

Are Manatee Over-Wintering Strategies and Restoration Efforts Compatible in the Northwestern Everglades Region?



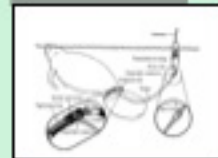
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INTRODUCTION

Florida manatees (*Trichechus manatus latirostris*) have adapted behavioral strategies to over-winter in the subtropical environments of Florida. Identified winter use patterns include migration south along the coast to warmer ambient waters, directed movements to natural and artificial thermal refuges, and use of specific warm water sources and surrounding resources. A large portion of the southwest Florida manatee population occurs throughout the Everglades National Park (ENP) and north into the Ten Thousand Islands (TTI). Cold-related mortality is especially high for manatees in this region due to the absence of industrial warm-water effluent, major springs, or the influence of the Gulf Stream.

Manatees are currently being tracked in the TTI as part of a study on the Southern Golden Gate Estates (SGGE) restoration effort, which focuses primarily on freshwater flows and manatee use patterns outside the winter season. As an extension of this work, we initiated a two-year study to understand manatee over-wintering strategies in the greater Everglades and to relate these to planned hydrologic changes.

METHODS

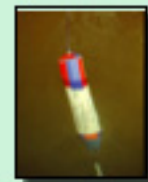


Wild manatees were captured and radio-tagged at Port of the Islands during each of the winters of 2001 through 2004. A total of 26 individuals (8 males, 18 females) were tagged and tracked in this study through December 2003.

Argos and GPS Tracking Techniques

We relied on several technologies to acquire geographic locations from tagged manatees.

Most manatees were fitted with satellite-based Argos transmitters, which have a serviceable battery life of six months and provided an average of six quality locations per day along with data on temperature and transmitter activity.



Argos radio tag

We also deployed newly developed Argos-linked GPS tags which relay GPS locations as sensor data through the Argos satellite link, enabling detailed tracking data to be acquired remotely.

In combination, the Argos data provided region-wide, long-term coverage suitable for revealing general patterns of habitat use, while the GPS data showed fine details of travel pathways and time spent in specific areas.

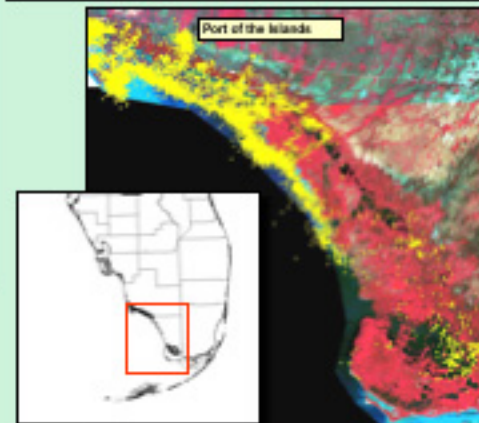


Argos/GPS tag

In addition to tracking tagged manatees, we characterized spatial and temporal changes in water temperature and manatee use patterns at known winter aggregation sites. We established a network of data-logging temperature probes to profile temperatures within the water column at these sites. Additional information was collected on numbers of manatees present during cold periods.

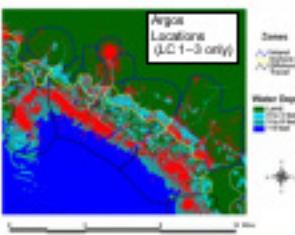
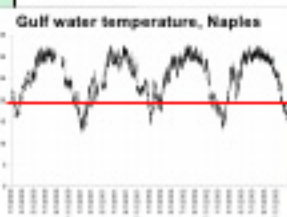
RESULTS and DISCUSSION

From June 2000 through December 2003, a total of 17,753 high quality Argos fixes over 6,157 tracking days were recorded from 26 tagged manatees. Warm season movement patterns for all individuals suggest a preference for foraging on seagrass beds in marine areas with brief trips to inland creeks and canals, which provide a source of fresh water.



Tracking data during the winter season documented strong responses to cold fronts by tagged manatees. Four of the manatees traveled to areas more than 100 km north of the Ten Thousand Islands. We also documented several individuals making large movements of 40-60 km south from TTI to Whitewater Bay associated with the onset of the winter season. Tracks of individuals that moved south and inshore during cold winter weather may reflect historic manatee movement patterns prior to the availability of northern artificial warm water refuges.

Most tagged manatees remained within the study area, however, providing the first detailed movement data collected across seasons from wild manatees in this region. Cool Gulf water temperatures (<20C) during much of the winter season limit the duration of feeding bouts on offshore seagrass beds.



Delineated habitat zones are used to classify Argos satellite locations for comparisons of areas occupied. Argos satellite locations, GPS tracks, and autonomous VHF data-logging stations are detailing the frequency and duration of inland moves to access freshwater and winter thermal refuges.

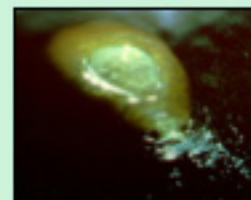
During cold periods, tagged manatees spent much more time inshore at a few key aggregation sites that serve as passive thermal refuges, notably, Port of the Islands basin in the Faka Union canal, Wooten's basin in the canal system along US 41, and the canal system at the Big Cypress Preserve, Oasis Ranger Station.

Characteristics of these sites include...

- Man-made canals with minimal current/mixing
- Little or no known spring/groundwater flow
- Bottom-resting behavior; muddy substrate
- Inverted temperatures/thermocline; warmer bottom waters
- Halocline; dense salty water as source of trapped warmth

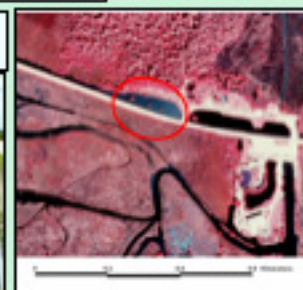
Port of the Islands

- Primary over-wintering site in the TTI region
- Thermocline/halocline



US41 canal/Wooten's Basin

- Tamiami canal
- Thermocline/halocline



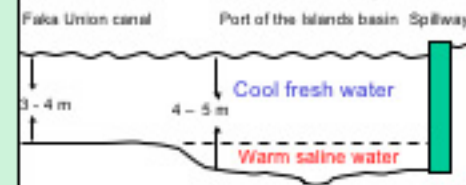
Big Cypress canals

- Dead-end canal
- Little or no halocline

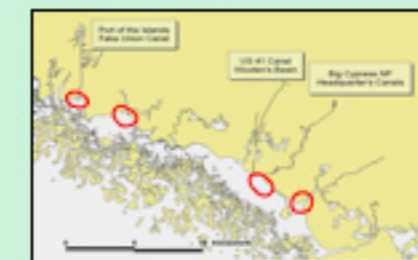


Observations and temperature data show that manatees using these passive-thermal refuges bottom-rest within thermally-inverted, higher salinity bottom layers that are several degrees warmer than surface waters.

Profile of Port of the Islands Passive Thermal Refuge



With the return of warm weather following extended cold fronts, significant numbers of manatees move from the inland refuges to deep-water sites adjacent to shallow in-shore bays, where water temperatures increase rapidly due to solar heating. These shifts in use areas demonstrate the ability of manatees to detect subtle variations in water temperatures and to utilize a network of thermal sites during winter.



CONCLUSIONS

Expected reductions in freshwater discharges during winter resulting from SGGE restoration should prevent the deep warm saline waters from being flushed out of the inland canals, so the attraction of these basins to manatees as thermal refuges should remain. For this reason, we anticipate that altered water management regimes and associated environmental changes should have a negligible effect on the winter-season habitat use and movement patterns of manatee within the region. Specific restoration-related construction activities planned along US 41 should be reviewed to guarantee continued manatee access to these traditional sites.

Because this is the least developed area in the state occupied by significant numbers of manatees, we suggest that understanding their winter behavior is of importance to the long-term management of manatees in this natural region, and in regions where power plants will be shut down or spring flow is diminishing.

ACKNOWLEDGMENTS

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