An Overview of Recent Research on the Florida Manatee in Tampa Bay: Population, Ecology, and Behavior

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The Sea Cow

The Palm Beach

FIS pull cows out of Intracoastal

y cow! Bovines moo-ve in wild chase
Warm-Water Refuge Network

- Tropical/Subtropical Herbivores
- Need Warm Water (>20 °C) in Winter
- Aggregate at Natural Springs & Industrial Discharges
Overview

* Manatee Population Monitoring
  - Distribution and Abundance
  - Mortality and Causes of Death
  - Vital Rates: Survival & Reproduction
  - Population Growth Rate

* Manatee Ecology and Behavior Research
  - Warm-water Habitat Use in Winter
  - Foraging Movements and Habitat Use
  - Impact of Foraging on Seagrass Beds
Aerial Surveys for Manatee Distribution: Tampa Bay
Water Conditions and Manatee Behavior Affect Detectability

Most areas are like this.

Few sites are like this.
Components of Detection Probability for Site-specific Surveys

- **Absence Bias**: probability manatee is present in area counted.

- **Availability Bias**: probability manatee is available to be counted (visible near surface). Affected by manatee diving behavior and water clarity.

- **Perception Bias**: probability manatee is sighted, given that it is available (visible near surface). Affected by environmental conditions (e.g., wind) and observer skill.
Manatee Detection Probability Estimated at TECO Big Bend Power Plant Refuge

- 6 Series of Aerial Surveys
- 15 Flagged Manatees per Year
- Mark-resight Analysis

Overall Detection Probability across flight series:
Mean = 58% (45 - 69%)

Estimated Manatee Abundance at TECO Power Plant: 2001-2003

High of 345 in 2007

Edwards et al. (2007), Fonnesbeck et al. (2009)
Manatees as Central-Place Foragers

Ahhhh . . . Hungry!

Munch . . . Brrrrr!

Thermal Refuge

Food Source
Central-place Foraging

29Jan:1420 - 30Jan:0700

Hillsborough Bay

Tampa Bay

Adult Male TTB099

TECO POWER PLANT
Captures by Boat and from Shore

- Apollo Beach, near Tampa, FL
Tracking with Argos-linked GPS Tags

- 32 Manatees Tagged over 4 winters, Tampa Bay
- Tracked 1-6 months, starting in Dec
- GPS Sampling Interval: 15 or 20 min
- 193,883 GPS locations
- **Temperature Loggers:** Ambient, Power Plant, and on Manatee
Individual Ranges in Tampa Bay: GPS Locations during Winter 2003-04

TTB105 and TTB107

TTB106 and TTB110

TTB108 and TTB109

GPS Locations

- TTB105 SubF "Bofa"
- TTB107 AdF "Lorax"
- TTB110 AdF "Vlumbus"
- TTB106 AdF "Yurtle"
- TTB108 AdF "Breve"
- TTB109 AdF "Hedge"
Individual Ranges in Tampa Bay: GPS Locations during Winter 2004-05

TTB069 and TTB090

TTB081 and TTB118

TTB115 and TTB117
Thermal Map of TECO Refuge from Manatee Temperature Loggers

Winters 2002-06

°C above ambient
N = 28 manatees
n = 84,329 records

Mean Delta-T in Refuge
= 9.2 °C

Ordinary Kriging:
20 m cell size
Variable search radius to 10 nearest points

Created by Mark Barrett
Manatee Winter Time Budget across Habitats

- Seagrass: 24%
- Thermal Refuge: 47%
- Other: 29%

(31 - 64% across individuals)

Winters 2002-2006, Dec-Feb, N = 26-31 manatees
Manatee Use of Thermal Refuge by Temperature

Winters 2002-03 to 2005-06
Dec - Mar
N = 31 manatees
n = 206,031 records
Manatee Use of Seagrass vs. Water Level

![Graph showing the mean percentage of time spent in seagrass for different water levels. The x-axis represents water levels (ft above MLLW) with intervals from < -1.0 to > 2.5. The y-axis represents the mean percentage of time in seagrass (SE). The graph shows an increase in the mean percentage of time in seagrass as water levels increase from < -1.0 to > 2.5.]
Manatee Winter Distribution in relation to Tide

Cockroach Bay, Dec - Feb, 2002 - 2005 (N = 13)

LOW Tide

HIGH Tide

GPS Locations
- < 0.5' MLLW
- > 1.5' MLLW

Seagrass

Bathymetry
- 0 - 3 ft MLLW
- 3 - 6 ft MLLW
- > 6 ft MLLW
Manatee Use of Seagrass vs. Water Level and Time of Day

The diagram shows the mean percentage of time spent in seagrass as a function of water level at Port Manatee, categorized by night (18:00 - 07:00 hr) and day (07:00 - 18:00 hr). The graph illustrates that as water levels increase, the time spent in seagrass also increases, with a greater percentage during nighttime compared to daytime.
Summary: Manatee Use of Thermal Refuge and Foraging Movements

✓ Manatees Behaved as *Central-Place Foragers* in Winter: stayed within 20 km of refuge ¾ of time

✓ Strong Site Fidelity to power plant Thermal Refuge and to Foraging Grounds

✓ Spent average of Half their Time at the Refuge—Fasting; this varied among individuals (31 - 64%)

✓ % Time at Refuge ↑ as $T_a$ ↓

✓ Access to shallow, inshore seagrass beds was restricted to times of higher tidal levels

✓ Most foraging occurred at night, especially in areas with extensive grass flats without access to deep water
Impacts of Manatee Foraging on Seagrass Beds

Paul Carlson, lead PI

- Seagrass biomass & productivity lowest in winter
- Manatees aggregated around WW sites in winter
Relative Density of Tagged Manatee GPS Locations

Winters 2002-06

\[ N = 32 \text{ manatees} \]

Highest use outside TECO was in Apollo Beach grass flats.

Also in the Kitchen and outside Cockroach Bay.
Seagrass Monitoring Sites

The Kitchen
Apollo Beach
Cockroach Bay

Exclosures
3 installed at each site
3 x 3 m
Dec 2005 – May 2006
(to May 2007 at ApBch)

Metrics
• Seagrass Cover
  (Balloon Photography)
• Biomass Cores
• Leaf Productivity
Defoliation caused by tidal emersion dramatically reduces SG leaf biomass.
Cownose Ray (*Rhinoptera bonasus*)

Stingrays (*Dasyatis spp.*)
Effect of Exclosures on Leaf Production: Apollo Beach, Mar 2006 – May 2007

P. Carlson et al.

The Kitchen: Treatment effect is the same in March (higher *Halodule* biomass & leaf production inside), but reverses in May.
Seasonal Variation in *Dense* Seagrass Cover: Apollo Beach Outer Plots, Oct 2005 – Aug 2007

**Inner Plots:** Similar seasonal pattern, but higher cover in winter and faster recovery in spring.
Impacts of Animal Disturbance on Seagrass Beds

- Animal Disturbance impacted seagrass beds closest to the TECO power plant during winter => reduced biomass & leaf productivity by end of winter.

- The separate effects of manatees, stingrays, and cownose rays could not be reliably distinguished. These species excavated seagrasses, including roots and rhizomes.

- Seagrass beds appeared to recover during the growing season, taking longer in the sparser outer edge than in the denser inshore side of the beds.

- Apollo Beach grass bed is particularly vulnerable to animal disturbance due to (1) historic seagrass losses (only 10% remains), (2) proximity to TECO power plant. Seagrass restoration here would increase food available to manatees.
THANKS TO MANY FOLKS!

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