Watercraft Access Facilities in the State of Florida
Biological Assessment

Introduction

The U.S. Army Corps of Engineers (Corps) issues numerous permits for watercraft access facilities in Florida manatee (*Trichechus manatus latirostris*) habitat within Florida. Permitting actions that involve the rehabilitation of existing facilities and the construction of new facilities that include 4 slips or less in manatee habitat are currently evaluated using a programmatic approach that meets the consultation requirements of the Endangered Species Act.

The purpose of this action is to develop and implement a programmatic framework to encompass the majority of proposals (with the exception of proposals that involve the rehabilitation of existing facilities and the construction of new facilities that include 4 slips or less in manatee habitat), regardless of size or extent, in order to streamline the formal consultation process and ensure that adequate measures are in place to avoid and minimize impacts to manatees, as well as any adverse modification(s) of critical habitat.

Project Description / Area of Analysis

The actions addressed by this Biological Opinion include all new watercraft access facilities (i.e., docks, boat ramps, and marinas and any dredging, pipes and culverts included in project plans and build out) which are likely to adversely affect manatees as determined via the 2011 Manatee Key.

This analysis is intended to assist biologists in assessing the potential impacts of watercraft access facilities on the Florida manatee (*Trichechus manatus latirostris*) in the State of Florida.

Manatee Occurrence

Florida manatees are found throughout the southeastern United States. As a subspecies of the West Indian manatee, their presence here represents the northern limit of this species range (Lefebvre *et al.* 2001). Because they are a sub-tropical species with little tolerance for cold, they remain in the vicinity of warm-water sites in peninsular Florida during the winter. During periods of intense cold, manatees will remain at these sites; during warm interludes, they move from the warm-water areas to feed, and return once again when the water temperature is too cold (Hartman 1979, Stith *et al.* 2007).

Within the area of analysis, Florida manatees are found in freshwater, brackish, and marine environments. Typical coastal and inland habitats include coastal tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs, and vegetated bottoms (FWC 2005). As herbivores, manatees feed on the wide range of aquatic vegetation that these habitats provide. Shallow grass beds, with ready access to deep channels, are

generally preferred feeding areas in coastal and riverine habitats (Smith 1993). In coastal Georgia and northeastern Florida, manatees feed in salt marshes on smooth cordgrass (*Spartina alterniflora*) by timing feeding periods with high tides (Baugh *et al*. 1989, Zoodsma 1991). Manatees use springs and freshwater runoff sites for drinking water; secluded canals, creeks, embayments, and lagoons for resting, cavorting, mating, calving and nurturing their young; and open waterways and channels as travel corridors. (Gannon, *et al*. 2007; Marine Mammal Commission 1986, 1988). As mentioned above, manatees occupy different habitats during various times of the year, with a focus on warm-water sites during winter.

Manatees have also adapted to changing ecosystems in Florida. Industrial warm-water discharges and deep-dredged areas are used as wintering sites, stormwater/freshwater discharges provide manatees with drinking water, and the imported exotic plant, *Hydrilla sp.* (which has replaced native aquatic species in some areas), has become an important food source at wintering sites (Smith 1993).

Manatee Population and Demographic Information

The most recent five-year status review of the manatee assessed the population in four regional management units: an Atlantic Coast unit that occupies the east coast of Florida, including the Florida Keys and the lower St. Johns River north of Palatka; an Upper St. Johns River unit that occurs in the river south of Palatka; a Northwest unit that occupies the Florida Panhandle south to Hernando County; and a Southwest unit that occurs from Pasco County south to Whitewater Bay in Monroe County (USFWS 2001 and 2007). (Figure 1). Within these management units manatees tend to return to the same warm-water sites each winter and have similar non-winter distribution patterns. Exchange of individuals between these units is considered to be limited during winter months, based on data from telemetry (Rathbun *et al*. 1990; Reid *et al.* 1991; Weigle *et al*. 2001; Deutsch *et al*. 1998, 2003) and photo-identification (Rathbun *et al*. 1990; C. A. Beck, USGS FISC Sirenia Project, unpub. data, 2006; K. Higgs, FWC FWRI, unpub. data, 2006). Exchanges between units occur during warm seasons and there are some documented cases of wide-ranging coastal movements and isolated events of intercoastal migration (Reid *et al*. 1991; Deutsch *et al*. 1998, 2003; C. A. Beck, USGS FISC Sirenia Project, pers. comm., 2007).

One to three times each winter, a coordinated series of statewide aerial surveys and ground counts, known as the synoptic surveys, are coordinated by the Florida Fish and Wildlife Conservation Commission (FWC) to count the number of manatees statewide. In January 2011, at least 4,800 manatees were counted (FWC FWRI Manatee Synoptic Aerial Surveys 2011). The highest count ever recorded was 5,067 manatees in 2010.

The most current information on Florida manatee population demographics (growth, survival, and reproductive rates) can be found in publications by Runge *et al.* (2004, 2007b), Craig and Reynolds (2004), Kendall *et al.* (2004), and Langtimm *et al.* (2004), and a report by the Florida Manatee Population Status Working Group (MPSWG 2005).

All of those analyses indicate that, with the exception of the Southwest Region, manatee populations are increasing or stable throughout Florida. Craig and Reynolds (2004) additionally suggested that populations of wintering manatees in the Atlantic Coast Region have been increasing at rates of between 4 and 6% per year since 1994.

In southwest Florida, estimates of adult survival and reproduction are less precise than for manatees in the other regions of Florida because the time series of data is comparatively shorter for this region and there are no demographic data available for manatees in the southern-most part of this region. Current estimates could also be biased low due to effects from temporary emigration (Langtimm *et al.* 2004).

More recent analyses indicate that adult manatee survival rates in all four regions of Florida are more consistent, and higher than previously reported (Langtimm, pers. comm.). New analyses of manatee growth rates using those updated demographic parameters will be done in the near future using in the Manatee Core Biological Model.

Threats to the Species

Data on manatee mortality in the southeastern United States have been collected since 1974 by the Manatee Carcass Salvage Program (O'Shea *et al.* 1985, Ackerman *et al.* 1995, Lightsey *et al.* 2006). Based on these data, the major threats to the population are readily apparent. The primary human-related threats include watercraft-related strikes (direct impacts and/or propeller cuts) which can cause injury and death (Rommel *et al.* 2007, Lightsey *et al.* 2006), entrapment and/or crushing in water control structures (gates, locks, *etc.*), and entanglement in fishing lines, crab pot lines, *etc.* Natural threats include red tide and exposure to cold.

Watercraft Strikes - The greatest human-related threat to manatees in Florida is collisions with boats, based on mortality data from the Manatee Carcass Salvage Program (O'Shea *et al.* 1985, Ackerman *et al.* 1995, Wright *et al.* 1995, Deutsch *et al.* 2002, Lightsey *et al.* 2006, Rommel *et al.* 2007). Just over 400 manatees are known to have been killed in collisions with boats over the past five years (2004-2008); this total does not include any of 445 additional manatee deaths that occurred during this period and for which causes of death were identified as "undetermined" - some unknown fraction of these are most likely due to watercraft strikes. According to Fonnesbeck and Runge (2007), watercraft mortality accounts for the largest fraction of human-related manatee deaths in Florida, and in most regions is unconditionally the predominant cause of death.

The primary conservation action in place to reduce the risk of manatee injury and death from watercraft collisions is a limitation on watercraft speed. The rationale behind this is that a slower speed affords both manatees and boaters additional response time to avoid a collision. Furthermore, if an impact occurs, the degree of trauma will generally be lessened if the colliding boat is operating at slower speeds.

Federal, State, and local speed zones have been established and/or significantly revised in 25 counties (Table 1). In Brevard and Lee counties, where watercraft-related mortality is

among the highest reported, speed zone regulations have been substantially revised and regulated areas have been better posted to improve manatee protection. State-approved, county manatee protection plans that provide additional strategies for reducing watercraft collisions with manatees have been adopted in all of the thirteen counties identified in 1989 as in need of manatee protection plans. At least two additional counties (Clay and Levy counties) have proactively developed their own MPPs. Implementation of these protective measures are expected to stabilize if not reduce the mortality rate from watercraft collisions.

Entrapment and Crushing in Water Control Structures - This threat to manatees was first recognized in the 1970s (Odell and Reynolds 1979), and measures were immediately implemented to address this cause of human-related manatee mortality. While the initial measures appeared to be working over the course of several years, the number of deaths suddenly spiked, requiring a re-evaluation of measures and the development of new measures. These recent advances in protection/detection technology have nearly eliminated this threat to Florida manatees. The most recent 5-year average for manatee deaths at structures and locks is 2.6 manatee deaths per year as opposed to 7.6 manatee deaths per year during the preceding 15 years (R.R. Mezich, FWC ISMS, pers. comm. 2006).

Entanglement in Fishing Gear - The hazards of lost and improperly discarded fishing gear (especially crab traps and monofilament fishing line) have been a continuous problem for manatees, albeit a small source of mortality. Rescues associated with entanglement constituted 25% of all manatee rescues between 1991 and 2005. Much has been accomplished in recent years toward reducing the threat of entanglement. An Entanglement Working Group, comprised of agency representatives and stakeholders, routinely conducts derelict crab trap removals and assists other organizations planning similar clean ups (J.J. Dodson, FWC Marine Fisheries Management Section, pers. comm. 2006). Members also conduct a monofilament recycling program and engage in extensive education and outreach efforts, including workshops and the development and distribution of outreach materials to increase awareness of monofilament entanglements and to promote the recycling program.

Red Tide - The most common environmentally-induced source of mortality in manatees is due to a naturally-occurring toxin from the red tide dinoflagellate, *Karenia brevis*. Manatees may be exposed to this brevetoxin through inhalation and/or ingestion (Bossart *et al*. 1998). "Red tide" epizootic events are the largest single cause of manatee mortality in certain years, and are considered to be "periodic catastrophic events" when modeling predictions of future survival, particularly in the Southwest Region. The most severe red tide on event occurred in 1996, when there was a mass mortality of at least 149 animals in the Southwest Region. The critical circumstances contributing to high numbers of red tide-related deaths are concentration and distribution of the red tide, timing and scale of manatee aggregations, salinity, and timing and persistence of the bloom (Landsberg and Steidinger 1998).

New analyses (such Enzyme-Link Immunosorbant Assays [ELISA]) show that brevetoxin exposure is a continuous source of low-level mortality even in the absence of significant red tide blooms (S.L. McDonald, FWC FWRI, pers. comm. 2006). The consistent presence of red tide events on Florida's west coast has prompted additional field training for agency personnel to improve awareness and monitoring activities. A Florida Harmful Algal Bloom Task Force has conducted extensive research and monitoring on the effects of harmful algal blooms on natural resources and human health (Steidinger *et al*. 1999). When red tide exposure has not been extensive, exposed manatees can be rescued, treated for the short term in captivity, and successfully released (Service Manatee Rescue Rehabilitation and Release Program Database, unpub. data 2007).

Cold Stress - The Florida manatee has not experienced any curtailment in the extent of its range throughout the southeastern U.S. It has, however, experienced a shift in its winter distribution. Manatees are sub-tropical animals and require stable, long-term sources of warm water during cold weather. Prolonged exposure to cold water temperatures can result in debilitation and/or death due to a phenomenon known as "cold stress syndrome" (Bossart *et al*. 2004, Rommel *et al.* 2001). Historically, manatees relied on the warm, temperate waters of south Florida and on natural warm-water springs scattered throughout their range as buffers to the lethal effects of cold winter temperatures. In part, as a result of human disturbance at natural sites (Laist and Reynolds 2005a, b), manatees expanded their winter range to include industrial sites and their associated warm-water discharges as refuges from the cold. Today, nearly two-thirds of the manatee population winters at industrial warm-water sites, which are now made up almost entirely of power plants (FWC FWRI, unpub. synoptic aerial survey data, 2007).

Critical Habitat and Threats to Habitat

Critical Habitat for the Florida manatee (*Trichechus manatus*) as defined in the Code of Federal Regulations 50 Parts 1 to 199, revised as of October 1, 2000, as follows:

"Crystal River and its headwaters known as King's Bay, Citrus County; the Little Manatee River downstream from the U.S. Highway 301 bridge, Hillsborough County; the Manatee River downstream from the Lake Manatee Dam, Manatee County; the Myakka River downstream from Myakka River State Park, Sarasota and Charlotte Counties; the Peace River downstream from the Florida State Highway 760 bridge, De Soto and Charlotte Counties; Charlotte Harbor north of the Charlotte-Lee County line, Charlotte County; Caloosahatchee River downstream from the Florida State Highway 31 bridge, Lee County; all U.S. territorial waters adjoining the coast and islands of Lee County; all U.S. territorial waters adjoining the coast and islands and all connected bays, estuaries , and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County; all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood Sounds between Key Largo, Monroe County, and the mainland of Dade County; Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and

including Maule Lake, Dade County; all of Lake Worth, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Seawalls Point, Martin County to Jupiter Inlet, Palm Beach County; the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway I and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Sewalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between Indian and Banana Rivers, Brevard County; the St. Johns River including Lake George, and including Blue Springs and Silver Glen Springs from their points of origin to their confluences with the St. Johns River; that section of the Intracoastal Waterway from its confluences with the St. Marys River on the Georgia-Florida border to the Florida State Highway A1A bridge south of Coastal City, Nassau and Duval Counties."

Critical habitat was described for the Florida manatee before critical habitat regulations and guidance were developed, therefore the current critical habitat designation does not identify the constituent elements for this species' habitat. Given the significance of warm water to this species, it's apparent that the most significant habitat threat to the Florida manatee is the potential loss of warm water at power plants and natural, warm-water springs (Laist and Reynolds 2005a, b). Natural springs are threatened by potential reductions in flow and water quality and by factors which affect manatee access and use of the springs (Florida Springs Task Force 2001). Power plants, which provide winter refuges for a majority of the Florida manatee population, are not permanent reliable sources of warm water. In the past, some industrial sources of warm water have been eliminated due to plant obsolescence, environmental permitting requirements, economic pressures, and other factors (Service 2000). Experience with disruptions at some sites has shown that some manatees can adapt to minor changes at these sites; during temporary power plant shutdowns, manatees have been observed to use less preferred nearby sites. In other cases, manatees have died when thermal discharges have been eliminated due to behavioral persistence or site fidelity (Service 2000).

Although native aquatic plants have diminished or disappeared in some locations due to human activities (including reductions in water quality, outright destruction of forage from coastal and riverine construction activities, waterborne recreational and commercial activities, *etc.*) and introduced exotic vegetation has increased in other areas, the availability of forage plants is not known to be a limiting factor for manatees (Orth *et al*. 2006; G.A.J. Worthy, University of Central Florida, unpub. data 2006). Similarly, the availability of drinking water is also not thought to be a limiting factor. There are no other manatee habitat elements thought to limit Florida's manatee populations.

Cumulative Threats Analysis

Runge *et al.* (2007b) conducted a "prospective" assessment of the risk of known threats on the persistence of the Florida manatee. This effort was essentially a comparative

population viability analysis that considered the demographic effects of threats to Florida manatees, and evaluated how those demographic effects influence the probability of quasi-extinction. Quasi-extinction is defined as a particular threshold below which the species is not expected to persist (due to genetic, demographic, or behavioral reasons).

The analysis involved forecasting the manatee population under different threat scenarios and provides guidance for identifying the most beneficial and effective management actions.

The modeling framework used for the threats analysis was a customized population model for the Florida manatee, referred to as the Manatee Core Biological Model (CBM). A more detailed description of the modeling methods and the parameters used, as well as a discussion of the assumptions, process variation (environmental, demographic, and catastrophic stochasticity), and parametric and structural uncertainty associated with the analysis is provided in Runge *et al.* (2007a,b).

Data from the Manatee Carcass Salvage Program, 1986-2004 (FWC FWRI Manatee Carcass Salvage Program, unpub. data 2006) were used by these authors to estimate the *fractions of mortality* due to each of the most significant known threats: watercraft strikes, loss of warm-water habitat, red tide, entrapment and crushing in water control structures, and entanglement. These are the first estimates for fractions of mortality based on a full statistical model that accounts for the carcasses in the "undetermined" category of the Manatee Carcass Salvage Program's database (Fonnesbeck and Runge 2007).

The model essentially expresses the contribution of each threat as it affects manatee persistence, by removing them, one at a time, and comparing the results to the "status quo" scenario. The "status quo" represents the population status in the continued presence of *all* of the threats, including the threat of the potential loss of warm water in the future due to power plant closures and the loss of springs and/or reduction in spring flows. Estimates for the projections of future warm water loss were previously developed by an expert panel in 2002-2003 (Runge 2004).

The threats due to watercraft, water-control structures, and entanglement were each "removed" by reducing the regional mortality of adults and calves by the estimated fractions of mortality. The threat due to loss of warm water was removed by assuming that the winter warm-water capacity for manatees will remain at current levels for the indefinite future. The threat of red tide was removed by setting the probability of occurrence of a *major* red tide event to zero; low background levels of red tide mortality that occurs each year were already incorporated into the baseline. The various scenarios were considered as "all or nothing;" either a particular threat was present at its current level (and remained at that level indefinitely), or it was removed completely. Thus, this comparison provides a measure of the relative effect of each threat on the status of the Florida manatee population. The results are based on 5,000 model replicate sets.

Under the *status quo* scenario, the statewide manatee population is expected to increase slowly for the next 10 to 15 years, then decline as a result of the loss of warm-water capacity (Figure 2). The initiation of that threat was delayed by 15-40 years, a time frame suggested by the U. S. Fish and Wildlife Service's (Service) Warm Water Task Force. As the warm-water capacity eventually stabilizes at some lower level in about 50 years, the manatee population will then stabilize over time. Under this scenario, the model predicts that it is unlikely (< 2 % chance) the statewide population will fall below 1,000 total individuals over the next 100 years, assuming the current threats remain at their current levels indefinitely. The probability of quasi-extinction for the statewide *total* population is very small (Figure 3). Outright extinction did not occur in the model replications and, in the model runs, the total population size never fell below 300 individuals.

Removal of each of these threats changes the projected population size considerably, but in quite different ways (Figure 4). Removal of watercraft mortality allows the population to grow more quickly in the short term, but then it declines somewhat after about 20 years as a result of the effect of warm water loss. However, because of the higher intrinsic growth rate of the population, the population is more resilient and can recover more quickly from other potential threats. The population is able to maintain a greater total size in the long-term relative to the status quo, even with the same warm water limitation. In contrast, removal of the threat of warm water loss provides a buffer to the population against other threats. The population increases slowly over time and stabilizes at a much higher level (mean > 4,500) than either the status quo or the no watercraft collision scenarios. Because watercraft mortality still occurs, however, there is no change in the intrinsic growth, and the population cannot rebound as quickly. Thus, these two threats operate in different ways and over different time scales, and removal of them produces quite different consequences.

Results for each threat scenario (status quo, plus removal of each of the five threats, one at a time) were also expressed as probabilities of quasi-extinction over different time frames and for different levels of *effective population size* (or its surrogate, adult population size). This analysis was conducted for two "coastal" regions of Florida – an East Coast (Upper St. Johns River and Atlantic Coast) Region, and a Gulf Coast (Northwest and Southwest) Region. For example, the status quo scenario in Figure 5 shows about a 26% to 33% probability that the effective population size could fall below 500 adult manatees within 100 years for the East Coast and Gulf Coast, respectively.

The major threat to manatees in both regions is clearly watercraft-related mortality. Removal of this one threat alone would reduce the quasi-extinction probability by an order of magnitude – this is particularly evident on the Gulf Coast. On the East Coast, the loss of warm water is more of a threat to the population than it is on the Gulf coast. The other threats (water control structures, entanglement, and red tide) are of substantially less impact; on the East Coast, red tide is not identified as a substantial threat.

Runge *et al.* (2007b) combined the coastal analyses to provide an overall measure of status; quasi-extinction was then calculated as the probability that either coastal region would fall below some particular threshold (Figure 6). This was to evaluate the persistence of manatees on either coast of Florida because the Service envisions a recovered population would exist on both coasts. Thus, using the example above, the probability that the effective population size could fall below 500 adults on *either* coast within 100 years under the status quo scenario is close to 50% (higher than the individual coastal probabilities given above). Figure 7 and Table 2 show the combinations of scenarios for the probability of the effective manatee population falling below certain thresholds over time. The Service looked at quasi-extinction levels of 100, 250, or 500 manatees on *either* coast of Florida for this analysis.

If threats remain at the status quo, there is about an 8.6% probability of falling below a threshold of 250 adults on either coast within 100 years (Table 2). The scenarios presented in Table 2 also show that watercraft-related mortality is the single largest threat to the Florida manatee population statewide. Removal of watercraft-related mortality alone results in a 20-fold reduction from the status quo in the probability of the effective population falling below 250 adult manatees on either coast in 100 years (from 8.6 to 0.4%). Removal of the threat of loss of warm water reduces the probability of falling below 250 adults to half that of the status quo (from 8.6 to 4.2%). Runge *et al.* (2007b) also present a matrix of how various combinations of threat removal affect the persistence of the Florida manatee.

Effects Analysis

The proposed action requires protective measures to be in place to avoid and minimize impacts to manatees and their critical habitat to the extent that incidental take of manatees is not reasonably certain to occur. While some measures may be beyond the authority of Corps to require and enforce, Corps will not issue permits under this programmatic approach without the Service's the concurrence that adequate protective measures are in place either as a permit requirement or are included in the baseline conditions. As such, Corps permits issued under this programmatic approach are not likely to adversely impact manatees as a result of direct, indirect, or cumulative affects of these projects.

Alternatives

The alternative to this programmatic approach is to continue the current consultation framework. The current approach is less efficient in terms of staff time and budget, increases applicant expense, and provides no greater protection for the species.

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Table 1. Existing International, Federal, and State of Florida regulatory mechanisms.

Laws	Citation	Description
International		
Convention on International Trade in Endangered Species of Wild Fauna and Florida (CITES)	27 U.S.T. 1087 T.I.A.S. No. 8249	Secures international cooperation to regulate trade that might threaten the survival of wild plant and animal species.
Federal		
Animal Welfare Act	7 U.S.C. 2131 et seq.	Provides regulatory standards for the maintenance, care, and transportation of captive animals.
Clean Water Act (Federal Water Pollution Control Act)	33 U.S.C. 1251 et seq.	Sections of the CWA protect manatee habitat viz the NPDES program which addresses thermal discharges, point source discharges and non-point source discharges.
Coastal Zone Management Act of 1972 and amendments	16 U.S.C. 1451 et seq.	Encourages states to protect coastal marine resources. For states that develop and implement coastal management programs, the Federal government provides financial incentives.
Endangered Species Act of 1973, as amended (ESA)	16 U.S.C. 1531 et seq.	Establishes policies for identifying, listing, and protecting species of wildlife that endangered or are threatened with extinction.

Federal Manatee Protection Areas	50 CFR 17 Subpart J	Provides for the designation of manatee refuges or sanctuaries in locations where there the taking of a single manatee is likely to occur.
Brevard Barge Canal Manatee Refuge (adopted Jan 7, 2002) Cocoa Beach Manatee Refuge (withdrawn July 7, 2005) Haulover Canal Manatee Refuge (adopted Nov 8, 2002) *Sykes Creek Manatee Refuge (adopted Jan 7, 2002)*	67 FR 693, 67 FR 66473. 69 FR 40805	Protects manatees from watercraft-related takings.
Charlotte Lemon Bay Manatee Refuge (adopted Nov 8, 2002) Peace River Manatee Refuge (adopted Nov 8, 2002)	67 FR 66473	Protects manatees from watercraft-related takings.
Citrus Blue Waters Manatee Sanctuary (adopted Nov 8, 2002) Kings Bay (Crystal River) Manatee Sanctuaries: Banana Island Sanctuary (northern shore) (adopted May 12, 1994) Banana Island Sanctuary (southern shore) (amended Feb 19, 1992) Buzzard Island Sanctuary (adopted May 12, 1994) Sunset Shores Sanctuary (amended Feb 19, 1992) Three Sisters Springs Manatee Sanctuary (adopted Oct 16, 1998) Vicinity of Paradise Isle Sub-division (Sanctuary) (amended Feb 19, 1992) Warden Key Sanctuary (adopted May 12, 1994)	FR 74881, 57 FR 5990, FR 24658, 63 FR 55556, 67 FR 66473	Protects manatees from in-water harassment.
Duval (and Clay and St. Johns counties) Lower St. Johns River Manatee Refuge (amended Apr 28, 2005)	68 FR 46898, 70 FR 21966	Protects manatees from watercraft-related takings.

Federal Manatee Protection Areas (cont.)	50 CFR 17 Subpart J	Provides for the designation of manatee refuges or sanctuaries in locations where there the taking of a single manatee is likely to occur.
Hillsborough Port Sutton Manatee Sanctuary (adopted Nov 8, 2002) Port Sutton Manatee Refuge (adopted Nov 8, 2002) TECO Big Bend Manatee Sanctuary (adopted Nov 8, 2002) TECO Big Bend Manatee Refuge (adopted Nov 8, 2002)	67 FR 66473	Protects manatees from watercraft-related takings.
Lee Caloosahatchee River- San Carlos Bay Manatee Refuge (adopted Aug 6, 2003) Pine Island-Estero Bay Manatee Refuge (amended May 23, 2005) Shell Island Manatee Refuge (adopted Nov 8, 2002)	67 FR 66473, 68 FR 46898, 70 FR 29458, 70 FR 29458	Protects manatees from watercraft-related takings.
Pinellas Bartow Electric Generating Plant Manatee Sanctuary (adopted Nov 8, 2002)	67 FR 66473	Protects manatees from watercraft-related takings.
Sarasota Little Sarasota Bay Manatee Refuge (adopted Nov 8, 2002) Pansy Bayou Manatee Refuge (withdrawn July 7, 2004)	67 FR 66473, 69 FR 40805	Protects manatees from watercraft-related takings.
Volusia Halifax and Tomoka Rivers Manatee Refuge(adopted Aug 6, 2003)	68 FR 46898	Protects manatees from watercraft-related takings.
Fish and Wildlife Coordination Act of 1958	48 Stat. 401; 16 U.S.C. 661 et seq.	Authorization to provide assistance and cooperation between Federal and State agencies to protect and increase supplies of game and fur-bearing animals, as well as to assess the effects of pollutants on wildlife.
Fishermen's Protective Act of 1967, Pelly Amendment	22 U.S.C. 1971 to 1980	Authorizes the President to restrict the importation of wildlife products from a nation that directly or indirectly engages in trade or taking that diminishes the effectiveness of any international program for endangered and threatened species.

Lacey Act	16 U.S.C. 3371-3378	Addresses the unlawful importation, export, sale, acquisition and purchase of fauna and flora collected in violation of U.S. or Indian law, as well as interstate or foreign commerce involving flora and fauna taken in violation of state or foreign law.
Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. 1801	Ensures that all fisheries management plans assure optimum yields from specific fisheries while taking into account protection of marine ecosystems.
Marine Mammal Protection Act of 1972 (MMPA)	16 U.S.C. 1361 et seq.	Addresses the fate of individual marine mammal species, provides for protection of marine ecosystems, promotes research and international cooperation.
Marine Plastic Pollution Research and Control Act of 1987	33 U.S.C. 1912 - 1914	Implementing legislation for MARPOL, an international program that seeks to minimize discharges from ships.
Marine Protection, Research, and Sanctuaries Act of 1972 (aka Ocean Dumping Act)	16 U.S.C. 1431 et seq.	Provides for enhanced protection of unique areas in the marine environment.
Marine Resources and Engineering Development Act	16 U.S.C. 1431 et seq.	Addresses protection of coastal waters, including non-point sources; addresses the establishment of National Estuarine Research Reserves.
National Environmental Protection Act (NEPA)	42 U.S.C. 4321 et seq.	Requires reviews of legislation and other Federal actions that may affect the quality of the human environment.
National Park Service Organic Act	16 U.S.C. 1 et seq.	Conserves scenery, and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations.
Refuge Recreation Act	16 U.S.C. 460k	Authorizes the Secretary to administer refuges, hatcheries, and other conservation areas for recreational use when such uses do not interfere with the areas primary purpose

Rivers and Harbors Act	33 U.S.C. 304 et seq.	The Corps uses this authority to permit construction, excavation and fill activities in manatee habitat. As a Federal action, the ESA provides for a thorough review of these activities to ensure that they minimally affect listed species.
Wildlife Refuge System Administration Act	16 U.S.C. 668	Authorizes the Secretary of Interior to permit the use of any area within the National Wildlife Refuge System for any purpose, compatible with the major purposes for which such areas were established.

State of Florida[1]		
Crimes Animals: Cruelty	828.12	Identifies cruel acts and penalties for persons engaged in cruel or inhumane Actions towards to animals.
Florida Air and Water Pollution Control Act	403.011 f.s.	Insures that air and waters of the State meet certain quality standards.
Florida Aquatic Preserve Act	258.35 f.s.	Establishes aquatic preserves for the purpose of protecting biological, scientific, and aesthetic resources.
Florida Coastal Management Act of 1978	380.20 f.s.	Provides for developing, adopting, amending, and implementing a program for management of the coastal zone.
Florida Endangered and Threatened Species Act of 1977	372.072 f.s.	Provides for the conservation and management of endangered and threatened species.
Florida Environmental Land and Water Management Act of 1972 (DRIs)	380.012 f.s.	Provides for restoration of water quality and optimal use of state water resources.
Florida Environmental Protection Act of 1971	373.136 f.s.	Prevents any persons, agencies, or authorities from violating any laws, rules, or regulations that protect the air, water, and other natural resources of the state.

Florida Manatee Sanctuary Act 1978[2]	68C-22	Makes it unlawful in the State of Florida for anyone to intentionally or negligently treat a manatee, allows the State to promulgate rules to regulate boat speeds to prevent boat collisions with manatees and requires counties to develop manatee protection plans where substantial risks to manatees are likely.
Lee County Zones (amended Sep 20, 2005)	68C-22.005	Protects manatees from watercraft-related takings.
Brevard County Zones (amended June 24, 2002)	68C-22.006	Protects manatees from watercraft-related takings.
Indian River County Zones (amended Dec 12, 2002)	68C-22.007	Protects manatees from watercraft-related takings.
St. Lucie County Zones (amended Aug 16, 1994)	68C-22.008	Protects manatees from watercraft-related takings.
Palm Beach County Zones (amended July 20, 1993)	68C-22.009	Protects manatees from watercraft-related takings.
Broward County Zones (amended June 25, 1996)	68C-22.010	Protects manatees from watercraft-related takings.
Citrus and Associated County (Parts of Levy and Hernando) Zones (amended Nov 4, 2002)	68C-22.011	Protects manatees from watercraft-related takings.
Volusia and Associated County (Parts of Putnam, Lake, Seminole and Flagler) Zones (amended May 31, 1995)	68C-22.012	Protects manatees from watercraft-related takings.
Hillsborough County Zones (amended Jan 5, 2005)	68C-22.013	Protects manatees from watercraft-related takings.
Manatee County Zones (amended Jan 5, 2005)	68C-22.014	Protects manatees from watercraft-related takings.
Charlotte County (and Part of De Soto County) Zones (amended July 7, 2006)	68C-22.015	Protects manatees from watercraft-related takings.
Turkey Creek Zones Established (repealed June 24, 2002)	68C-22.018	Protects manatees from watercraft-related takings.
Manatee Cove Zone Established (repealed June 24, 2002)	68C-22.021	Protects manatees from watercraft-related takings.
Hillsborough County – Big Bend Zones Established (repealed June 24, 2002)	68C-22.022	Protects manatees from watercraft-related takings.
Collier County Zones (amended June 5, 1997)	68C-22.023	Protects manatees from watercraft-related takings.

Florida Manatee Sanctuary Act 1978[2] (cont.)	68C-22	Makes it unlawful in the State of Florida for anyone to intentionally or negligently treat a manatee, allows the State to promulgate rules to regulate boat speeds to prevent boat collisions with manatees and requires counties to develop manatee protection plans where substantial risks to manatees are likely.
Martin County Zones (adopted Dec 24, 1990)	68C-22.024	Protects manatees from watercraft-related takings.
Dade County Zones (adopted Dec 25, 1991)	68C-22.025	Protects manatees from watercraft-related takings.
Sarasota and Associated County (Parts of Manatee and Charlotte) Zones (amended Dec 12, 2002)	68C-22.026	Protects manatees from watercraft-related takings.
Duval County and Associated County (Parts of Clay and St. Johns) Zones (amended Aug 1, 2000)	68C-22.027	Protects manatees from watercraft-related takings.
Florida State Comprehensive Planning Act of 1972	186.001 f.s.	Establishes an integrated planning system ensures the coordinated administration of government policies that address a multitude of issues posed by the state's continued growth and development. (Includes the State's DRI process.)
Florida Statutes, Inhumane Treatment of Animals	828.12 f.s.	Provides for penalties for any person who kills any animal, or causes the same to be done, in a cruel or inhumane manner
Florida Water Resources Act	373.217 f.s.	Authorizes certain state agencies to regulate storm water management systems and the withdrawal, diversion, storage and consumption of water. Most significantly, this Act provides for spring protection through the establishment of minimum flows.

[1]In addition to Florida county regulatory measures (boat speed restrictions, sanctuaries, boat facility siting restrictions, etc.), numerous Florida municipalities have ordinances addressing similar manatee related concerns. These municipalities include (but are not limited to): Anna Maria, Boca Raton, Bradenton, Clearwater, Cocoa Beach, Crystal River, Fernandina Beach, Fort Pierce, Fort Walton Beach, Holmes Beach, Indian Shores, Inglis, Key Colony Beach, Key West, Lynn Haven, Marco Island, Melbourne, Naples, New Port

Richey, New Smyrna Beach, North Port, Port Orange, Port Richey, Port St. Lucie, Sanibel, Sarasota, Sebastian, Seminole, St. Augustine, Stuart, Tampa, Tarpon Springs, Treasure Island, Wakulla, and West Palm Beach.

[2]The Florida Manatee Sanctuary Act requires certain counties to adopt county manatee protection plans. The following counties have adopted plans: Brevard County (2003), Broward County (2005), Citrus County (1991), Clay County (2006), Collier County (1995), Duval County (1999), Indian River County (2000), Lee County (2004), Levy County (1995), Martin County (2002), Miami Dade County (1995), St. Lucie County (2002), and Volusia County (2005). (Palm Beach County was also required to develop an MPP; while they currently have a county approved plan, the plan has yet to be adopted by FWC). The following counties have local ordinances that include manatee protection areas: Hernando and Pinellas counties.

NOTE: The states of Georgia, South Carolina, North Carolina, Virginia, Alabama, Mississippi, Louisiana, Texas, and others have natural resource regulations that provide manatees with protective measures when the species appears in local waters.

Table 2. Probability of the adult manatee population falling below various thresholds (100, 250, or 500 animals) on either the Gulf coast or the East coast of Florida. The scenarios consider the removal of threats one at a time (except the last which removes the threats due to both watercraft and loss of warm-water). For example, in the absence of the threat due to water control structures, the probability is 4.34% that the adult population will fall below 250 animals on either the East or Gulf coasts within 100 yr, compared to a probability of 8.60% with the threat present at its current level (status quo).

Scenario	Threshold	50 yr	100 yr	150 yr
Status quo	**100**	**0.18 %**	**1.02 %**	**1.94 %**
–Watercraft	100	0.00 %	0.02 %	0.02 %
–Warm-water	100	0.16 %	0.52 %	0.88 %
–Red tide	100	0.01 %	0.66 %	1.28 %
–WCS	100	0.04 %	0.40 %	0.82 %
–Entanglement	100	0.02 %	0.46 %	0.86 %
–Watercraft & WW	100	0.00 %	0.00 %	0.00 %
Status quo	**250**	**2.46 %**	**8.60 %**	**13.10 %**
–Watercraft	250	0.12 %	0.38 %	0.60 %
–Warm-water	250	1.66 %	4.20 %	6.04 %
–Red tide	250	1.84 %	6.90 %	10.72 %
–WCS	250	1.18 %	4.34 %	7.18 %
–Entanglement	250	1.36 %	4.58 %	7.68 %
–Watercraft & WW	250	0.08 %	0.12 %	0.14 %
Status quo	**500**	**26.36 %**	**49.32 %**	**59.82 %**
–Watercraft	500	2.20 %	5.82 %	9.08 %
–Warm-water	500	18.04 %	25.06 %	29.14 %
–Red tide	500	19.52 %	40.36 %	50.66 %
–WCS	500	15.90 %	35.64 %	46.32 %
–Entanglement	500	16.32 %	36.90 %	47.08 %
–Watercraft & WW	500	0.84 %	1.18 %	1.40 %

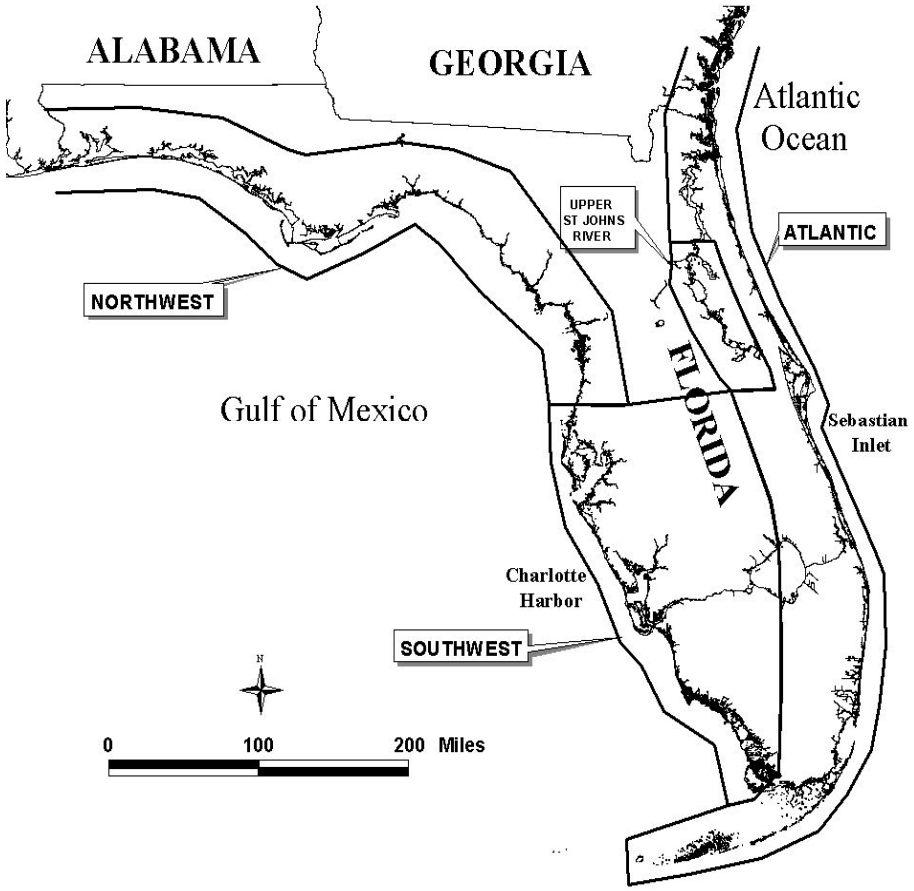

Figure 1. Florida manatee distribution within the four designated regional management units. USFWS (2001).

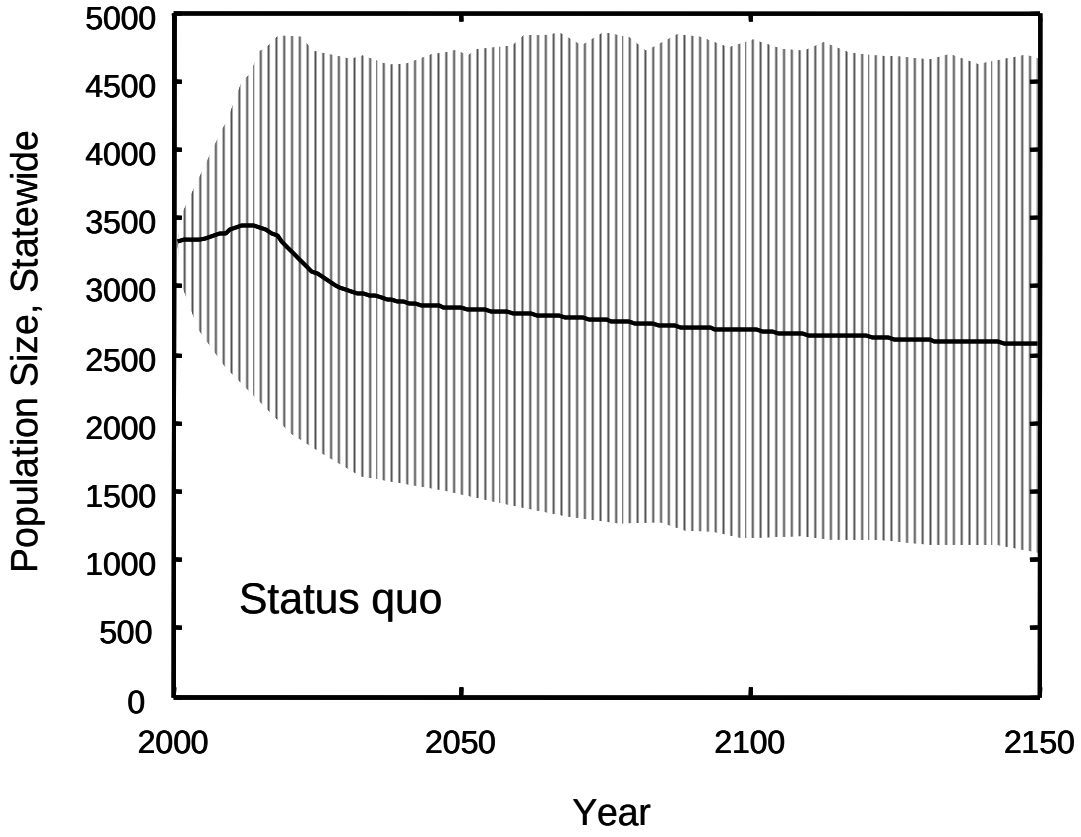

Figure 2. Projected Florida manatee population size, 2001-2150, under the status quo scenario. The bold line depicts the mean population size; the shaded area represents the 95% projection intervals (Runge *et al.* 2007).

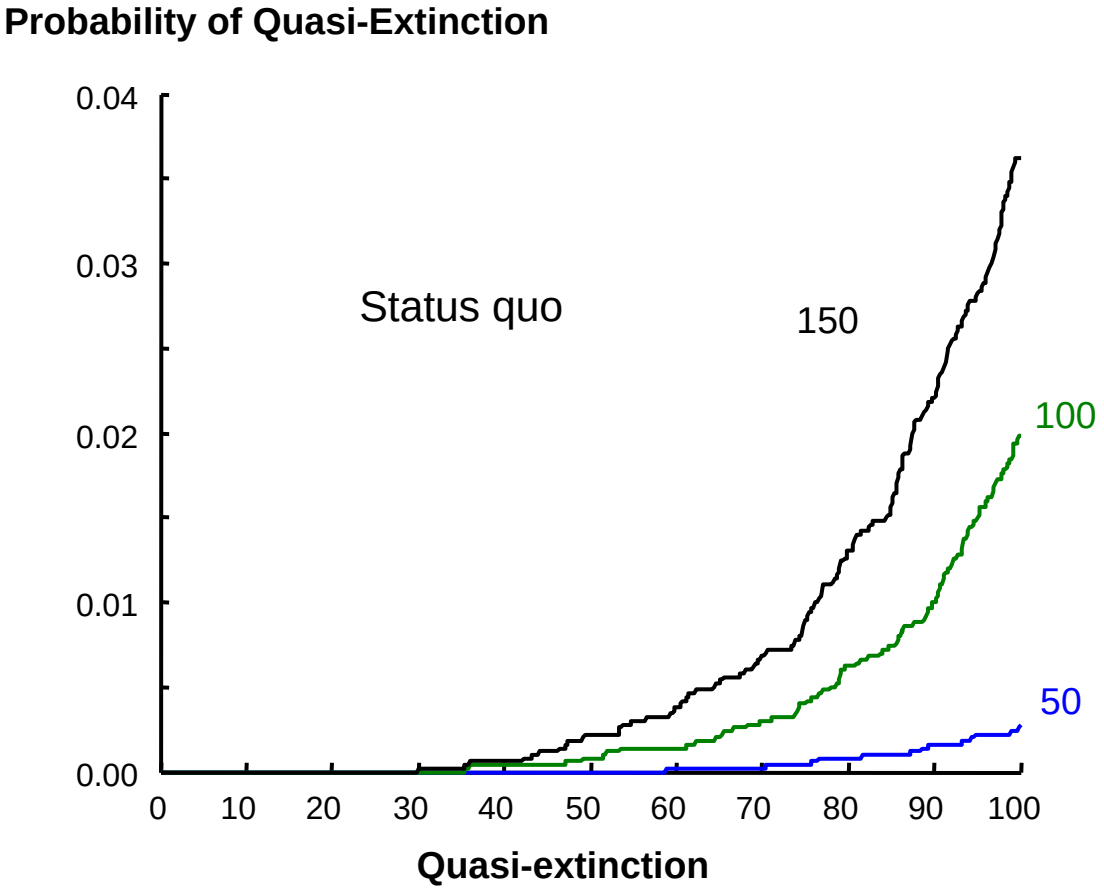

Figure 3. Probability of the total population size falling below a range of thresholds, for the statewide population under the status quo scenario. For example, the probability that the total statewide population will fall below 1000 animals within 100 yr is 2.0%. Note that the sample size in the simulation was 5000 replicates, so 0 should be read as <0.0002, and the reader should bear in mind that there is sampling uncertainty associated with very low frequencies (Runge *et al.* 2007).

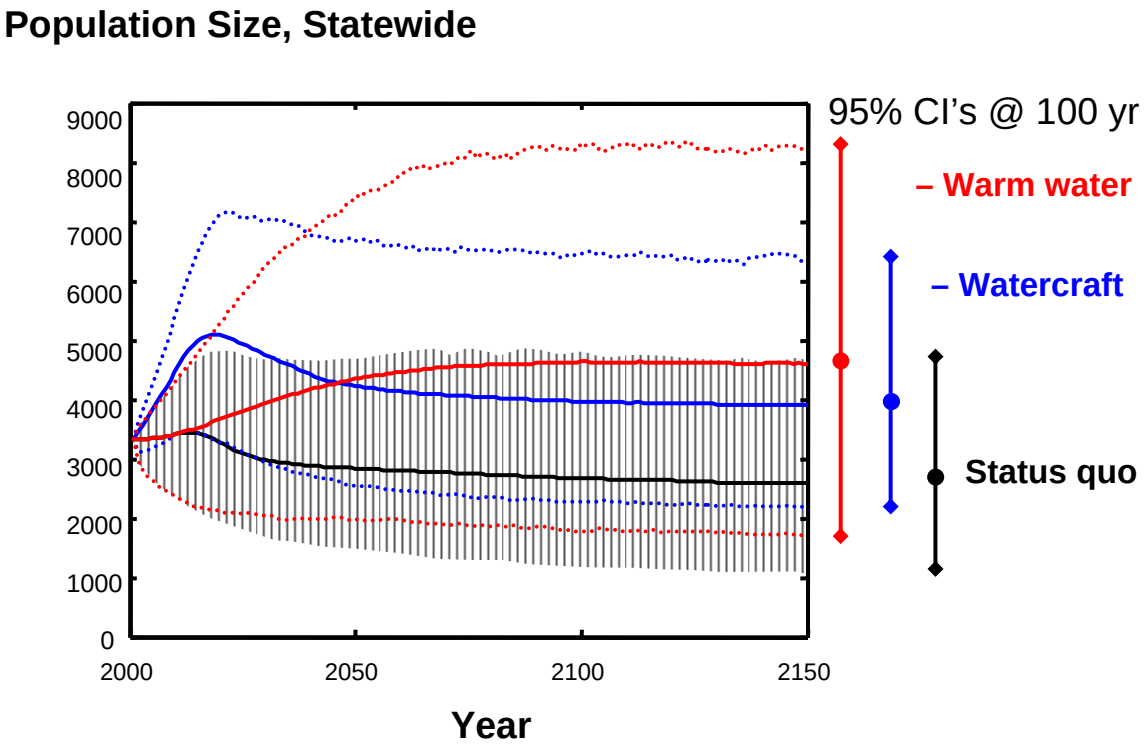

Figure 4. Projected Florida manatee population size, 2001-2150, under three scenarios: status quo (black), *without* watercraft mortality (blue), and *without* loss of warm-water (red). The bold lines depicts the mean population size; the shaded area represents the 95% projection intervals for the status quo scenario (as in Fig. 3), and the dotted lines represent the 95% projection intervals for the other two scenarios. The bars to the right of the graph show the mean and 95% projection intervals at 100 years for the three scenarios (Runge *et al.* 2007).

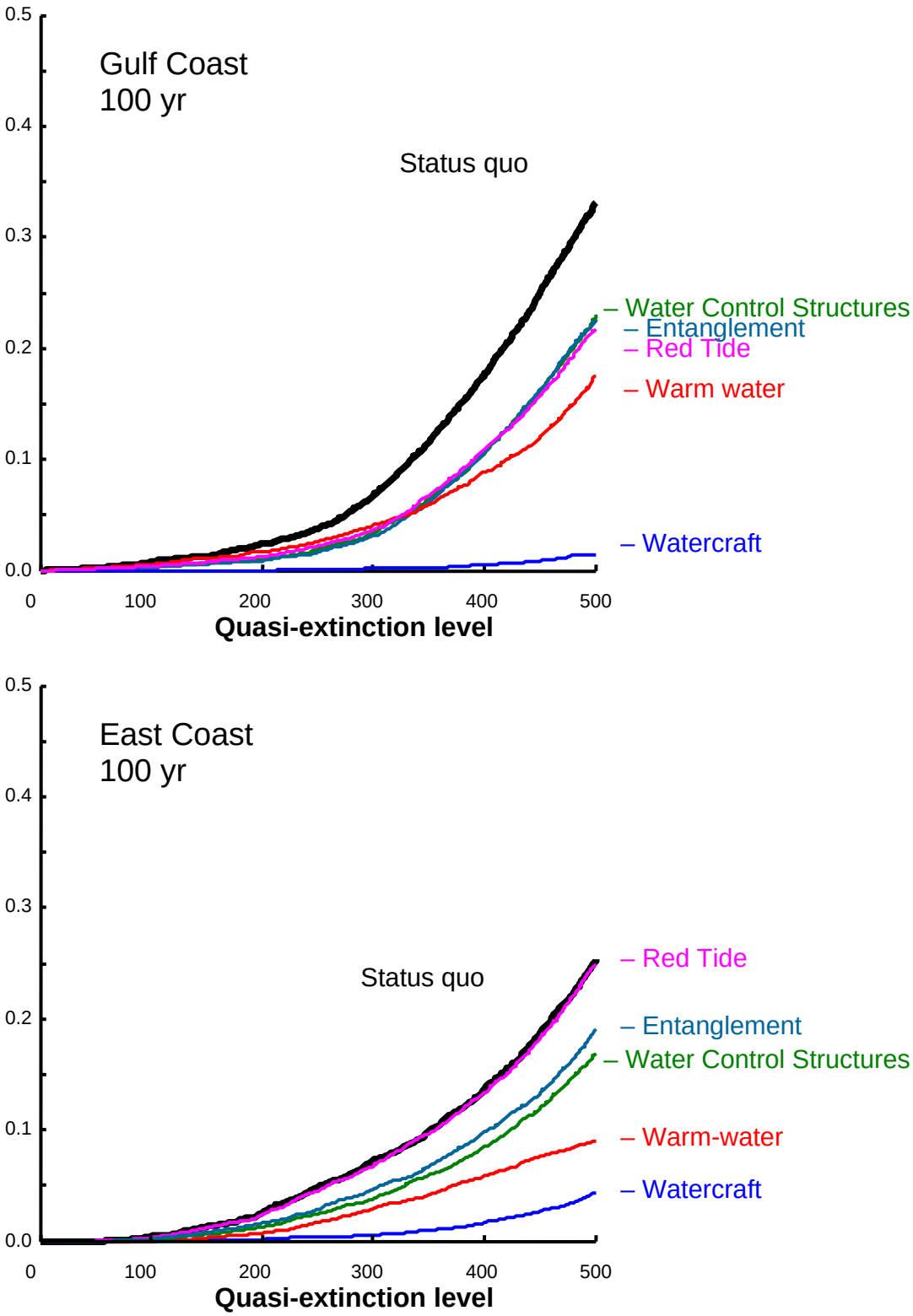

Figure 5. Probability of the adult (effective) population falling below a threshold within 100 years, as a function of the threshold, for six threat scenarios, on the Gulf coast or the East coast. The status quo scenario is shown with a solid, bold line. The other scenarios consider the one-by-one removal of major threats (Runge *et al.* 2007).

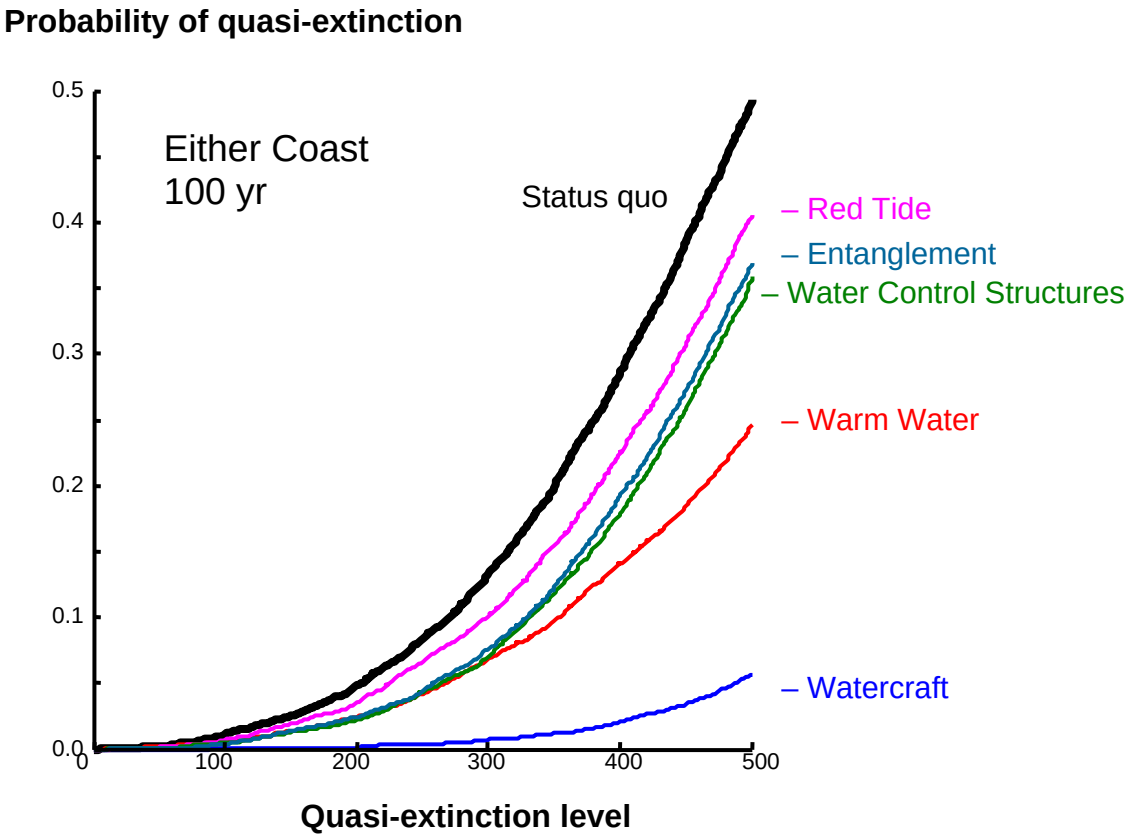

Figure 6. Probability of the adult (effective) population falling below a threshold on either the Gulf or the East coast within 100 years, as a function of the threshold, for six threat scenarios. The status quo scenario is shown with a solid, bold line. The other scenarios consider the one-by-one removal of major threats (Runge *et al.* 2007).

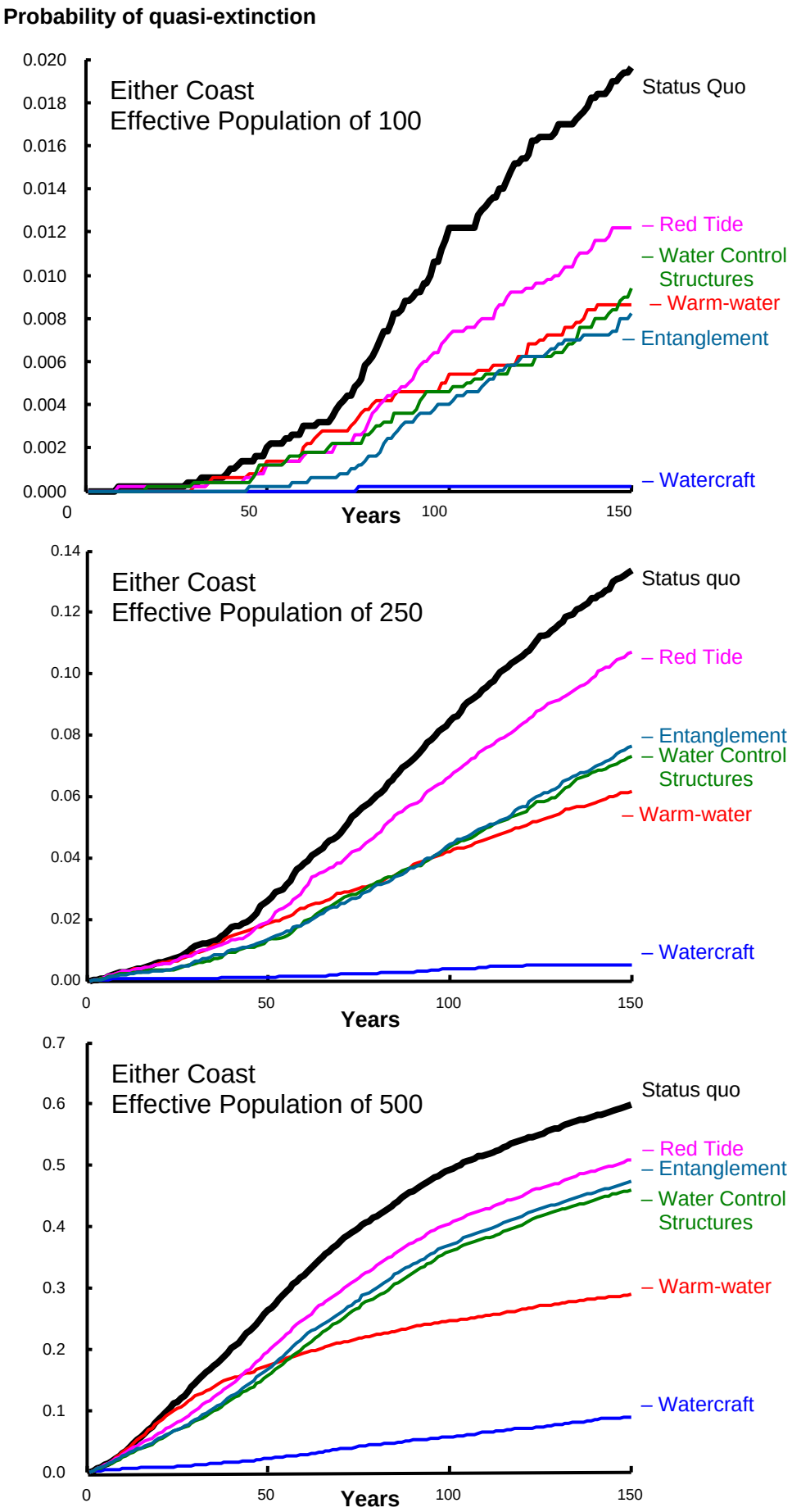

Figure 7. Probability of the adult (effective) population falling below a threshold of 100, 250 or 500 on either the Gulf or East coast, as a function of years from present, for six threat scenarios (removal of each of the threats).