

Opportunistic carnivory by Florida manatees (*Trichechus manatus latirostris*)

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Abstract

The Florida manatee (*Trichechus manatus latirostris*) is one of the most endangered marine mammals in the US. To protect this species, it is important to understand the feeding ecology to define critical habitats. Manatees generally are considered to be strictly herbivorous mammals that only incidentally consume animal species. This concept is based on the preponderance of freshwater vegetation, seagrasses, and algae that is found in most stomach content and fecal analyses.

In the present study, manatees were observed feeding in areas of the Indian River Lagoon in Vero Beach and Fort Pierce, Florida, USA during June to August 2001. Most manatees were observed to be feeding on seagrasses and algae; however, on two occasions, manatees were observed apparently preferentially consuming invertebrates that were attached to a dock. Although some fibrous algae were present on the dock structure, the majority of biomass present was made up of invertebrates. Manatees were heard crunching invertebrate shells and seen pulling animals, such as tunicates, into their mouths. These observations suggest that manatees actively, rather than incidentally, consume invertebrates in some cases.

Key words: manatee, *Trichechus manatus latirostris*, Florida, feeding, carnivory, herbivory, Indian River, seagrass, foraging, invertebrates, sirenian.

Introduction

The Florida manatee (*Trichechus manatus latirostris*) remains one of the most endangered marine mammals in US waters (O'Shea *et al.*, 1992), with one of the greatest threats to its long-term survival being the loss of critical habitat (O'Shea, 1988; Florida Department of Environmental Protection, 1997; Marine Mammal Commission, 1998; U.S.

Fish & Wildlife Service, 1998). In 1980, the first manatee recovery plan was approved. It was revised in 1989 and again in 1996 (U.S. Fish & Wildlife Service, 1998). Since then, the U.S. Fish & Wildlife Service has set aside thousands of acres considered to be critical habitat for manatees in the Crystal, Homosassa, and Suwannee rivers. Three new sanctuaries have been established in Florida, and two motorboat-prohibited areas have been established in the Merritt Island National Wildlife Reserve and the Kennedy Space Center (U.S. Fish & Wildlife Service, 1998).

To define critical habitat, it is important to understand the feeding ecology of manatees. Historically, the feeding ecology of the Florida manatee has been studied by analyzing feces of living manatees or by stomach content analysis of recently deceased animals (Campbell & Irvine, 1977; Hartman, 1979; Packard, 1981; Packard, 1984; Ledder, 1986; Hurst & Beck, 1988; Lefebvre & Powell, 1990; O'Shea *et al.*, 1991; Provancha & Hall, 1991; Lefebvre *et al.*, 2000). These methods provide information on recent feeding events, but they cannot give a complete picture of the diet of manatees.

Materials and Methods

Observations of manatees in the Fort Pierce and Vero Beach, Florida areas of the Indian River Lagoon were begun on 6 June 2001 and completed on 14 August 2001. A pair of observers made daily trips into the lagoon to record manatee feeding behaviour and to collect seagrass for ongoing stable isotope analyses. Stable isotopes in seagrasses will be compared to those in manatee tissue samples to learn more about seasonal manatee food preferences. Sources including the local manatee centre, Harbor Branch Oceanographic Institution, local fishermen and boaters, and Smithsonian Fort Pierce Marine Station researchers were consulted to

obtain information regarding likely locations to find manatees. Observations were made from a canoe and from shore. When a manatee was spotted, its behaviour was observed to determine if feeding was taking place. A manatee was considered to be feeding on the bottom if it was sinking to the bottom between breaths and plumes of mud were observed coming from the area of its mouth.

When feeding was observed, the forage species were collected for the isotope analysis project. Seagrasses and algae also were collected in areas where manatees were suspected to be feeding. This included areas where they were seen possibly engaging in feeding behaviour and areas where flora appeared to be cropped down by grazing manatees.

Results

Most observations of manatees feeding or possibly feeding occurred in shallow water (<2 m deep), where manatees consumed seagrasses and algae, mainly consisting of the species *Gracilaria* spp., *Halodule wrightii*, *Syringodium filiforme*, and *Thalassia testudinum*.¹ Manatees were seen feeding on *Gracilaria* spp. in Herman Bay (27°19'53.7"N, 80°14'12.5"W) at 12:15 on 25 June. Cropped *Halodule wrightii* were seen in Thumb Cove (27°20'22.0"N, 80°14'13.8"W) on 20 June. Manatees were seen on four days (30 June, 18 July, 30 July, and 11 August) at Round Island (27°33'51.2"N, 80°19'50.8"W). They were suspected to be feeding on *Gracilaria* spp., *Halodule wrightii*, and *Syringodium filiforme* that surrounded the island. A local homeowner reported manatees feeding near Jack Island (27°29'59.0"N, 80°18'28.2"W) in August. *Halodule wrightii* were collected in that area on 13 August. Manatees were also seen in the area of Harbor Branch Oceanographic Institution on five days (29 June, 11 July, 17 July, 31 July, and 13 August). Although manatees were only seen in the boating canals, cropped grasses along the shore suggested that some feeding was taking place there. *Halodule wrightii*, *Thalassia testudinum*, and *Syringodium filiforme* were collected in the shore areas on 29 June, 11 July, 31 July, and 13 August. It often was difficult to see manatees clearly due to the murkiness of the water. Therefore, feeding behaviour was difficult to document, and no ethogram of behaviour could be made.

On two of five days of observation at Harbor Branch, manatees were observed apparently feeding on invertebrates on the institution's boat dock in Fort Pierce, Florida (27°31'58.8"N, 80°21'1.1"W). The top of the dock was approximately 4 m long

and 1 m wide. Around the entire base of the top of the dock was an approximately 25-cm lip set back about 10 cm from the edge of the dock. About 20 cm of the lip extended into the water and were covered with a wide variety of invertebrates. At least three adult manatees were observed near the dock on 29 June 2001. All three animals were loudly gnawing barnacles, bivalves, gastropods, crabs, tunicates, and possibly other invertebrates off of the lip of the dock and a 1 m rope attached to the dock. This behaviour continued intermittently for approximately 1 h. No other manatees were observed in the area. The manatees were not seen eating anything on the pilings around the dock, but the murkiness of the water made observation difficult. One manatee was observed sucking a dislodged, floating tunicate into its mouth.

On 11 July 2001, a lone adult manatee was observed gnawing invertebrates off of the same dock for approximately 15 min. Some barren areas among the encrusting organisms on the lip of the dock could be seen where the manatees had gnawed. These areas ranged in size from about 5 cm square to about 10 cm square.

Although organisms were collected from the dock on 29 June and 11 July, no expert was available to identify the organisms at that time. Additionally, many organisms were crushed beyond recognition during collection. The collections were frozen for stable isotope analysis, which does not have the resolution to allow keying of species from the results. The observers who made the collections were not aware that it was unusual for manatees to feed on invertebrates, so no special attempts were made to determine the species of the organisms involved. The wooden dock, on which these organisms were growing has since been replaced by a new metal dock, so it is not currently possible to determine which species of organisms were living on the original dock. However, the observers did make note that there were crustaceans, bivalves, gastropods, and tunicates, as well as some filamentous algae on the original dock and rope.

Discussion

Observations of manatees feeding on such plant species as *Gracilaria* spp., *Halodule wrightii*, *Syringodium filiforme*, and *Thalassia testudinum* were expected based on the fact that these species have commonly been found in stomach content and fecal analyses (Campbell & Irvine, 1977; Hartman, 1979; Packard, 1981; Packard, 1984; Ledder, 1986; Hurst & Beck, 1988; Lefebvre & Powell, 1990; Provanca & Hall, 1991; Lefebvre *et al.*, 2000). However, observations of manatees feeding on invertebrates are not commonly documented in the literature. Although remains of

¹Identified by Dr. Diane Littler, Senior Scientist, Harbor Branch Oceanographic Institution, 5600 U.S. 1 North, Fort Pierce, Florida 34946 USA in August 2001.

animal organisms have been found in stomach contents, it is generally thought that manatees incidentally ingest such species when consuming seagrass or algae² (Powell, 1978).

O'Shea *et al.* (1991) examined stomach contents of Florida manatees that died during a red tide in 1982. They found that eight of their fourteen stomach samples contained ascidians (filter feeding tunicates), primarily *Molgula occidentalis*, *M. manhattanensis*, and *Styela plicata*. Numbers of ascidians they counted in complete gastrointestinal tracts ranged from one to an estimated 4000. O'Shea *et al.* (1991) considered this a relatively high incidence of ingestion of tunicates. Although O'Shea *et al.* (1991) drew no conclusions as to whether the tunicates were incidentally or opportunistically ingested, the high level of consumption suggests that manatees may indeed feed purposely on tunicates under some circumstances. An additional description of carnivory in manatees is reported by Powell (1978), who described manatees in Jamaica opportunistically feeding on fish caught in gillnets.

When considering stomach content analyses, it is important to note that stomach contents were usually taken from animals that are found dead of trauma or disease, so they may not be completely representative of live, healthy manatees. In addition, considering that animal tissues are likely to digest at a different rate than plant tissues, stomach content analyses could underestimate animal consumption. Therefore, visual observations of feeding manatees can be informative supplements to such analyses.

Manatees have been documented gnawing organisms off of objects similar to docks and ropes, but usually the main forage species on those objects are considered to be algae. Reynolds (1981) described manatees in Blue Lagoon, Florida feeding on a *Mougeotia* and *Spirogyra* algal complex found attached to rocks, pilings, and dams. Teidemann (1983) observed manatees in Turkey Creek, Florida feeding on unidentified green algae on pilings and boat bottoms. Our most recent observations at Harbor Branch appeared to show manatees eating barnacles, tunicates, bivalves, gastropods, small crustaceans, and other small invertebrates from the dock in addition to algae. Visual observations indicated that invertebrates made up the majority of the biomass on the dock, although there were some small coatings of fibrous algae present as well. The sound of animal shells being chewed by manatees was clearly audible.

It should be noted that manatees have a very complex sensory system associated with their mouths and vibrissae and are known to take objects into their mouths to 'explore' or 'play' (Reep *et al.* 1998). Therefore, it is possible that exploratory activity is the explanation of the behaviour at the Harbor Branch dock. However, the fact that chewing of shells could be heard suggests that manatees were in fact eating the invertebrates that they were removing from the dock. Further field observations of feeding manatees could help resolve such questions since they could provide behavioural evidence to supplement current information that is based mostly on stomach contents of stranded individuals.

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Literature Cited

- Florida Department of Environmental Protection. (1997) Florida Marine Research Institute. Atlas of Marine Resources, Version 1.1.
- Marine Mammal Commission. (1998) Chapter II – Species of special concern: Florida
- U.S. Fish & Wildlife Service. (1998) Multi-species recovery plan for the threatened and endangered species of South Florida. Technical/Agency Draft. Volume 1 of 2: The Species. Vero Beach, Florida.
- Campbell, H., & Irvine, B. (1977) Feeding ecology of the West Indian manatee *Trichechus manatus Linnaeus*. *Aquaculture* **12**, 249–251.
- Hartman, D. (1979) Ecology and behavior of the manatee (*Trichechus manatus*). American Society of Mammalogists Florida Special Publication No. 5. 153 pp.
- Hurst, L. & Beck, C. (1988) Microhistological characteristics of selected aquatic plants of Florida with techniques for the study of manatee food habits. U.S. Fish & Wildlife Service Biological Report **88**(18).
- Ledder, D. (1986) Food habits of the West Indian manatee, *Trichechus manatus latirostris*, in south Florida. M.S. Thesis University of Miami.
- Lefebvre, L., Reid, J., Kenworthy, W. & Powell, J. (2000) Characterizing manatee habitat use and seagrass grazing in Florida and Puerto Rico: Implications for conservation and management. *Pacific Conservation Biology* **5**, 289–298.

²Personal communication from Cathy Beck, U.S.G.S. Sirenia Project, 412 N.E. 16th Avenue, Gainesville, Florida 32601 USA in August 2001.

- Lefebvre, L. & Powell, J. (1990) Manatee grazing impacts on seagrasses in Hobe Sound and Jupiter Sound in southeast Florida during the winter of 1988–89. National Technical Information Service, PB90–271883, Springfield, VA. 36 pp.
- manatee (*Trichechus manatus latirostris*). Washington DC: Marine Mammal Commission. Annual Report for 1997.
- O'Shea, T. J. (1988) The past, present, and future of manatees in the southeastern United States: Realities, misunderstandings, and enigmas. In: R. R. Odum, K. A. Riddleberger, & J. C. Ozier (eds.). *Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium*. pp. 184–204. Georgia Department of Natural Resources, Social Circle, Georgia.
- O'Shea, T., Rathbun, G., Bonde, R., Buergelt, C. & Odell, D. (1991) An epizootic of Florida manatees associated with a dinoflagellate bloom. *Marine Mammal Science* **7**, 165–179.
- Packard, J. (1981) Abundance, distribution, and feeding habits of manatees (*Trichechus manatus*) wintering between St. Lucie and Palm Beach inlets, Florida. Report prepared for the U.S. Fish & Wildlife Service. Contract No. 14–16–0004–80–105.
- Packard, J. (1984) Impact of manatees *Trichechus manatus* on seagrass communities in eastern Florida. *Acta Zoologica Fennica* **172**, 21–22.
- Powell, J. (1978) Evidence of carnivory in manatees (*Trichechus manatus*). *Journal of Mammalogy* **59**, 442.
- Provancha, J. & Hall, C. (1991) Observations of associations between seagrass beds and manatees in east central Florida. *Florida Scientist* **54**, 87–98.
- Reep, R., Marshall, C., Stoll, M. & Witaker, D. (1998) Distribution and innervation of facial bristles and hairs in the Florida manatee (*Trichechus manatus latirostris*). *Marine Mammal Science* **14**, 257–273.
- Reynolds, J. (1981) Behavior patterns in the West Indian manatee, with emphasis on feeding and diving. *Florida Scientist* **44**, 228–232.
- Tiedemann, J. (1983) Observations of the West Indian manatee, *Trichechus manatus*, in Turkey Creek, Brevard County, Florida. *Florida Scientist* **46**, 1–9.