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Review

The People vs. Florida manatee: A review of the laws protecting Florida's endangered marine mammal and need for application

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ABSTRACT

Florida manatees (*Trichechus manatus latirostris*) are a tropical species endemic at their northernmost habitat range within the southeastern United States. Manatees face a thermoregulatory requirement during winter months and follow a seasonal migration to warm water sources. To avoid cold stress syndrome (CSS), manatees utilize the warmth from artificial sources such as power plant discharge canals or natural sources such as artesian springs. Already endangered, this species nonetheless continually faces an ever-growing threat from human impact within these important locations. This paper reviews the past and present laws protecting manatees in Florida, chronicles the impacts manatees are facing presently and in the future, and details the increasing need for the application of protection from a management standpoint. With the correct management plan in place, manatees and humans can cooperatively coexist together in a shared environment.

1. The Florida manatee

Florida manatees (*Trichechus manatus latirostris*) are large (2.7–3.5 m long, 400–550 kg), slow moving aquatic mammals that inhabit the shallow coastal bays and estuaries around the state of Florida. They can be found in salt, fresh or brackish waters along the Atlantic Ocean and Gulf of Mexico (Irvine and Campbell, 1978). Strictly herbivorous, the Florida manatee consumes 4%–9% [7.1%] of its body weight in a day (Bengtson, 1983; Etheridge et al. 1985), feeding on a wide variety of aquatic plants, marine seagrasses and algae (Hartman, 1979; Bengtson, 1981, 1983; Best, 1981; Etheridge et al. 1985; Ledder, 1986; Hurst and Beck, 1988). Like other K-selected species, Florida manatees mature slowly around 3–7 years of age, give birth after a long gestation period of twelve to thirteen months, and have a low reproductive rate with one calf every three years (Marmontel, 1995; Odell et al. 1995; O'Shea and Hartley, 1995; Rathbun et al. 1995; Reid et al. 1995; Anderson, 2002). Species with this type of life-history strategy must have high and stable adult survival rates in order to persist (MacArthur and Wilson, 1967; O'Shea and Hartley, 1995; O'Shea and Langtimm, 1995; Langtimm et al. 1998). In 2011, the annual aerial survey of manatees counted a population of 4,834 manatees in the waters around the State of Florida (Florida Fish and Wildlife Conservation Commission, 2011). Because of these low population numbers in concurrence with ongoing and anticipated future threats, manatees have been placed on the endangered species list. Unfortunately, the effects of natural and human-related mortalities, primarily caused by harmful algal blooms (HABs), cold stress and watercraft strikes, continue to jeopardize the long-term existence of the Florida manatee population.

2. Mortality and its causes

Florida manatees inhabit warm waters where aquatic vegetation is abundant and rise to the surface every few minutes to breathe. Because they dwell just below the surface, often making them invisible to boaters, manatees are susceptible to fatal thoracic injuries sustained from collisions with watercraft (Ackerman et al. 1995; O'Shea, 1995; Bossart, 1999; O'Shea et al., 2001; Reep and Bonde, 2006). The number of registered watercraft vessels in Florida has steadily increased over the past 25 years, doubling since 1980 (FWC, unpublished data). In 2010, Florida led the nation in number of registered vessels (FWC, 2010). Today, Florida manatees share the waterways with roughly 1 million registered boats and watercraft in the State of Florida (FWC, 2011). Florida's more than 11,000 miles of waterway attracts numerous out-of-state boaters and visitors for fishing and other recreational activities. It is estimated that approximately 1 million additional non-registered

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boats actively use Florida's waterways (FWC, 2010). Not surprisingly, boating ranked first in Florida with an economic value of $10.3 billion in 2012 (National Marine Manufacturers Association, 2013). Just about every manatee in Florida waters bears scars on its body from collisions with boats. According to the United States Geological Survey (USGS) manatee photo-identification database project (MIPS), by the year 2000, more than 1 000 manatees had unique scar patterns from boat collisions with 97% of those animals displaying scars from multiple boat strikes (Beck and Reid, 1995; O'Shea et al., 2001).

Recreational activities have been encouraged in recent decades as a way of connecting humans with the natural environment and supporting local businesses. Fishing, both commercially and recreationally, is an important economic resource in the state of Florida. Florida is known as the "fishing capital of the world." With its expansive coastal environment, Florida offers vast opportunities and resources for recreational fishing. According to the Florida Fish and Wildlife Conservation Commission (FWC), over $25 million of revenue was generated from saltwater licenses in FY2011-2012. Freshwater licenses generated over $9 million (FWC, 2011; FWC, 2013). Although fishing is a popular activity among people in the state of Florida, it greatly impacts manatees as well. Often times, manatees become entangled in discarded monofilament fishing lines and crab traps. Entanglement can have severe detrimental effects on the manatee as it can cause amputation of limbs and risks drowning (Beck and Barros, 1991; Guillory et al. 2001). An even greater threat to the manatee is ingestion of these items or other trash embedded in the seagrass beds they consume (Buergelt et al. 1984; Smith, 1993). Ingesting such items can create blockages in the manatees' digestive tract, causing a slow, agonizing death.

Protection of waterways and seagrass beds is crucial for the manatees' survival. One important means for protecting manatees is to minimize detrimental effects to their environment caused by anthropogenic impacts. Unfortunately, manatees inhabit one of the fastest growing states in the United States. Approximately 20 million people reside in the state of Florida, representing roughly 6% of the country's entire population (U.S. Census Bureau, 2012). According to the U.S. Census Bureau, over 1,000 people move to the state of Florida each day. Of those people, a majority resides close to or on the water, and this number is only expected to increase over time. Due to this influx, endangered species like the manatee face the challenge of finding safe places to inhabit and have difficulty accessing the resources they need to survive. To support such a growing human population, actions need to be put into practice to reduce the stress placed on declining natural areas within the state of Florida.

Manatees in Florida are at the northernmost habitat range for any species in the Family Trichechidae (Irvine, 1983; Lefebvre et al. 2001; Allen, 2013). These animals maintain a seasonal thermoregulatory need that is not faced by other Trichechids. Manatee physiology, including an extremely low metabolic rate and a high thermal conductance, limits the animal's ability to thermoregulate in cold waters (Irvine, 1983; Bossart, 1999; FWC, 2007). Long-term exposure to water temperatures below 20 °C may result in hypothermia, frostbite, pneumonia, or a combination of all these factors (Laist and Reynolds, 2005a, 2005b; Allen, 2013). Consequently, manatees may develop cold stress syndrome (CSS), a chronic and acute cause of death. CSS can also work synergistically to supress the immune system (Bossart et al. 2003; Walsh et al. 2005; Halvorsen and Keith, 2008) and has had a significant impact on the manatee population (Laist and Reynolds, 2005a, 2005b). Since 1974, the FWC has collected statistics on the causes of death in manatees. In the winters of 2009 and 2010, Florida experienced unusually cold temperatures that included record lows on several occasions. During this spell, 282 manatees perished due to cold stress syndrome and an additional 275 manatees died of unidentified or undetermined causes (FWC – manatee mortality statistics). It is likely that several of these deaths attributed to unidentified/undetermined causes could be categorized under cold stress. During the months from January to April of 2010, 503 manatee carcasses were collected (FWC, unpublished data). This number surpassed previously recorded mortality rates from preceding years in only four months. As a result of their dependence on warm water, a seasonal migration occurs by Florida manatees (Shane, 1983b; O'Shea and Kochman 1990; Reid et al. 1991; Deutsch et al. 1998); animals seek thermal refuge in artificial sources like power plant discharge canals (Shane, 1983a, 1984; Reynolds and Wilcox, 1985, 1986, 1987, 1994; Laist and Reynolds, 2005a, 2005b) or natural warm water springs (Bengtson, 1981; Shane, 1983b; Reid et al. 1991; Laist and Reynolds, 2005a, 2005b; Allen, 2013). With more than 700 freshwater springs, Florida provides warm water refuges for species like the manatee. These natural springs, where water temperatures remain at a constant ≥20–22 °C year round, allow manatees to thermoregulate during the winter months (Laist and Reynolds, 2005a,b; Allen, 2013). Manatees occasionally appear in the springs earlier with the arrival of an early winter and may remain there longer following severe or extended winters. Nevertheless, these springs are utilized by both humans and manatees. Humans utilize natural freshwater springs for several purposes including swimming, drinking, watering lawns, and even manufacturing bottled water, while manatees use this resource for life-saving warmth during the colder months (Moore, 1951; Samek, 2004; Florida Department of Environmental Protection, 2012; Flamm et al. 2013). Currently, these springs remain vulnerable due to human usage. Poor land use decisions have had the greatest direct impact on the springs' health (Samek, 2004).

Harmful algal blooms (HABs) are an additional risk to manatees. A frequent occurrence in Florida is red tide, a dangerous phenomenon caused by a dinoflagellate that produces a toxin deadly to manatees (Buergelt et al. 1984; O'Shea et al., 1991; Bossart et al. 1998). While the exact cause of red tide is unknown, it is thought to be enhanced by human pollution (e.g., groundwater runoff of chemicals and fertilizers). In 2013, an outbreak occurred on the Gulf Coast of Florida which resulted in the highest number of manatee mortalities attributed to red tide since carcass collection began.

Natural causes of death in manatees do occur occasionally but are not a significant threat to their continued survival. In fact, natural diseases in manatees are uncommon; the true extent of the species' remarkable immune system remains to be fully characterized (Buergelt and Bonde, 1983; Buergelt et al. 1984; Bossart, 2001; McGee, 2012). With the numerous threats manatees succumb to, old age is not a likely factor as a cause of death. The average life span of a manatee in the wild is 8–13 years (FWC – manatee mortality statistics). In captivity, manatees do not face the same challenges and threats as they would in nature, and some individuals have lived up to several decades. The world's oldest manatee, Snooty, who is currently 66 years old, shows little to no sign of old age or declining health (personal communication, D. Murphy, D.V.M., South Florida Museum, 2013). This exemplifies that without cold stress, HABs and other anthropogenic means to menace and shorten their existence in the wild, manatees are able to sustain significantly longer lives.

3. Future problems

As manatees inhabit warm climates, it would appear that a change in climate due to global warming will benefit manatees by reducing the effects of cold stress syndrome, one of the annual leading causes of death in manatees. However, it is evident that manatees will face serious consequences from this as well. Although climate models are uncertain, models project an increase