator Bay | PC | 30.4 | 28.4 | None | 6 | Mill | 1883 | 637 |
| Moo-nar | 7-Jun-01 | 10:23 | Barton | Boat | Peace River | PC | | 15 | None | 6 | Travel | 5192 | 535 |
| Pipe | 14-Jun-01 | 17:05 | Public | Land | Port Charlotte, W of Little Alligator Creek | | | | | | | 1883 | 637 |
| Moo-nar | 21-Jun-01 | 13:45 | Barton | Boat | Peace River, Bird Key | PC | 27.1 | 26 | None | 8.5 | Travel | 5192 | 535 |
| CH040 | 28-Jun-01 | 14:40 | Barton | Boat | TTI, Outer Coon Key Pass | MC | 28.5 | 42 | Halo,Thala,Syrin | 5 | Feed | | 619 |
| Pipe | 28-Jun-01 | 16:20 | Barton | Boat | TTI, SE of Brush Island | OC | 28 | 40 | | 5.75 | Travel | 1883 | 637 |
| Blinky | 6-Jul-01 | 9:40 | Barton | Boat | Tampa Bay, Mullet Key | MC | 30.1 | 37 | | 4 | | 5193 | 589 |
| CH106 | 6-Jul-01 | 11:43 | Barton | Boat | Tampa Bay, Little Bird Key | PC | 30.2 | 36 | Halo,Thala,Syrin | 5 | Feed | 3054 | 703 |
| CH040 | 6-Jul-01 | 15:55 | Public | Land | Marco Island, Smokehouse Creek | | | | | | | | 619 |
| CH040 | 12-Jul-01 | 12:43 | Barton | Boat | TTI, Calusa Island Marina | PC | 28 | 30 | None | 5.5 | Rest | | 619 |
| CH040 | 18-Jul-01 | 11:55 | Barton | Boat | TTI, near Goodland | OC | | | | | | | 619 |
| CH106 | 21-Jul-01 | 18:58 | Public | Land | St. Pete Beach, Gulf of Mexico | | | | | | | 3054 | 703 |

| Animal ID | Date | Time | Observer | Mode | Location | Weather | Water Temp. (C) | Salinity (ppt) | Seagrass | Depth (ft) | Activity | PTT | Freq |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CH106 | 25-Jul-01 | 10:08 | Barton | Boat | Tampa Bay, Boca Ciega Bay | PC | 26.7 | 34 | Halo,Thala,Syrin | 4.5 | Rest,Feed | 3054 | 703 |
| Blinky | 22-Aug-01 | 11:53 | Barton | Boat | Tampa Bay, Maximo Park | PC | | | Halodule | 3 | Feed | 5193 | 589 |
| CH106 | 22-Aug-01 | 10:45 | Barton | Boat | Tampa Bay, Boca Ciega Bay | PC | | | | | | | |

Seagrass: Thala = Thalassia, Halo = Halodule, Syrin = Syringodium

Table 6. Matlacha habitat sampling schedule, October 16, 2000 - May 30, 2001

| Date | Activity | Location | Comments |
|---|---|---|---|
| 16-Oct-00 | SOTP | Matlacha Pass, marker 56 | |
| 16-Oct-00 | SOTP | Matlacha Pass, marker 56 | |
| 16-Oct-00 | SOTP | Matlacha Pass, marker 71 | Later taken from site |
| 16-Oct-00 | SOTP | Matlacha Pass, marker 71 | Later taken from site |
| 16-Oct-00 | SOTP | Matlacha Isles, site 1 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 1 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 6 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 5 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 4 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 2 | |
| 16-Oct-00 | SOTP | Matlacha Isles, site 2 | |
| 30-Oct-00 | SOTP | Matlacha Pass, marker 30 | |
| 30-Oct-00 | SOTP | Matlacha Pass, marker 30 | |
| 30-Oct-00 | SOTP | Matlacha Isles, site 3 | |
| 30-Oct-00 | SOTP | West Island | |
| 30-Oct-00 | SOTP | N. Pine Island canals | |
| 30-Oct-00 | DTP | Matlacha Pass, marker 71 | |
| 30-Oct-00 | DTP | Matlacha Pass, marker 71 | |
| 30-Oct-00 | DTP | Matlacha Pass, marker 56 | |
| 30-Oct-00 | DTP | Matlacha Pass, marker 56 | |
| 30-Oct-00 | DTP | Matlacha Isles, site 1 | |
| 30-Oct-00 | DTP | Matlacha Isles, site 1 | |
| 30-Oct-00 | T/S stations | Matlacha Isles Stations 1-7 | |
| 30-Oct-00 | T/S stations | West Island Stations 1-2 | |
| 30-Oct-00 | T/S stations | N. Pine Island Stations 1-3 | |
| 6-Nov-00 | SOTP | Matlacha Isles, site 4 | |
| 6-Nov-00 | SOTP | Matlacha Isles, site 5 | |
| 6-Nov-00 | SOTP | Matlacha Isles, site 6 | |
| 6-Nov-00 | DTP | Matlacha Isles, site 4 | |
| 6-Nov-00 | DTP | Matlacha Isles, site 5 | |
| 6-Nov-00 | DTP | Matlacha Isles, site 6 | |
| 6-Nov-00 | DTP | Matlacha Isles, site 2 | |
| 6-Nov-00 | DTP | Matlacha Isles, site 2 | |
| 27-Nov-00 | DTP | Matlacha Pass, marker 56 | |
| 27-Nov-00 | DTP | Matlacha Pass, marker 56 | |
| 27-Nov-00 | DTP | N. Pine Island canals | |
| 27-Nov-00 | DTP | Matlacha Pass, marker 30 | |
| 27-Nov-00 | DTP | Matlacha Pass, marker 30 | |
| 27-Nov-00 | DTP | West Island | |
| 27-Nov-00 | DTP | Matlacha Isles, site 3 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 6 | |

| Date | Activity | Location | Comments |
|---|---|---|---|
| 27-Nov-00 | DTP | Matlacha Isles, site 6 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 5 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 5 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 4 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 4 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 2 | |
| 27-Nov-00 | DTP | Matlacha Isles, site 2 | |
| 27-Nov-00 | T/S stations | Matlacha Isles Stations 1-2 & 4-7 | |
| 27-Nov-00 | T/S stations | West Island Stations 1-2 | |
| 27-Nov-00 | T/S stations | N. Pine Island Stations 1-3 | |
| 1-Dec-00 | T/S stations | Matlacha Isles Stations 1-7 | |
| 4-Dec-00 | SOTP | Matlacha Pass, marker 71 | Replaced the one taken |
| 4-Dec-00 | DTP | Matlacha Isles, site 1 | |
| 4-Dec-00 | DTP | Matlacha Isles, site 1 | |
| 21-Dec-00 | SOTP | Matlacha Pass, marker 71 | Replaced the one taken |
| 21-Dec-00 | DTP | Matlacha Pass, marker 71 | |
| 27-Dec-00 | DTP | Matlacha Pass, marker 71 | |
| 27-Dec-00 | DTP | Matlacha Pass, marker 71 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 2 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 2 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 6 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 6 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 5 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 5 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 4 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 4 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 1 | |
| 2-Jan-01 | DTP | Matlacha Isles, site 1 | |
| 2-Jan-01 | T/S stations | Matlacha Isles Stations 2-6 | |
| 11-Jan-01 | T/S stations | Matlacha Isles Stations 1-7 | |
| 11-Jan-01 | T/S stations | West Island Stations 1-2 | |
| 16-Jan-01 | DTP | West Island | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 30 | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 30 | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 56 | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 56 | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 71 | |
| 16-Jan-01 | DTP | Matlacha Pass, marker 71 | |
| 16-Jan-01 | DTP | N. Pine Island canals | |
| 16-Jan-01 | T/S stations | West Island Station 1 | |
| 16-Jan-01 | T/S stations | N. Pine Island Stations 1-3 | |
| 19-Jan-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 2 | |

| Date | Activity | Location | Comments |
|---|---|---|---|
| 26-Jan-01 | DTP | Matlacha Isles, site 2 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 6 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 6 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 5 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 5 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 4 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 4 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 3 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 1 | |
| 26-Jan-01 | DTP | Matlacha Isles, site 1 | |
| 26-Jan-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 7-Feb-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 8-Feb-01 | DTP | N. Pine Island canals | |
| 8-Feb-01 | DTP | Matlacha Pass, marker 71 | |
| 8-Feb-01 | DTP | Matlacha Pass, marker 71 | |
| 8-Feb-01 | DTP | Matlacha Pass, marker 56 | |
| 8-Feb-01 | DTP | Matlacha Pass, marker 56 | |
| 8-Feb-01 | DTP | West Island | |
| 8-Feb-01 | T/S stations | West Island Stations 1-2 | |
| 8-Feb-01 | T/S stations | N. Pine Island Stations 1-3 | |
| 15-Feb-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 16-Feb-01 | DTP | Matlacha Pass, marker 30 | |
| 16-Feb-01 | DTP | Matlacha Pass, marker 30 | |
| 16-Feb-01 | T/S stations | West Island Stations 1-2 | |
| 22-Feb-01 | DTP | Matlacha Isles, site 1 | |
| 22-Feb-01 | DTP | Matlacha Isles, site 1 | |
| 22-Feb-01 | DTP | Matlacha Isles, site 2 | |
| 22-Feb-01 | DTP | Matlacha Isles, site 2 | |
| 23-Feb-01 | DTP | N. Pine Island canals | |
| 23-Feb-01 | DTP | Matlacha Pass, marker 71 | |
| 23-Feb-01 | DTP | Matlacha Pass, marker 71 | |
| 23-Feb-01 | DTP | Matlacha Pass, marker 56 | |
| 23-Feb-01 | DTP | Matlacha Pass, marker 56 | |
| 23-Feb-01 | DTP | West Island | |
| 23-Feb-01 | DTP | Matlacha Isles, site 3 | |
| 23-Feb-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 23-Feb-01 | T/S stations | West Island Stations 1-2 | |
| 23-Feb-01 | T/S stations | N. Pine Island Stations 1-3 | |
| 1-Mar-01 | DTP | N. Pine Island canals | |
| 1-Mar-01 | T/S stations | West Island Stations 1-2 | |
| 1-Mar-01 | T/S stations | N. Pine Island Stations 1-3 | |
| 2-Mar-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 2-Mar-01 | T/S stations | West Island Stations 1-2 | |

| Date | Activity | Location | Comments |
|---|---|---|---|
| 2-Mar-01 | T/S stations | N. Pine Island Stations 1-3 | |
| 9-Mar-01 | T/S stations | Matlacha Isles Stations 1-6 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 6 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 6 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 4 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 4 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 5 | |
| 13-Mar-01 | DTP | Matlacha Isles, site 5 | |
| 13-Mar-01 | T/S stations | Matlacha Isles Stations 1-7 | |
| 22-Mar-01 | DTP | Matlacha Isles, site 2 | |
| 22-Mar-01 | DTP | Matlacha Isles, site 2 | |
| 22-Mar-00 | DTP | West Island | |
| 22-Mar-01 | T/S stations | Matlacha Isles Stations 1-7 | |
| 22-Mar-01 | T/S stations | West Island Stations 1-2 | |
| 5-Apr-01 | T/S stations | Matlacha Isles Stations 1-7 | |
| 5-Apr-01 | DTP | Matlacha Isles, site 6 | |
| 5-Apr-01 | DTP | Matlacha Isles, site 6 | |
| 5-Apr-01 | DTP | Matlacha Isles, site 2 | |
| 5-Apr-01 | DTP | Matlacha Isles, site 2 | |
| 5-Apr-01 | DTP | West Island | |
| 5-Apr-01 | DTP | Matlacha Pass, marker 56 | |
| 5-Apr-01 | DTP | Matlacha Pass, marker 56 | |
| 10-Apr-01 | DTP | Matlacha Isles, site 1 | |
| 10-Apr-01 | DTP | Matlacha Isles, site 1 | |
| 10-Apr-01 | DTP | Matlacha Isles, site 3 | |
| 3-May-01 | DTP | Matlacha Pass, marker 71 | Probes Removed |
| 3-May-01 | DTP | Matlacha Pass, marker 71 | Probes Removed |
| 3-May-01 | DTP | Matlacha Pass, marker 56 | Probes Removed |
| 3-May-01 | DTP | Matlacha Pass, marker 56 | Probe was lost |
| 3-May-01 | DTP | Matlacha Pass, marker 30 | Probes Removed |
| 3-May-01 | DTP | Matlacha Pass, marker 30 | Probes Removed |
| 30-May-01 | DTP | N. Pine Island canals | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 1 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 1 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 2 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 2 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 6 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 6 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 4 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 4 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 5 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 5 | Probes Removed |
| 30-May-01 | DTP | Matlacha Isles, site 3 | Probes Removed |

| Date | Activity | Location | Comments |
|---|---|---|---|
| 30-May-01 | DTP | West Island | Probes Removed |

Activity = T/S stations, T/S transects, SOTP (Set Out Temperature Probe), DTP (Download Temperature Probe)

**Figure 1. Matlacha study area, including Matlacha Isles and Matlacha Pass (northern Pine Island to the power lines south of Little Pine Island). Dotted lines indicate boundaries. Locations of temperature loggers placed on channel markers are indicated by flags.**

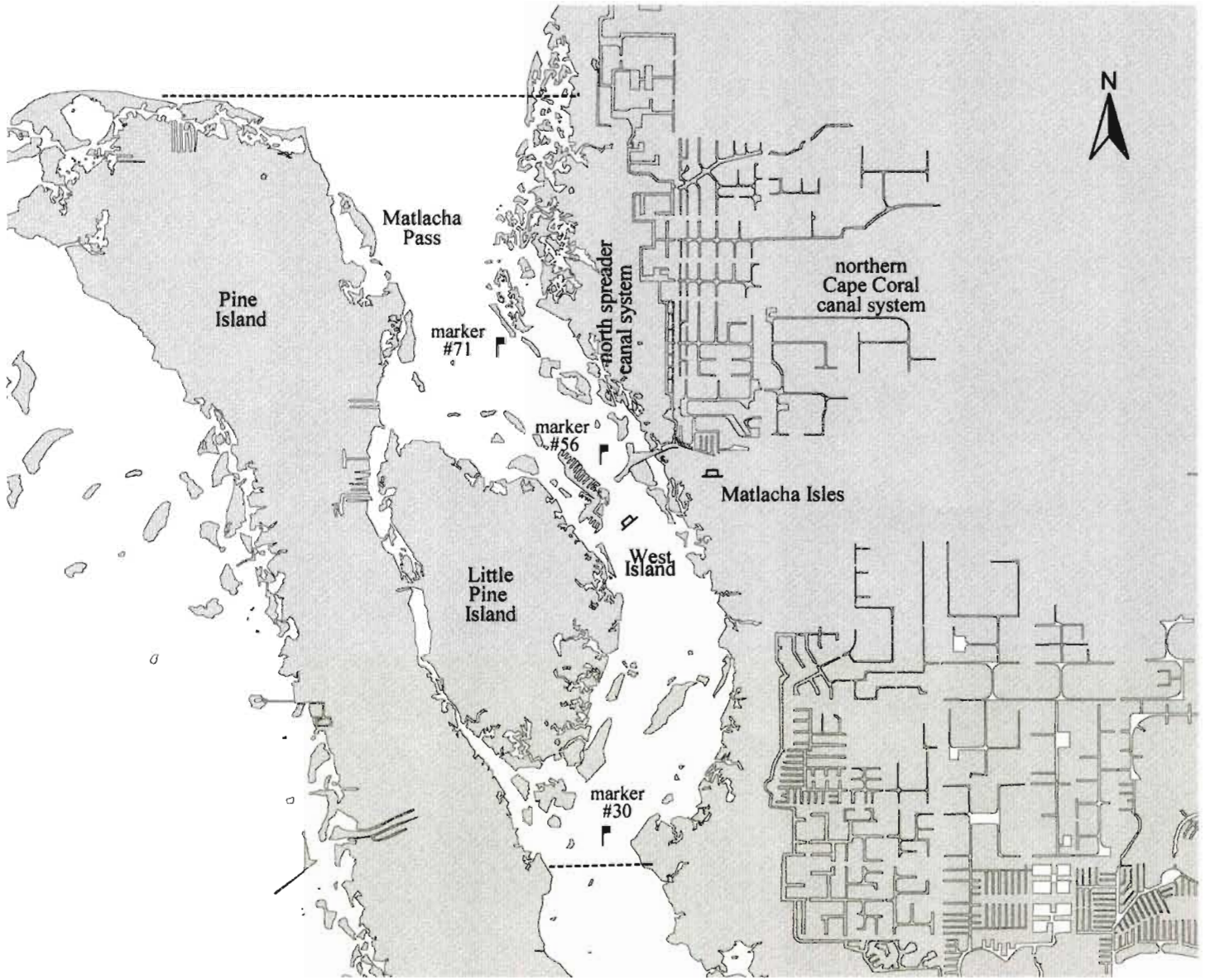

**Figure 2. Site identifications within the Matlacha Isles canal system, including the location of the small "bay" outside the entrance to Matlacha Isles (site #3) and Matlacha Bridge.**

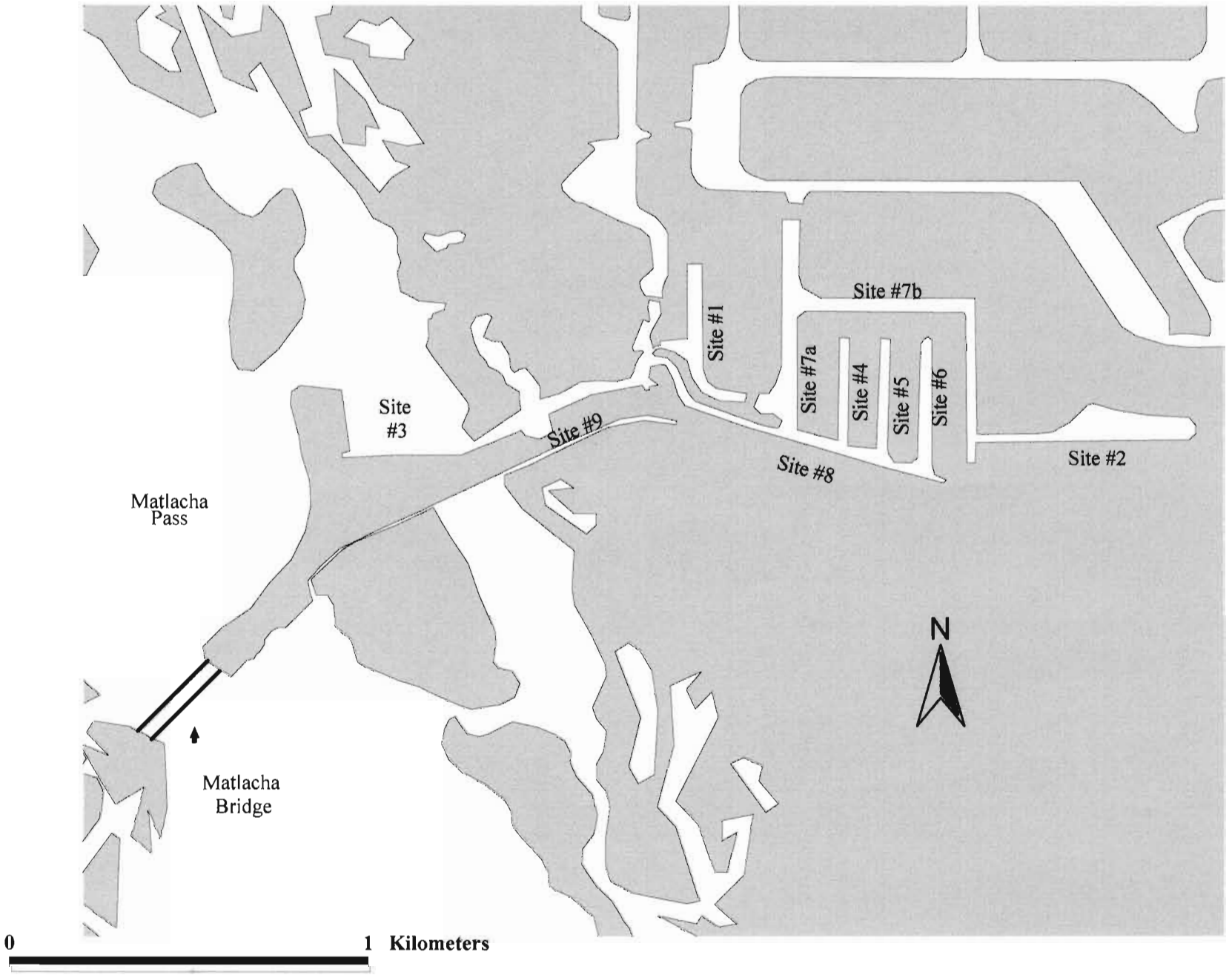

**Figure 3. Locations of temperature loggers in Matlacha Isles, West Island, and at channel marker 56.**

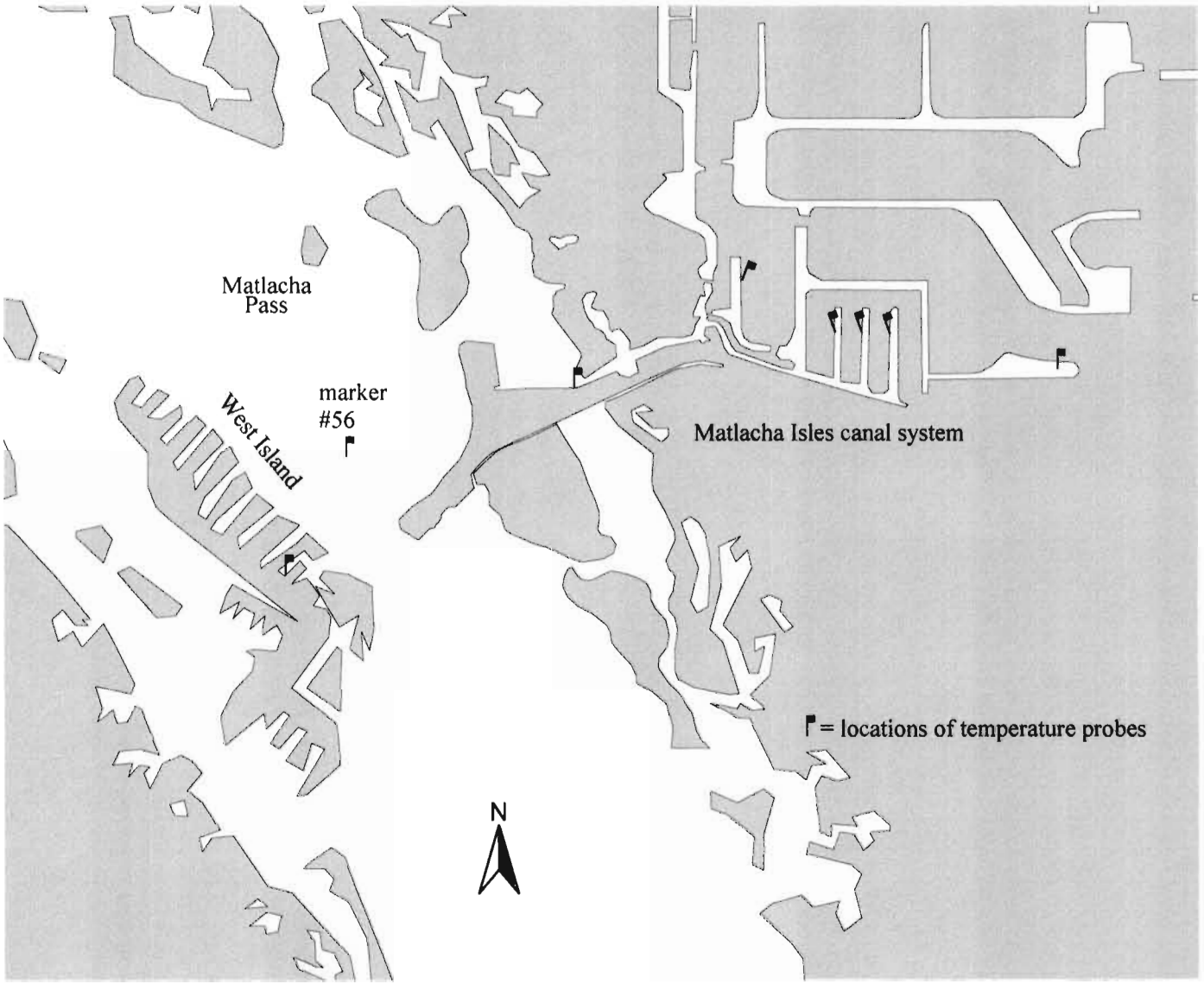

**Figure 4. Location of the temperature logger in the northern Pine Island canal system. Locations of temperature/salinity stations are numbered.**

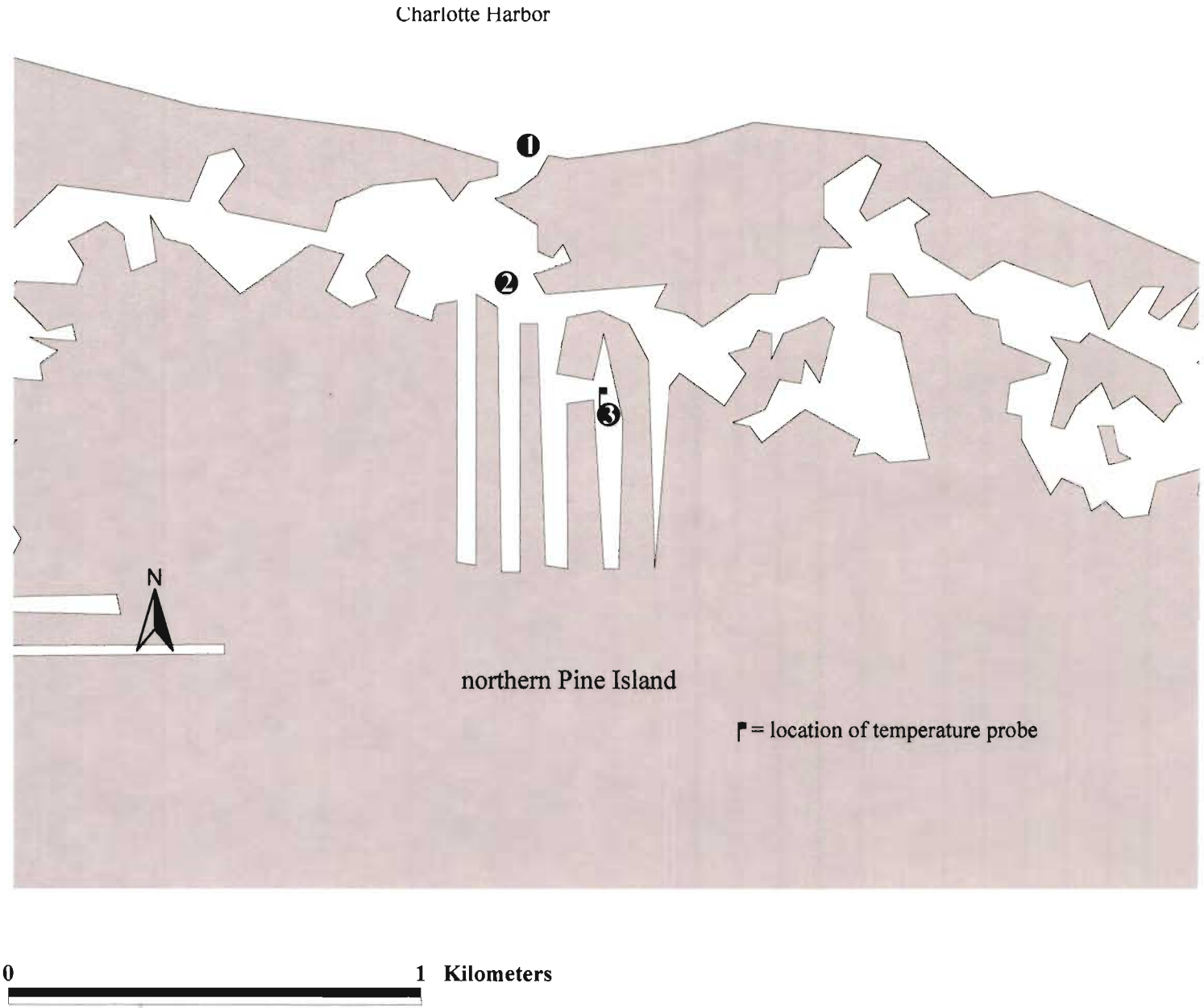

**Figure 5. Locations of temperature/salinity stations in Matlacha Isles and West Island.**

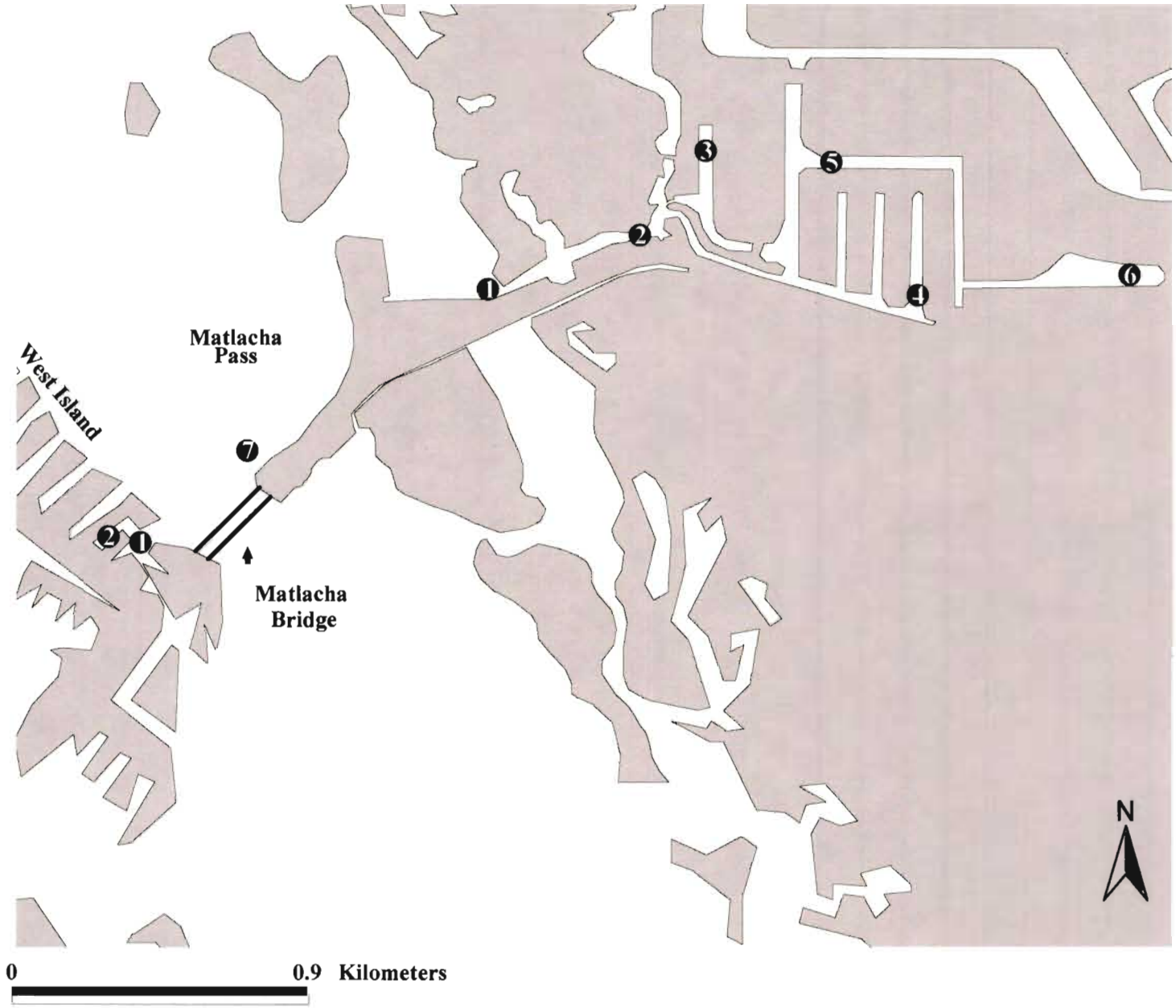

Figure 6. Number of manatees observed traveling into (IN) and out of (OUT) Matlacha Isles during each 24-hour sampling period, both winters 1999-2001. Note that it is possible to count some individuals more than once within a 24-hour period.

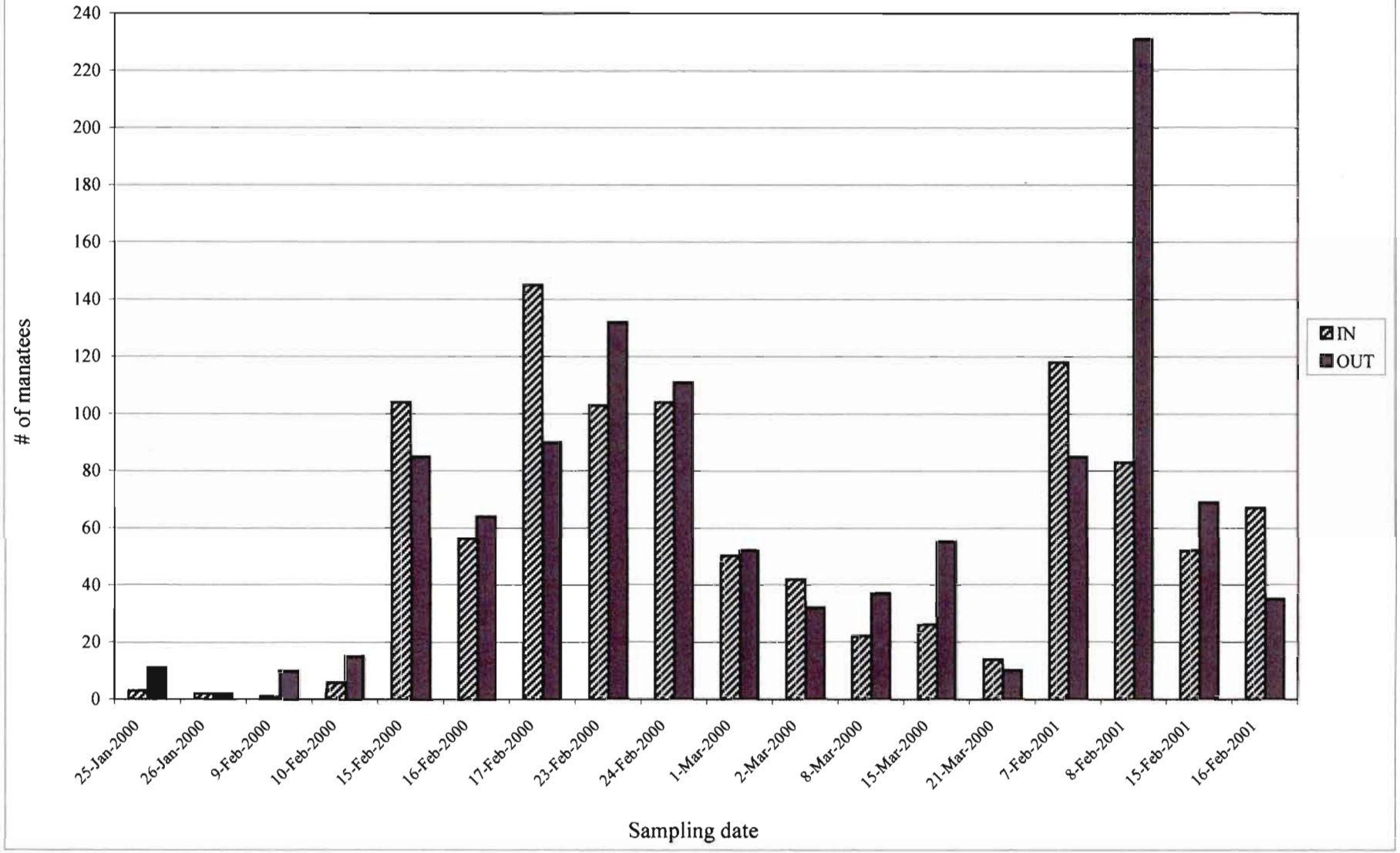

Figure 7. Bottom water temperatures (°C) for sites within Matlacha Isles and Matlacha Pass on low (<50 manatees), medium (50-100 manatees), and high (>100) manatee observation days during winter 1999/2000 fixed point surveys.

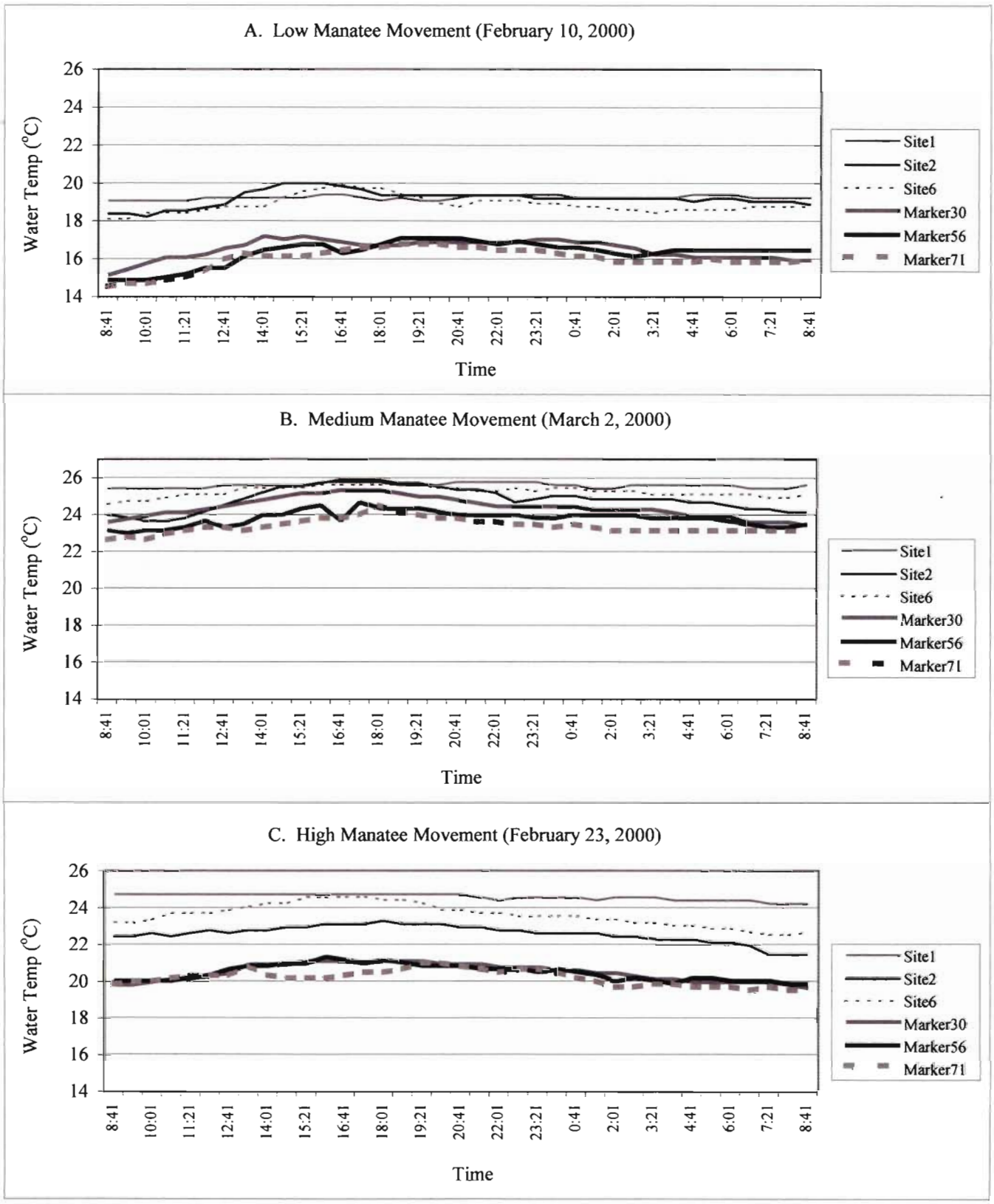

Figure 8. Bottom water temperatures (°C) for sites within Matlacha Isles (sites 1, 2, and 6), Matlacha Pass (markers 30, 56, and 71), West Island, and northern Pine Island during focal and fixed point observations.

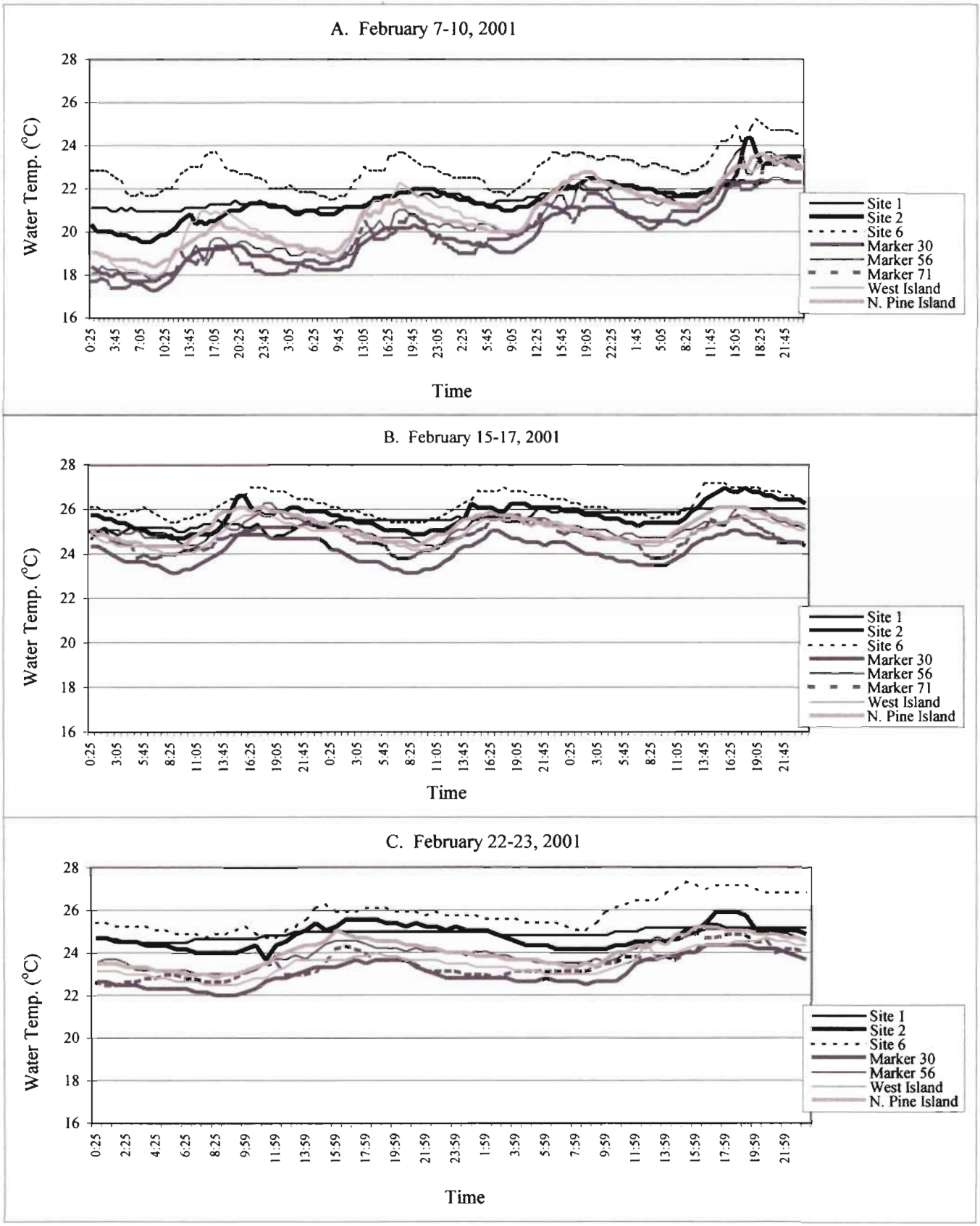

Figure 8. Bottom water temperatures (°C) for sites within Matlacha Isles (sites 1, 2, and 6), Matlacha Pass (markers 30, 56, and 71), West Island, and northern Pine Island during focal and fixed point observations. (continued)

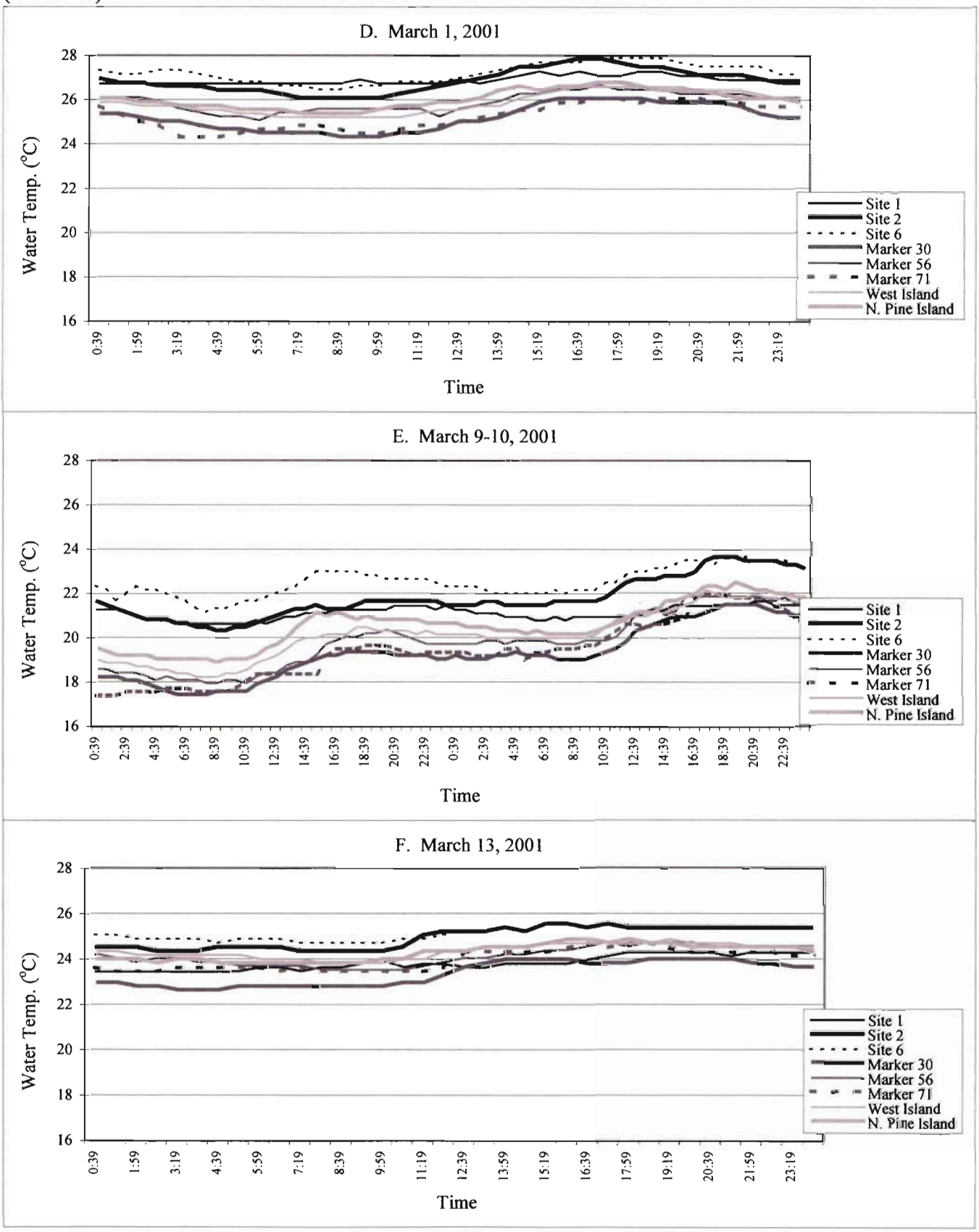

Figure 9. Manatee movements into (IN) and out of (OUT) Matlacha Isles during each hour, both winters (1999-2001).

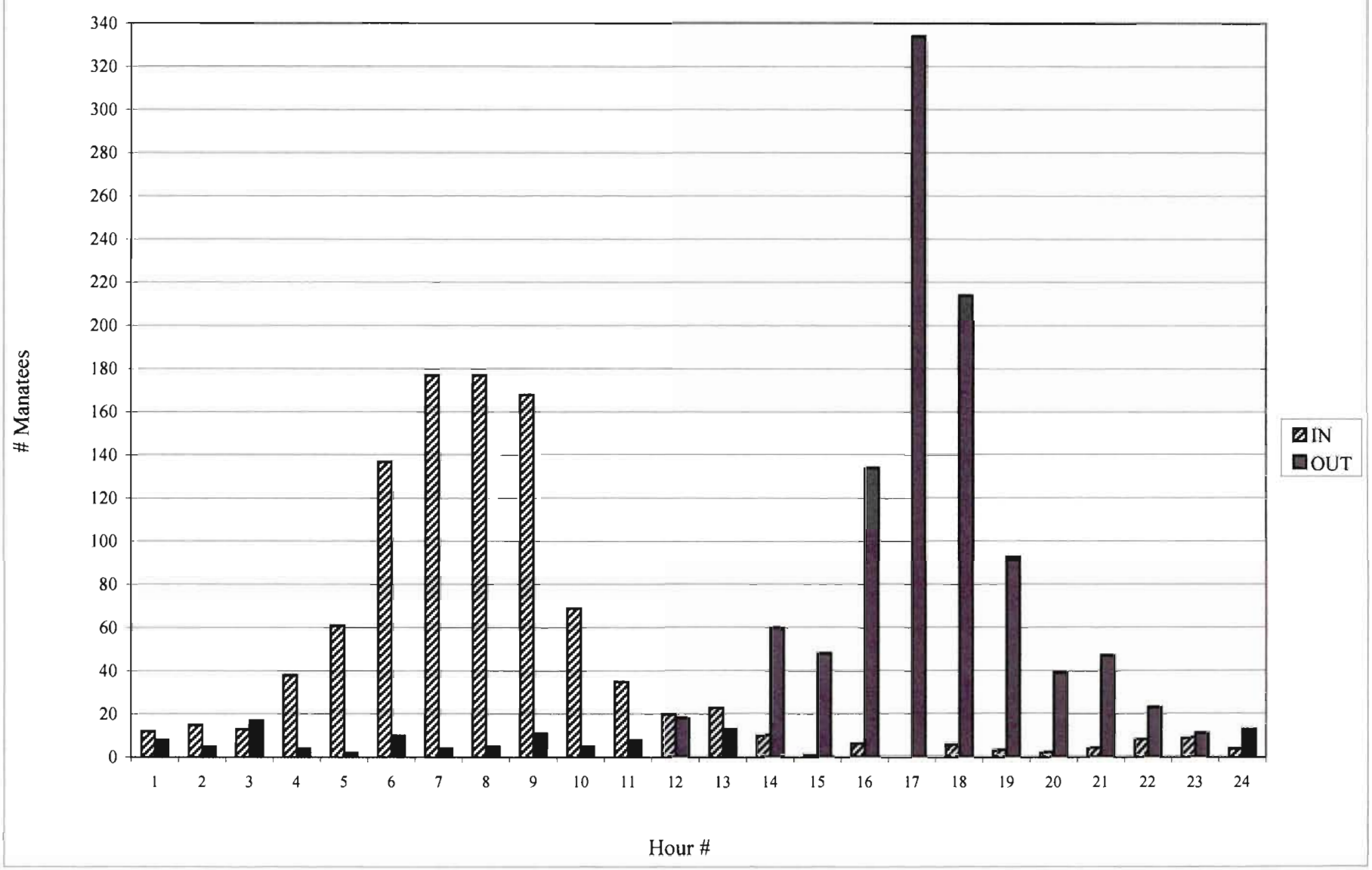

Figure 10. Frequencies and proportions of hourly manatee activities during focal observations, both winters 1999-2001 (confidence levels 1 and 2).

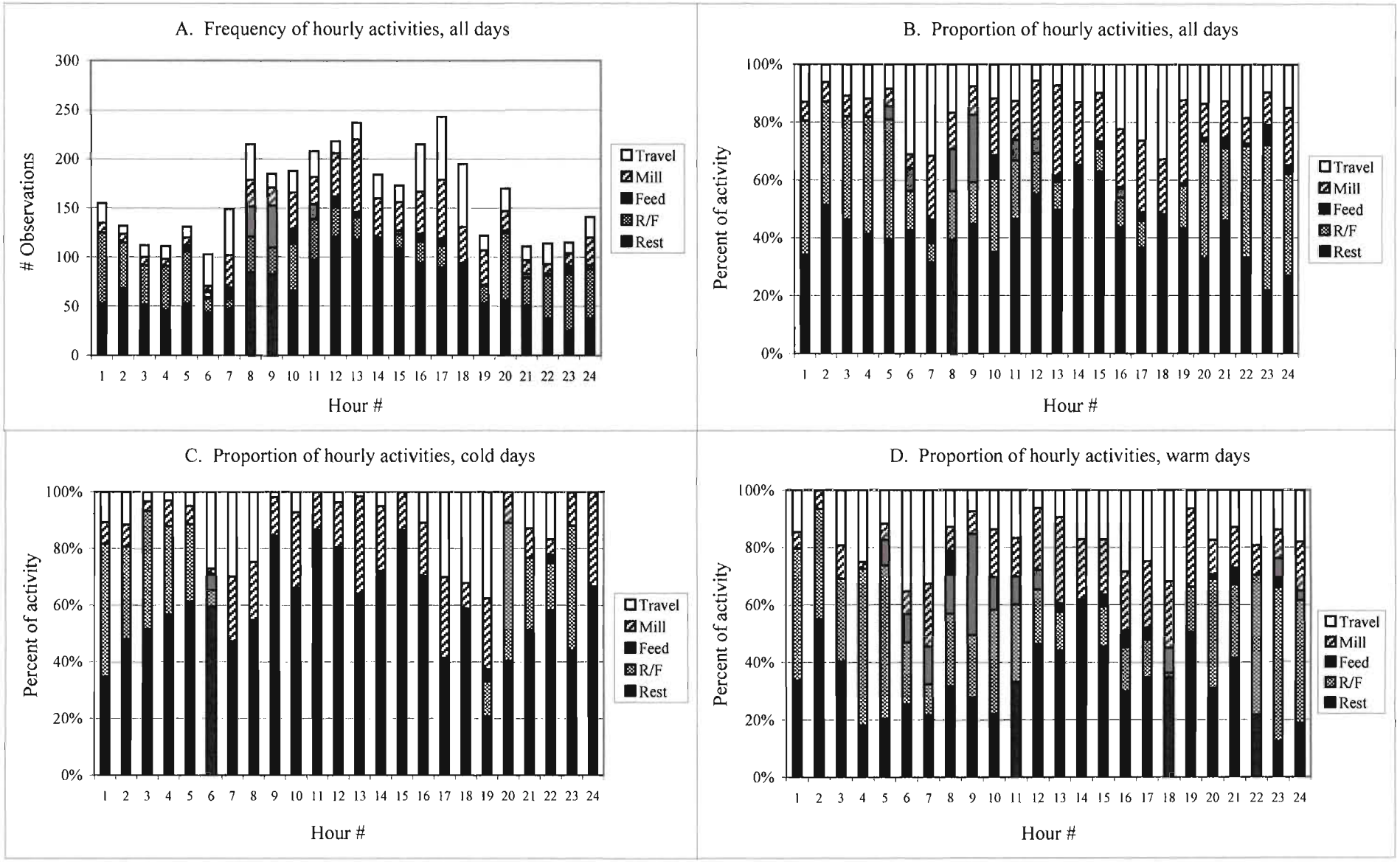

Figure 11. Frequencies and proportions of hourly habitat use during focal observations, both winters 1999-2001 (all confidence levels). Habitat types are abbreviated: SB = shoal/sandy bottom, OB = open bay, GB/SB = grass bed/shoal-sandy bottom, GB = grass bed, DC = dredged channel, DB = dredged basin.

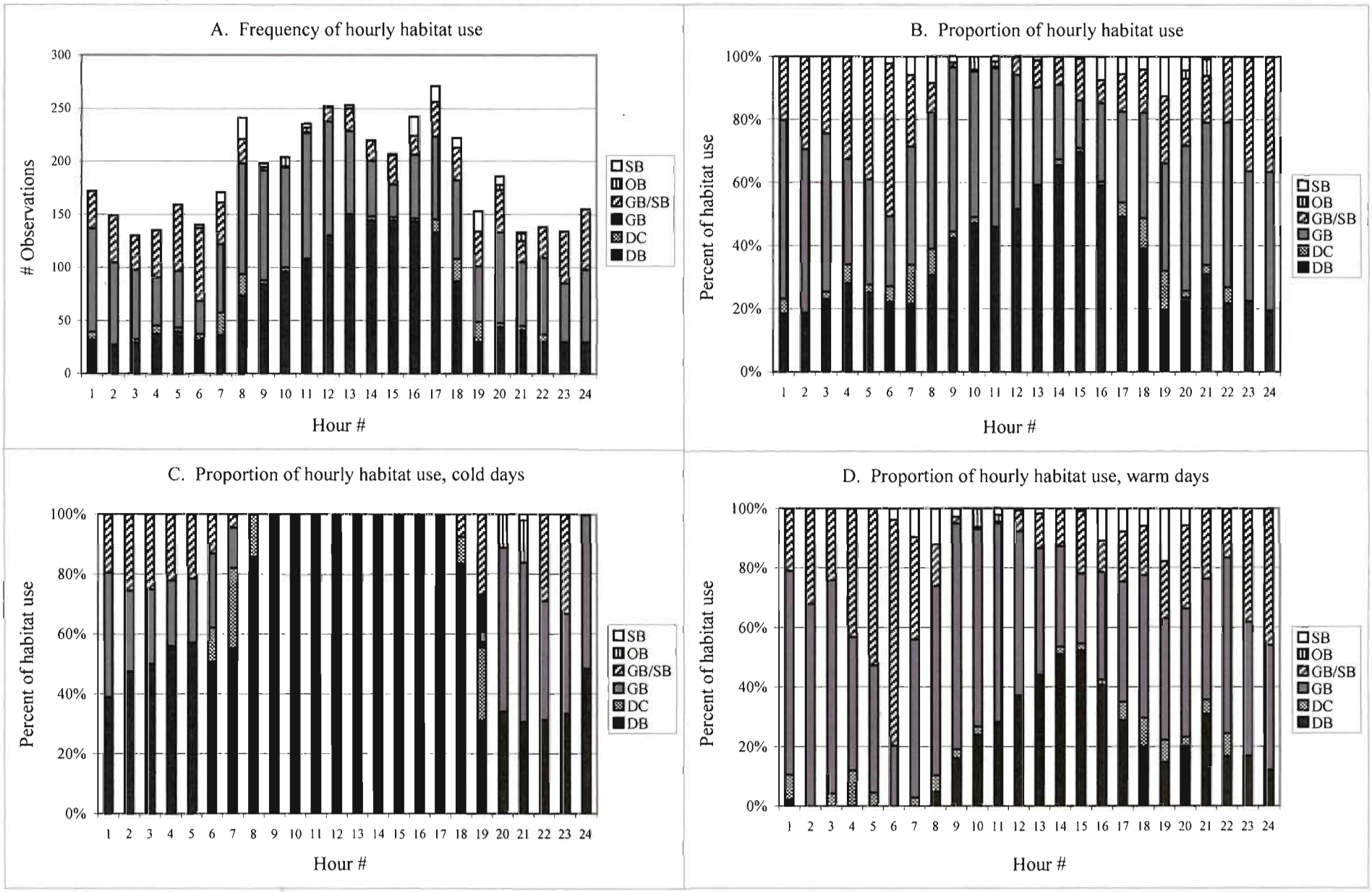

Figure 12. Frequencies and proportions of manatee activities in each habitat during focal observations, both winters 1999-2001 (confidence levels 1 and 2 only). Habitat types are abbreviated: DB = dredged basin, DC = dredged channel, GB = grass bed, GB/SB = grass bed/shoal-sandy bottom, OB = open bay, and SB = shoal/sandy bottom.

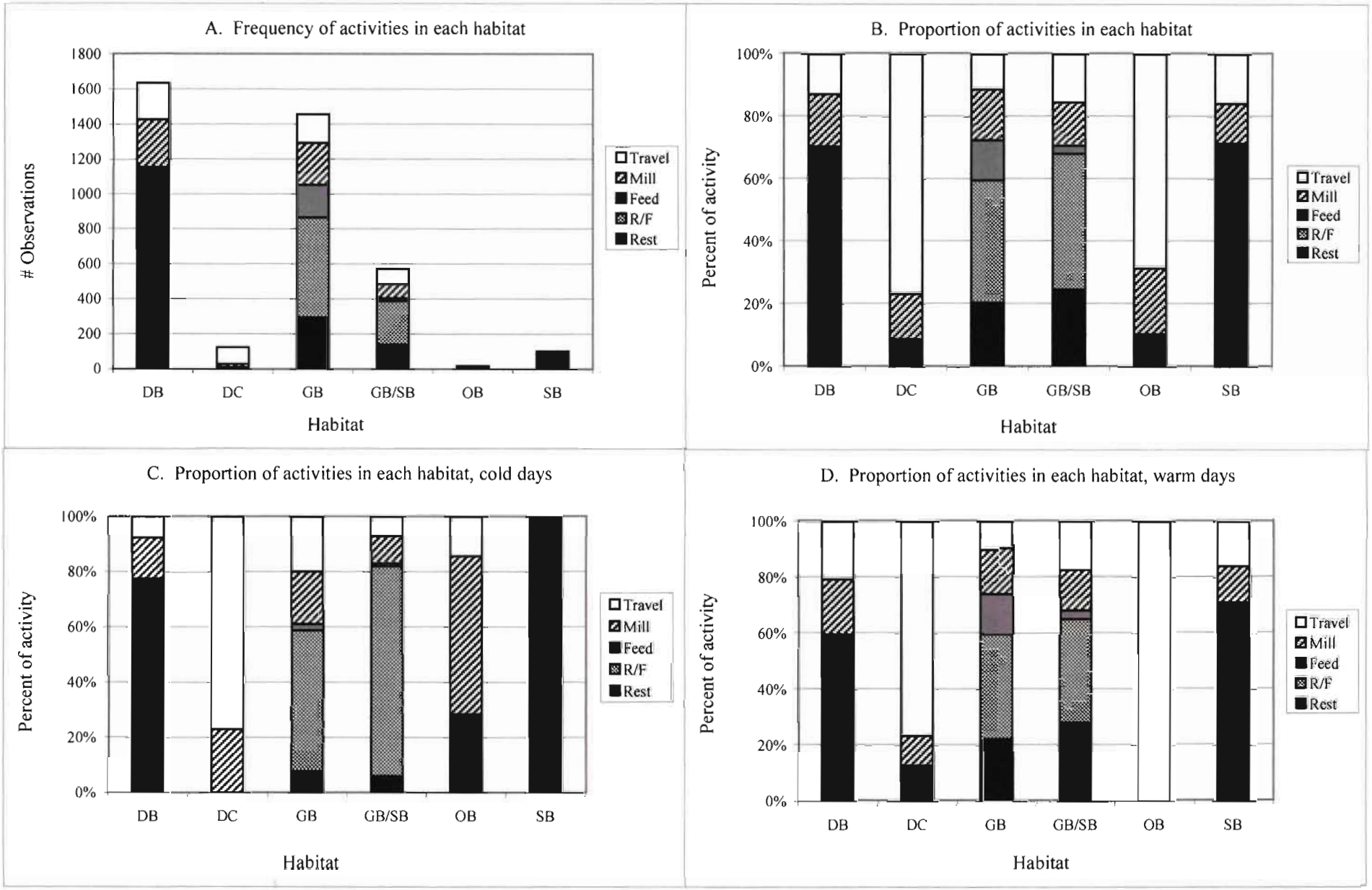

**Figure 13a. Locations of tagged manatee, CH106, in the study area and in southwestern Florida, January 31 - July 30, 2001.**

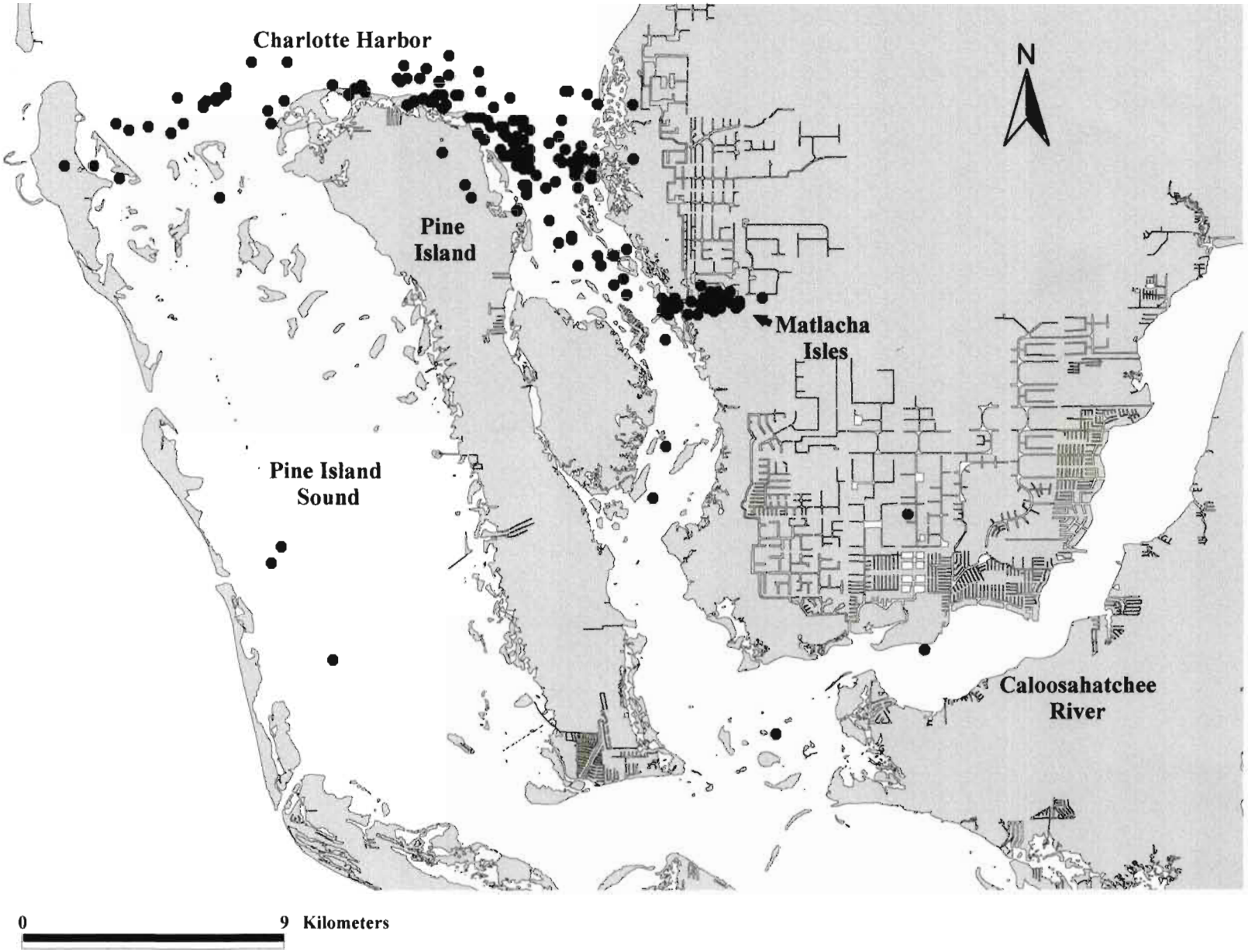

Figure 13b. Locations of tagged manatee, CH106, from Charlotte Harbor to Sarasota Bay, January 31 - July 30, 2001.

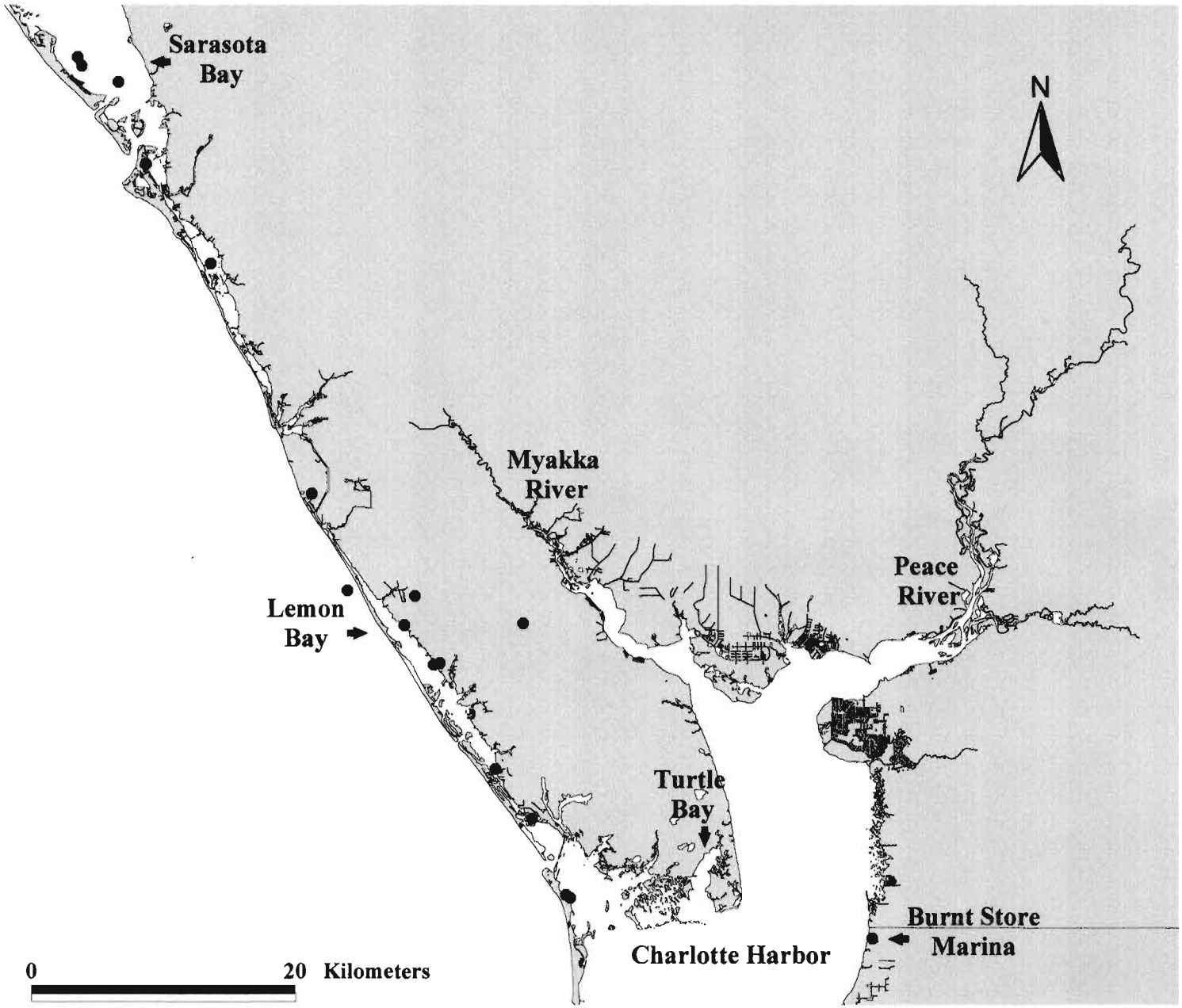

**Figure 13c. Locations of tagged manatee, CH106, in the Tampa Bay area, January 31 - July 30, 2001.**

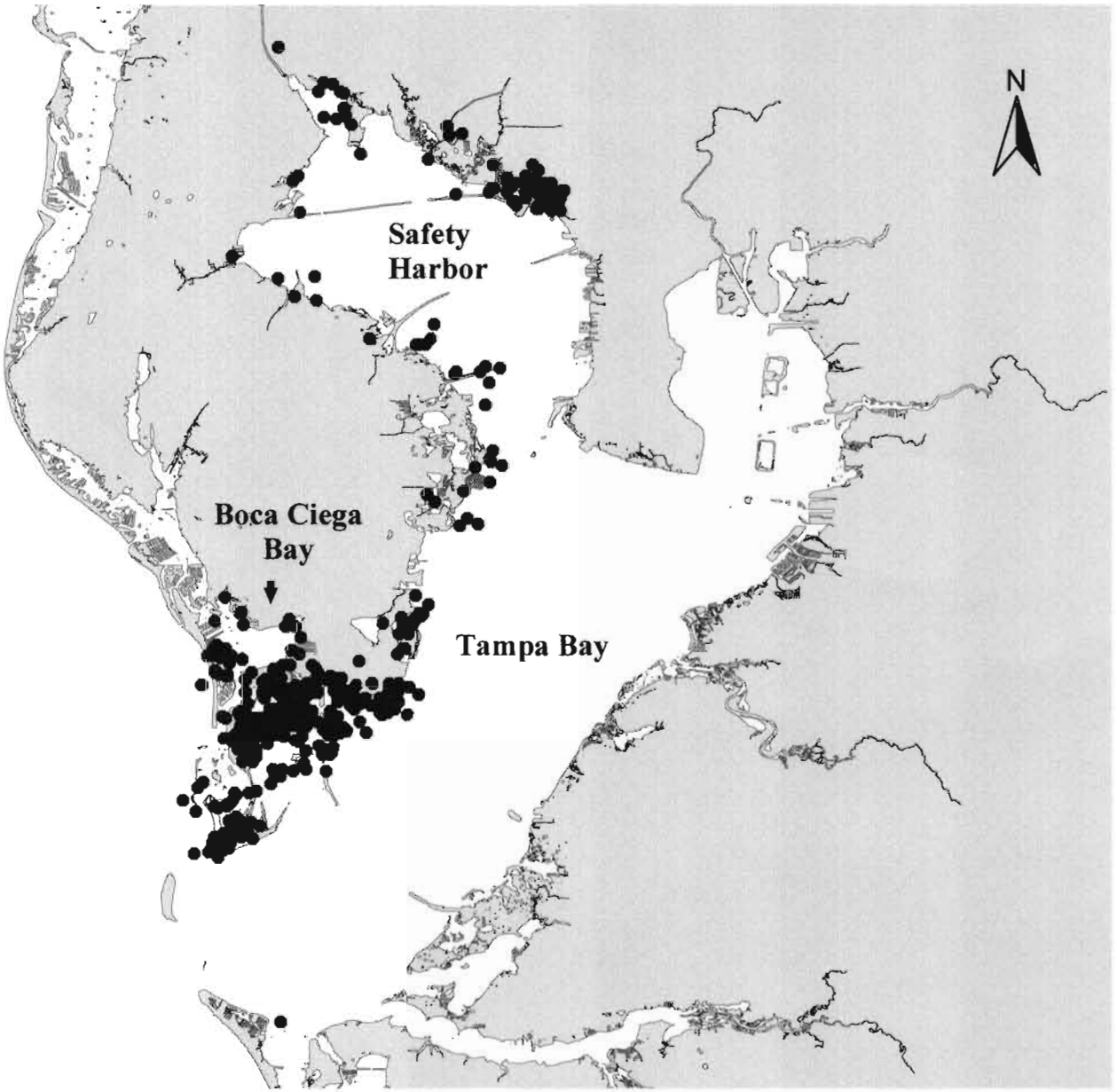

**Figure 14a. Locations of tagged manatee, CH040, in the study area and in southwestern Florida, January 30 - September 10, 2001**

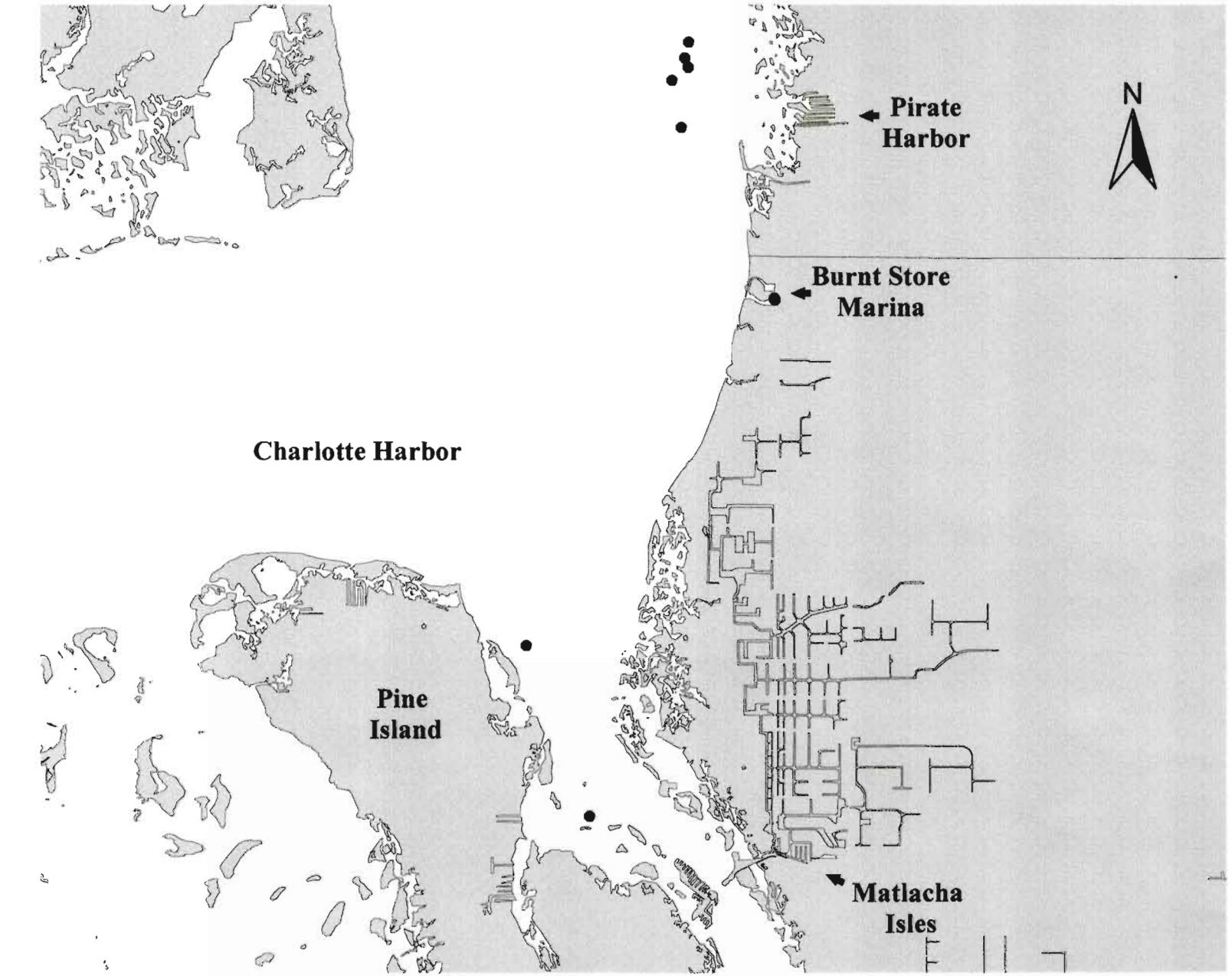

**Figure 14b. Locations of tagged manatee, CH040, in the Ten Thousand Islands area, January 30 - September 10, 2001. The points appearing on land may coincide with an animal located in an unmapped waterway, or could be attributed to lower classification satellite hits.**

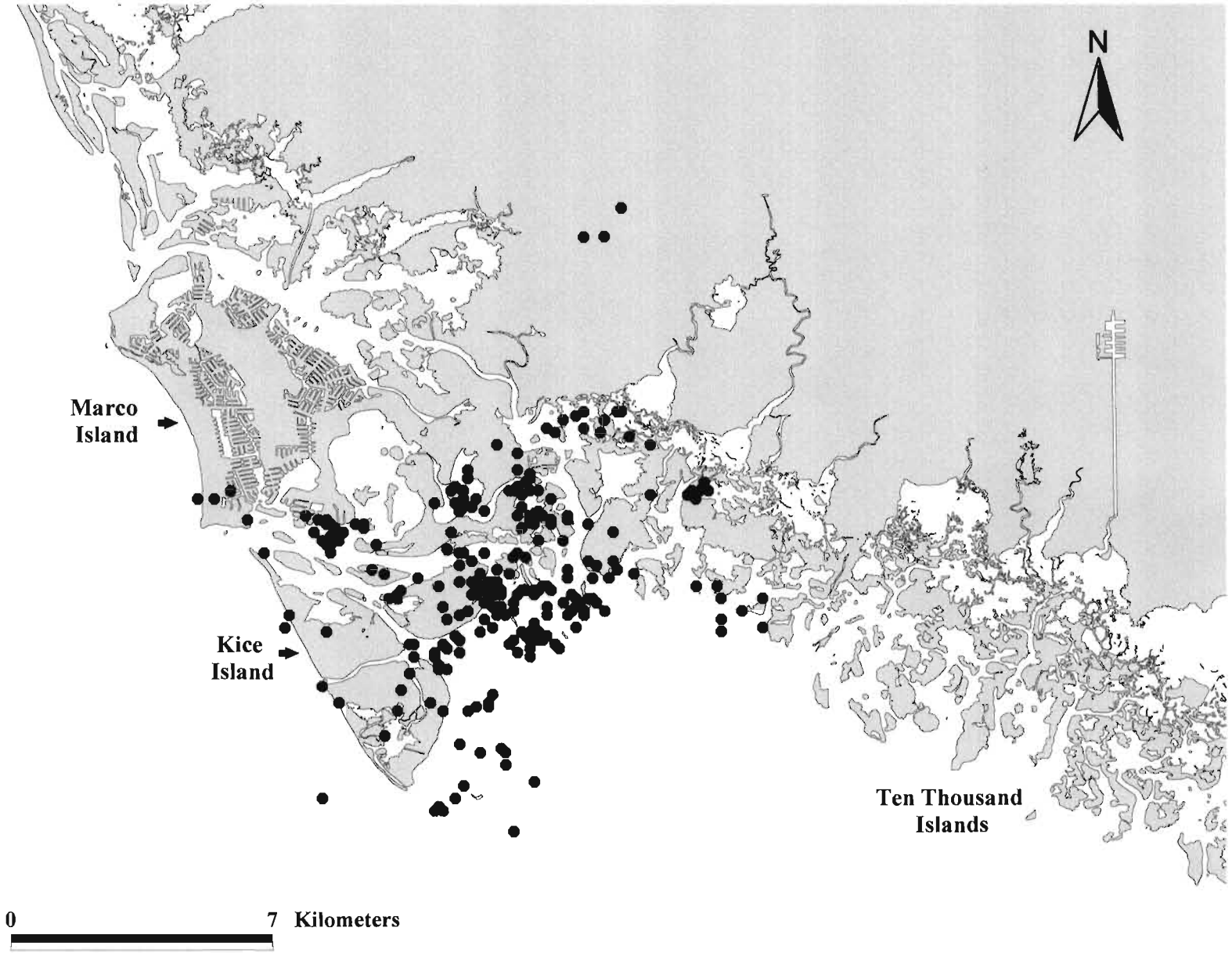

**Figure 15. Locations of tagged manatee, FM007 ("Bandito"), in the study area and in southwestern Florida, January 30 - February 18, 2001.**

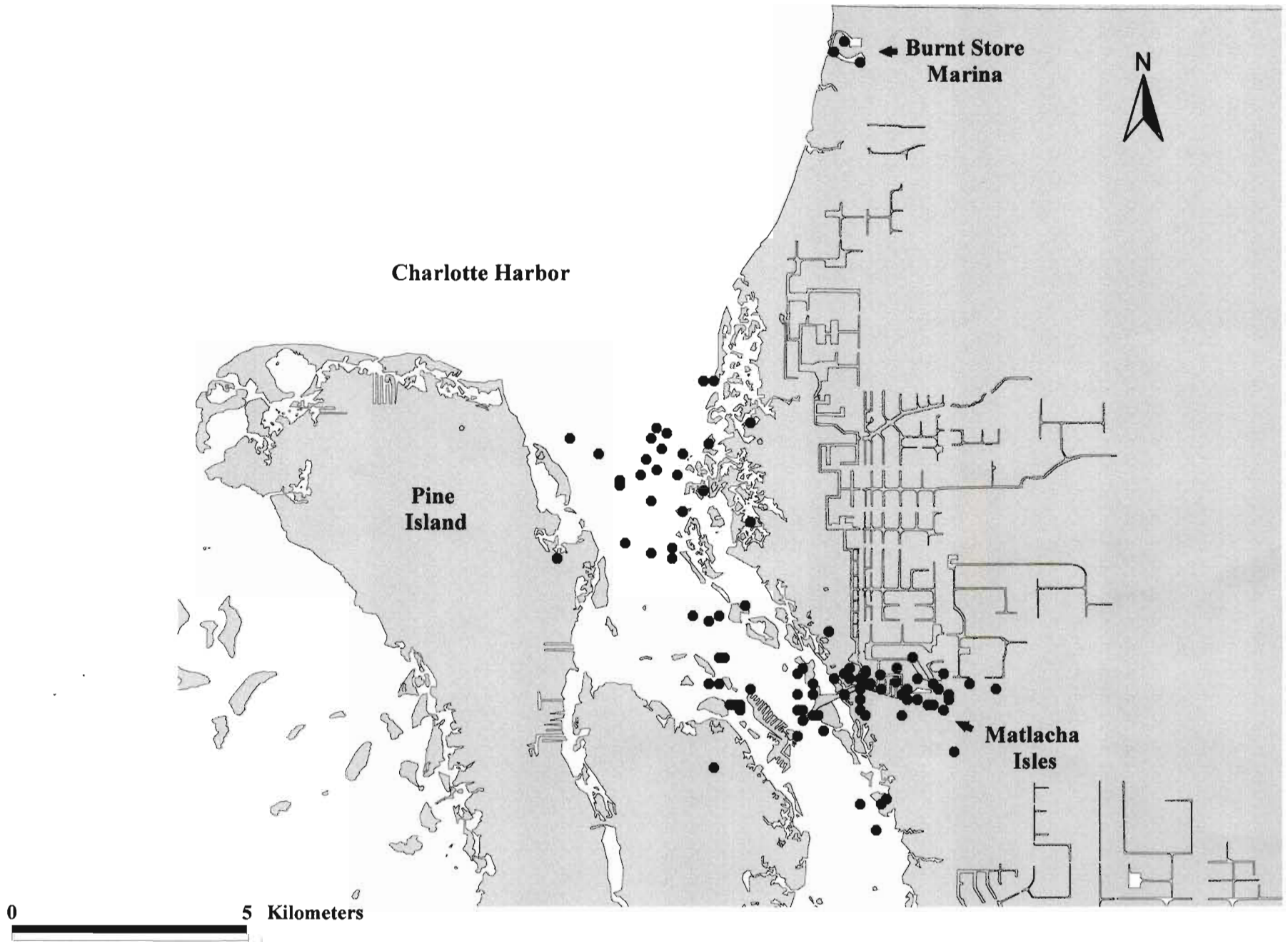

Figure 16a. Locations of tagged manatee, FM281 ("Pipe"), in the study area and in southwestern Florida, January 31 - August 31, 2001.

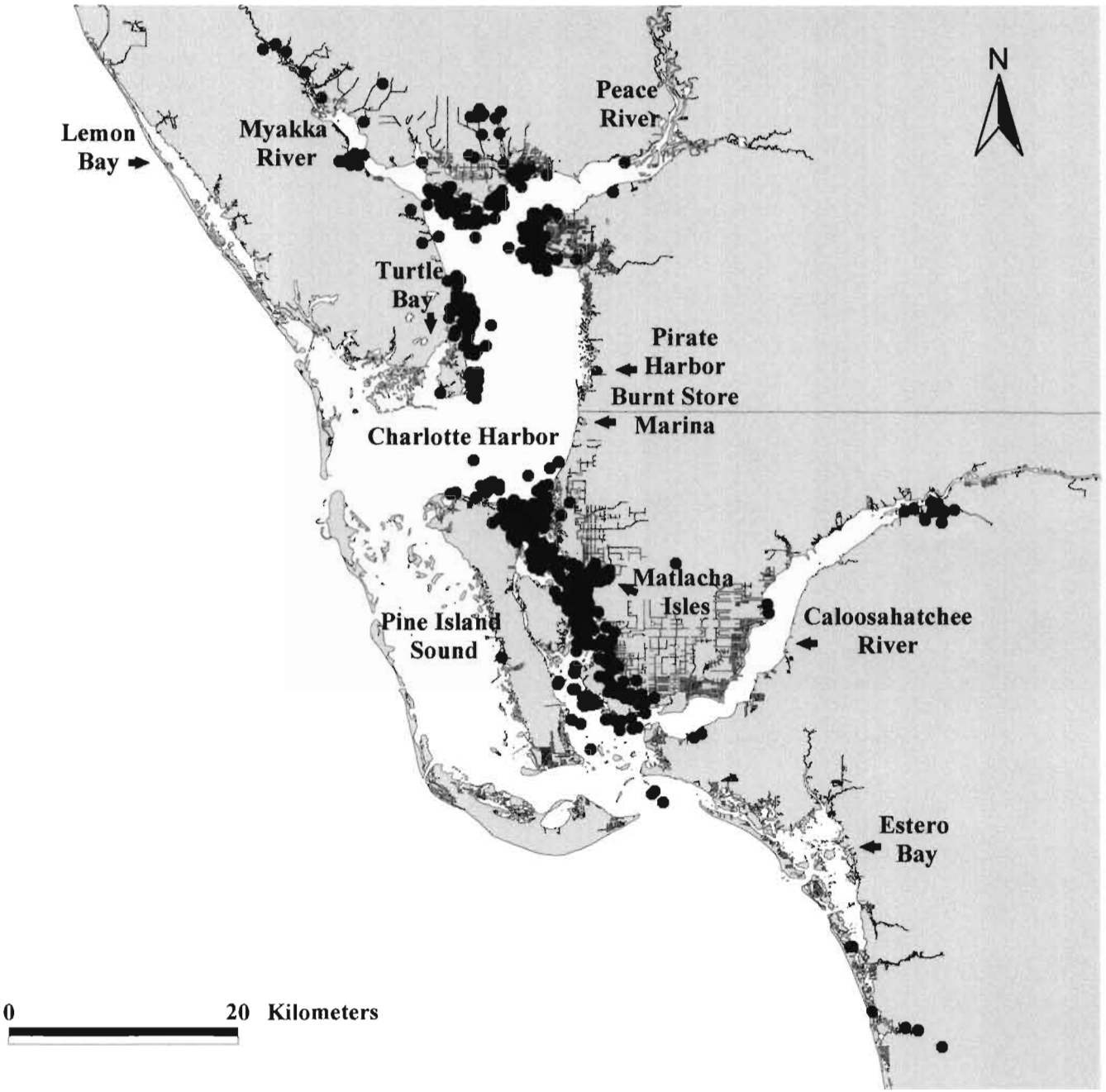

Fig 16b. Locations of tagged manatee, FM281 ("Pipe"), in the Ten Thousand Islands and Everglades areas, January 31 - August 31, 2001.

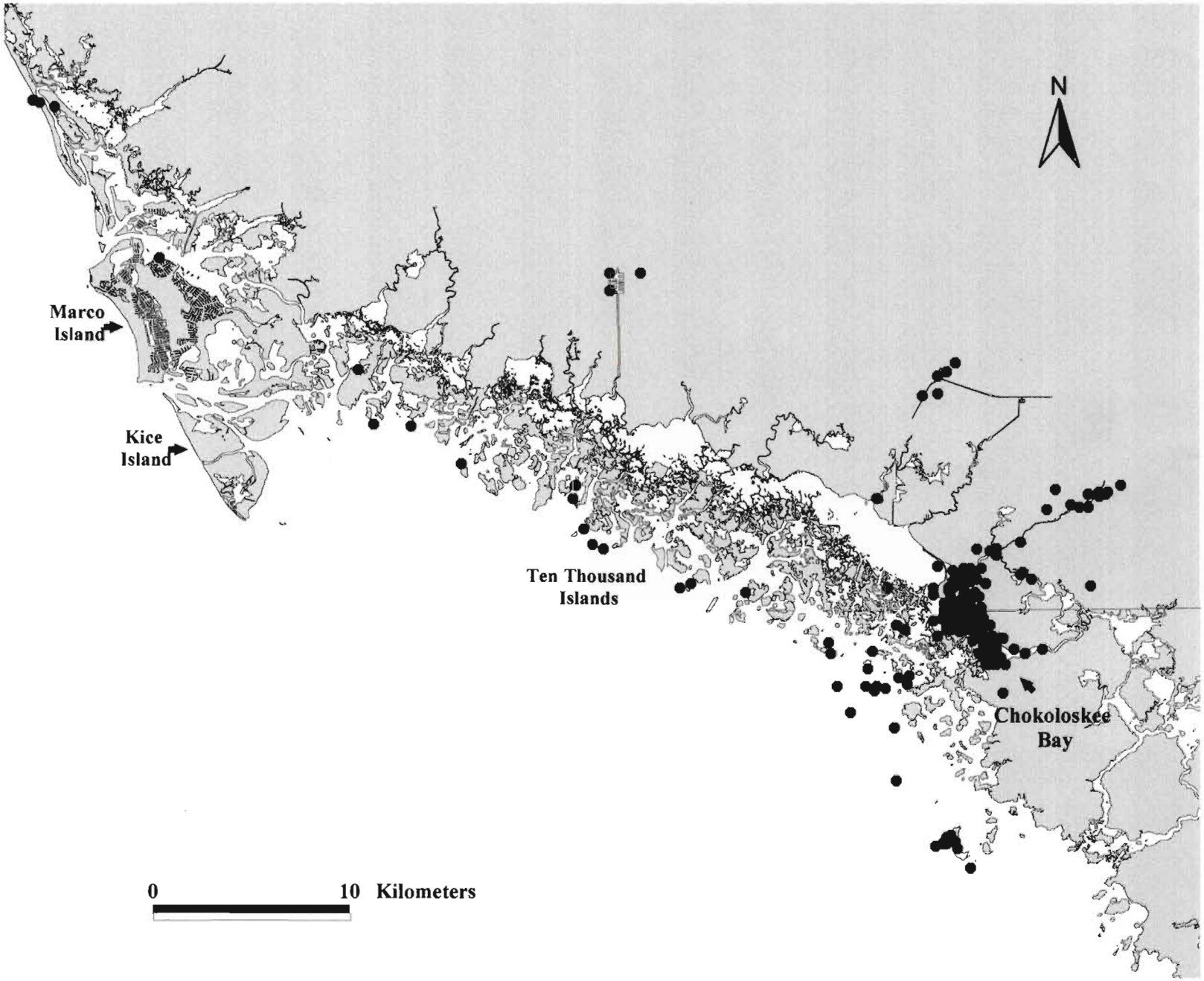

Figure 17. Locations of tagged manatee, FM316 ("Moo-nar"), in the study area and in southwestern Florida, January 31 - June 21, 2001.

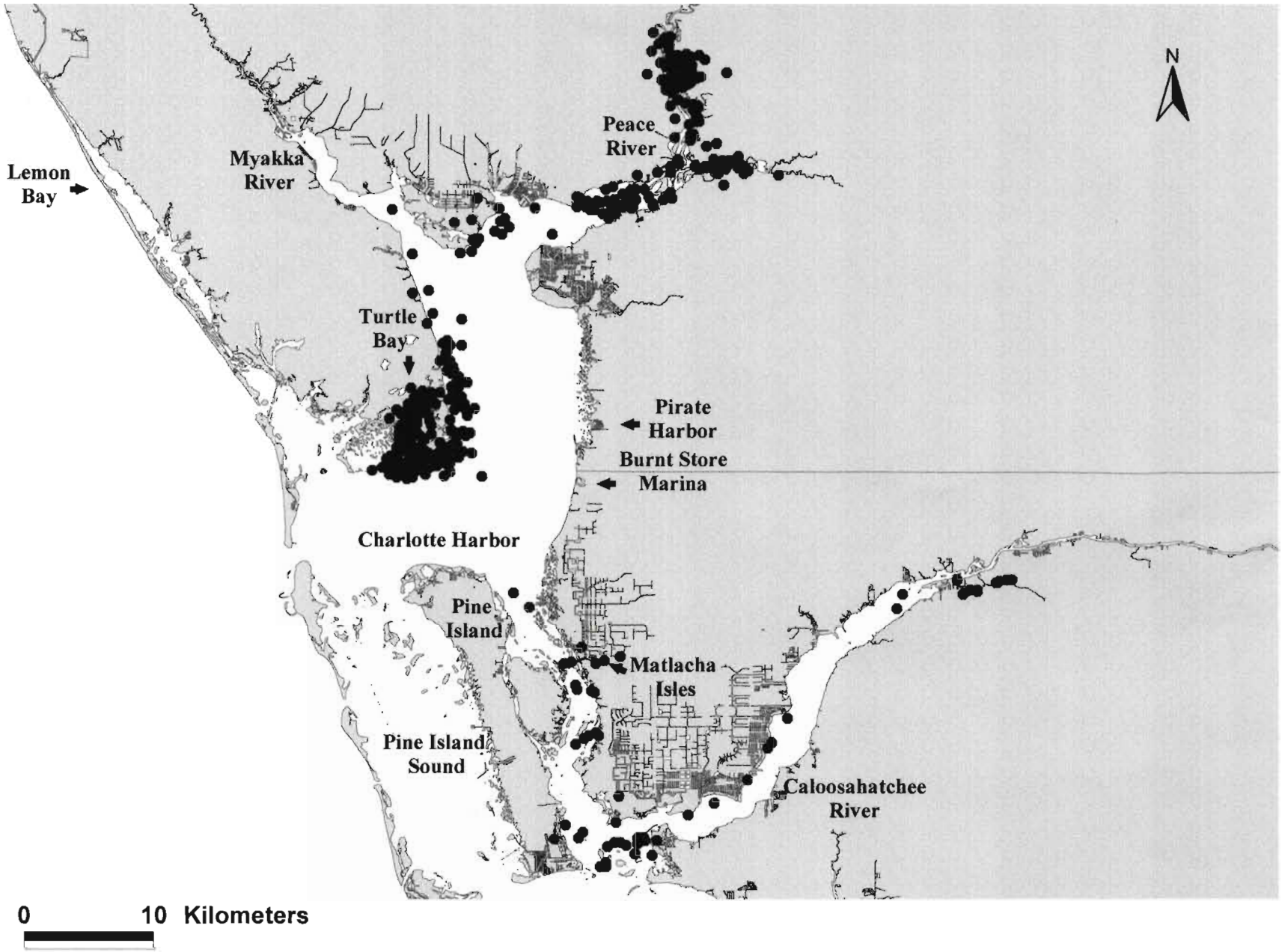

Figure 18. Bottom water temperatures (°C) for sites within Matlacha Isles (sites 1, 2, and 6), Matlacha Pass (markers 30, 56, and 71), West Island, and northern Pine Island, January 16-31, 2001.

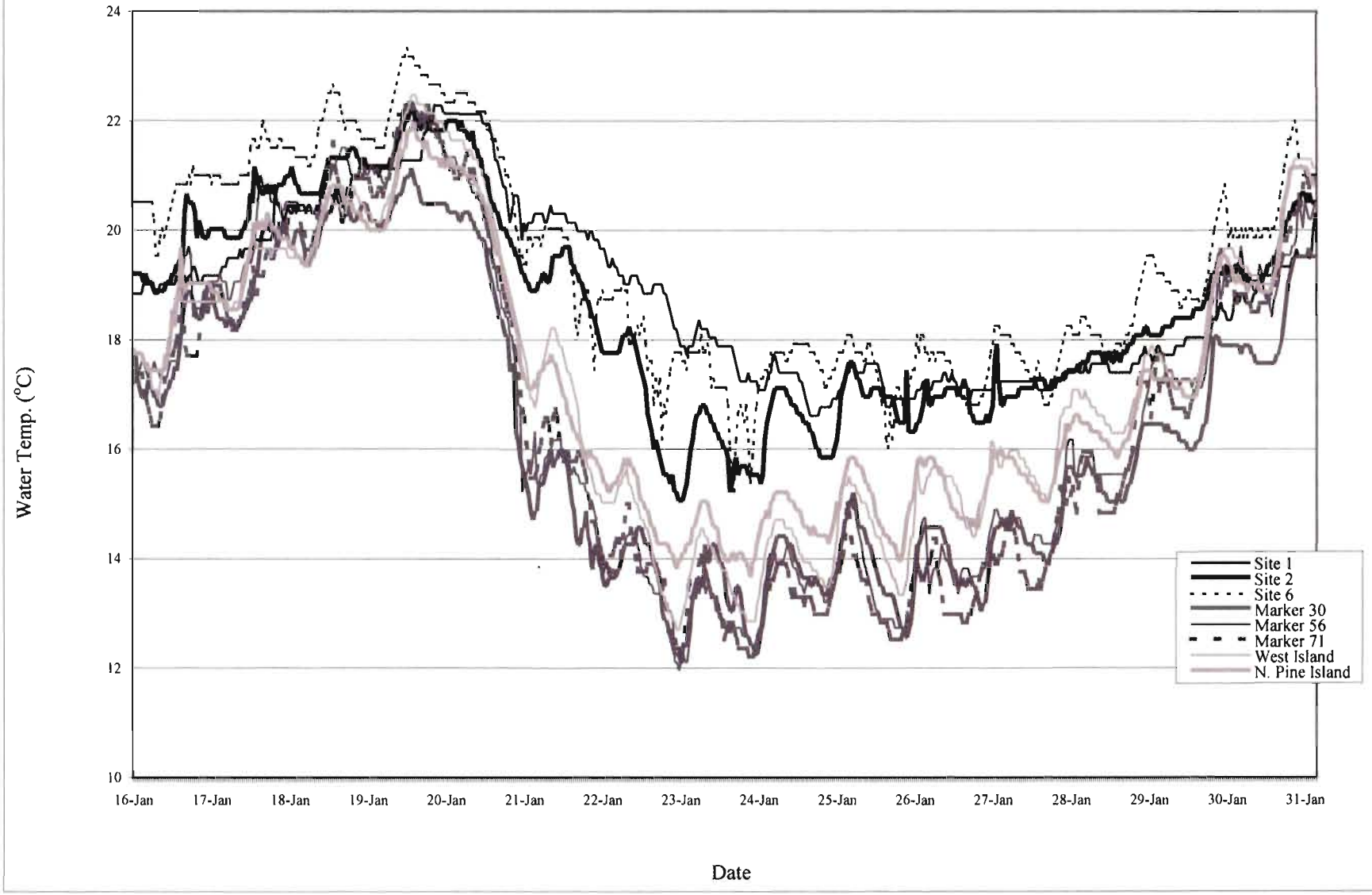

Figure 19. Ranges and means of surface water salinities recorded at stations in Matlacha Isles (MI), West Island (WI), and northern Pine Island (nPI), both winters 1999-2001

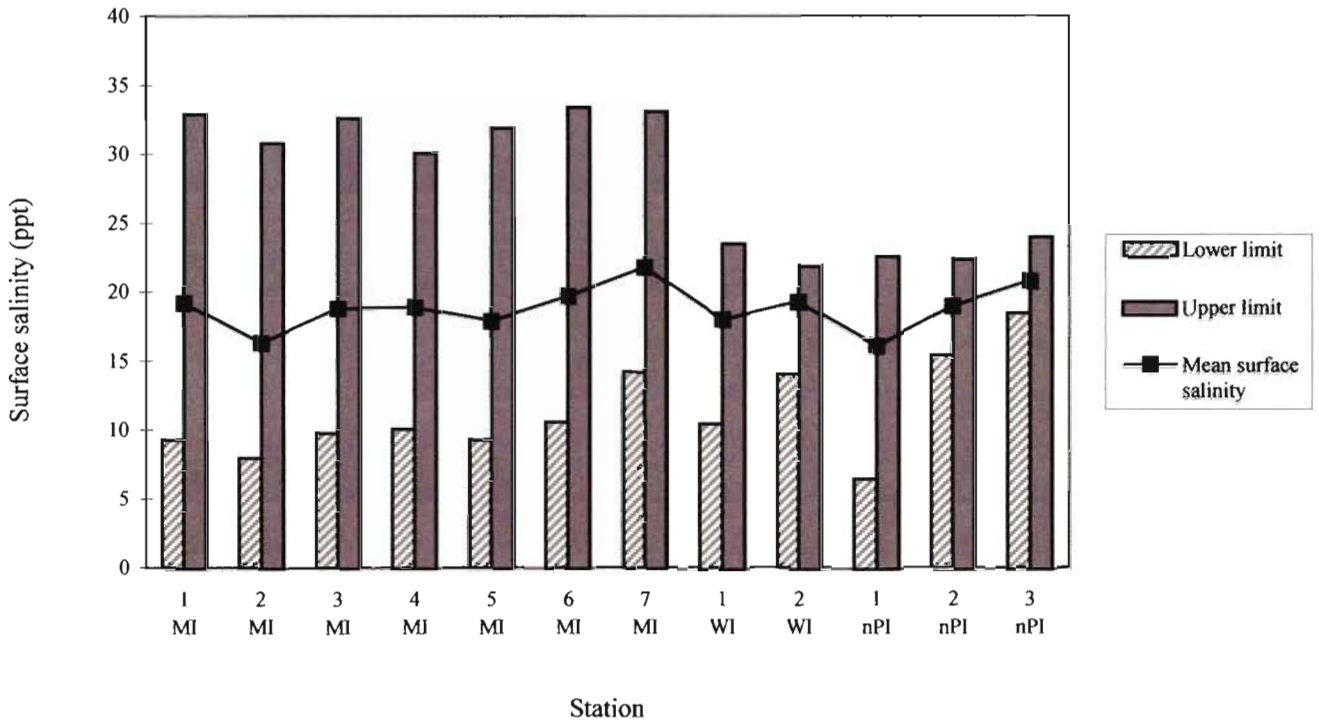


Figure 20. Ranges and means of bottom salinities recorded at stations in Matlacha Ises (MI), West Island (WI), and northern Pine Island (nPI), both winters 1999-2001