FINAL BIOLOGICAL STATUS REVIEW OF THE FLORIDA MANATEE (*Trichechus manatus latirostris*)

Status Assessment by the 2005-2006 Florida Manatee Biological Review Panel:
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Table of Contents

LIST OF FIGURES, TABLES, AND APPENDICES 3
EXECUTIVE SUMMARY 4
ACKNOWLEDGEMENTS 5
INTRODUCTION 6
The State of Florida's Imperiled Species Listing Criteria 6
PUBLIC COMMENT 7
BIOLOGICAL INFORMATION 9
Taxonomic Classification 9
Geographic Range and Distribution 9
Life History Overview 11
Habitat and Ecology 12
Threats to the Manatee Population and its Habitat 12
BIOLOGICAL STATUS ASSESSMENT INFORMATION 16
Data Sources 16
Parameter Estimates for the Status Assessment 17
Population Trends 21
BIOLOGICAL STATUS ASSESSMENT 36
Statewide Population Assessment 36
Regional Assessment of Subpopulations 44
SUMMARY OF THE INDEPENDENT REVIEW: 49
LITERATURE CITED 54

LIST OF FIGURES, TABLES, AND APPENDICES

Tables

Table 1. Current and proposed listing status of the West Indian and Florida manatee by various entities 8
Table 2. Projected probabilities of extinction for each of the four subpopulations 34
Table 3. State of Florida's 2005 listing criteria overview for Florida manatee 39
Table 4. Summary of the biological status of the Florida manatee 41
Table 5. Summary of regional analysis of Florida manatee subpopulations 48

Figures

Figure 1. Subpopulations of the manatee in Florida (USFWS 2001) 10
Figure 2. Florida manatee extent of occurrence 19
Figure 3. Florida manatee area of occupancy in South Florida 20
Figure 4. Predicted mean fractional change in Atlantic manatee subpopulation size 28
Figure 5. Predicted fractional change in Upper St. Johns manatee subpopulation size 29
Figure 6. Predicted fractional change in Northwest manatee subpopulation size 30
Figure 7. Predicted fractional change in Southwest manatee subpopulation size 31
Figure 8. Predicted statewide fractional change manatee population size 32
Figure 9. Projected state-wide manatee population size 33

Appendices

Appendix A. Manatee biological review panel brief bios
Appendix B. 68A-27.0012 Procedures for listing, delisting, and reclassifying endangered, threatened, and species of special concern.
Appendix C. 68A-1.004 Definitions
Appendix D. Abbreviations
Appendix E. Glossary
Appendix F. Public comments (Save the Manatee Club and Wade Hopping)
Appendix G. Core biological model parameters
Appendix H. Estimates of population change and extinction probability
Appendix I. Reviewers' comments

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) received a petition from the Coastal Conservation Association (CCA) to re-evaluate the endangered status of the Florida manatee (*Trichechus manatus latirostris*). A report on the status of the manatee was completed; however, in December 2003 the FWC postponed all but emergency listing petition decisions in order to evaluate the existing listing process. A new listing process was adopted by the FWC in April 2005 and staff members were directed to proceed with conducting a biological status review of the Florida manatee under the new process. A biological review panel (BRP) consisting of a staff member from the FWC as chair and four additional members from federal agencies, a university, and the private sector was appointed to conduct the assessment. This assessment is an evaluation of the biological status of the Florida manatee pursuant to State of Florida criteria and definitions in Rule 68A-1.004 F.A.C. A species need meet only one of the five criteria to qualify for listing.

The criteria consider past and future population trends, area of geographic range (extent of occurrence) and critical habitat (area of occupancy), number of mature individuals, and the probability of extinction. Although manatee numbers appear to have increased in the past few decades, many anthropogenic threats to the Florida manatee population continue to increase and may affect the survival of the species. Natural catastrophes, events that occur infrequently but cause significant declines in the population (e.g., hurricanes, red tide), are expected to continue to occur in the future. Area of occupancy for the Florida manatee was estimated to be 100-300mi^2 (warm water availability in the winter) and the extent of occurrence in Florida was estimated to be approximately 7500mi^2. The number of mature individuals was calculated to be 2310 mature individuals. The probability of extinction for the statewide population is low in the next 100 years.

The BRP analyzed each criterion with data from scientific studies about the Florida manatee population. There was a 12.1% chance of a 50% decline in the next three generations, meeting the requirements for listing under Criterion A as threatened. The Florida manatee had fewer than 2500 mature individuals and also a 55.5% chance of a 20% reduction in the next two generations, meeting Criterion C for threatened. The 2005-2006 FWC Florida Manatee Biological Review Panel recommends that the Florida manatee be listed as Threatened under 68A-27.0012 F.A.C. according to the criteria A and C defined in 68A-1.004 F.A.C. Regional assessments were also conducted on each of the defined subpopulations to provide additional information to managers charged with developing a conservation management plan to protect the species. These assessments demonstrated that, when considered separately, both the Southwest and Upper St. Johns subpopulations would qualify as Endangered while the Atlantic and Northwest subpopulations would qualify as Threatened.

ACKNOWLEDGEMENTS

Many FWC staff contributed to the development of the 2002-2003 Florida Manatee Biological Status Review and much of that information was used in this report. FWC staff who provided input for this current report include Scott Calleson, Dr. Holly Edwards, Dr. Richard Flamm, Kari Higgs, Carol Knox, Sara McDonald, Gil McRae, Kent Smith, Ron Mezich, Dan Sullivan, and Leslie Ward. Carol Sanders-Reed of IAP World Services, under contract with US Geological Survey (USGS) worked tirelessly on the core biological model. We are grateful to Dr. Perran Ross of the University of Florida who provided training to and facilitation of the Biological Review Panel (BRP) meeting.

DRAFT FINAL BIOLOGICAL STATUS REVIEW
FLORIDA MANATEE
(T*richechus manatus latirostris*)

INTRODUCTION

In August 2001, the Florida Fish and Wildlife Conservation Commission (FWC) received a petition from the Coastal Conservation Association (CCA) to re-evaluate the endangered status of the West Indian manatee (*Trichechus manatus*), specifically the Florida subspecies (*T. manatus latirostris*) with the state of Florida's imperiled species listing process. The petition stated "An accurate assessment of the manatee's status is necessary to correctly place the animal in the proper classification and establish the true status of manatees in Florida" and that "extensive data compiled by the FWC and others clearly shows that manatee populations have increased to a level of abundance which no longer fits the defined parameters for listing as an endangered species under FWC rules."

In October 2001, the Commission accepted CCA's petition and directed staff to complete a biological status review of the Florida manatee with the state of Florida's imperiled species listing process. FWC Fish and Wildlife Research Institute (FWRI; formerly Florida Marine Research Institute, FMRI) staff produced the draft report in 2002, the report was sent out for peer review, and recommendations from the reviewers were incorporated into the final report (FWC 2002ab; 2003a). The final report was then sent back to the original peer reviewers and several others to ensure that staff had adequately addressed the comments in the reviews (FWC 2003b). In December 2003, the FWC postponed all but emergency listing petition decisions in order to evaluate the existing listing process. A new process was adopted by the FWC in April 2005 and staff members were directed to proceed with conducting a biological status review of the Florida manatee under the new process. The new process required that a biological review panel (BRP) appointed by the FWC conduct the biological status review assessment (Phase I of Florida's listing process). In June 2005 membership for the manatee BRP was approved (Appendix A). The first portion of this report was compiled by FWC-FWRI staff and summarizes biological information about the Florida manatee, datasets used for the assessment, and a brief description of the population forecasting "core biological model" (CBM). The second component of the report is a summary by the BRP of the assessment they conducted of the Florida manatee against the five listing criteria.

This biological status review is focused only on the Florida manatee and does not include the Antillean manatee (*T. manatus manatus*), the other subspecies of the West Indian manatee.

The State of Florida's Imperiled Species Listing Criteria

The State listing process by which species are evaluated and designated as to the risk of extinction into the categories of Endangered, Threatened, or Species of Special Concern in Florida was revised in April 2005 (Rule 68A-27, Florida Administrative Code (F.A.C.)). The objective of Phase I of the State wildlife listing process is to conduct a biological status review to identify the risk of extinction a species is facing. This should not be confused with the process

of setting conservation priorities. Under the current FWC listing process (Rule 68A-27.0012, Florida Administrative Code (F.A.C.)), conservation needs are outlined during Phase II of the process, the drafting of the management plan. The intent of having a 2-phase process is to separate the process of identifying the extinction risk from the process of establishing conservation priorities; to allow the extinction risk analysis to be science based, without the influence of socio-economic issues.

FWC adopted three of the definitions for imperiled species that had been developed previously by The World Conservation Union (IUCN) for the IUCN Red List (IUCN 2001). The three IUCN categories were paired with existing FWC categories as follows: IUCN's *critically endangered* corresponded to FWC's *endangered*, IUCN's e*ndangered* corresponded to FWC's *threatened*, and IUCN's *vulnerable* corresponded to FWC's *species of special concern*. A further difference in the two ranking systems is that FWC did not adopt IUCN's other categories; *extinct*, *extinct in the wild*, *lower risk*, *data deficient*, and *not evaluated*. Musick (1999) compared various classification systems for imperiled species and noted that the IUCN's *endangered* category is roughly equivalent to the *endangered* categories under the U.S. Endangered Species Act, the Committee on the Status of Endangered Wildlife in Canada, and the American Fisheries Society criteria. Table 1 provides a comparison of manatee listing status for the USFWS, IUCN, and Florida's current and recommended status.

Manatees have had a long history of protection in the state of Florida, beginning in 1893 when the killing of manatees was outlawed. Sanctuaries and additional State protections were added in 1978 with the passage of the Florida Manatee Sanctuary Act, and additional manatee protections (i.e., safe havens and boat speed limits) have been added by administrative rule between 1979 and 2005. The manatee is currently listed as endangered in the State of Florida under Rule 68A-27.003, F.A.C. The CCA petition requested that FWC determine the proper classification of the manatee under the rule, which they proposed should be either threatened, species of special concern, or removed from the list altogether. According to the procedural requirements of Rule 68A-27.0012 F.A.C. (Appendix B), the Florida manatee must meet at least one of the five criteria in 68A-1.004 F.A.C. (Appendix C) to warrant listing as endangered, threatened, or species of special concern. When Rule 68A-27 F.A.C. was originally adopted in 1999, the manatee remained on the State endangered list without re-evaluation of its status under the new criteria. The assessment is an evaluation of the biological status of the Florida manatee pursuant to State of Florida criteria and definitions in Rule 68A-1.004 F.A.C. The report begins with a description of general manatee biology and threats to the survival of the species followed by a description of available data sources and analyses that were used in the assessment. The report concludes with a summary of the BRPs assessment and peer reviewers' comments. A list of abbreviations and a glossary of terms used in this report are provided in Appendices D and E, respectively.

PUBLIC COMMENT

The FWC requested written comments from the public on the biological status of the Florida manatee during a 45-day period from July 15, 2005 until 5:00 pm August 31, 2005. The request was noticed in the Florida Administrative Weekly and posted on the FWC website. A total of two comments were received (Appendix F); no new salient information about the biological status of the manatee was provided.

Table 1. Current and proposed listing status of the West Indian and Florida manatee by various entities.

Listing Entity	**State of Florida (FWC) *Current***	**State of Florida (FWC) *Recommended* under new listing criteria adopted by FWC in April 2005.**	**US Federal status (USFWS) (listed under the Endangered Species Act)**	**IUCN status *Current***	**IUCN Status *Proposed****
Species	Florida Manatee *(Trichechus manatus latirostris)*	Florida Manatee *(Trichechus manatus latirostris)*	West Indian Manatee *(Trichechus manatus)*	West Indian Manatee *(Trichechus manatus)*	Florida Manatee *(Trichechus manatus latirostris)*
Status	Endangered	Threatened	Endangered	Vulnerable	Endangered
Last assessment	--	2002-2003	--	1996	2005*
Date listed	1960s		1967	1982	
Website/Comments			http://ecos.fws.gov/species_profile/servlet/gov.doi.species_profile.servlets.SpeciesProfile?spcode=A007	http://www.redlist.org/search/details.php?species=22103	*The IUCN Sirenian Specialist Group met in August 2005, conducted a draft assessment of *Trichechus manatus latirostris*, and proposed the species meets endangered under IUCN criteria. This assessment is not final. (J. Reynolds, personal communication)

BIOLOGICAL INFORMATION

This section provides a brief synopsis of information on selected aspects of the biology and life history of Florida manatees and on threats facing the population over the coming century. For more detailed reviews and information on the biology and conservation of this subspecies, we point the reader to the Florida Manatee Recovery Plan (USFWS 2001), to the primary literature cited below, and to general texts on manatees (Reynolds and Odell 1991; Reynolds 1999; Glaser and Reynolds 2003; Reep and Bonde 2006).

Taxonomic Classification

The Florida manatee (*T. manatus latirostris*) is a member of the Class Mammalia, Order Sirenia, and Family Trichechidae. It is one of two subspecies of the West Indian manatee (*T. manatus,* Linnaeus 1758), the other being the Antillean manatee (*T. manatus manatus*). These subspecies are morphologically and genetically distinct from one another (Domning and Hayek 1986; Garcia-Rodriguez *et al.,* 1998).

Geographic Range and Distribution

Florida manatees are found only in the United States, although a few vagrants have been known to reach the Bahamas (Lefebvre *et al.,* 2001). Their year-round distribution is generally restricted to peninsular Florida because they need warm water to survive the winter. During the non-winter months (March to November), some manatees disperse to adjoining states. Along the Atlantic coast these states include Georgia, South Carolina, North Carolina, and Virginia (Rathbun *et al*., 1982); one satellite-tagged manatee was documented to travel as far north as Rhode Island (Deutsch *et al.,* 2003), and another manatee was observed in New York (Long Island) (USGS, unpublished data). Along the Gulf coast west of Florida, manatees are occasionally sighted in Alabama, Mississippi, Louisiana, and Texas (Powell and Rathbun 1984; Fertl *et al.,* 2005). The source (Florida or Mexico) of the Texas manatees is unclear.

During the warm season when water temperatures exceed 20°C (March/April through October/November), manatees disperse throughout the coastal waters, estuaries, and major rivers of Florida and some migrate to neighboring states, particularly southeastern Georgia (Lefebvre *et al.,* 2001). Their range constricts dramatically in the winter season (December to February) when manatees seek shelter from the cold at a limited number of warm-water sites or areas in the southern two-thirds of Florida (Reynolds and Wilcox 1994; USFWS 2001; Laist and Reynolds 2005a,b). These aggregation sites include 10 principal power plant thermal outfalls (7 on the Atlantic coast, 3 on the Gulf coast) and four major artesian springs (Blue Spring, Crystal River, Homosassa Spring, and Warm Mineral Spring) that are frequented by a large proportion of the manatee population during winter. Other industrial outfalls, smaller springs, and passive thermal basins that retain heat longer than ambient waters provide additional secondary warm-water habitat for manatees.

Long-term studies of the Florida manatee suggest that there are four relatively distinct regional subpopulations (see Fig. 1), as recognized in the Florida Manatee Recovery Plan

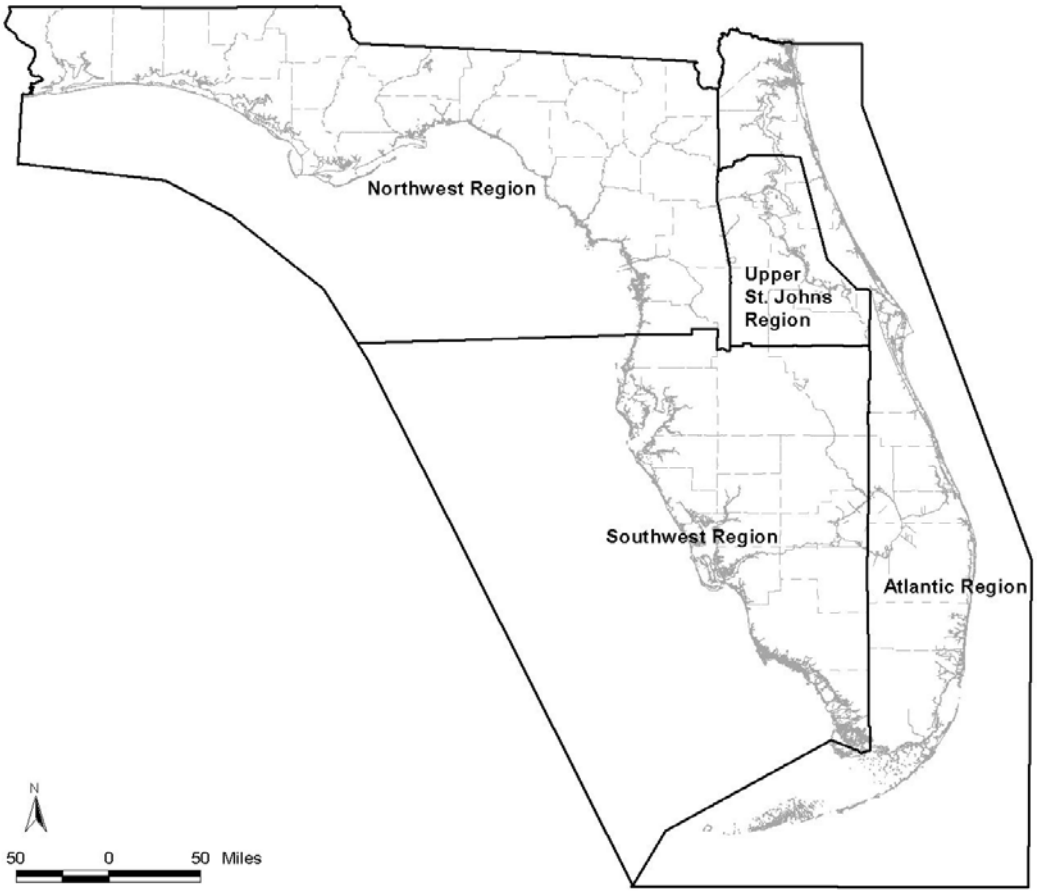

Figure 1. Subpopulations of the manatee in Florida (USFWS 2001).

(USFWS 2001). These subpopulations are defined geographically as the Northwest, Southwest, Atlantic, and Upper St. Johns River. The Northwest subpopulation extends from the Pasco-Hernando County line along the central Gulf coast northward through the Florida Panhandle and including the coastal areas of adjoining states at least as far as Louisiana. The Southwest subpopulation extends from the Pasco-Hernando County line southward to Whitewater Bay (part of Everglades National Park) in Monroe County. The Atlantic Coast subpopulation extends along the entire east coast of Florida (including the Florida Keys and Florida Bay), coastal states northward along the Atlantic seaboard, and the lower St. Johns River north of Palatka. The Upper St. Johns River subpopulation occurs in a relatively much smaller area in the river south of Palatka. Demographic characteristics used as parameter estimates in the CBM are described in Appendix G. Each subpopulation is composed of individuals that tend to return to the same network of warm-water refuges each winter and have similar non-winter distribution patterns. Exchange of individuals among subpopulations is considered to be limited, based on data from telemetry (Bengtson 1981; Rathbun *et al.,* 1990; Weigle *et al.,* 2001; Deutsch *et al.,* 2003) and photo-identification (Rathbun *et al.,* 1990; Reid *et al.,* 1991; FWC, Mote Marine Laboratory, and USGS, unpublished data).

Life History Overview

Like many other large mammals, manatees have a potentially long life-span, older age at maturity, a low reproductive rate, and a high parental investment. For species with this life-history strategy to persist, adult survival rates need to be high and stable. Consequently, manatee populations are vulnerable to human activities that elevate mortality rates. Florida manatees have a low level of genetic diversity, possibly resulting from a founder effect or a population bottleneck (Garcia-Rodriguez *et al.,* 1998).

Analysis of growth-layer-groups in the earbone indicates that manatees can live up to about 60 years of age in the wild (Marmontel *et al.,* 1996). The median age of first reproduction for females is about five years; some individuals give birth to their first calf at age four and most do so by age seven (Marmontel 1995; O'Shea and Hartley 1995; Rathbun *et al.,* 1995). Although males undergo spermatogenesis as young as 2-3 years of age (Hernandez *et al.,* 1995), the age at which they sire and produce their first offspring is unknown. There is no conclusive evidence on reproductive senescence in manatees, but free-ranging females are known to continue reproducing at least into their thirties (Marmontel 1995; USGS-Sirenia, unpublished data). Gestation lasts between 11 and 13 months (Rathbun *et al.,* 1995; Reid *et al.,* 1995). The typical litter size is one, with twins reported rarely (Marmontel 1995; Odell *et al.,* 1995; O'Shea and Hartley 1995; Rathbun *et al.,* 1995). Calves are dependent on their mothers for one to two years after birth (O'Shea and Hartley 1995; Rathbun *et al.,* 1995; Reid *et al.,* 1995). Inter-birth intervals average about 2.5 - 3 years when the calf survives to weaning (Marmontel 1995; Rathbun *et al.,* 1995; Reid *et al.,* 1995). Females that abort or lose a calf due to perinatal death may become pregnant again within a few months (Hartman 1979; Odell *et al.,* 1995). Long-term photo-identification studies show that adult manatees have an annual survival rate of about 96% in growing subpopulations with relatively low human-related mortality (Langtimm *et al.,* 2004).

Habitat and Ecology

Florida manatees are habitat generalists that live in a wide variety of environments, from canal systems in densely populated urban settings to nearly pristine areas dominated by mangroves or salt marsh habitats. They can tolerate a range of salinities, including freshwater rivers, estuarine bays, and marine coastlines. Manatees in estuarine or marine environments, however, regularly seek freshwater sources to drink, such as creeks or industrial outfalls (Lefebvre *et al.,* 2001). Manatees are generalist herbivores that feed on a large variety of marine and freshwater vegetation (Smith 1993). Seagrass is a staple of their diet in estuarine and marine areas. In addition to benthic foraging, manatees also feed on floating, emergent, and bank vegetation. Manatees frequently feed over shallow grass beds in close proximity to deeper water, to which they flee when startled by approaching watercraft or other disturbances.

The manatee's unusual physiology, including an extremely low metabolic rate and a high thermal conductance, limits its ability to thermoregulate in cold waters and makes it susceptible to cold-related stress and mortality (Irvine 1983). Death from exposure to cold can occur acutely (from hypothermia), or from chronic exposure (O'Shea *et al.,* 1985; Bossart *et al.,* 2002b). Since 1974, major spikes in cold-related manatee deaths have occurred on average every five years, with juveniles and subadults experiencing the greatest mortality (O'Shea *et al.,* 1985; Ackerman *et al.,* 1995; FWC, unpublished data). Manatees seek warm-water sites when temperatures drop below 20°C and they are unable to tolerate prolonged exposure to temperatures below about 16°C. Some winter aggregations can number in the hundreds (Reynolds and Wilcox 1994). The creation of warm-water outfalls from electric power generating plants and other industrial facilities over the past 50 years has probably contributed to manatee population growth by providing access to more habitat during winter and by reducing the extent of cold-related mortality.

Telemetry studies have demonstrated that Florida manatees are highly mobile, migrating seasonally over extensive geographic areas (Weigle *et al.,* 2001; Deutsch *et al.,* 2003). The most important environmental factor driving long-distance movements is seasonal fluctuation in water temperature, but breeding behavior and temporal-spatial variation in forage can also be important. Manatees are individualistic and exhibit a diversity of seasonal movement patterns, ranging from those that are resident year-round in a local area to long-distance migrants that travel over several hundred kilometers of coastline annually (Weigle *et al.,* 2001; Deutsch *et al.,* 2003). Their movement patterns are structured by strong philopatry to the same seasonal ranges year after year; this includes winter aggregation sites as well as warm season home ranges (Reid *et al.,* 1991; Koelsch 1997; Deutsch *et al.,* 2003). Individual manatees typically occupy a few, relatively small core areas that are linked by lengthy travel corridors (Deutsch *et al.,* 2003).

Threats to the Manatee Population and its Habitat

To accurately assess the biological status of a taxon, current and future threats to the population have to be considered. The following section briefly describes the major threats facing the Florida manatee over the next several decades. Threats encompass anthropogenic factors and catastrophic natural events that could cause declines in reproductive and survival rates or loss and degradation of habitat. The largest known cause of human-related mortality of manatees in Florida is watercraft collisions. Watercraft strikes result in numerous injuries and deaths each year. The future of the Florida manatee is jeopardized by the predicted loss and

deterioration of warm-water habitat, including retirement or deregulation of aging power plants and reduction in natural spring flows.

About half of adult mortality rangewide is attributable to human-related causes, primarily watercraft collisions (Deutsch *et al.,* 2002). This is significant because the manatee population growth rate is highly sensitive to changes in adult survival rate (Eberhardt and O'Shea 1995; Marmontel *et al.,* 1997; Runge *et al.,* 2004). Consequently, human activities play an important role in depressing manatee population growth in the Atlantic and Southwest regions. For all four subpopulations, the immature age class most common "cause of death" category is perinatal mortality and watercraft collisions is the next highest known cause of death.

Anthropogenic Threats

Watercraft Collisions

Watercraft collisions account for approximately 25% of all documented manatee deaths and 35% of documented deaths of known cause; this is the single greatest known cause of mortality (Ackerman *et al.,* 1995; Wright *et al.,* 1995; Deutsch *et al.,* 2002; FWC-FWRI unpublished data). In 2004 there were over 982,900 registered vessels in Florida (FWC, http://myfwc.com/whatsnew/05/statewide/boatingstats.html) and many thousands more out-of-state boaters visit Florida annually. The number of registered vessels in Florida has increased by an average of 2.9% per year over the past 25 years, doubling since 1980 (FWC, unpublished data). Given that about 97% of registrations are for recreational watercraft (Wright *et al.,* 1995), it can be expected that there will be a continued increase in recreational vessels plying the waterways of Florida concomitant with an increase in the human population. In addition to the expected increase in boat numbers over the coming century, there are other factors that may act synergistically to increase the risk of fatal collisions between manatees and watercraft. Relatively new modifications to the design of vessel hulls and engines are allowing boats to travel at higher speeds in shallower waters, thus threatening manatees and scarring seagrass beds (Wright *et al.,* 1995). In areas that have been intensively studied, boater compliance with existing slow speed zones is inconsistent (Shapiro 2001; Gorzelany 2004).

Sub-lethal effects of increased vessel traffic on manatees are also cause for concern. A large percentage of adult manatee carcasses bear scars from previous boat strikes and the healed, skeletal fractures of some indicate that they had survived previous traumatic impacts (Wright *et al.,* 1995; Lightsey *et al*. in press). Based on manatees documented in the photo-identification database through 2000 (Beck and Reid 1995), more than 1,000 individuals are known to have been scarred from boat collisions, and 97% of that sample had scar patterns from multiple boat strikes (O'Shea *et al.,* 2001). Many of these individuals were severely mutilated, especially on the tail and the dorsum. At least two carcasses examined at necropsy each had evidence of more than 50 past collisions with watercraft. Non-lethal injuries may reduce the breeding success of wounded females and may permanently remove some animals from the breeding population (O'Shea 1995; Reynolds 1999). Vessel traffic and recreational activities that disturb manatees may cause them to leave preferred habitats and may alter biologically important behaviors such as feeding, suckling, or resting (O'Shea 1995; Wright *et al.,* 1995).

Other Direct Threats to Manatees from Human Activities

Other human-related causes of manatee death and injury are entrapment in water-control structures and pipes, crushing (in flood-control structures, in canal locks, or between large ships and docks), entanglement in fishing gear or debris, and incidental ingestion of debris (Beck and Barros 1991; Ackerman *et al.,* 1995). Together these other human-related causes accounted for approximately 6% of all documented manatee deaths over the past two decades. Considerable effort and funding have been invested in modifications of water-control structures and navigation locks to prevent manatee entrapment and drowning or crushing (USFWS 2001). These efforts have been mostly successful in reducing this source of mortality and should be continued. Although entanglement does not result in many deaths each year (Ackerman *et al.,* 1995), entanglement can result in disfiguring injuries that may hamper an animal's ability to survive and reproduce in the wild (Beck and Barros 1991). Over the past decade, there have generally been between 10-15 rescues per year to disentangle manatees, most due to crab trap lines (FWC, unpublished data). Entanglement in monofilament fishing line occurs and efforts are underway statewide to promote recycling of monofilament line. Entanglement will likely continue to be a hazard for manatees for the foreseeable future. Manatees ingest a variety of debris incidental to feeding, especially monofilament line but also plastic bags, fish hooks, string, and other items (Beck and Barros 1991; FWC unpublished data). Sometimes this foreign object ingestion causes illness or death due to blockage or perforation of the digestive tract.

Loss of Warm-water Habitat

Expected changes in the network of warm-water refuges over the next several decades present the most serious long-term threat to manatees in Florida, as noted in the federal Recovery Plan: "one of the greatest threats to the continued existence of the Florida manatee is the stability and longevity of warm-water refuges" (USFWS 2001, p. 28). Ultimately, the discharges from power plants provide unreliable warm-water habitat when viewed over the long term (i.e., next 20-100 years) because the once-through cooling technology that creates the large thermal plumes is being replaced by more efficient and alternative cooling technologies (Laist and Reynolds 2005a). Short-term threats to the network of warm-water sites also loom on the immediate horizon. Some aging power plants may be shut down and potential deregulation of the electric utility industry may eliminate or reduce the reliability of warm-water effluents that large numbers of manatees depend on to survive winter cold periods (USFWS 2000). Temporary disruptions in heated effluents during winter have caused changes in local manatee distribution (Packard *et al*., 1989) and have been implicated in elevated numbers of deaths from cold stress (Campbell and Irvine 1981; Ackerman *et al*., 1995). The complete elimination of a secondary warm-water refuge in northeastern Florida through diffusion of the heated effluent resulted in a shift in manatee distribution within the area and in substantial mortality of manatees that remained in the region (Deutsch *et al*., 2000; Laist and Reynolds 2005a). Loss of certain key warm-water sites could result in catastrophic mortality and would likely reduce the environmental carrying capacity for manatees in Florida.

The long-term reliability of artesian springs that provide natural warm-water refuges for manatees is also in doubt because human demand for ground water and loss of recharge areas through development will likely result in diminished spring flows (Reynolds 2000; Laist and Reynolds 2005a). According to the U.S. Census Bureau (2001), Florida's human population increased by 23% to 16 million between 1990-2000, and projections suggest the human population of Florida will increase by 5.5 million people over the next 25 years. Growth in the

human population has been accompanied by reduced spring flow and declining water quality. For example, Blue Spring---a first-order magnitude spring that provides essential winter habitat for the upper St. Johns River subpopulation---has experienced declines in spring flow (Sucsy *et al*., 1998). To meet the increased demand for water caused by continued growth in the human population, it is likely that spring flows and water quality will continue to decline. Continued declines at this and other springs will shrink available natural warm-water habitat for manatees; this natural habitat will become even more important in the future as existing industrial sites disappear.

Effects of Pollution on Manatee Forage Plants

The tremendous growth in the human population in coastal Florida over the past half century has resulted in drastic losses of coastal wetland habitats. Seagrass distribution and abundance in many estuaries have declined as the result of direct human impacts (dredging and propeller scarring) and indirect effects of development (declining water quality and nutrient loading). Within Tampa Bay, for example, an estimated 80% of the seagrass present in the early 1900's was lost by 1980 (Kurz *et al.,* 2000). This decline in seagrass coverage is slowly being reversed through actions to reduce nitrogen loading in the regional watershed, which have improved water clarity in much of Tampa Bay (Johansson and Greening 2000; Kurz *et al.,* 2000). Non-point-source runoff is difficult to control, however, so water clarity declines in years of above-average precipitation. Reductions in optical water clarity cause declines in the health and abundance of submerged aquatic vegetation (Stevenson *et al.,* 1993). Indirect effects from increased vessel traffic include increased water turbidity from wake action and scarring of seagrass beds by propellers (Sargent *et al.,* 1995). It will be particularly important to protect, restore, and maintain aquatic vegetation communities in the vicinity of warm-water aggregation sites. Without conservation measures to secure these winter habitats, manatees would have to travel greater distances, concentrate into smaller areas, and forage in sub-optimal environments.

Natural Threats

Naturally-occurring catastrophic threats to manatees include prolonged periods of very cold temperatures, hurricanes, harmful algal blooms (i.e., "red tide"), and the potential for a disease epizootic. The threat from extended periods of cold weather relates to the availability and quality of warm-water habitat, which has already been discussed above.

Hurricanes are another type of weather-related phenomenon that can potentially impact manatee populations. In the Northwest subpopulation, Langtimm and Beck (2003) found that adult survival rate was depressed in years with severe storms or hurricanes. The mechanism(s) underlying the lower survival probabilities are unknown, as there has not been a corresponding elevation in the number of reported carcasses. Such events could also result in large-scale emigration out of the affected region. In eastern Australia, for example, the simultaneous occurrence of flooding and a cyclone, combined with poor watershed management practices, resulted in the loss of 1,000 km^2 of seagrass beds and in the mass movement and mortality of dugongs (*Dugong dugon;* Preen and Marsh 1995), a sirenian relative of the manatee. Dugongs emigrate in response to habitat loss associated with extreme weather events. However there is no evidence that such emigration is permanent (Marsh *et al.,* 2004). Given the notice from

meteorologists that we have entered a new 25- to 50-year cycle of greater hurricane activity and intensity (Landsea *et al.*, 1996), as well as possible longer-term changes associated with global climate change (McCarthy *et al.*, 2001), storm activity may have a greater impact on manatee populations in the future.

Manatees on Florida's Gulf coast are frequently exposed to brevetoxin, a potent neurotoxin produced by the dinoflagellate *Karenia brevis*, during red tide events. In 1996, 151 manatees were documented to have died in southwest Florida from brevetoxicosis (Landsberg and Steidinger 1998; Bossart *et al.*, 1998). This epizootic was particularly detrimental to the manatee population because more adults were killed than any other age class. Other red tide epizootics in 1982, 2002, 2003, and 2005 resulted in the deaths of 37, 34, 96, and (preliminarily) 81 manatees, respectively (O'Shea *et al.*, 1991; FWC, unpublished data). Recent studies have determined that brevetoxin can exist outside of the algal cells on seagrass for extended periods of time, thus further increasing the threat to foraging manatees (Flewelling *et al.*, 2005). Red tide represents a major natural source of mortality for the Southwest subpopulation that is beyond the control of managers. There is no clear evidence that these events have been increasing in frequency along Florida's coast, but certainly the impact on the manatee population has increased over the past two decades. Viewed globally, harmful algal blooms have been increasing over the past 25 years in frequency and in their impacts on the economy, public health, and marine life (Landsberg *et al.*, 2005).

In addition to red tide, manatees could potentially be exposed to pathogens. Spread of such pathogens could be particularly rapid during winter when manatees are concentrated in warm-water refuges. Large-scale mortality events caused by disease or toxins have decimated other populations of marine mammals, including seals and dolphins, removing 50% or more of the individuals in some events (Harwood and Hall 1990). Manatees have robust immune systems that have, through the present time, provided disease resistance. Since 1997 papillomavirus has been found in captive Florida manatees and there is some evidence that it may also be present in the wild population in northwest Florida (Bossart *et al.*, 2002a; Woodruff *et al.*, 2005). While the consensus is that this virus probably does not present a serious threat to manatees at this time, managers are proceeding cautiously (e.g., by establishing a quarantine on exposed captives) and surveillance for papilloma lesions in wild manatees continues.

BIOLOGICAL STATUS ASSESSMENT INFORMATION

Data Sources

Aerial Surveys

FWC uses state-wide synoptic surveys to obtain a count of manatees at known winter aggregation sites (Ackerman 1995). The counts, conducted 22 times since 1991, are flown following cold fronts, when animals aggregate at warm springs and thermal discharges from power plants. There are unresolved biases that confound survey data, associated with the detectability (related to observer skill and conditions) and availability (related to the location of manatees in the water column) of manatees, and with a poorly-defined sampling frame. As a result, synoptic surveys yield only minimum counts of the number of manatees using these

aggregation sites. Therefore, this dataset cannot validly be used to estimate the size of, or trends in, the population state.

Carcass Necropsy

FWC has a wide-reaching manatee carcass salvage and necropsy program that recovers nearly every dead manatee reported in the State of Florida. Consequently, there is a long time series of data on causes of death since the 1970s (O'Shea *et al.,* 1985; Ackerman *et al.,* 1995). Information is collected regarding the cause of death, location, age, sex, size, and condition of each carcass. A range of other morphological variables is collected from carcasses, depending on the state of decomposition. Inferences from this dataset must be tempered by the fact that data are sampled opportunistically, and compose a non-random sample from both the population of carcasses and the population of manatees as a whole. Not all manatee carcasses are detected, either by researchers or the public, and the recovery rate is unknown. Moreover, the relative rates of recovery, both among cause of death classes and among regions, may not be equal, or even constant. Additionally, carcasses may drift from the site of death to the site of recovery, making it difficult to attribute carcasses accurately to particular waterways.

Photo-identification Program

Manatee photo-identification uses photographs of the unique pattern of scars and mutilations on a manatee's trunk and tail fluke to identify individual animals, and re-sight them over time and space. Scars are usually the result of encounters with boats, but can also be the result of fishing gear entanglement or infections. Data collected by the photo-identification program inform estimates of manatee movement, site fidelity, adult survival rates, and reproductive parameters. Images are processed and managed in an integrated, inter-agency sightings database, known as the Manatee Individual Photo-identification System (MIPS). Although researchers attempt to photograph Florida manatees throughout their range during the winter, allocation of effort is biased in favor of areas with easier accessibility and better visibility for detecting manatees. As a result, a geographically biased fraction of the Florida manatee population is included in the database at any time. This and the inability to account for unscarred animals in the photographed sample prevent the use of resighting data for population size estimation.

Parameter Estimates for the Status Assessment

Extent of Occurrence (EO)

The area covered by the current range of the manatee within Florida was calculated using the geographic information system ArcGIS (ESRI®) (FWC 2002a). The EO included all areas within large bays, estuaries, and rivers plus remaining areas lying between the shoreline and the 12-foot depth contour for the entire State of Florida (Fig. 2). It is understood that the Florida manatee can occur in waters deeper than 12 feet, however our survey data suggest that most

manatees occur in relatively shallow water so the 12-foot contour line was selected to facilitate the process of calculating EO. For similar reasons, we also excluded waters outside the State of Florida. The GIS maps used were National Oceanic and Atmospheric Administration bathymetry maps and the Florida shoreline map maintained at FWC's Fish and Wildlife Research Institute. Once the map representing the EO was created, it was transformed to a raster surface with a cell size of 25 meters to determine area. The calculated EO for the state of Florida only was ~19,500 km^2 or ~7,500 mi^2. Including other states in the analyses would result in a much larger EO.

Area of Occupancy (AO)

The AO is expressed as the smallest critical or "essential" area that is able to sustain the current population through some temporary time frame. The Florida manatee does not occupy all areas within its range. In winter, the manatee limits most of its activities to areas in and around warm water. For the Florida manatee, this smallest "essential" area is best represented during the coldest days of the year when manatees aggregate around natural and man-made warm-water sources located throughout the State of Florida. On these coldest days, biologists from around the state conduct a statewide, synoptic survey to obtain a minimum population count of manatees for the state of Florida (Ackerman 1995; FWC, unpublished data). The AO was calculated using ArcGIS's raster processing module GRID (ESRI^R), applied to synoptic survey spatial data for nine winters between 1991 – 2001. When multiple surveys were conducted in a year, the survey that had the highest count of manatees was used to ensure that the maximum critical habitat would be calculated. Synoptic survey point locations representing from one to many manatees were transformed to circles having a radius of 325 meters (Flamm *et al.*, 2001). Area of occupancy in km^2 was calculated by summing the number of cells that were occupied in at least two of the nine synoptic surveys. The calculated AO for the synoptic survey areas was 37.6 km^2 or 14.5 mi^2. In addition, we applied this technique to the federally designated critical habitat region of south Florida. The AO in South Florida was 553.4mi^2 (Fig. 3). The area of critical habitat in Everglades National Park alone is approximately 335mi^2. The area that manatees require on extremely cold days is expected to be relatively small since it intentionally included only critical thermal needs but not other year-round needs such as food or freshwater. The inclusion of South Florida in our AO calculation may represent a considerably larger area than manatees would occupy during prolonged cold since animals typically congregate in nearshore coastal waters and tributaries rather than open water during these times. Because of this complication we cannot provide a single figure for AO with exact certainty, but based on the best information available, the value for the entire population during extreme winters likely is 100-300mi^2.

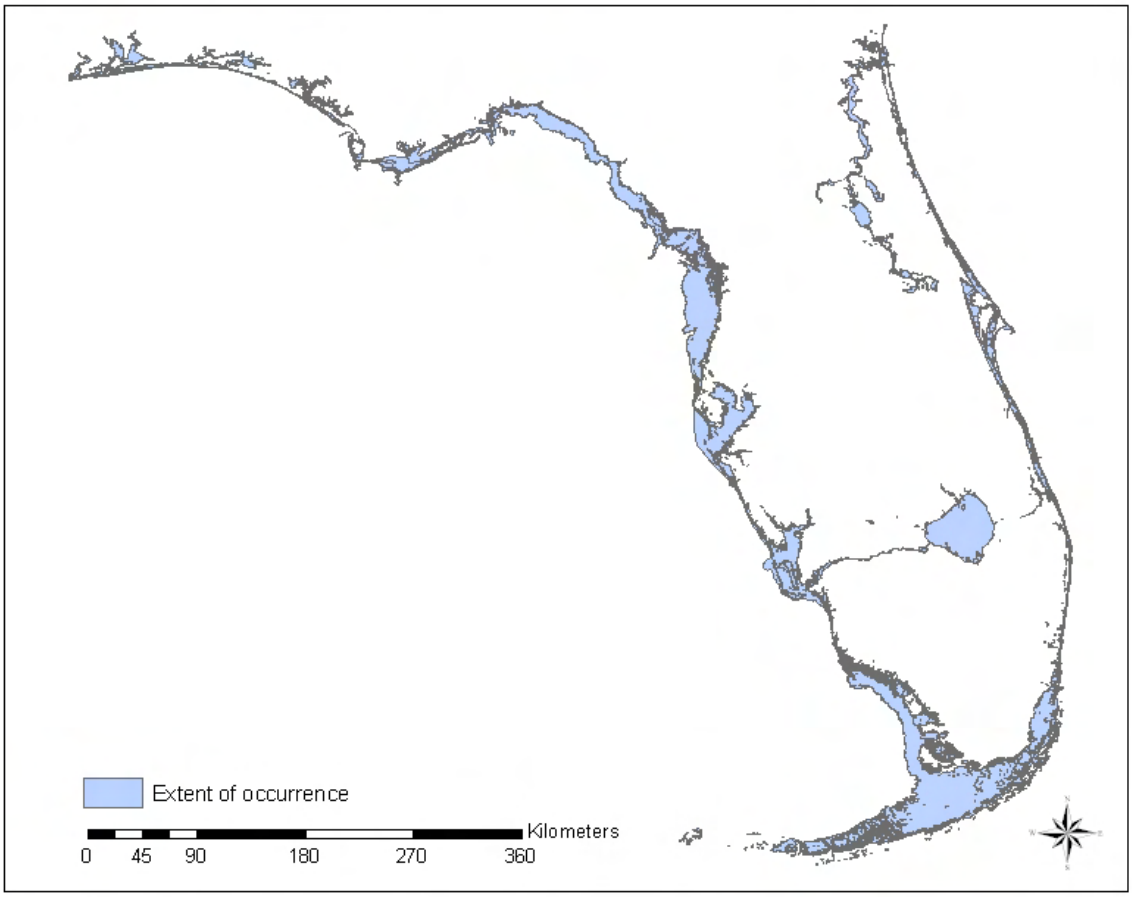

Figure 2. Florida manatee extent of occurrence.

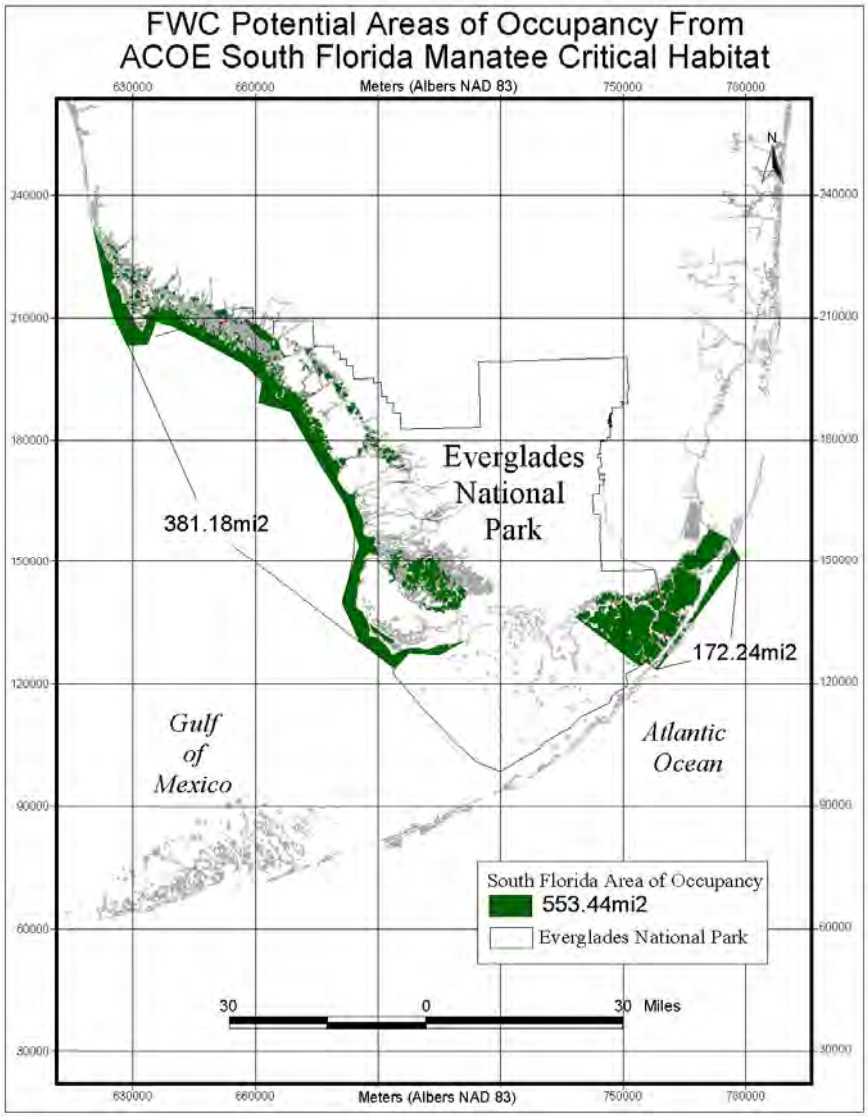

Figure 3. Florida manatee area of occupancy in South Florida.

Population Size and Number of Mature Individuals

There are no statistically-based estimates (with variance) of abundance for the entire Florida manatee population. The minimum documented abundance is determined from range-wide synoptic surveys which have been conducted nearly every winter since 1991. The surveys are timed to coincide with periods of extreme cold weather when manatees aggregate at a limited number of warm-water sites. The highest count obtained during these surveys was 3300 manatees in January 2001 (http://research.myfwc.com); this is presumed to be a minimum count, but the fraction detected is unknown. This number is considered as the minimum population size for this status review. Because detection probability varies greatly with weather conditions and across sites, population experts have consistently cautioned against using these data for trend analyses.

A total of 1447 manatees were counted in the Atlantic region during the 2001 synoptic survey. Craig and Reynolds (2004) estimated that the population size of manatees using power plants on the Atlantic Coast during winter 2001 was 1607 (95% Bayesian credible interval: 1353 - 1972). This is the only subpopulation with an independently collected set of data to assess abundance and trends. A total of 112 manatees were counted during the 2001 synoptic survey in the Upper St. Johns River subpopulation, but intensive observations that facilitate identification of nearly every individual using Blue Spring, the main overwintering site in the region, indicate that at least 141 different manatees visited the spring during that winter. A total of 154 manatees were counted at Blue Spring during the most recent synoptic survey in January 2005. A total of 377 manatees were counted in the Northwest region during the 2001 synoptic survey. Minimum subpopulation size from the high synoptic survey count in 2001 was 1364 individuals for the Southwest region.

Empirical estimates of the age composition of the living population over its entire range are not currently available. The proportion of mature individuals (i.e., four years and older) was calculated by simulating an age-dependent model (see Population Forecasting Model, below) for 10 years under current conditions, and calculating the mean number of adult female pre-breeder, female with calf, female breeder, and adult male animals, relative to the total number of individuals. This ratio was estimated to be 0.700, but ranged from 0.669 to 0.732 (the 95% credible interval). Applying this percentage to the highest synoptic survey count (3300) yields a total of 2310 mature individuals (2208 to 2416). We recognize that this is likely an underestimate of the total number of mature individuals because the synoptic count represents a minimum population number. If the actual population size was more than 3571 manatees (i.e., 271 more than the highest count), then the estimated number of mature individuals would exceed 2500. However, lacking estimates of bias and precision for the aerial survey counts and guided by the precautionary principle, we used the highest observed count in this calculation.

Population Trends

Past Trend

Current data, both scientific and anecdotal, indicate that the Florida manatee population has increased since the 1970's (O'Shea 1988; O'Shea and Ackerman 1995; Craig and Reynolds

2004; Runge *et al.,* 2004). Evidence supporting this increase in population size includes increasing winter counts at aggregation sites along the Atlantic coast (Garrott *et al.,* 1994; Reynolds and Wilcox 1994), on the southwest coast for Tampa Bay (Wright *et al.,* 2002) and at natural warm-water sites, including Crystal and Homosassa Rivers, Blue Spring, and Warm Mineral Spring (Ackerman 1995; FWC and USFWS, unpublished data). Caution is warranted in interpreting population trends from uncorrected aerial and ground count data, however, because counts are affected by numerous uncontrolled variables that limit their usefulness as reliable indices of population size (Lefebvre *et al.,* 1995).

What follows is a summary of our understanding of manatee population growth rates over the past decade and very brief statements on the status of each subpopulation. Population growth rates cited below were estimated by Runge *et al.,* (2004) using a stage-based model that integrated mark-recapture estimates of survival and reproduction (Kendall *et al.,* 2004; Langtimm *et al.,* 2004). The estimates of vital rates were made possible through a long-term, multi-agency effort to photographically identify individual manatees based on their distinct patterns of scars and mutilations (Beck and Reid 1995).

Atlantic Subpopulation: Over the most recent 10-year period, Runge *et al.,* (2004) estimated that the Atlantic subpopulation had grown at an annual rate of 1.0% per year (95% CI: –1.2 to 2.9%), but this was not statistically different from zero. The subpopulation may have increased slowly or it may have declined slightly over this time period. Apparently lower adult survival rates over the more recent 5-year period suggest that the subpopulation may be declining at –3.0% per year (95% CI: –6.2 to –0.2%). This needs to be confirmed with more data, however, as the survival rates may have been biased low due to low recapture rates (warm winters) at the end of the time series. Craig and Reynolds (2004) used a Bayesian approach to model growth in aerial counts of manatees at several major aggregation sites along the Atlantic coast (primarily power plants). This model took into account manatee movement between surveys and variation in detection rates with ambient temperature. The trends in counts suggest the population of animals using Atlantic coast power plants increased at a rate of 5-7% per year from 1982-1989, leveled off (growth rate 0-4%/yr) between 1990 and 1993, and has been increasing at about 4-6% per year since 1994. The discrepancy in growth rates of these two modeling approaches needs further investigation to provide a better understanding of population trends along the Atlantic coast.

Upper St. Johns River (USJ) Subpopulation: The subpopulation occupying the Upper St. Johns River has shown strong growth over the past decade, increasing at an annual rate of 6.2% (95% CI: 3.7 - 8.1%) (Runge *et al.,* 2004). This growth rate is supported by high survival and reproductive rates. This is the smallest of the four subpopulations, contributing less than 5% to the maximum synoptic count, but the Upper St. Johns is the fastest growing subpopulation.

Northwest Subpopulation: This subpopulation has grown at an annual rate of 3.7% (95% CI: 1.6 - 5.6%) over the 10 years prior to 2001 (Runge *et al.,* 2004). This is the second smallest subpopulation, accounting for about 11% of the highest synoptic count. Its dynamics are similar to those of the USJ, with a high adult survival rate, except reproduction seems to be lower.

Southwest Subpopulation: This subpopulation has declined at an estimated rate of –1.1% per year (95% CI: –5.4 to +2.4%) over the eight year period prior to 2002. The relatively wide confidence interval reflects greater uncertainty about survival and reproductive rates in this region, in part due to a shorter time series of sight-resight data. Estimates of adult survival are lower than those of all other subpopulations, probably due to the combined effects of chronic human-related (watercraft) mortality and episodic mortality events caused by red tide, but

possibly also due to the geographic extent of current sampling. Manatees in the Southwest subpopulation are found in a broad diversity of habitats from the more developed Tampa Bay to the more pristine reaches of Everglades National Park; demographic data are lacking for individuals in the southernmost parts of the region.

Projected Trend

Although manatee numbers appear to have increased in the past few decades, many anthropogenic threats to the Florida manatee population continue to increase and may affect the survival of the species. Most natural catastrophes, defined as events that occur infrequently but cause significant declines in the population (e.g., hurricanes), are expected to continue to occur in the future; some (e.g. red tide mortalities) appear to be occurring at greater frequencies than in the past. A decline in survival over the next half century is plausible, given the expected reduction or loss of warm-water discharges, the projected increase in Florida's human population in coastal areas, and the continued threat from increases in number of motorized vessels in Florida waters. A population forecasting model was used to estimate future population trends.

Population Forecasting Model

A core biological model (CBM) was developed to forecast changes in regional subpopulations (Runge *et al.*, in prep) and to conduct population viability analyses, according to estimated life-history and environmental parameters. Key parameters include survival and breeding rates (with temporal variability), carrying capacity, demographic stochasticity, and the effects of red tide and emergent disease. Appendix G summarizes these parameters, including the uncertainty bounds for each, where applicable. The model was formulated based on three earlier models of manatee ecology: a stage-structured matrix projection model (Runge *et al.*, 2004), a model of incidental take (Runge 2003) and the FWC Population Viability Analysis of the Florida manatee (FWC 2002b). The core biological model is an age- and stage-based expression of manatee population dynamics, which includes 6 female stages, according to the age and reproductive condition of individuals, and 4 male age classes. Changes in population size were predicted over 1, 2, 3, and 5 generations, and over the entire 100-year simulation. Generation time was estimated between 16.8 and 22.6 years, and sampled from a uniform distribution over this range for each simulation. The resulting summary statistics are based on 5000 replicate model simulations.

Model structure

The CBM consists of a projection matrix formulation of manatee population dynamics, whereby the manatee population, split into 10 life stages, is advanced annually when multiplied by a matrix of associated reproductive and survival rates. The life stage classifications are as follows:

1. First-year calves (0.5 years), male and female.

2. Second-year calves (1.5 years), male and female.

3. Third-year female subadults (2.5 years).

4. Third-year male subadults (2.5 years).
5. Fourth-year female subadults (3.5 years).
6. Fourth-year male subadults (3.5 years).
7. Pre-breeding females (4.5+ years).
8. Reproductive females (4.5+ years), no calves.
9. Reproductive females (4.5+ years), with first-year calves (i.e. will not reproduce in current year).
10. Male adults (4.5+ years).

The CBM simulation procedure includes the following general steps, cycling for 100 simulated years in each replicate simulation:

1. Input initial population states, warm water carrying capacity, and correlation coefficients.
2. Determine effect of exceeding warm water carrying capacity, according to whether it is a cold or normal year, and the number of animals inside or outside refuges (stochastically determined).
3. Determine vital rates (survival and reproduction) for current year, according to sampled values, the occurrence of catastrophes and density dependence, if applicable.
4. Apply vital rates to population in current year, to yield surviving animals, reproductive females, and calf age ratio.
5. Advance time index by one year, and return to step 2, unless current year is the final year of the simulation, in which case the simulation ends.

Generation time

Ecological literature provides an array of definitions for generation time, which generally refers to the length of time separating the arrival of successive generations into the population. In its guidelines, the IUCN defines generation time as the average age of the parents of newborns in the population. This quantity can be calculated from the elements of a life table, as shown in Caswell (2001). It is important to note that this definition of generation time tends to produce lower estimates of generation time relative to most others for manatees, because the age ratio of growing populations is skewed towards younger animals. To be conservative in the CBM, generation length was sampled from a range of values, extending from the estimated mean to the upper boundary of the 95% confidence interval.

Density dependence

All growing populations are eventually constrained by one or more limiting resources that slow or prevent continued growth when populations become large. This density-dependent growth leads to the general observation that large populations tend to grow more slowly, or even shrink, relative to small populations. Such density effects have not yet been observed or inferred for the Florida manatee, due either to the population being too small for resources to become limiting, or to past and current monitoring programs not being powerful enough to detect such change.

A primary limiting factor for the growth of manatees in Florida is believed to be the availability of warm water refugia during periods of prolonged cold weather during winter. The two major sources of warm water are natural springs and outflows from power plants used to generate electricity. The availability of warm water will likely be reduced in the future, due to the reduction in spring flows from human use of water in the aquifers, and to the closing or re-powering of existing power plants. In the absence of mitigating actions, the continued loss of warm water may hamper long-term recovery of the manatee population. To this end, a density dependent growth model is used to characterize this limitation in the CBM.

In the CBM, warm water limitation influences population growth in two ways. First, as the simulated population approaches the estimated carrying capacity, the reproductive rate of the population is reduced, relative to smaller population sizes. Second, populations above warm-water carrying capacity experience additional mortality, presumably due to cold stress for individuals unable to access warm water. Both the event of a severe winter and the number of animals subjected to cold stress, given a severe winter, are determined probabilistically. Calves are assigned higher levels of mortality, both in cold and normal years, relative to adults and subadults.

Sources of variability

The model incorporates several sources of variation: (1) annual survival, (2) annual reproduction, (3) demographic stochasticity, (4) environmental stochasticity, (5) catastrophic events, and (6) carrying capacity. Estimates of survival and reproduction, with associated uncertainty, are estimated from photo-identification data (MIPS, see above; Langtimm *et al.*, 1998; Langtimm *et al.*, 2003; Langtimm *et al*. 2004). These photo-identification data suggest no important differences in survival rates between males and females, so these rates are pooled. Male reproductive states are not modeled separately because, as is common for many species, males do not limit population dynamics. Demographic stochasticity represents the independence of the fates of individuals, with each having their own opportunity for survival (even if they are identical probabilities). As a result, demographic rates are applied to the simulated population by drawing individuals (e.g., survivors of a particular year) from a probability distribution, according to associated parameter values. Life history parameters, in turn, may be influenced by uncontrollable environmental factors, which may cause either regular, relatively moderate fluctuation (environmental stochasticity) or irregular, relatively severe negative effects (catastrophes). Environmental stochasticity is represented by a distribution of plausible values for each parameter, from which annual realizations are drawn for each year simulated. Two types of catastrophes are modeled in the CBM: emergent infectious disease (Type 1), and harmful algal blooms (red tide, Type 2). These events are generated according to probabilities listed in

Appendix G. Carrying capacity reduces the growth rate of populations that are large relative to their available space and resources. Though this density-dependent effect has not been documented or estimated for Florida manatees, potential future changes in manatee population size or habitat warrant its consideration in the CBM. However, considerable uncertainty surrounds both the occurrence of density effects, and the degree of such effects, should they occur; whether they are rapid and severe, or gradual and mild, is unknown. This is characterized by a range of plausible parameter values for carrying capacity and the effects on the population of exceeding carrying capacity; individual values are drawn from this distribution for use in simulation by the CBM.

Parameter uncertainty

Each model parameter is accompanied by an associated estimate of uncertainty. A range of plausible parameter values characterizes this uncertainty. Where parameter estimates are informed by data, this uncertainty is due either to sampling error associated with data collection, or to natural variability in the parameter itself; this uncertainty is typically parametric, associated with an appropriate statistical distribution. Where parameters are based on expert opinion, the uncertainty is a function of the range of plausible values elicited from subject experts; a narrower range of values represents better consensus regarding the true population parameter value. CBM simulations integrate the uncertainty from all model parameters simultaneously, so that the results appropriately characterize current system knowledge.

Sensitivity and elasticity analyses

Variability in model parameters, due either to imperfect knowledge of the system, or to natural variation, influences the reliability of model dynamics and predictions. However, model parameters are not equally influential on resulting output; the model is more sensitive to changes in some parameter values than to others. Sensitivity analysis associates changes in any derived model metric with deviations in the value of individual parameters. Similarly, elasticity measures the proportional (rather than absolute) change in model outputs relative to proportional changes in parameters. In the case of the CBM, response variables of interest are the population growth rate, population size and variance, and probability of persistence.

Analyses revealed growth rate to be most sensitive to variation in adult survival, and secondarily to environmental stochasticity of adult survival (all regions except Upper St. Johns), virulent disease catastrophe (all regions), and the density dependent parameter (Upper St. Johns). Elasticity analysis identified adult survival as having the greatest proportional influence on population growth rate (all regions), followed by long- and short-term carrying capacity in the Upper St. Johns region, and sub-adult survival and calf survival in all other regions.

Population projections

Regional projections predict probable population declines in the Atlantic and Southwest subpopulations, and increases in the Upper St. Johns and Northwest (Figs. 4-7, Appendix H). Note that most 95% confidence intervals intersect zero in the Northwest and Atlantic predictions. Overall, expected values of state-wide predictions decline over 1-5 generations, though with similarly wide confidence intervals (Figs. 8-9). The probability of extinction is less than 1% in

three of four regions after 3 generations, 5 generations, and 100 years, with only the Southwest subpopulation exceeding a one percent probability over any interval (Table 2, Appendix H). Estimates of the state-wide probabilities of extinction are not yet available because the CBM is currently structured to model the individual subpopulations, though work is underway to add this additional capability. The statewide probabilities of extinction, however, are highly unlikely to approach any of the thresholds specified in the listing criteria, because only one of the four subpopulations approaches those thresholds.

Model limitations

Though the CBM represents the most complete model of manatee population dynamics to date, several outstanding issues persist which should be considered when using its results for guidance on listing status. First, the CBM treats each regional sub-population as independent entities, with no movement of individuals among sub-populations. The addition of migration to the model would allow for phenomena such as source-sink dynamics or rescue effects to be captured, should they be important. Second, although two types of catastrophic events are modeled, the CBM does not account explicitly for the effects of hurricanes on population dynamics (though they are implicitly associated with the estimates of some parameters (e.g. survival and reproduction), based on their past influence on these estimates. This may be of increased importance, given an apparent increase in the frequency of large storms in the state. Third, parameters for warm water carrying capacity (and associated trends) were almost completely reliant on the consensus opinion of subject experts on the Warm Water Task Force of the Florida Manatee Recovery and Implementation Team, and may not be realistic. Refinements to these parameters using more quantitative information, when available, should improve these estimates. Fourth, the CBM does not separately account for watercraft-related mortality. This is widely regarded to be the most important cause of adult mortality in many parts of the state, and its proportional influence on overall mortality may not be constant over time and space. In addition, representing important components of mortality separately would allow modeling of the effects of management decisions on survival and growth rates. Finally, although the majority of model parameters are specified with associated estimates of uncertainty, a few are simply point estimates. In particular, the initial population size and catastrophe parameters are not allowed to vary in the CBM. If these parameters vary from these estimates, outputs from the model may not be robust. The initial population size should be regarded as a minimum estimate, given the biases of the surveys noted above, but we believe that the model should not be strongly influenced by a moderately larger population. However, projected growth rates were found to be relatively sensitive to variation in some catastrophe parameters, so some estimate of uncertainty is warranted.

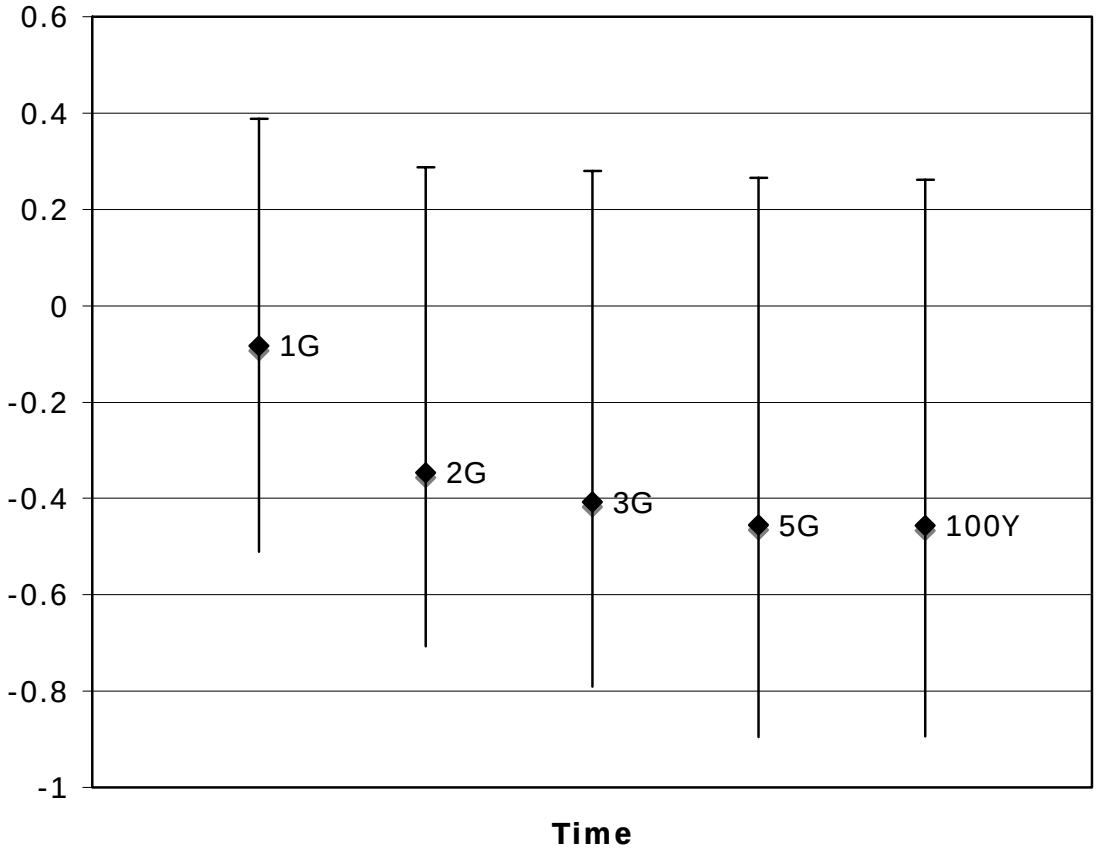

Figure 4. Predicted mean fractional change (represented by points) in Atlantic manatee subpopulation size (mature individuals) after 1, 2, 3, 5 generations (G), and 100 years (Y), with 95% confidence intervals.

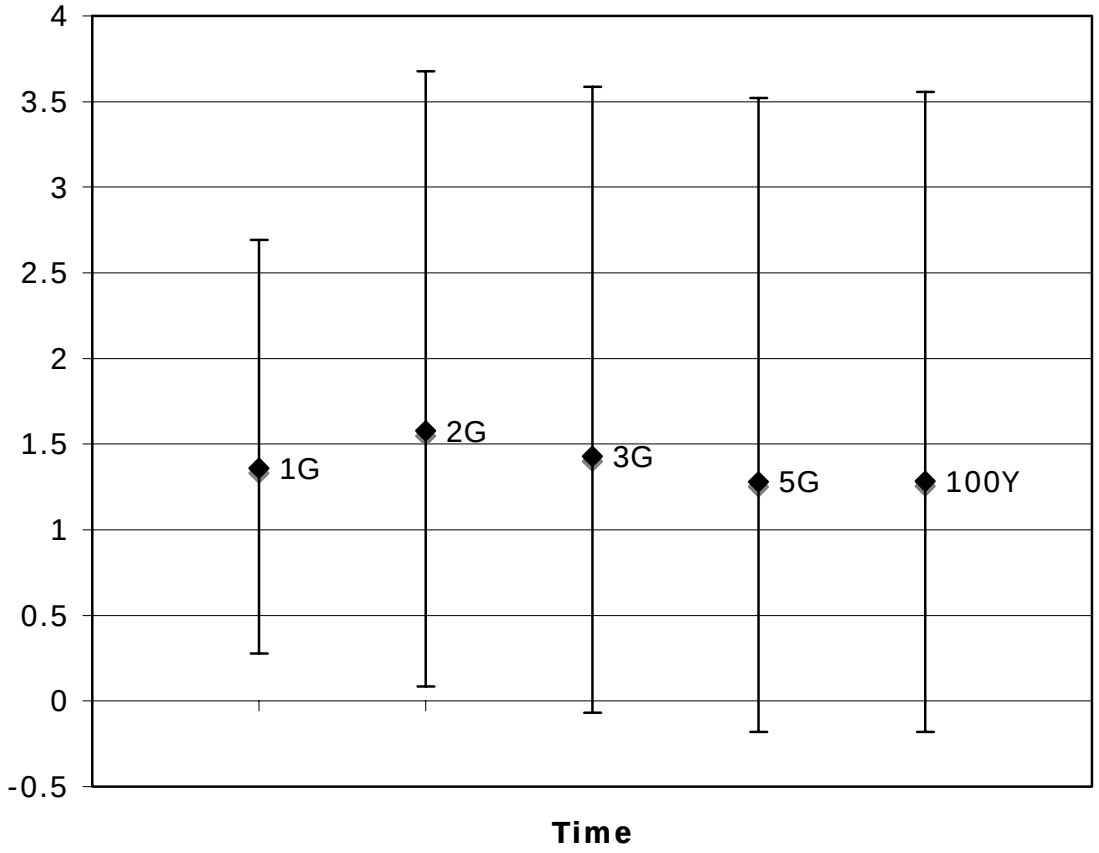

Figure 5. Predicted fractional change (represented by points) in Upper St. Johns manatee subpopulation size (mature individuals) after 1, 2, 3, 5 generations (G), and 100 years (Y), with 95% confidence intervals.

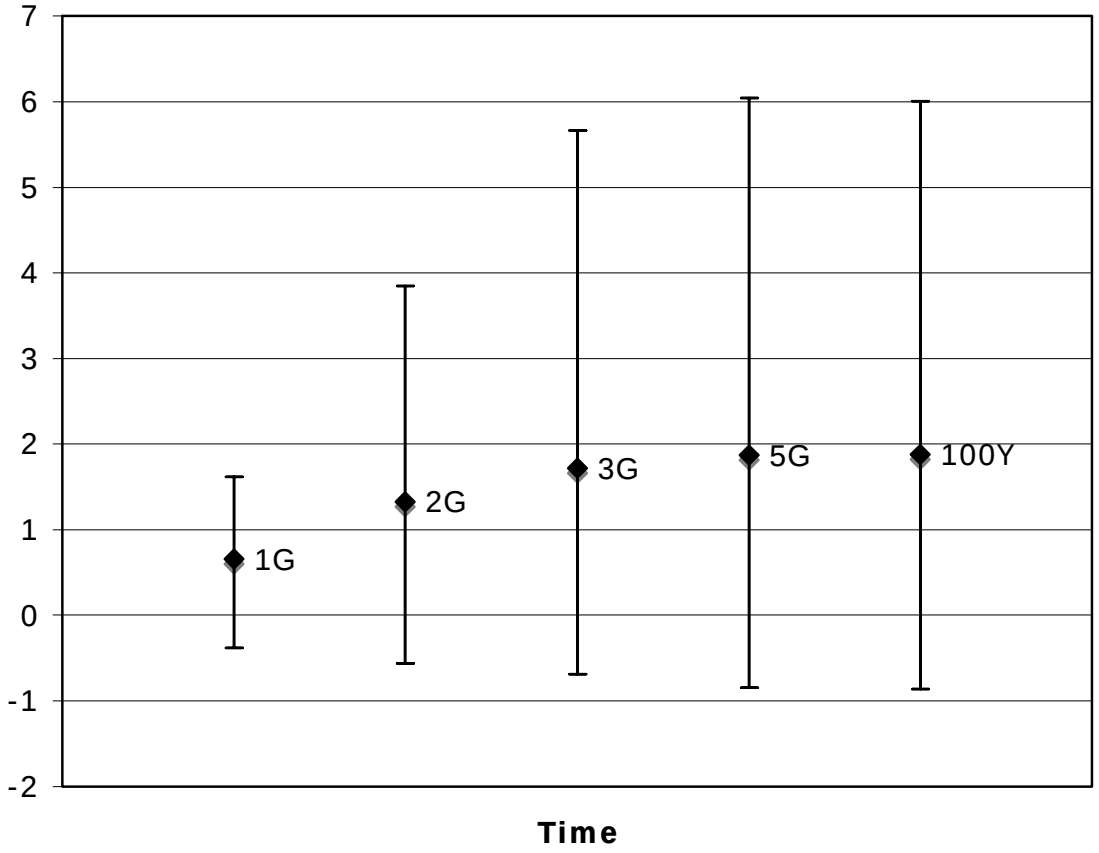

Figure 6. Predicted fractional change (represented by points) in Northwest manatee subpopulation size (mature individuals) after 1, 2, 3, 5 generations (G), and 100 years (Y), with 95% confidence intervals.

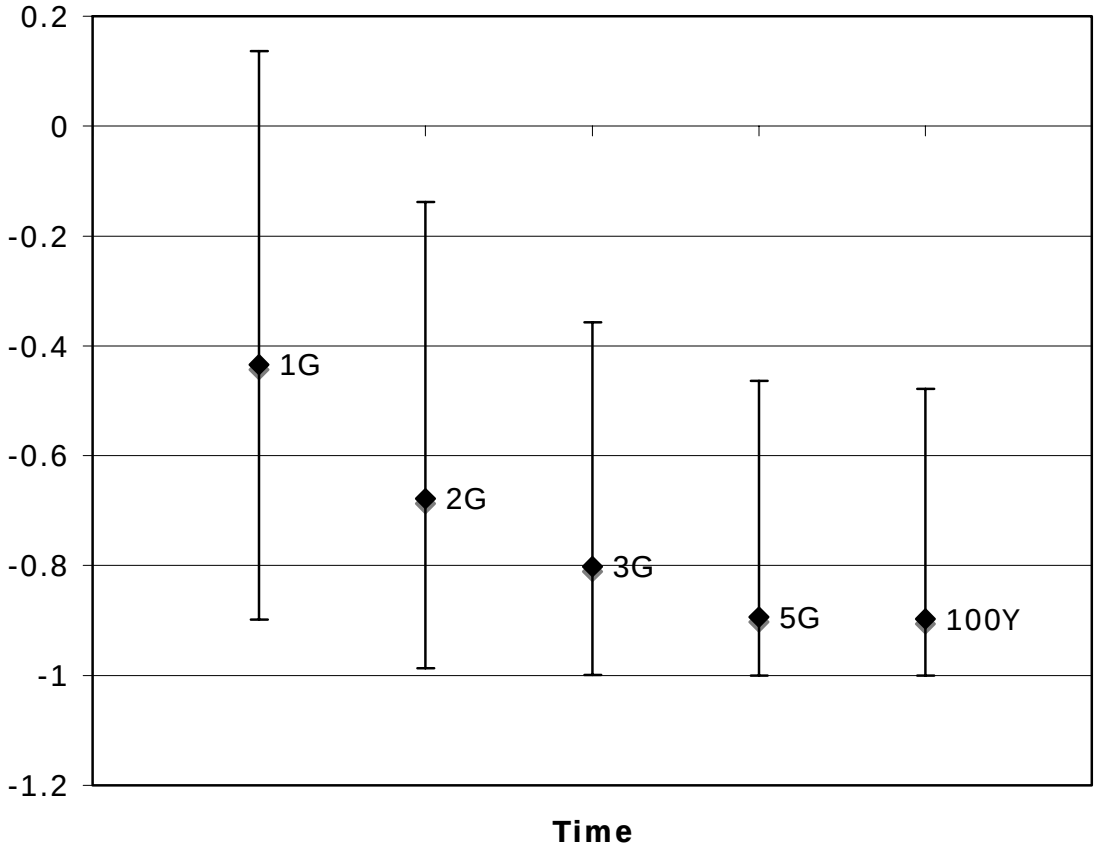

Figure 7. Predicted fractional change (represented by points) in Southwest manatee subpopulation size (mature individuals) after 1, 2, 3, 5 generations (G), and 100 years (Y), with 95% confidence intervals.

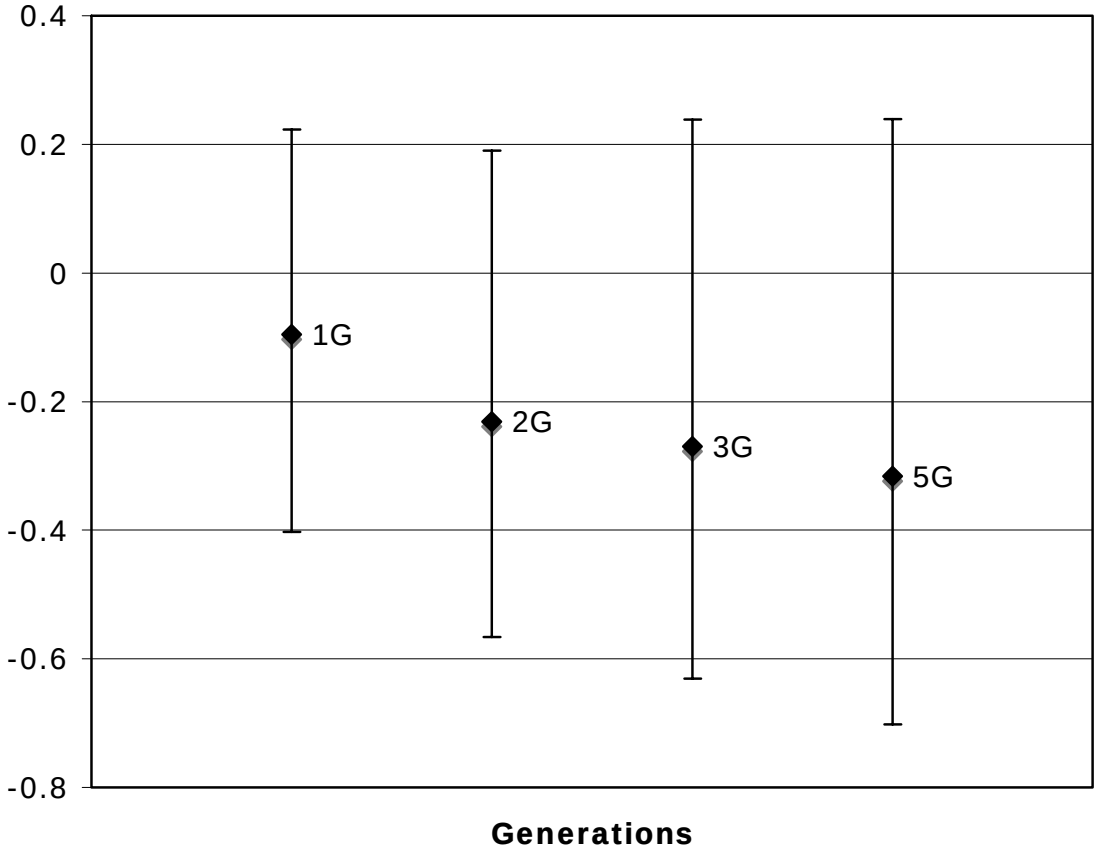

Figure 8. Predicted state-wide fractional change (represented by points) in manatee population size (mature individuals) after 1, 2, 3, and 5 generations (G), with 95% confidence intervals.

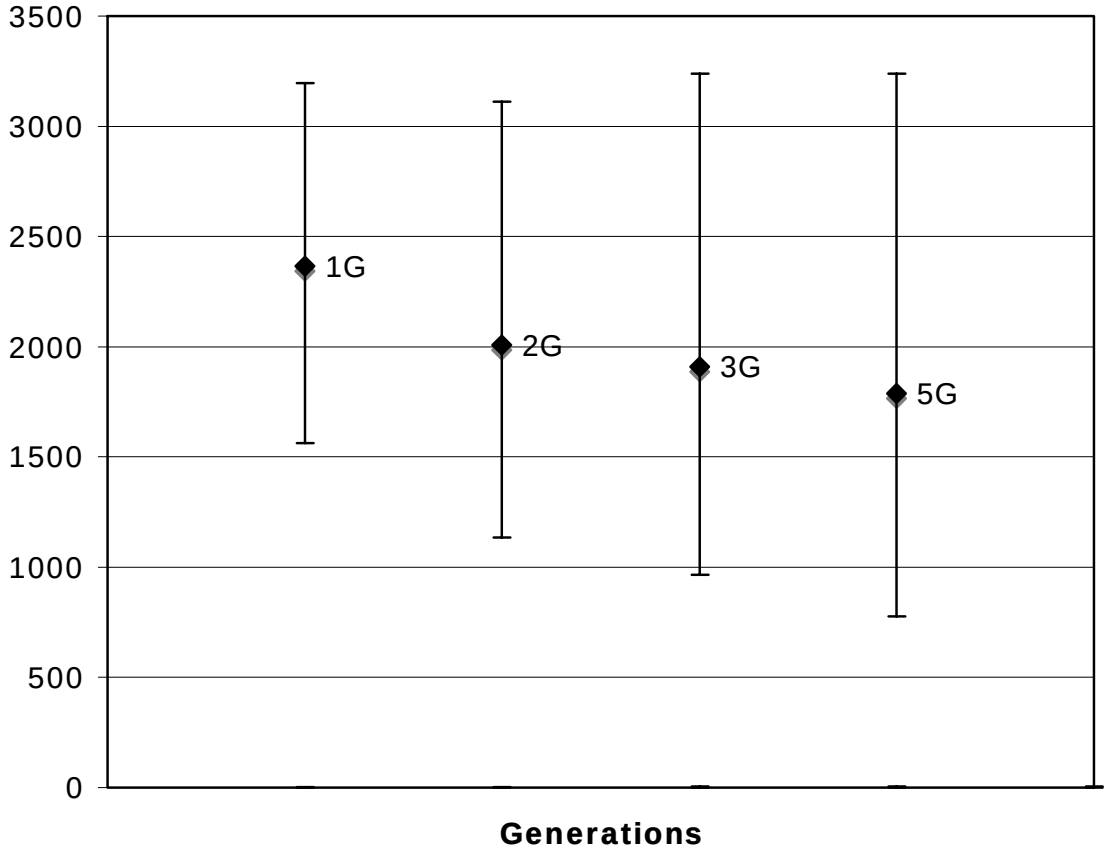

Figure 9. Projected state-wide manatee population (points with 95% confidence intervals) size (mature individuals) after 1, 2, 3 and 5 generations (G).

Table 2. Projected probabilities of extinction for each of the four regional subpopulations over 3 generations, 5 generations and 100 years. These results are based on 5000 replicates using the Core Biological Model (Runge *et al.*, in preparation).

Region	**3G**	**5G**	**100Y**
Atlantic	< 0.0002	0.0004	0.0004
Upper St. Johns	< 0.0002	< 0.0002	< 0.0002
Northwest	0.0018	0.0056	0.0062
Southwest	0.0172	0.1154	0.1194

BIOLOGICAL STATUS ASSESSMENT

The Florida manatee biological review panel (BRP) met in St.Petersburg, Florida at FWC-FWRI Headquarters on Nov. 17-18, 2005. Dr. Perran Ross, contracted by FWC from the University of Florida, provided training in the use of the listing criteria and also facilitated the meeting. Dr. Chris Fonnesbeck of FWC-FWRI attended the entire meeting to provide input about the forecasting model. Carol Knox of FWC's Division of Habitat and Species Conservation attended on Nov. 17 to provide input from the management perspective as needed and to ensure a coordinated approach in Phase II of the listing process (i.e., producing a management plan). The BRP reviewed the information summarized previously in this report and they had access to all of the recent scientific literature relating to manatees cited in this report. According to the procedural requirements of Rule 68A-27.0012 F.A.C. (Appendix B), the Florida manatee must meet only one of the five criteria in 68A-1.004 F.A.C. (Appendix C) to warrant listing as endangered, threatened, or species of special concern. The criteria are summarized in Table 3. Statewide population assessment results described below are summarized in Table 4.

Statewide Population Assessment

Criterion A: Population Reduction

This criterion requires the assessment of an observed, estimated, inferred, or suspected population reduction of the Florida manatee over (1) the past, (2) the future, or (3) a time period including past and future for ten years or three generations, whichever is longer. The causes of the reduction may not have ceased or may not be understood or reversible. The criteria for listing are as follows: past or future population reduction of at least 80% (endangered=EN), 50% (threatened=TH), or 30% (species of special concern=SC). Alternatively, where the causes of the population reduction are clearly reversible, and understood and have ceased, the criteria for listing is a population reduction of at least 90% (EN), 70% (TH), or 50% (SC) over the last ten years or three generations, whichever is longer.

There was no evidence of a past decline in the manatee population in the last 50 years so the manatee did not meet Criterion A under sub-criterion 1, 3, or 4. However, there was a 12.1% chance of a 50% decline in the next three manatee generations and there was a 46.5% chance of a 30% decline in the population in 3 generations. Even without the model results, it is the opinion of the manatee BRP that the threats facing the manatee in the future, particularly the projected loss of warm water, could cause a significant decline in the population. Using a precautionary approach as defined by the IUCN (2004) guidelines adopted by FWC, the BRP unanimously agreed that the **manatee should be listed as threatened under criterion A**.

Criterion B: Extent of Occurrence and Area of Occupancy

This criterion requires an estimate of the Florida manatee's extent of occurrence (i.e., total range) and area occupied (i.e., "essential" or critical regions which sustain the population for at least some temporary time frame). The requirements for listing under this criterion are as follows: extent of occurrence must be less than 40 square miles (EN), 2000 square miles (TH), or 7700 square miles (SC); or the area of occupancy must be less than 4 square miles (EN), 200

square miles (TH), or 770 square miles (SC). In addition, two of the following conditions for the population must be met:

1) Severely fragmented or known to exist at no more than 1 (EN), 5 (TH), or 10 (SC) locations.

2) Continuing decline observed, inferred, or projected in any of the following: (a) extent of occurrence; (b) area of occupancy; (c) area, extent, and/or quality of habitat; (d) number of locations or subpopulations; or (e) number of mature individuals.

3) Extreme fluctuations in any of the following: (a) extent of occurrence; (b) area of occupancy; (c) number of locations or subpopulations; (d) number of mature individuals.

The extent of occurrence is approximately 7500 mi^2 and the area of occupancy ranges from 100-300 mi^2. The panel agreed that the manatee population met the condition of a decline in area of occupancy but did not believe the evidence supports severe fragmentation or limited numbers of locations. Because the Florida manatee only meets one of the three stated conditions for this criterion, it **does not qualify for listing under Criterion B**.

Criterion C: Population Size and Trends

This criterion combines an estimate of range-wide population size (in terms of the number of mature individuals) with an estimate of future population trends and an assessment of population fragmentation. To meet this criterion for State listing, the number of mature individuals must be less than 250 (EN), 2500 (TH), or 10000 (SC). One of the following sub-criteria must also be met: (1) an estimated population decline of at least 25% over one generation (EN), 20% over two generations (TH), or 10% over three generations (SC); or (2) an observed, projected, or inferred decline in number of mature individuals, and either (a) no subpopulation estimated to contain more than 50 (EN), 250 (TH), or 1000 mature individuals (SC)—or at least 90% (EN), 95% (TH), or 100% (SC) of mature individuals in one subpopulation or (b) extreme fluctuations in number of mature individuals.

A minimum of 2310 mature individuals was calculated to be in the population therefore, the manatee qualifies as threatened under this sub-criterion. Additionally, there is a 55.5% chance of a 20% reduction in the manatee population over the next two generations and a 77.1% chance of a 10% reduction. Therefore, the BRP determined that **the Florida manatee should be listed as threatened under criterion C**. The Florida manatee population does not have more than 90% of mature individuals in one subpopulation and there is no evidence for extreme fluctuations in the number of mature individuals.

Criterion D: Number of Mature Individuals

This criterion requires an estimate of the number of mature individuals in the population as an assessment of whether the population is extremely small. To meet this criterion for listing, the range-wide population estimate for the species must be no more than 50 (EN), 250 (TH), or 1000 (SC) mature individuals. Alternatively, to meet SC, the population may be characterized by very restricted area of occupancy defined as less than 8 square miles (20.7 square kilometers), or by occupying a limited number of locations (typically 5 or fewer), where ‘location’ is defined

as a distinct area in which a single threatening event can rapidly affect all individuals of the taxon present.

The number of mature individuals was calculated as 2310 and the area of occupancy as 100-300 mi^2. Therefore, **the Florida manatee does not qualify for listing under Criterion D.**

Criterion E: Probability of Extinction

This criterion requires an estimate of the probability of a species' extinction in the wild within specific time-frames. The probability of extinction would have to be at least 50% within the next three generations to qualify as EN, 20% within the next five generations to qualify as TH, or 10% within the next 100 years to qualify as SC.

While direct estimates of the statewide probability of extinction are not yet available, the estimated probability of extinction in three of the four subpopulations did not exceed 1% over 100 years. Thus, the statewide probabilities of extinction, are highly unlikely to approach any of the thresholds specified in the listing criteria, because only one of the four subpopulations approaches those thresholds. **The manatee does not qualify for listing under Criterion E**.

Statewide Assessment Summary:

The 2005-2006 FWC Florida Manatee Biological Review Panel recommends that the Florida manatee be listed as Threatened under 68A-27.0012 F.A.C. according to the criteria A and C defined in 68A-1.004 F.A.C. The IUCN guidelines provide the BRP with the option of raising or lowering the listing status by one category. The panel unanimously agreed that the data for the Florida manatee did not warrant uplisting the species to the state of Florida's Endangered category and also did not warrant downlisting to the State of Florida's Species of Special Concern category.

Table 3. State of Florida's 2005 listing criteria overview for Florida manatee

Criteria	**Endangered**	**Threatened**	**Special Concern**
A. Population Decline			
1) Past decline where reduction or causes may not have ceased or may not be understood or reversible	≥80% in 3 generations	≥50% in 3 generations	≥30% in 3 generations
OR 2) Projected decline in future of at least…….	≥80% in 3 generations	≥50% in 3 generations	≥30% in 3 generations
OR 3) Time period of past and future decline where reduction or causes may not have ceased or may not be understood or reversible	≥80% in 3 generations	≥50% in 3 generations	≥30% in 3 generations
OR 4) Past decline where reduction or causes are clearly reversible and understood and ceased	≥90% in 3 generations	≥70% in 3 generations	≥50% in 3 generations
B. Extent of Occurrence*	<40 mi^2	<2000 mi^2	<7700 mi^2
OR Area of Occupancy*	<4 mi^2	<200 mi^2	<770 mi^2

Table 3. (continued)

Criteria	**Endangered**	**Threatened**	**Special Concern**
C. Population Size (# mature manatees)	<250	<2,500	<10,000
AND Population Decline	25% in 1 generation	20% in 2 generations	10% in 3 generations
OR Decline and either no subpopulation containing more than x mature individuals OR extreme fluctuations in number	50	250	1,000
D. Population Size (# mature manatees)	<50	<250	<1,000
OR Area of Occupancy	-	-	<8 mi^2 or <5 locations
E. Probability of Extinction	50% in 3 generations	20% in 5 generations	10% in 100 yrs

*And to be listed under Criterion B, species must also meet two of following three:

a) Severely fragmented population, or exist at specified number of locations (1, 5, 10, respectively)
b) Continuing decline in Extent of Occurrence, Area of Occupancy, habitat, number of locations or subpopulations, or number of mature individuals
c) Extreme fluctuations in Extent of Occurrence, Area of Occupancy, number of locations or subpopulations, or number of mature individuals

Table 4. Summary of the biological status of the Florida manatee relative to the criteria for State listing.

PART I. Criteria for Endangered Status (from Rule 68A-1.004, F.A.C.)			
CRITERIA - LISTING MEASURE	**CRITERION SATISFIED?**	**JUSTIFICATION**	**SOURCE**
A Population Reduction	**NO**		
1. ≥ 80% decline over last 3 generations **OR**	No	No evidence of decline in last 50 years	Estimated
2. ≥ 80% decline over next 3 generations **OR**	No	Model does not project 80% decline	Projected
3. ≥ 80% decline over 3 generations past and future, where decline causes not understood or not ceased **OR**	No	No evidence of past and future decline	Estimated
4. ≥ 90% decline in past 3 generations where decline has ceased	No	No evidence of decline in last 50 years	Estimated
B Occurrence and Occupancy	**NO**		
Extent of occurrence <40 miles^2 **OR**	No	EO: 7,500 miles^2 in Florida alone	Estimated
Area of occupancy < 4 miles^2	No	AO: 100-300 miles^2	Estimated
AND 2 of 3: 1. Severely fragmented 2. Decline in EO, AO, habitat or population 3. Extreme fluctuations in EO, AO, habitat or population	No	Only # 2 applies	Estimated
C Population Size and Trend	**NO**		
< 250 mature individuals (≥ 4 years old)	No	2,310 minimum estimate mature	Estimated
AND either: 1. Decline ≥ 25% in 1 generation **OR**	No	No evidence	Projected
2. Decline & no sub population contains >50 mature individuals, or 90% of individuals in single subpopulation	No	Does not apply	Estimated
D Number of Mature Individuals	**NO**		
< 50 mature individuals	No	2,310 minimum estimate mature	Estimated
E Species' Extinction Probability	**NO**		
≥ 50% probability over next 3 generations	No	No evidence	Projected

Table 4. (Continued)

PART II. Criteria for Threatened Status (from Rule 68A-1.004, F.A.C.)			
CRITERIA - LISTING MEASURE	**CRITERION SATISFIED?**	**JUSTIFICATION**	**SOURCE**
A Population Reduction	**YES**		
1. ≥ 50% decline over last 3 generations **OR**	No	No evidence of decline in last 50 years	Estimated
2. ≥ 50% decline over next 3 generations **OR**	Yes	12.1% chance of 50% decline in 3 generations	Projected
3. ≥ 50% decline over 3 generations past and future, where decline causes not understood or not ceased **OR**	No	Nothing in recent past will supercede effects of A2	Estimated
4. ≥ 70% decline in past 3 generations where decline has ceased	No	No evidence of decline in last 50 years	Estimated
B Occurrence and Occupancy	**NO**		
Extent of occurrence <2,000 miles^2 **OR**	No	EO: 7,500 miles^2 in Florida alone	Estimated
Area of occupancy < 200 miles^2	Maybe	AO: 100-300 miles^2	Estimated
AND 2 of 3: 1. Severely fragmented 2. Decline in EO, AO, habitat, or population 3. Extreme fluctuations in EO, AO, habitat, or population	No	Only # 2 applies	Estimated
C Population Size and Trend	**YES**		
< 2,500 mature individuals (≥ 4 years old)	Yes	2,310 minimum estimate mature	Estimated
AND either: 1. Decline ≥ 20% in 2 generations **OR**	Yes	55.5% chance of 20% reduction in 2 generations	Projected
2. Decline & no sub population contains >250 mature individuals, or 95% of individuals in single subpopulation	No	Does not apply	Estimated
D Number of Mature Individuals	**NO**		
< 250 mature individuals	No	2,310 minimum estimate mature	Estimated
E Species' Extinction Probability	**NO**		
≥ 20% probability over next five generations	No	No evidence	Projected

Table 4. (Continued)

PART III. Criteria for Species of Special Concern Status (from Rule 68A-1.004, F.A.C.)			
CRITERIA - LISTING MEASURE	**CRITERION SATISFIED?**	**JUSTIFICATION**	**SOURCE**
A Population Reduction	**YES**		
1. ≥ 30% decline over last 3 generations **OR**	No	No evidence for past decline	Estimated
2. ≥ 30% decline over next 3 generations **OR**	Yes	46.5% chance of 30% decline in 3 generations	Projected
3. ≥ 30% decline over 3 generations past and future, where decline causes not understood or not ceased **OR**	No	No evidence for past decline	Estimated
4. ≥ 50% decline in past 3 generations where decline has ceased	No	No evidence for past decline	Estimated
B Occurrence and Occupancy	**NO**		
Extent of occurrence <7,700 miles^2 **OR**	Yes	EO: 7,500 miles^2 in Florida	Estimated
Area of occupancy < 770 miles^2	Yes	AO: 100-300 miles^2	Estimated
AND 2 of 3: 1. Severely fragmented 2. Continuing decline in EO, AO, habitat, or population 3. Extreme fluctuations in EO, AO, habitat, or population	No	Only # 2 applies	Estimated
C Population Size and Trend	**YES**		
< 10,000 mature individuals (≥ 4 years old)	Yes	2,310 minimum estimate mature	Estimated
AND either: 1. Decline ≥ 10% in next 3 generations **OR**	Yes	77.1% chance of >10% decline in 3 generations	Projected
2. a) Decline & no sub population contains >1,000 mature individuals, or 100% of individuals in single subpopulation OR b) extreme fluctuations in number of mature individuals	No	Does not apply	Estimated
D Number of Mature Individuals	**NO**		
< 1000 mature individuals **OR**	No	2,310 minimum estimate mature	Estimated
AO < 8 miles^2 or <5 locations	No	AO: 100-300 miles^2, >5 locations	Estimated
E Species' Extinction Probability	**NO**		
>10% probability over next 100 years	No	No evidence	Projected

Regional Assessment of Subpopulations

The regional assessment is a process for determining the relative extinction risk of a regional population. In the statewide assessment of the biological status review, the BRP evaluated the entire Florida manatee subspecies as if it occurs entirely within Florida (a single region). In order to better inform conservation managers about the species, the BRP felt it was important to apply the regional assessment criteria (IUCN 2003) to each of the four subpopulations of the species. The IUCN uses the word "regional" to indicate any "subglobal geographical area such as a continent, country, state, or province." While the term "subpopulation" is defined differently by the IUCN, in this report "subpopulation" refers to one of the four Florida manatee subpopulations recognized by the USFWS (2001). The definition of "regional population" is "the portion of the global population within the area being studied; which may comprise one or more subpopulations."

Regional Assessments consist of a two-step process. Step one applies the five criteria to the regional population. Step two assesses the impacts of other regions on the Florida manatee subpopulation under evaluation. This process allows for an adjustment of the imperilment level if the other subpopulations impact the extinction risk of the subpopulation under evaluation.

This evaluation is provided solely to highlight areas of particular relevance for conservation managers as they develop a management plan for the species under Phase II of the state of Florida's imperiled species listing process. It does not change the statewide Florida manatee population's listing status but the BRP felt strongly that it was important to include in the BSR. The following is a brief overview of the BRP findings and is summarized in Table 5.

Step One, Criteria Assessment

Northwest Subpopulation

Criterion A – There was no evidence of a past decline in the last 50 years but a 95% confidence interval included a 30% decline within the next 3 generations based on an index of abundance and a decline in area of occupancy and/or quality of habitat. The BRP determined that **the Northwest subpopulation qualifies as Species of Special Concern under Criterion A**.

Criterion B – The warm water aggregation sites in the Northwest subpopulation are smaller than 200mi^2; in addition subcriterion (1) was met -- there are only four known winter aggregation sites in the subpopulation and subcriterion (2c) was met -- a continuing decline in the area, extent and/or quality of habitat is inferred. Therefore **the Northwest subpopulation meets the Threatened category under Criterion B**.

Criterion C – The subpopulation is smaller than 250 mature individuals and there is a projected decline of 20% in two generations. Additionally, because the entire subpopulation is in the region, it meets the subcriterion that more than 90% of the individuals are in the subpopulation. There is no evidence for extreme fluctuation in the number of mature individuals. Although the population size met the criterion for EN, the species did not meet the sub-criterion of a projected decline of 25% in one generation to qualify as Endangered. However it did meet all the sub-criteria for Threatened. The BRP agreed that the **Northwest subpopulation meets the definition of Threatened under Criterion C**.

Criterion D – The number of mature individuals is less than 250 so the **Northwest subpopulation met the Threatened listing category under criterion D.**

Criterion E – The Northwest subpopulation was projected to have a 0.062% risk of extinction in the next 100 years and **does not meet this criterion**.

Upper St. Johns Subpopulation

Criterion A –There is no evidence for a past or future decline in three generations so the **USJ subpopulation does not meet this criterion**.

Criterion B – Extent of occurrence is less than 2000 mi^2 and the area of occupancy is confined to Blue Spring which covers an area less than $4mi^2$. In addition, the population aggregates at one location in the winter and the extent and quality of habitat is inferred to decline in the future. The BRP determined that **the USJ subpopulation qualifies as Endangered under Criterion B**.

Criterion C – The USJ subpopulation is comprised of approximately 100 mature individuals. There is no evidence to support a past or future reduction in the population size; however, >90% of the animals are located in the subpopulation. The BRP determined that the **USJ subpopulation qualifies as Endangered under Criterion C**.

Criterion D – The USJ subpopulation is comprised of approximately 100 mature individuals. **The USJ subpopulation meets Criterion D as Threatened**.

Criterion E— The USJ subpopulation was projected to have a <0.02% risk of extinction in the next 100 years and **does not meet this criterion**.

Atlantic Subpopulation

Criterion A – There is no evidence of a past decline in the last 50 years in the Atlantic subpopulation but a 95% confidence interval includes a 50% decline within the next three generations. The BRP determined that the **Atlantic subpopulation should be listed as Threatened under Criterion A**.

Criterion B – The extent of occurrence is less than $7700mi^2$ and the area of occupancy is less than $200mi^2$. The subpopulation also met the sub-criteria of severely fragmented and an inferred decline in area of occupancy, extent and quality of habitat, number of locations, and number of mature individuals. The BRP determined that the Atlantic subpopulation meets the requirements for listing as **Species of Special Concern under Criterion B**.

Criterion C – The Atlantic subpopulation is comprised of less than 1000 mature individuals. There is a projected decline of 20% in the population size in the next two generations. The BRP determined that the **Atlantic subpopulation qualifies as Threatened under Criterion C**.

Criterion D – The Atlantic subpopulation is comprised of less than 1000 mature individuals and the area of occupancy is no more than the statewide estimate of $100\text{-}300mi^2$. **The Atlantic subpopulation meets Criterion D as Species of Special Concern.**

Criterion E – The Atlantic subpopulation was projected to have a <0.04% risk of extinction in the next 100 years and **does not meet this criterion**.

Southwest Subpopulation

Criterion A –There is no evidence of a past decline in the last 50 years in the Southwest subpopulation but a 95% confidence interval includes an 80% decline within the next three generations. The BRP determined that **the Southwest subpopulation should be listed as Endangered under Criterion A**.

Criterion B – The extent of occurrence is less than 7700mi^2 and the area of occupancy is less than 200mi^2. However, the subpopulation only met the sub-criteria of a continuing decline in area of occupancy. The BRP determined that the **Southwest subpopulation does not meet the requirements for listing under Criterion B**.

Criterion C – The Southwest subpopulation is comprised of less than 1000 mature individuals. There is a projected decline of 20% in the population size in the next two generations. The BRP determined that **the Southwest subpopulation qualifies as Threatened under Criterion C**.

Criterion D – The Southwest subpopulation is comprised of less than 1000 mature individuals. **The Southwest subpopulation meets Criterion D as Species of Special Concern.**

Criterion E – The Southwest subpopulation was projected to have an 11.9% risk of extinction in the next 100 years and **meets criterion E as Species of Special Concern**.

<u>Step Two, Impact of other subpopulations on extinction risk</u>

Following the assessment procedure described in the Guidelines for Application of IUCN Red List Criteria at Regional Levels Version 3.0 (IUCN 2003), we evaluated the potential for the four subpopulations to impact the extinction risk of each of the other subpopulations of the Florida manatee. This discussion, process used, and outcome were similar for each of the four subpopulations and are summarized here. Following Figure 2 in the guidelines, question 2a asks if the taxon is a non-breeding visitor. The manatee resides in and breeds in all four subpopulations or regions, therefore, the answer was no. The following question, 2b, then asks if the region experiences any significant immigration of other manatees capable of reproducing in the region. Manatees are known to move between regions during the warmer season so the answer to 2b is yes. The next question, 2c then asks if the immigration is expected to decrease. The BRP concluded that we did not know due to, among other things, future impacts of loss of warm water, or red tide. Question 2d asks if the regional population is a sink and the answer for each of the subpopulations was no. As a result, it was determined that there would be no change in the listing category from step one of the regional assessment for any of the subpopulations.

Summary of subpopulation regional assessment

This regional assessment of manatee subpopulations in Florida highlighted several areas for managers to address in the manatee management plan. The BRP found that the Northwest subpopulation is Threatened due to small area of occupancy, a projected decline in warm-water habitat, a population of less than 250 mature individuals, and a projected population decline. The USJ subpopulation is Endangered because of the small population size and the small number of locations (Blue Spring) where manatees aggregate in the region. The Atlantic subpopulation is Threatened because it's mature population numbers less than 1,000 and there is a projected decline in the future. Finally, the Southwest subpopulation is Endangered because an 80%

decline in the population was projected over three generations. Different risks among the subpopulations were captured using the five listing criteria; the USJ subpopulation is at risk due to its small size and the small number of locations it inhabits, while the Southwest subpopulation has a high projected decline due to the combination of threats it faces in the region.

Table 5. Summary of regional analysis of Florida manatee subpopulations against listing criteria.

	Subpopulation				
	Northwest	**Southwest**	**Atlantic**	**Upper St. Johns**	**Entire Population**
Criterion A1	N/A	N/A	N/A	N/A	N/A
Criterion A 2	Species of Special Concern	**Endangered**	**Threatened**	N/A	**Threatened**
Criterion A 3	N/A	N/A	N/A	N/A	N/A
Criterion A 4	N/A	N/A	N/A	N/A	N/A
Criterion B	**Threatened**	N/A	Species of Special Concern	**Endangered**	N/A
Criterion C	**Threatened**	Threatened	**Threatened**	**Endangered**	**Threatened**
Criterion D	**Threatened**	Species of Special Concern	Species of Special Concern	Threatened	
Criterion E	N/A	Species of Special Concern	N/A	N/A	N/A

SUMMARY OF THE INDEPENDENT REVIEW:

Four scientists provided independent review of the preliminary BSR. These reviews are provided in Appendix I.

Dr. Conroy, Dr. Ragen and Dr. Marsh agreed that the BRP gave the proper recommendation under the State of Florida's listing process. Dr. Pollock stated that the status assessment is subject to great uncertainty but that he liked the use of the precautionary principle.

Positive Comments:

- The conclusions of the preliminary status review do not surprise me. In aggregate, the available data provide good evidence that the total Florida manatee population has grown over recent decades and the increase in numbers appears to provide a buffer of sorts from the risk of extinction.
- As a scientist with a background in computer modeling of marine mammal population dynamics, I have a large degree of confidence in this core model.
- I like the use of the precautionary principle
- I think the Runge *et al*., 2004 model is a great approach
- I would like to congratulate you and your team for the generally high standard of the documentation forwarded to me.
- I found the section on biological information and data analyses to be comprehensive and largely accurate
- I agreed with the rationale for and conclusions regarding the statewide assessment
- In general, the BSR is based on comprehensive and up-to-date synthesis of data, estimates, and projections.
- In contrast to the VORTEX-based PVAs, the current modeling approach is customized to both the life history of manatees, and the peculiarities of the data that are available to parameterize the model. This combination of improved statistical modeling, and more realistic modeling of population response, is enabling biologists to better characterize the likely response of manatee populations to environmental, demographic, and human impacts.
- I am encouraged by the recent modeling efforts by Runge (2003), Runge *et al.*, (2004), and Runge *et al*., (in prep). These all seem to be based on the best use of available data, and generally do a good job of incorporating known and anticipated sources of uncertainty.
- *Previous trend:* "…counts are affected by numerous uncontrolled variables that limit their usefulness as reliable indices of population size (Lefebvre *et al*., 1995)." This is an absolutely essential point, with which I strongly concur.

General Comments and Concerns

A criticism of the preliminary report by most reviewers was that the description of the core biological model was inadequate for the reviewers to properly evaluate.

In response to these comments, we have added additional description of the model to this report. Two of the models upon which the core biological model was built have been peer reviewed previously (FWC 2002b; Runge et al 2004). A more detailed description of this model will be submitted for publication.

Several reviewers stated that the report should include more information about data sources, strengths and weaknesses of the datasets and the model, that the text should be better organized, and should be made more accessible to readers outside of the manatee scientific community.

To address this, the biological information section was expanded to be more comprehensive. A description of data sources was added to the biological status assessment information section. A description of the population forecasting model was added.

<u>Further comments included:</u>

- Insert summary of sub-population characteristics.
  A summary of subpopulation characteristics was added.

- Provide a list of threats in a table
  Threats were further described but not prioritized in a table.

- More adequate referencing in text
  This was done

- Treat sub-population estimate more robustly by calculating from several high synoptic counts instead of just one. Create a table for range of values.
  We conducted a sensitivity analysis of key metrics to variation in the value of the initial population size (from 10% reduction to 25% increase). Probability of extinction was almost completely insensitive to the initial states, while the probability of reduction in regional population size was sensitive only in the Atlantic and Southwest. State-wide, only reductions in population size of 30% or less in two or more generations were sensitive to initial state; larger reductions, or those over only one generation were relatively insensitive. This sensitivity analysis did not cast any doubt for the BRP on their recommended listing classification.

- Use suggested methodology for calculating AO and EO as described in the IUCN Guidelines
  FWC developed the methodology for AO based on our understanding of manatee movements on the coldest days of the year. This methodology was used previously by Flamm et al. (2001) to map relative abundance of manatees. The IUCN guidelines refer to scale issues and had we applied the 2km grid methodology they recommend, our AO and EO likely would have been larger. However, because the manatee did not qualify for listing under any of the criteria for AO and EO, and therefore, applying the IUCN methodology would not have altered the recommendation, we did not re-analyze these two parameters.

- Drop Regional Assessment section or provide more information about the conclusions reached.

  The manatee BRP felt strongly that this section should remain in the biological status review. We have provided further description of the process used to reach the recommendations. Again, the BRP provided this assessment to highlight issues that FWC staff should consider when they develop the manatee management plan in Phase II of the listing process.

- Move up table describing differences in IUCN, USFWS, and FWC

  This was done

- Put tables and figures within the text

  This was done

- Beef up intro to address extinction risk versus conservation priority and development of management plan

  In the first paragraph of the Introduction description of the State of Florida's Imperiled Species process, we have included an explanation of the purpose of phase I and how it is separate from development of a management plan (Phase II of the listing process).

- Convert all figures to miles to be consistent

- Three specific areas that more work is needed in or for which further cautionary remarks are called for or both:
  - Inferences from carcass recovery data
  - Inferences from synoptic population counts
  - Inferences from so-called PVA models

  The BRP agrees and efforts are underway by FWC and other scientists to improve our methods.

- Strongly recommend that the BSR avoid reliance on earlier analysis in VORTEX

  In the preliminary BSR, VORTEX results from the FWC 2002b PVA were used solely to determine age distribution. In this final report, we recalculated age distribution using a matrix approach and have dropped analyses formerly conducted in VORTEX for the statewide assessment.

- "…..have a long time series on causes of death…… mostly attributable to human-related causes". – This evidence is based solely on carcass recoveries, here uncorrected for recovery probability. As noted above, this could result in serious biases in proportion of mortality due to this causative factor.

  This paragraph was modified and included in a more comprehensive description of carcass mortality data in the "data sources" section. This section comments on biases associated with this dataset.

- "…..approximately 25% of all manatee deaths" should perhaps be modified to

"approximately 25% of all *documented* manatee deaths".

S*tatements were modified throughout the review to reflect that mortality numbers are those documented as we do not know how many carcasses are undetected.*

- What is the evidence that reduced boat speed effectively reduces manatee mortality? Are there any data, either experimental or observational, on mortality rates in areas subject to different speed limits?

  Efforts are currently underway by FWC and USFWS to evaluate this question. Laist and Shaw (2006) provided preliminary evidence for a decline in watercraft-related deaths following establishment of speed zones; however, a longer time series of data and more comprehensive analysis is required to determine if this pattern is valid. There are currently no data available on mortality rates in areas subject to different speed limits.

- It is obviously tricky here to make inferences about the general population, given that these data are by definition conditional on the individual having been struck at least once. Presumably, however, the scar data could be used via capture-recapture to estimate abundance, and thus (indirectly) the proportion of manatees bearing scarred (fraction of N that is marked). Has this been done?

  No, we have highlighted this in the new data sources section describing the photo identification program. Because it is unknown how many individuals are un-scarred, we cannot estimate population size from the current photo-identification program.

- *Previous trend:* "…counts are affected by numerous uncontrolled variables that limit their usefulness as reliable indices of population size (Lefebvre et al. 1995)." This is an absolutely essential point, with which I strongly concur.

- *Trends in counts vs. model projections*: Could some of the discrepancy be due to changes in the degree of aggregation around power plants, resulting in changes in availability/ detection rates?

  It is possible that these changes are occurring but further preliminary comparisons of these two methodologies indicates that the discrepancy between the two methods may be smaller than originally thought.

- Next Par: Presumably these are projections, not observed growth. Nevertheless, given the difficulties with surveys and detection issues, these projections (with caveats) may provide the best long-term view of population health.

- Page 10, *Future projections* .. "10.3 % increase per year in water-related deaths". Presumably, this is an increase in the *number* of manatees killed (assumptions about classification and recovery rates notwithstanding). If abundance is also increasing, this increase would be expected, even if mortality *rates* were level. Therefore, there is a need to express this as a per-capita rate, ideally looking at proportion of mortality rate accounted for by boating.

  We have replaced the original sentence in the text. However, yes, this represents an increase in the number of manatees killed by watercraft, reported, and recovered. If

abundance or reporting/recovery rate are increasing, then the number of recovered carcasses would be expected to increase even if mortality rate were constant. Given the lack of information on carcass recovery rate and synoptic survey detection rates, we cannot directly estimate a per-capita mortality rate from these data. We can address this indirectly for adults, however, by setting mortality rate = 1.0 - survival rate (estimated from photo-identification) and then apportioning the mortality fraction by cause of death category.

- *Population size and numbers "* Because detection probability varies greatly with weather conditions and across sites, population experts have consistently cautioned against using these data for trend analyses". It would be nice if, instead of continually having to apologize for this fact, appropriate surveys/ estimators were actually available!

  We agree and work is underway to develop a new survey design that addresses these concerns.

- Next par: "This is the only subpopulation with an independent set of data to assess abundance and trends". Were these data independently collected, or just analyzed independently (via temperature corrections)?

  These data were independently collected by J. Reynolds during aerial survey flights he has conducted for more than 20 years. The text has been modified to reflect this.

- Address stability of age distribution

  Subsequent analysis of changes in age distribution during simulations using the CBM show the numbers of older individuals increasing relative to younger animals during the first 25 years, followed by a generally stable distribution.

- Give range of values for mature population

  Addressed on p. 21

- Age composition. Presumably, this is based on age-specific survival and recruitment estimates. If so, what's the source for these estimates (not VORTEX!)? Why not directly use a matrix projection model, instead of VORTEX?

  We analyzed age composition as suggested, using a matrix projection model. We have revised the text to reflect the change in analysis and results.

- Page 12, last sentence: Lack of a precision estimate is a different issue. If detection =1, then we'd still assume that on average the synoptic count C represents N (but because of sampling variance any individual estimate might be < N or >N). If detection <1 (as it almost certainly is) then we expect on average C<N.

  Addressed on p. 21

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Appendix A: Manatee Biological Review Panel Brief Bios

Elsa M. Haubold, Ph.D., is the program administrator for marine mammal research in the wildlife research section at the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWC-FWRI). She has overseen that program for almost four years and was also administrator for the FWC sea turtle research program for three of those years. Haubold currently serves as a member of the steering committee of the U.S. Fish and Wildlife Service (USFWS) Florida manatee recovery and implementation team, and as co-chair of its manatee population status working group. She was the project manager for the FWC biological status review of the Florida manatee completed in 2003. Recently, she has served as a member of the Manatee Forum planning team, helping to coordinate meeting agendas relating to research and enlisting scientists to participate as speakers and expert resources.

Dawn Jennings has worked as a biologist for USFWS both in Florida and Colorado for 26 years. While serving in the USFWS's research program, she studied the ecological effects of introduced, non-native species on the behavioral ecology and environmental physiology of native populations. She also served as research liaison for USFWS's Southeast and Southwest regions to integrate fish and wildlife management needs with research activities. For the past nine years she has served in USFWS's Ecological Services Program as a senior biologist working on threatened and endangered species conservation and recovery issues. As leader of the Recovery, Listing and Candidate Conservation Program in Vero Beach, she coordinated the development of the South Florida Multi-Species Recovery Plan for 68 threatened and endangered species, and a landscape conservation strategy for the Florida panther. She is currently serving as the endangered species special assistant for the Jacksonville field office to handle science, policy and litigation issues. She is actively working on manatee conservation and recovery issues as chair of the Manatee Recovery and Implementation Team's steering committee, co-chair of the Recovery Team's Population Status working group and as a service planning representative for the manatee forums.

Jane Packard, Ph.D., is an associate professor of Wildlife and Fisheries Sciences and Director of the Ethology Laboratory at Texas A&M University. After completing a Ph.D. in Ecology and Behavioral Biology at the University of Minnesota, Dr. Packard conducted postdoctoral research on marine mammals at the Florida Cooperative Research Unit at the University of Florida and served on the Committee of Scientific Advisors to the U.S. Marine Mammal Commission. Her teaching interests include behavioral ecology, vertebrate ethology, and conservation biology. Her research interests include conditional strategies of parental care in mammals, collaboration with secondary school teachers to develop and use animal behavior exercises to illustrate the scientific method, and Biodiversity Stewardship. Projects currently being conducted in her lab are trends in distribution and abundance of river otters in northeastern Texas and communication and behavioral ecology of manatees in the Drowned Cayes, Belize. Dr. Packard has more than 75 scientific publications and just recently completed a term as an Elected Member of the Board of Governors in the Society for Conservation Biology.

Jane Provancha received a B.S., in biological science from the University of Central Florida (UCF) in 1978 with additional graduate studies in zoology at UCF. She has 25 years experience working in Florida coastal habitats with a primary interest in wildlife ecology. Her experience ranges from field science and data management, to staff management, contracting, and marketing. She has worked on numerous projects involving fish, reptiles, birds, terrestrial and marine mammals, seagrass, and water quality. She has extensive experience in the conduct and design of ecological surveys and environmental monitoring projects, particularly in reference to threatened and endangered species. For her work with Kennedy Space Center's ecological program, she maintains a liaison position with federal and state regulatory agencies and continues collaborations with researchers from other agencies and organizations. Since 1984 she has been principal investigator on several long term projects including tracking trends in manatee abundance, distribution and foraging in the northern Banana River. She has coordinated a sea turtle and marine mammal stranding and salvage network in Brevard County. She has presented scientific data at numerous national and international conferences and published on a wide variety of ecological subjects. She was president of a small business, providing ecological services in the Port Canaveral area, related to monitoring impacts on manatees, whales and sea turtles. Provancha has performed as program manager for 8 years managing costs, projects and staff on environmental services contracts for USACE, USFWS, USAF, the state of Florida, and others. She currently manages Dynamac's Florida operations office.

Michael C. Runge, Ph.D., is a research ecologist at the U.S. Geological Survey's Patuxent Wildlife Research Center in Laurel, MD. His research emphasis is on the use of quantitative methods in wildlife management decision making, with particular focus on population modeling and adaptive management. Recent and current projects include analysis of population dynamics of ducks, evaluation of grassland management on national wildlife refuges and development of adaptive management approaches for threatened and endangered species. Runge has led development of the state-of-the-art population models for Florida manatees, including a stage-based model for retrospective assessment (Runge *et al.* 2004) and a forecasting model for analysis of incidental take (Runge 2003). He is leading development of the core biological model, a collaborative effort between USGS and FWC-FWRI, to develop a flexible manatee population model for assessment.

June 2005

Appendix B.

68A-27.0012 Procedures for Listing, Delisting and Reclassifying Endangered, Threatened and Species of Special Concern.

(1) Petition to list, delist, or reclassify a species in Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C.

(a) Persons wishing to add, delete or reclassify species in Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C., shall submit a written petition to the Commission. Petitions will be reviewed for completeness from July 1 through December 31.

(b) Petitions shall be clearly identified as such, and must contain the following in order to be considered complete:

1. The rule to which the species is proposed to be added, removed from, or reclassified to,
2. The name, address, and signature of the petitioner, and
3. Sufficient information on the biology and distribution of the species to warrant investigation of its status using the criteria contained in definitions of endangered, threatened, or species of special concern in Rule 68A-1.004, F.A.C.

(c) Incomplete petitions will be returned to the petitioner with insufficiencies clearly noted in writing. Corrected petitions may be resubmitted for consideration.

(d) Complete petitions will be evaluated in accordance with the provisions in subsection (2).

(e) Emergency petitions may be submitted at any time and, if in the opinion of the Executive Director, immediate inclusion of a species in Rule 68A-27.003, F.A.C., is essential to prevent imminent extinction, such listing may be effected on a temporary basis by Executive Order; provided that the Executive Order shall be approved or terminated at the next regularly scheduled meeting of the Commission. Commission staff shall, within 365 days after the effective date of such approval, conduct the evaluations prescribed in subsections (2) and (3) of this rule to determine the appropriate final classification of the species. The Commission shall take final action on the listing at the next regularly scheduled meeting following the 365 day evaluation period.

(f) Notwithstanding the provisions contained in this paragraph, these procedures shall not be applied to harvested marine species that: would only meet the listing criteria in Rule 68A-1.004, F.A.C., due to declines caused by either recreational harvest, commercial harvest, or both; that are monitored through periodic stock assessments or other techniques; that are the subject of any rule in Title 68B, F.A.C., that allows harvest; and that have a management plan or other system of rules and processes that functions as a management plan.

(2) Review of petitions to determine biological status; Phase 1.

(a) The Commission shall establish an annual work plan for investigating pending complete petitions, considering conservation priorities and available resources. The work plan shall establish a deadline for completion of each biological status review. Complete petitions not identified for staff action will be reconsidered with new complete petitions each subsequent year.

(b) The Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a solicitation of information on the biological status of the petitioned species. Written comments regarding biological status shall be accepted by the Commission for a period of no less than 45 days following public notice.

(c) Staff shall recommend and the Commission shall designate a biological review panel of scientists with demonstrated knowledge of species conservation and management that consists of an odd number of three to seven members. The biological review panel shall summarize information provided in the petition, information obtained from the public, and other available biological data on the status of the petitioned species into a biological status report. When assessing a species, this panel shall follow “Guidelines for Application of IUCN Red List Criteria at Regional Levels Version 3.0” and “Guidelines for Using the IUCN Red List Categories and Criteria, March 2004.” The biological status report shall contain a listing classification based on the IUCN guidelines and criteria in Rule 68A-1.004, F.A.C. In addition, the panel may provide within the report a biologically justified recommended classification which differs from the criteria-based classification by one level.

(d) Staff shall seek a minimum of three independent scientific reviews focused on the science used in the biological status report, including methodology, data, analysis, and interpretation. Reviewers will be provided no less than 45 days to comment on the biological status report.

(e) The Commission shall consider the biological status report, independent scientific reviews received, and public comments regarding the biological status in making a final determination whether addition, deletion or reclassification of the petitioned species in Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C., is warranted.

(f) If the petitioned species is determined by the Commission to warrant inclusion in or removal from Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C., the Commission shall:

1. Specify the appropriate listing category for the species based on biological status.
2. Establish a deadline for completion of Phase 2 for the species as described in subsection (3) below, considering the recommendation of Commission employees and other interested parties.
3. If the species is not already listed in Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C., it shall be added to the list of candidate species in Rule 68A-27.0021, F.A.C., and the protective provisions therein shall apply to the species.

(3) Development of management plans; Phase 2.

(a) Phase 2 will be initiated subsequent to Commission action pursuant to subsection (2) except for a decision not to list a previously unlisted species. Within 45 days following the Commission meeting, the Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a solicitation of information on the conservation needs of the species, and any economic and social factors that should be considered in its management.

(b) The Commission shall use information obtained from the public and other available information to develop a draft management plan for each species described in paragraph (3)(a) of this rule section. This draft plan shall at a minimum address:

1. Biological status as determined in Phase 1,
2. Conservation objectives,
3. Recommended management actions,
4. Recommended regulations and incentives,
5. Anticipated economic, ecological, and social impacts of implementing or not implementing the recommended conservation actions.

(c) The Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a notice of the availability of the draft management plan. Written comments regarding conservation recommendations and expected economic and social impacts of implementation of the management plan shall be accepted by the Commission for a period of no less than 45 days following public notice.

(d) Final Commission action on the petition shall include:

1. Deletion of the species from Rule 68A-27.0021, F.A.C., if appropriate, and addition to and/or deletion from Rule 68A-27.003, 68A-27.004, or 68A-27.005, F.A.C., in accordance with the determination made in subsection (2) of this rule.
2. A determination on any proposed regulations in the management plan.

Specific Authority Art. IV, Sec. 9, Fla. Const. Law Implemented Art. IV, Sec. 9, Fla. Const. History–New 6-23-99, Formerly 39-27.0012, Amended 7-1-03, 5-26-05.

Appendix C.

68A-1.004 Definitions.

(26) Direct take – Intentionally pursuing, hunting, capturing, killing, or destroying fish or wildlife or the nests, eggs, homes or dens of fish or wildlife.

(27) Endangered species – As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is so few or depleted in number or so restricted in range or habitat due to any man-made or natural factors that it is in imminent danger of extinction, or extirpation from Florida, as determined by paragraph (a), (b), (c), (d), or (e) below in accordance with Rule 68A-27.0012, F.A.C.

(a) Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of at least 80% over the previous ten years or three generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on (and specifying) any of the following:
   a. Direct observation,
   b. An index of abundance appropriate for the taxon,
   c. A decline in area of occupancy, extent of occurrence, or quality of habitat,
   d. Actual or potential levels of exploitation,
   e. The effects of introduced taxa, hybridization, pathogens, pollutants, competitors, or parasites.
2. A population size reduction of at least 80%, projected or suspected to be met within the next ten years or three generations, whichever is longer (up to a maximum of 100 years), based on (and specifying) any of subparagraph 1.b., 1.c., 1.d., or 1.e. above.
3. An observed, estimated, inferred, projected, or suspected population size reduction of at least 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both past and future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.
4. An observed, estimated, inferred, or suspected population size reduction of at least 90% over the last 10 years or three generations, whichever is longer, where the causes of reduction are clearly reversible and understood and ceased, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.

(b) Geographic range in the form of either extent of occurrence estimated to be less than 40 square miles or area of occupancy estimated to be less than 4 square miles, and estimates indicating any two of the following:

1. Severely fragmented or known to exist at only a single location.
2. Continuing decline, observed, inferred or projected, in any of the following:
   a. Extent of occurrence
   b. Area of occupancy
   c. Area, extent, and/or quality of habitat
   d. Number of locations or subpopulations
   e. Number of mature individuals
3. Extreme fluctuations in any of the following:
   a. Extent of occurrence
   b. Area of occupancy
   c. Number of locations or subpopulations
   d. Number of mature individuals

(c) Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer (up to a maximum of 100 years in the future), or

2. A continuing decline, observed, projected or inferred, in numbers of mature individuals and at least one of the following:
    a. Population structure in the form of either no subpopulation estimated to contain more than 50 mature individuals, or at least 90% of mature individuals in one subpopulation.
    b. Extreme fluctuations in number of mature individuals.

(d) Population size estimated to number less than 50 mature individuals.

(e) Quantitative analysis showing the probability of extinction in the wild is at least 50% within ten years or three generations, whichever is longer (up to a maximum of 100 years).

(74) Species of special concern – As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is facing a moderate risk of extinction, or extirpation from Florida, in the future, as determined by paragraph (a), (b), (c), (d), or (e) below in accordance with Rule 68A-27.0012, F.A.C.

(a) Reduction in population size based on any of the following:
1. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last ten years or three generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on (and specifying) any of the following:
    a. Direct observation.
    b. An index of abundance appropriate for the taxon.
    c. A decline in area of occupancy, extent of occurrence, and/or quality of habitat.
    d. Actual or potential levels of exploitation.
    e. The effects of introduced taxa, hybridization, pathogens, pollutants, competitors, or parasites.
2. A population size reduction of at least 30%, projected or suspected to be met within the next ten years or three generations, whichever is longer (up to a maximum of 100 years), based on (and specifying) any of subparagraph 1.b., 1.c., 1.d., or 1.e. above.
3. An observed, estimated, inferred, projected, or suspected population size reduction of at least 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both past and future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.
4. An observed, estimated, inferred, or suspected population size reduction of at least 50% over the last 10 years or three generations, whichever is longer, where the causes of reduction are clearly understood and reversible and ceased, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.

(b) Geographic range in the form of either extent of occurrence estimated to be less than 7,700 square miles or area of occupancy estimated to be less than 770 square miles, and estimates indicating any two of the following:
1. Severely fragmented or known to exist at no more than 10 locations.
2. Continuing decline, observed, inferred or projected, in any of the following:
    a. Extent of occurrence.
    b. Area of occupancy.
    c. Area, extent, and/or quality of habitat.
    d. Number of locations or subpopulations.
    e. Number of mature individuals.
3. Extreme fluctuations in any of the following:
    a. Extent of occurrence.
    b. Area of occupancy.
    c. Number of locations or subpopulations.
    d. Number of mature individuals.

(c) Population size estimated to number fewer than 10,000 mature individuals and either:
1. An estimated continuing decline of at least 10% within ten years or three generations, whichever is longer (up to a maximum of 100 years in the future); or

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and at least one of the following:
    a. Population structure in the form of either no subpopulations estimated to contain more than 1,000 mature individuals, or all mature individuals are in one subpopulation.
    b. Extreme fluctuations in number of mature individuals.

(d) Population very small or restricted in the form of either of the following:
1. Population size estimated to number fewer than 1,000 mature individuals.
2. Population with a very restricted area of occupancy (typically less than 8 square miles) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future.

(e) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

(77) Take – The term shall include taking, attempting to take, pursuing, hunting, molesting, capturing, or killing any wildlife or freshwater fish, or their nests or eggs by any means whether or not such actions result in obtaining possession of such wildlife or freshwater fish or their nests or eggs.

(78) Threatened species – As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is facing a very high risk of extinction, or extirpation from Florida, in the future, as determined by paragraph (a),(b), (c), (d), or (e) below in accordance with Rule 68A-27.0012, F.A.C.:

(a) Reduction in population size based on any of the following:
1. An observed, estimated, inferred, or suspected population size reduction of at least 50% over the last ten years or three generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on (and specifying) any of the following:
    a. Direct observation
    b. An index of abundance appropriate for the taxon
    c. A decline in area of occupancy, extent of occurrence, and/or quality of habitat
    d. Actual or potential levels of exploitation
    e. The effects of introduced taxa, hybridization, pathogens, pollutants, competitors, or parasites
2. A population size reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is longer, (up to a maximum of 100 years), based on (and specifying) any of subparagraph 1.b., 1.c., 1.d. or 1.e. above.
3. An observed, estimated, inferred, projected, or suspected population size reduction of at least 50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both past and future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.
4. An observed, estimated, inferred, or suspected population size reduction of at least 70% over the last 10 years or three generations, whichever is longer, where the causes of reduction are clearly understood and reversible and ceased, based on (and specifying) any of subparagraph 1.a., 1.b., 1.c., 1.d., or 1.e. above.

(b) Geographic range in the form of either extent of occurrence estimated to be less than 2,000 square miles or area of occupancy estimated to be less than 200 square miles, and estimates indicating any two of the following:
1. Severely fragmented or known to exist at no more than five locations.
2. Continuing decline, observed, inferred or projected, in any of the following:
    a. Extent of occurrence
    b. Area of occupancy
    c. Area, extent, and/or quality of habitat
    d. Number of locations or subpopulations
    e. Number of mature individuals

3. Extreme fluctuations in any of the following:
    a. Extent of occurrence
    b. Area of occupancy
    c. Number of locations or subpopulations
    d. Number of mature individuals

(c) Population size estimated to number fewer than 2,500 mature individuals and either:
1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer (up to a maximum of 100 years in the future); or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and at least one of the following:
    a. Population structure in the form of either no subpopulation estimated to contain more than 250 mature individuals, or at least 95% of mature individuals in one subpopulation
    b. Extreme fluctuations in number of mature individuals

(d) Population size estimated to number fewer than 250 mature individuals.

(e) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is longer (up to a maximum of 100 years).

Appendix D: Abbreviations

AO – area of occupancy

BRP – biological review panel

CBM – core biological model

CCA – Coastal Conservation Association

EN – endangered

EO – extent of occurrence

FAC – Florida Administrative Code

FWC – Florida Fish and Wildlife Conservation Commission

FWRI – Fish and Wildlife Research Institute

GIS – Geographic Information System

PVA – population viability analysis

SAV – submerged aquatic vegetation

SC – species of special concern

TH – threatened

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

USJ – Upper St Johns subpopulation

Appendix E: Glossary

Area of Occupancy: The area within the extent of occurrence that is occupied by the taxon, excluding sites to which individuals may have strayed by accident. This measure reflects the fact that a taxon does not usually occupy its entire EOO and that the range of that taxon may contain unsuitable or unoccupied habitats.

Estimated information: Information that is based on calculations that may involve: (1) statistical assumptions (2) biological assumptions about the relationship between variables or (3) interpolation in time to calculate the variable of interest

Extent of Occurrence: The area contained within the shortest continuous imaginary boundary which encompasses all the known, inferred or projected sites of the present occurrence of a taxon, excluding sites to which individuals may have strayed by accident.

Extreme fluctuations: Temporal variation where population size or the area of distribution varies widely, rapidly and frequently; typically with a variation greater than a tenfold increase or decrease.

Generation length: The average age of parents of the current cohort (i.e., newborn individuals in the population).

Inferred information: Information based on indirect evidence (i.e., variables that are indirectly related to the variable of interest, but are in the same general type of units).

Location: A geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals present.

Mature individuals: The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction.

Observed information: Information directly based on well-documented observations of all known individuals in the population.

Projected information: The same as “estimated” information, but the variable of interest is extrapolated in time towards the future.

Population: The total number of individuals of a given taxon.

Population size: The number of mature individuals.

Severely fragmented: describing a population whereby most of its individuals are found in small and relatively isolated subpopulations. These subpopulations may go extinct, with a low probability of recolonization.

Stochasticity: describing phenomena which are random, or occurring probabilistically.

Subpopulation: refers to one of the four Florida manatee subpopulations recognized by the USFWS (2001).

Save the Manatee® Club
The Voice For Manatees For More Than 20 Years

August 18, 2005

Dr. Elsa Haubold
Florida Fish & Wildlife Conservation Commission
Fish and Wildlife Research Institute
100 8th Avenue, Southeast
St. Petersburg, FL 33701

Re: Request for Written Comments on the Manatee's Biological Status

Dear Dr. Haubold:

Save the Manatee Club (SMC) remains extremely concerned about the sole use of IUCN criteria to determine the biological status of the manatee. We will continue to oppose the Florida categories of imperilment remaining mismatched with the IUCN categories (making IUCN's "endangered" equal to FWCC's "threatened"), and assert that this is a gross misapplication of IUCN standards on the part of the FWCC. The agency continues to stand by this misapplication despite the loud and sustained protestations of the environmental community and testimony from scientists, some of whom actually helped to develop the criteria for IUCN. Not to change the categories along with the definitions - even though this will likely result in the downlisting or delisting of manatees and numerous other native species - greatly appalls us. This has nothing to do with ensuring the recovery of the manatee and everything to do with removing manatees as an impediment to the full-scale development of Florida's coastline and the profits that will ensue.

Under the newly amended criteria, it appears likely that manatees stand a good chance of being delisted altogether. This is absurd as, according to your agency's own scientific data, of the four sub-populations of manatees, one sub-population (Southwest Florida) is probably already declining. The East Coast sub-population is too close to call - they may be stable or slightly declining or slightly increasing. As you know, these two sub-populations comprise the largest segment (about 84%) of the manatee population.

One of the many troubling aspects of adopting the IUCN listing criteria (regardless of the inexplicable misalignment of the categories) is what happens when they are used as downlisting criteria. For instance, take the example of a species that is currently listed as "endangered" and is being considered for downlisting to "threatened." This species has been protected by law for some period of time and its population has held on for several years, although in some parts of its range it may be declining slightly. In order to retain its endangered status, the species would have to be declining by 80 percent (with all the other caveats pertaining to generation time, etc.), which it clearly is not, even though it is not

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recovering and the threats to its survival are increasing. Because it meets the criteria, it is downlisted. As the threats increase, the population struggles and is probably declining at some rate. But the state receives yet another petition to review this species' biological status and since the decline is less than 50%, the species is downlisted to "species of special concern." In the next go-round it is delisted. This scenario, or a similar one, could actually play out for many species, including manatees, right whales, all Florida's sea turtles, black bears, and panthers. Their legal status is the only thing protecting them from serious further declines! And the fact that anyone can petition for downlisting, no matter how flimsy their supporting documentation, takes this into the realm of frightening, especially if it happens to be a species that stands in the way of economic growth.

The IUCN criteria may work for *listing* species on a global scale although they are still one-size-fits-all, which can be really problematic for some species (long-lived, colonial, fragmented, etc.), but they are inappropriate downlisting/delisting criteria for the many reasons we have cited before. The hypothetical scenario above could be even worse – it could be that an endangered species is delisted the first time around because it doesn't meet even the criteria for species of special concern, even though it could be barely stable or in decline. This may well end up being the case with manatees.

As part of our written comments on the manatee's biological status, please also include for the record a copy (attached) of a SMC letter dated June 10, 2005 addressed to Dawn Jennings of the U.S. Fish & Wildlife Service (Service) on the Service's five-year review of the Florida manatee. The Recovery Plan tasks that have yet to be met and the increasing threats to the manatee's long-term survival that we discuss in that letter are also applicable to the FWCC's biological status review. There are additional points that follow about increasing threats to the manatee population.

It seems absolutely implausible and unconscionable to us that, while manatee mortality from watercraft collisions continues unabated and habitat destruction and degradation continue unabated, the state is prioritizing reclassification over reducing take. With the future deregulation of power plants still a strong possibility, the decrease of natural spring flows, and the likelihood of future red tide blooms (including blooms that result in catastrophic mortality events) - combined with other growing threats outlined in this letter - our ability to recover this species now seems doubtful.

Since the Coastal Conservation Association (CCA) filed their petition asking for a biological status review in August, 2001, and through August 5th, 2005, 1,311 manatees died from all causes and 313 of those are known to have been killed by boats (that's 10% of the known population!), with 55 of those occurring in 2005 (only 2 less than the 5 year average). This is utterly frustrating since all of the watercraft-related deaths were preventable. Further, in 2005, manatee mortality in the "Other Human" category to date is 75% higher than the 5-year average. Perinatal deaths so far this year have exceeded the 5-year average by 21%. Again, rather than adopting additional measures to protect manatees and reduce take, the FWCC is instead pursuing reclassification.

According to the agency itself, two-thirds of state permitting regulations have a lesser standard for protecting threatened species than for endangered species. Species of special concern have virtually no protection in the permitting process. From a legal opinion we obtained, that species are defined differently as endangered or threatened by 372.072, F.S., implies they will be treated differently under the law and by the FWCC. Since every other state agency also relies upon the FWCC or the Department of Environmental Protection (DEP) to enforce the Florida Endangered Species Act, these agencies also rely upon the definitions provided in Florida Statutes and will also treat these listings differently. For instance, when permitting a marina, a water management district needs to determine if a proposed project will have an adverse impact on an endangered species. Since endangered species are defined differently from threatened, the analysis as to impact will also be different. An adverse impact for an endangered species is one that puts the prospects of survival for the species in jeopardy whereas an adverse impact for a threatened species is one where it might not put the animal in an immediate danger of extinction, but will increase stress and potentially put it in jeopardy of becoming endangered, a much more difficult determination to be made. The difference in definitions results in a heightened level of scrutiny for an endangered species that does not exist for a threatened species.

Presently, mitigation in state development permits to off-set negative impacts to manatees and their habitat are inadequate as evidenced by continued mortality from boat collisions and loss of habitat and habitat features. The FWCC takes a dangerous, short-term approach by changing the manatee's status because it will result in less protective measures while Florida's coasts continue to be rapidly developed. With this in mind, Save the Manatee Club must insist that before any change in the biological status of the manatee is adopted, a full internal review of the state's permitting process be done to both qualify and quantify how protective mitigation measures in permits and authorizations differ for the different levels of imperilment (i.e., endangered, threatened, species of special concern). These findings need to be incorporated in the report to the FWCC Commissioners that they will receive prior to their vote on this issue.

One of the most major and growing threats to manatees is the push by the marine industries, development interests, and boating rights groups to increase boating access to our waterways while preventing the adoption of new protective regulations and attempting to roll back existing ones. Through their actions, there are a number of adopted and proposed modifications to the permitting process, including the siting of new marina projects, that substantially raise the threat level to manatees.

In the spring 2005 session of the Florida Legislature, several bills were passed that effectively increased waterway access without also increasing protective conservation measures. New legislation amending 373.118, F.S. (General Permits) is an unprecedented broadening of the General Permit program, authorizing general permits for public marinas and boat ramps up to 50,000 square feet (nearly the size of a football field) of state owned submerged land without proper review of the environmental consequences. Facilities that would qualify for this general permit will be exempt from Development of Regional

Impact (DRI) review. Although this "streamlines" the permitting process, it eliminates essential review for environmental impacts.

Other legislation amending 253, F.S. (State Lands/Working Waterfronts) expedited permitting for wetland resource permits and environmental resource permits if 10% of the slips are available to the public. Although this also "streamlines" the permitting process, in many cases, it does not allow for a thorough review of the environmental impacts of the project. Further, now the DEP must identify state parks where new or expanded facilities can be built. Although wildlife and environmental values will be considered, they will not dictate the final outcome. Boat facilities will be built in areas that have not historically been launching points and/or high traffic areas. Sites such as Blue Spring State Park, Manatee Springs State Park, and Homosassa Springs Wildlife State Park could see docks built regardless of the parks' importance to manatees.

In addition, 373.4144, F.S. (Federal Environmental Permitting) was amended requesting delegation of the U.S. Army Corps of Engineers' (COE) permitting authority to the state for wetlands projects of 10 acres or less. It is now likely that this delegation of authority will be adopted by the COE. This poses a major future threat to the long-term viability of the species. Review by the Service under the federal Endangered Species Act (ESA) will be eliminated altogether. Not one marina in the state of Florida - *no matter how large* - would be reviewed by the Service and assessed for negative impacts to manatees or manatee habitat! Until now, the COE has only issued general permits for projects that impacted a ½ acre or less of wetlands. Once the permitting process is transferred to the state, the ESA's Section 7 review process is no longer required, since a Section 7 review is only done on federally authorized projects. Nor will a COE review under the National Environmental Policy Act be required. These reviews will be eliminated, resulting in fewer protections for manatees. Presently, dock sales in some areas are astronomical and with such profits to be made, expect a flood of permit requests for additional docks and marinas that will be permitted without federal review, as is now required under the ESA. Additional docks and marinas will result in more boat traffic, which increases the probability of manatee/watercraft collisions, as well as sub-lethal injuries and harassment from boating activities.

While the marine industries and the development community continue to push for increased waterway access, both the Service and the FWCC have no plans to adopt additional protective measures, such as speed zones, to off-set the increasing threats more boats will pose to manatees. Worse, the marine industries and go-fast boating rights groups have stated in public forums that once the FWCC adopts measurable biological goals (MBG), boat speed zones should be rolled back in areas where MBGs are deemed to have been met. Under this scenario, it appears likely that FWCC will receive numerous rule challenges in these areas - if not to have the zones withdrawn altogether, then to have the zones modified to add higher speed corridors. It is clear our collective work in getting these protections on the books, that spans at least two decades, is in jeopardy. If the FWCC decides to roll back protective regulations in areas where the MBGs are being met, it would be analogous to a doctor prescribing medication to a patient suffering from high blood pressure and after his blood pressure goes down, the patient concludes he is cured

and doesn't need the medication any more. Similarly, once regulations are judged to be working, it is counterintuitive to weaken or withdraw them!

There is now a distinct possibility that protection measures afforded manatees under the federal ESA will be weakened. Representative Richard Pombo is introducing a bill that would altogether eliminate the requirement to recover endangered species. Add to this madness the loss of protections the manatee may face under the state's own permitting process should the species be downlisted at the state level (see above) and threats to the manatee's long-term survival have just increased substantially.

Governor Jeb Bush of Florida and his Cabinet may adopt detrimental language changes to the rule (Chapter 18-21 Florida Administrative Code) that protects state sovereignty submerged lands in order to increase waterway access. The Florida Department of Environmental Protection (FDEP) is suggesting that virtually unlimited growth over the state's water bottoms is a "net positive public benefit." The ramifications of this proposed rule change are a significant increase in vessel traffic, type, and size in areas where manatees are already at risk for watercraft-related harassment, injury, death, and habitat degradation and loss with absolutely no additional provisions whatsoever for more signage, law enforcement, or permit compliance officers.

Recently, Florida's First District Court of Appeals upheld a lower court's ruling that Manatee Protection Plans are not final agency actions but only guidelines (and therefore, cannot be challenged). Further, there are no standards for the development of MPPs. Because the MPPs are only guidelines, they - by definition - don't have to be implemented and they certainly can't be made stronger through a legal challenge. Several county-wide MPPs are insufficient to adequately protect manatees from existing boat traffic, yet allow for almost unlimited growth without concurrently providing additional protections. Since the development and implementation of MPPs was by all accounts going to be the mechanism to reduce incidental take, it now appears that MPPs without standards for their development or even legal requirements *for* their development, *cannot* be the answer to reducing take. Yet, incredibly, the FWCC is going to change the manatee's biological status without a viable strategy for take reduction.

Although a federal judge recently ruled against the Florida Marine Contractor's Association's (FMCA) allegation that the federal Marine Mammal Protection Act (MMPA) did not apply to Florida's inland waters, the FMCA has stated publicly that it is their intention to appeal this ruling. Should they win, manatees will no longer be protected by the provisions of the MMPA throughout much of their range. And an FMCA win may be moot as many in the development community continue to pressure Congress to weaken the MMPA.

What happens if the Service downlists manatees at the federal level? Although an unthinkable scenario just a few years ago, it is now plausible that manatees could be downlisted at both the state and federal levels, precluded from the protections of the MMPA, less protected under a weakened ESA (or not protected at all by this Act as

Pombo's bill repeals the entire Act by 2015), and have their habitat built-out by a state permitting process that allows for virtually unlimited coastal growth.

It is simply astonishing that the FWCC is considering downlisting without first having a mechanism in place for measuring recovery, before evaluating whether present protection measures are working, and before it has fulfilled many of its myriad tasks in the federal Manatee Recovery Plan. Perhaps the most egregious failure is that no agency to date has quantified how boating activities and their cumulative effects are affecting the aquatic environment. There seems to be agreement in the legislature and at the agencies to increase waterway access without any data to support such a move (a state evaluation of existing boat facility capacities and the need for new facilities has not yet been completed) and regardless of the probability of increased threats to the resource.

Finally, threats from boat traffic have continuously increased. From 1994 through 2004, the number of registered vessels in Florida increased by almost 41%. As Florida's human population grows, we can expect the number of registered vessels to keep pace.

I am disgusted by the state's deception. Like the story of *The Emperor's New Suit*, the FWCC continues to insist they have adopted IUCN criteria when, in reality, the agency has only adopted a spurious version. It is obvious to us this has been done purposefully and with the intent to marginalize the horrendous problems manatees face in order to develop Florida's publicly owned submerged lands for profit.

Sincerely,

Judith Vallee

Judith Vallee
Executive Director

cc: Ken Haddad
Governor Jeb Bush
Sam Hamilton
Senator Bill Nelson

Enclosures: Letter to Dawn Jennings

Save the Manatee® Club

The Voice For Manatees For More Than 20 Years

10 June 2005

Ms. Dawn Jennings
U.S. Fish and Wildlife Service
Jacksonville Ecological Services Office
6620 Southpoint Drive. South, Suite 310
Jacksonville, Florida 32216

Re: ESA 5-Year Review of the Florida Manatee

Dear Ms. Jennings.

Save the Manatee Club (SMC) submits these comments in response to the U.S. Fish and Wildlife Service's (Service) Federal Register notice of 14 April 2005 of the ESA 5- Year Review of the Florida Manatee. SMC has been an actively involved partner in manatee protection efforts since the organization was created in 1981 and has participated in the development of the Florida Manatee Recovery Plan (Plan) since the 1st revision in 1989.

Based on a thorough review of the available information and legal requirements, as well as SMC institutional knowledge from continued involvement in manatee recovery efforts, it is clear that the Florida manatee should retain its "endangered" listing status under the Endangered Species Act of 1973 (ESA). In providing supporting substantiation for this position, this letter will address only those actions (and non-actions) that related to the content of the 3rd revision of the Plan in October 2001, wherein several actions and associated tasks were identified to bring about manatee recovery. This time frame roughly corresponds to the five-year period implied in the notice of the review. While we recognize that there has been considerable activity intended to address issues of concern, i.e., population status, human-related take, habitat destruction, etc. (much of it motivated by a lawsuit filed in January 2000 by SMC and a coalition of environmental and animal protection groups), there is no evidence that the actual threats to manatees and their habitat have decreased. In fact, the threats are on-going and likely to increase in the future, making the manatee's recovery anything but certain.

Before turning to an analysis of how manatees have fared even under the Service's own recovery/delisting criteria, it is first important to stress the legal context within which any potential change in the manatee's status must be evaluated. Section 4(f) of the ESA requires the Service, "to the maximum extent practicable," to "incorporate in each [recovery] plan the "objective, measurable recovery criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list." 16 U.S.C. § 1533(f). As held by the U.S. District Court for the District of Columbia in the course of invalidating the Grizzly Bear

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Recovery Plan, this provision makes crystal-clear that the "FWS, in designing objective. measurable criteria, must address each of the five statutory delisting factors and measure whether threats to the [species] have been ameliorated." Fund for Animals v. Babbitt, 903 F. Supp. 96, 111 (D.D.C. 1995) (emphasis added). Hence, the Grizzly Bear Recovery Plan was set aside precisely because it did not expressly address the "five statutory delisting factors (threat to habitat, overutilization, disease or predation, inadequacy of existing regulatory mechanisms, other natural or manmade factors)" but, rather, simply "specifie[d] numerical or percentage population goals" and parameters which were not tied in any concrete way to the mandatory statutory listing/delisting factors. Id.

Accordingly, to seriously consider any change in the manatee's listing status, the Service must accomplish two tasks: (1) adopt a Recovery Plan that satisfies the plain terms of the ESA by establishing "objective, measurable criteria" that correlate with the five listing/delisting criteria, and (2) convincingly establish that all of these "criteria" are, in fact, being satisfied. However, neither of these tasks has even come close to being satisfied.

To begin with, as SMC and other organizations concerned with the fate of the manatee have previously pointed out, the Service has yet to even adopt a Recovery Plan for the manatee that satisfies the requirements of section 4(f) of the ESA. See August 8, 2001 Comments of SMC (see Attachment 1); August 8, 2001 Comments of The Ocean Conservancy (see Attachment 2). In particular, as we have pointed out in past correspondence, the current version of the Plan – although a marked improvement over past versions – fails to establish "objective, measurable" criteria with respect to the first statutory listing/delisting factor – the "present or threatened destruction, modification, or curtailment" of the manatee's habitat. Rather, with respect to such issues as "minimum flow levels" and the need for a "network of migratory corridors, feeding areas, calving and nursing areas," the Plan recognizes the need to address such issues before down- or delisting could be contemplated, but does not actually establish anything remotely resembling "objective, measurable" recovery criteria with respect to them. (See Attachment 2 at 2.) Instead, the Plan, at most, suggests that the Service will attempt to establish such criteria in the future. Legally, however, the Service must establish such criteria in a Recovery Plan made available for public notice and comment, before considering whether such criteria are being sufficiently met to warrant a change in listing status. In short, as summarized in our August 2001 comments – which are fully incorporated here by reference – "[s]ince the Service has yet even to issue a Recovery Plan that comports with the express requirements of the ESA, -- i.e., one which sets forth all of the 'objective, measurable' recovery criteria correlating with the statutory listing/delisting factors, and especially detailed habitat-based criteria – the last thing the Service should now" be doing is considering a change in listing status based on the existing, legally insufficient Recovery Plan.

Moreover, even with regard to the criteria incorporated in the Plan, as SMC and other groups have pointed out, the current Plan is not based on the best available scientific data, particularly because the Service failed to adopt the population criteria suggested by its

own Manatee Population Status Working Group. (See Attachment 1 at 3-6; Attachment 2 at 2) ("the arbitrary modification of the MPSWG's Recommendations is the most serious problem with the Recovery Plan"). For example, one of the Population Working Group's recommended benchmarks – which was been ignored by the Service – is that "average annual estimated rate of adult survival is at least 94% and average population growth of at least 4% (see Attachment 2 at 2). But the Service, without any reasonable scientific basis, adopted far less protective criterion, providing that the population could be deemed recovered (for purposes of both downlisting and delisting when there is only 90% adult survival and no population growth at all. Aside from the absurdity of declaring a population to be "recovered" when it has not only not reached its carrying capacity but is not growing at all in a significant portion of its range, the Recovery Plan is clearly not based on the views of the scientists that the Service itself has recognized as leading manatee experts.

In sum, rather than rely on its legally and scientifically deficient Plan as a basis for considering any change in the manatee's status, the Service should instead use this opportunity to finally adopt a Recovery Plan that comports with the law and the recommendations of leading experts on the species. Only then would the agency be in any position to address the manatee's status vis-à-vis the recovery criteria established in such a Plan.

However, even if the present Plan is employed as the pertinent framework for evaluating the species' status, it is abundantly clear that downlisting or delisting would not be appropriate even in view of the current, inadequate recovery criteria. Consequently, the remainder of this letter will evaluate that issue.

Analysis of the Florida Manatee Recovery Plan, 3rd Revision, October 2001 based on the Five Listing/Recovery Factors

The 2001 Recovery Plan refers to both "population benchmarks" that must be met in each of the four regions before downlisting or delisting could occur, as well as several generic criteria grouped according to the statutory listing/delisting factors. As explained above, SMC does not accept the legal or scientific validity of these criteria as a basis for evaluating the legal status of the species. Nonetheless, as explained below, since even these politically driven criteria are clearly not being satisfied, it is obvious that the Service cannot seriously entertain changing the species listing status but, rather should spend its time and resources on actions that will actually facilitate manatee recovery.

Population Benchmarks:
The Demographic Criteria section on page 44 of the Plan addresses the Population Benchmarks. As discussed above, the Service's own benchmarks are substantially weakened from those recommended by the MPSWG, found in Appendix A of the Plan. In an attempt to impress upon the Service the importance of maintaining the benchmarks as recommended by the MPSWG, they created a table (see Attachment 3) illuminating the differences between their version and what the Service ultimately adopted. Nonetheless, even the Service's own, less rigorous benchmarks have not been achieved in

either the Atlantic Coast or the Southwest regional populations. According to the most recent available information, the Atlantic regional population is showing at 1% growth (for benchmark "a") but the confidence interval is such that it could actually be declining slightly below the 90% benchmark. It is also probably not meeting benchmark "b" that requires that the average annual rate of adult females with first or second year calves is 40% or greater.

The data show that the Southwest regional population is slightly declining, with a growth rate of −1.1%. The confidence interval for this population is so wide, however, that it may actually be meeting benchmark "a" but conversely, it may also be declining at a far greater rate.

Both the Northwest and Upper St. Johns regional populations are meeting the benchmarks but they only comprise approximately 16% of the total Florida manatee population. Further, the Plan clearly states that the benchmarks must be met "in each of the four regions for the most recent ten year period of time" before downlisting can be considered. The Plan also states that the Listing/Recovery Factor criteria also must be met. This is clearly not the case. A critique of the factors follows here.

Listing/Recovery Factor A: The Present or Threatened Destruction, Modification, or Curtailment of a Species Habitat or Range
Under this factor, for downlisting purposes, the Plan states "in order to ensure the long-term recovery needs of the manatee and provide adequate assurance of population stability (i.e., achieving the demographic criteria), threats to manatee's habitat must be reduced or removed" and identifies four criteria designed to address the immediate and long-term threats to manatee habitat. None of these criteria has been accomplished to date. The Warm Water Task Force recognizes this and has drafted recommendations and a Policy Statement (see Attachments 4 and 5).

Criterion "a" speaks to minimum flows of natural springs requiring that "minimum flow levels [sic] to support manatees at the Crystal River Spring Complex, Homosassa Springs, Blue Springs, Warm Mineral Springs[] in terms of quality and quantity have been identified ..." in order for manatees to be considered for downlisting. This has not been accomplished for any of the springs listed in this criterion. The St. Johns River Water Management District has developed a draft rule for the minimum flow for Blue Spring but adoption of the rule has been delayed for a variety of reasons, mostly because the proposal is controversial. Several agencies and organizations have weighed in on the draft, including the Service, and most have expressed concern over the proposal's scheme to allow early, larger withdrawals from the spring (taking it below current flows and, claiming these lesser flows will provide protection for the existing manatee population), then gradually increasing the flows to current levels over an approximate 25 year time frame to provide protection for an increasing future manatee population. While this may sound feasible on its face, the reality of the situation is that Florida's ever-growing human population requires increasing amounts of ground water and it is a dubious claim that the water management district will be willing or able to ensure that the flows will indeed be restored and will be adequate for a growing Blue Spring manatee population. It

also does not take into account manatees' preferences for certain areas of the spring run over others. Rather, the district has calculated these minimum flows based on squeezing manatees into the spring run's usable space with no regard as to how manatees might behave under such conditions. (See Attachments 6 - 8.)

As to the Crystal River Springs complex, Homosassa Springs, and Warm Mineral Springs, no minimum flows have been established, let alone identified to protect manatees, and in the cases of the Crystal River Springs and Homosassa Springs, the Southwest Florida Water Management District has resisted requests by the Service, FWCC, and SMC to accelerate their schedule to prioritize establishment of minimum flows for these springs. Currently the completion date for the establishment of minimum flows for these springs systems is somewhere between 2007 - 2016. Minimum flows for other, smaller springs on the west coast of Florida, as well as in the St. Johns River system, are unlikely to be prioritized for manatee warm water needs.

Since the purpose of establishing minimum flows is to ensure a water supply for human consumption, and since most springs in Florida have experienced diminished flows over the period of record due to increasing demands on the ground water table from a burgeoning human population, it is of paramount concern that the Service enter into a dialog with the state agencies responsible for establishing minimum flows for the Florida springs upon which manatees depend. The importance of this cannot be overstated and the situation becomes even more crucial considering the potential loss of industrial warm water sources. In light of past and future alterations to and adverse impacts upon aquatic resources, including underground aquifers and springs, even Florida's natural springs can not be relied upon to sustain a viable future manatee population should the manatee's artificial warm water refuges be eliminated as a result of changes in how electricity is distributed to Florida's growing human population. Unless comprehensive and timely actions are taken to ensure the future of the manatees' warm water habitat while controlling for the cumulative impacts of human population growth in Florida, the manatees' prospects for long-term future survival are in grave doubt.

Criterion "b" requires that a network of level 1 and 2 warm water refuge sites be protected as either manatee sanctuaries, refuges (federal designations) or safe havens (state designation) to consider manatees for downlisting. For the most part this has been accomplished but there are several glaring omissions. The Riviera Beach FP&L plant effluent canal is designated as a "motorboat prohibited" zone by the state, which allows entry by non-power vessels as well as swimmers and divers and hence does not meet the criterion. SMC tried unsuccessfully to get the Service to address this site (and others) as part of our lawsuit settlement. Other sites identified as level 1 or 2 winter aggregations sites that have not been addressed with sanctuary, refuge, or safe haven protection status are: C-54 Canal in the Sebastian River (Brevard County), which is "motorboat prohibited" rather than "no entry;" Henry D. King Electric Station on Moore's Creek (St. Lucie County) which is also a motorboat prohibited zone; Palmer Lake (Dade County), which is idle speed; Weeki Watchee/Mud/Jenkins Creek Springs (Hernando County), which are unregulated for manatee protection; FPC Anclote Plant (Pasco County), which is unregulated for manatee protection; Matlacha Isles (Lee County), which is a slow

speed zone; Ten Mile Canal Borrow Pit (Lee County), which is slow speed; and Port of the Islands (Collier County), which is an idle speed zone.

Criterion "c" requires that feeding habitat sites associated with the network of warm water refuge sites have been identified by the Habitat Working Group (HWG) for protection. This criterion, while recognized as a high priority by the HWG, has not been accomplished. Discussions about research to quantify the extent, quantity, and quality of feeding habitat have taken place but only one preliminary study has been developed as of this writing (see Attachment 9).

Criterion "d" requires identification, for the purposes of protection as manatee sanctuaries, refuges or safe havens, of a network of migratory corridors, feeding areas, and calving and nursing areas in Duval, Volusia, Brevard, Indian River, Martin, Palm Beach, Broward, Dade, Monroe, Citrus, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Glades, and Collier counties. This criterion has not been accomplished. SMC tried to get the state to address a few feeding areas as safe havens as part of our lawsuit, but we were unsuccessful.

While the HWG is now working hard to meet and refine these criteria, the outlook is doubtful. In the current political climate, neither the FWCC nor the Service appears to have the will to secure habitat for manatee protection into the future. Indeed, on the state level, recent legislation has eroded the agencies' ability to protect habitat (see Attachment 10).

On the federal level, the Service has inexplicably failed to revise its critical habitat designation for the manatee to comport with current scientific research on the needs of the species, although the Service has, for many years, stressed that the existing designation lacks any identification of constituent elements of habitat that are necessary for species recovery. In addition, although a series of rulings by federal appeals courts has now made clear that critical habitat is vitally important to protect the habitat that is necessary for species recovery, the Service has not used the section 7 consultation process to protect habitat that is necessary to facilitate recovery of the species.

Indeed, to our knowledge, at least during the last ten years, the Service has never found, in conducting a section 7 consultation that any project is resulting in the destruction or adverse modification of critical habitat. Yet, at the same time, thousands of projects annually approved by the Corps and other agencies continue to result in the inexorable, incremental destruction and degradation of manatee habitat. Consequently, at least until the Service (along with the Corps and other agencies) finally starts using the designation of critical habitat and the section 7 process as a whole in the manner that Congress intended, the Service cannot seriously maintain that Listing/Delisting Factor A is being sufficiently addressed to allow a consideration of changing the manatee's listing status.

Industrial warm water sites are far from secure. A population viability analysis was performed by FWCC in 2002 as a basis for a Biological Status Review of the Florida Manatee (see Attachment 11). The results showed that, in the event of loss of industrial

warm water sites, there is the real potential for loss of 50% of the manatee population within three generations (45 years) time. These warm-water outfalls, such as power plant effluents, have played a pivotal role in allowing the manatee population in Florida to experience some growth subsequent to their installation and utilization by manatees. Their combined contribution may be second only to the cessation of hunting through the implementation of important laws to protect manatees. The relative distribution of these warm-water sources throughout Florida's coastal habitat has allowed manatees to extend their winter range and cushioned what would have been much greater losses during times of extreme cold (see Attachment 12). After several substantial and near-catastrophic losses of manatees due to cold weather at some of these facilities, and through years of close cooperation among the utility companies, the Service, the U.S. Environmental Protection Agency (EPA), and the Florida Department of Environmental Protection (DEP), it appeared that the prospects for ensuring that manatees' could be provided with secure warm-water sources well into the future might be at hand.

For example, during the early 1980's the Florida Power and Light Company (FPL) rerouted some of the discharge from newer units to allow the existing warm-water discharge to remain in a safer and more reliable place for manatees. A further example involved the re-powering of the old FPL Fort Lauderdale Inland Power Plant. This was an existing site on which manatees had already become dependent. Through re-powering at an existing site, a win/win/win scenario was created whereby FPL saved money, the adverse environmental impacts were minimized, and the site's reliability for manatees was improved through several physical modifications to the discharge area. This solution seemed to be an answer to providing new electric generation capacity when the various power plants in Florida outlived their planned operational cycles. This was especially important since virtually everyone involved with power plant siting agreed that new thermal discharges should not be created.

Only a few years later, however, a different and even more challenging problem arose, which in hindsight may have been a harbinger of more desperate times for manatees in Florida's future. It was learned that the FPL Ft. Myers (Tice) power plant was not going to operate during that winter. Executives at FPL had decided that since they could buy power cheaper from Georgia, they would not run the Tice plant. Fortunately for the manatees depending on the plant for survival serious harm was averted when Governor Bob Graham intervened and persuaded FPL to run the plant until the immanent threat to manatees passed, even though it would be more expensive to operate the plant than to purchase power. Ultimately, FPL re-powered the Tice Plant with more efficient natural gas turbines and installed additional cooling towers to reduce thermal pollution during warmer season operations.

Perhaps the single most important lesson learned at that point regarding efforts to protect manatees from catastrophic losses at warm-water sites (on which they now had become thoroughly dependent during the winter) was to require, as a condition for the National Pollution Discharge Permits (NPDES), the adoption of Manatee Protection Plans which maximized the reliability of the heated discharge from each utility that was already attracting manatees. At the same time, efforts have also continued to eliminate some

thermal discharges that were becoming less reliable and had the potential to put manatees at greater risks of exposure during major cold fronts. Unfortunately, even the elimination of some of those small marginal facilities has resulted in significant manatee mortality.

Although Florida's manatees narrowly averted a major catastrophe following 1998 and the California deregulation debacle, Florida utilities (and therefore the manatees) may be facing a new gravely serious deregulation scenario if the Federal Public Utility Holding Company Act (PUHCA) is repealed as part of the Energy Policy Act of 2005. Presently under PUHCA only utility companies may own utility companies. If PUHCA is repealed that will no longer be the case and many changes could occur that could have extremely serious consequences upon the prospects for future manatee survival. Having narrowly averted a deregulation crisis like that of California, which was facilitated by prior exemptions to PUHCA, repealing PUHCA could alter the electric utility landscape in Florida so radically that the power plants manatees depend upon for survival during the winter could not be economically run and therefore could be lost in the very near future. If PUHCA is repealed Florida will have no real say in how the scenario unfolds since they will not be allowed to exert control over interstate activities.

It is important not to loose sight of the fact that even with the retention of the modified version of PUHCA that the sheer age of the existing once-through-power plants will ultimately jeopardize those manatees that are dependant upon their production of heated water in the winter unless suitable alternative are implemented in time. Unfortunately, even under the most ambitious scenarios possible we are many years away from developing and implementing appropriate solutions necessary to prevent the deaths of hundreds of manatees if these plants are not run reliably during the winter for the foreseeable future. It is imperative that the utility industry that has benefited financially all these years from discharging heated waters, upon which manatees have now become dependent, be held to providing safe alternatives for manatees should they choose to abandon or diminish the reliability of these warm-water sites for purely economic reasons. Thanks to use of the existing "once through" cooling systems (which produce the warm-water discharges), the historical savings to the utilities have been enormous. Yet because the potential for future adverse impacts to manatees from unreliable effluents is so great, it will be necessary to consider a variety of alternatives for the future. Although many alternatives are being considered such as setting up a network of smaller but more numerous warm-water areas for manatees within a larger network of refuges and preserves located up and down the coasts and within important rivers, the development of these alternatives is in its infancy. With the majority of manatees now dependent upon the several existing warm-water outfalls, we must have sufficient contingency plans as soon as possible.

With all of the uncertainties regarding deregulation and its potential effects on the future survival of the Florida manatee it is imperative to take these future risks into account together with other human related impacts such as watercraft collisions and other natural factors like red-tide that have collectively killed thousands of manatees. Taken together, these cumulative risks are greatly exacerbated by Florida's frantic pace of development

and human population growth, which will double in less than 28 years and is, expected to reach nearly 34 million by the year 2030.

Listing/Recovery Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

In the Plan, the Service discusses "take" from harassment that is occurring at some of the winter refuges and other locations, admits that this take is not authorized under the MMPA but concludes that there are no data to indicate that harassment is limiting the recovery of manatees. It must be noted here that in reality there are no data indicating harassment is or is not limiting the recovery of manatees, as to date there have been very few directed studies of harassment specifically and none that quantitatively assess the impacts of harassment on manatees.

While there are actions identified in the Plan that are intended to achieve compliance with the ESA and the MMPA, the Plan unfortunately does not comprehensively address the full ramifications of take in the form of harassment (and disturbance), and it is only partially contemplated, under Listing/Recovery Factor B. For example, Factor B only specifically identifies recovery actions 1.1, 1.11, and 4.4 and "other tasks identified in Factors A, D, and E".

The goal of Objective 1 in the Plan is to "Minimize causes of manatee disturbance, harassment, injury, and mortality." Manatee harassment is a growing and chronic problem at numerous specific locations around Florida. Few of the recovery tasks that deal with harassment and disturbance have even been initiated, and those that have are in their infancy. The current management "strategy" to address chronic harassment sites is for SMC to provide an awareness sign at the location discouraging harassment. Signage alone has not curtailed harassment at any of the locations where signage has been provided. Out of frustration in the lack of response by either the Service or state agencies to resolve these chronic harassment sites, SMC has consolidated a preliminary list of known chronic harassment sites around Florida (see Attachment 13).

SMC conducted a 4-week study at a chronic harassment site in Brevard County at the Goode Park Boat Ramp on Turkey Creek to document the frequency and type of harassment. As an example of the extent of harassment that can occur at these sites, in one 3-hour period 83 different individuals were documented engaging in manatee harassment (feeding/petting/swimming). The study showed that the vast majority of people came to the location for the specific purpose of interacting with manatees.

In addition to the more commonly associated forms harassment and disturbance - feeding, watering, swimming with, riding, surrounding by swimmers, restraining, fishing/boating on top of manatee aggregations at both warm water sites and other locations – disturbance by boat traffic is also harassment that has not received the warranted focus in the Plan. The Plan neglects including Subtask 2.5.7 and its further subtasks, which deal with assessing the impacts of disturbance on manatees, under any of the Factors. Subtask 2.5.7.1 has only very limited investigation. For subtask 2.5.7.2, the recent and ongoing manatee boat studies by Nowacek, et.al., since the last revision of the

Plan, clearly document that manatees change their behavior in response to boating activity. [Nowacek S.M., R.S. Wells, E. C. G. Owen, T.R. Speakman, R.O. Flamm, and D.P. Nowacek, 2004. Florida manatees, *Trichechus manatus latirostris*, respond to approaching vessels. Biological Conservation 119 (2004), 517-523.] (See Attachment 14) The implications of the documented changes in manatee behavior in response to boat activity are quite compelling, especially when considered in relation to the frequency of these interactions and the expected increase in frequency as the number of boats operating in manatee habitat continues to rise. The impact of this type of stress on manatees has not been studied. How these changes in behavior affect energetics (i.e.. energy cost of manatees ceasing a feeding bout, moving, then either returning or seeking forage elsewhere vs. not being disturbed) has not been studied. The effect this disturbance has on risk of mortality and injury has not been studied. For example, do these interactions affect manatees using warm water refuges or forage areas in proximity to warm water refuges and does this disturbance contributed to cold stress deaths? Do high speed corridors create increased risk for manatee injury and death based on their behavioral response to boat disturbance (i.e. moving toward the deeper water channel where boats are traveling at high speed)? These interactions may also affect cow calf pairs, and contribute to perinatal mortality. Increasing frequency of boat disturbance may cause manatees to become desensitized to boat activity. The investigation into the impact of the harassment aspect of boating on manatee populations has barely scratched the surface of what must be known before any statement of whether or not harassment is affecting recovery of the manatee can be legitimately made.

Subtasks 2.5.7.4 and 2.5.7.5 direct the assessment of the impacts of human swimmers and the effectiveness of sanctuaries and the impacts of viewing by the public. The research completed to date has been focused on Crystal River National Wildlife Refuge. All of the studies indicate a negative impact on manatees from these interactions and suggest changes to reduce their frequency or impact. In a 2003 study conducted at Crystal River National Wildlife Refuge, the authors found that, "Over half of the direct interactions recorded between swimmers and manatees constituted some form of harassment as defined by Refuge guidelines..." (King and Heinen, 2003). In addition, the authors found that, "The time spent bottom-resting and nursing decreased while time spent milling and swimming increased when swimmers were present compared with when they were absent." [King, J.M., and J.T. Heinen, 2003. An Assessment of behaviors of overwintering manatees as influenced by interactions with tourists at two sites in central Florida. Biological Conservation 117, 227-234.] (See Attachment 15) The potential impacts of more passive viewing, like from the platforms at Blue Spring, have not been studied (i.e. manatees seeking out the far shore in the warm water refuge away from observation platforms). In the case of Blue Spring, this may have implications on the long-term carrying capacity of the spring run.

Listing/Recovery Factor C: Disease or Predation
While the Plan states that there are no data suggesting that this is a limiting factor, it would be wise to consider the role that red tide, which has caused several significant mortality events in recent years, plays in the species' recovery. If the Service determines

that a red tide discussion does not fit under this factor, it should be included under Factor E.

Listing/Recovery Factor D: The Inadequacy of Existing Regulatory Mechanisms
The Plan states, "The current legal framework outlined below allows federal and state government agencies to take both broad scale and highly protective action for the conservation of the manatee and its habitat." and further states that the Service "believes these regulatory mechanisms are adequate for recovery." Several state and federal laws are listed under this factor. However, for regulatory mechanisms to be effective the language must remain protective, they must be proactive such that the protections offered keep up with newly identified or increasing threats, they must be implemented by the agencies in a consistent and regular manner, and they must be regularly assessed for effectiveness. Many tasks listed under Factor D have no quantitative, measurable criteria to monitor, test, or assess efficacy of regulation (permitting, law enforcement, compliance/efficacy of zones). Further, the agencies have not proactively pursued additional manatee protection speed zones, refuges, and sanctuaries on their own volition. All state and federal speed zones put in place since 2001 have been enacted as part of legal settlement agreements.

The Service must note from the attached table entitled Summary of State of Florida Statutory and Rule Changes, 2001 – May 31, 2005, (Attachment 10) that the list of laws under Recovery Factor D is incomplete. The table cites the laws that directly affect manatees and their habitat that have been omitted from the Recovery Plan. The omitted laws include: 372.072(6), F.S., Threatened and Endangered Species Act, 370.1201, F.S., Manatee Protection; Intent; Conduct of Studies; Initiatives and Plans, 370.1202, F.S., Enhanced Manatee Protection Study; 163.3247, F.S., Growth Management Act; and 161.74, F.S., Oceans and Coastal Resources Management Act. All of these laws need to be included in the Plan, and an evaluation of the impacts to manatees and their habitat resulting from these laws must be completed in consideration of recovery of the manatee population. Some of the impacts from these laws, as well as the laws included in the Plan, are discussed in the table. Protection of manatees and their habitat obviously has been eroded in several cases.

In summary, SMC does not agree that the existing laws are adequate, particularly on the state level where the laws protecting manatees and habitat are continually under assault and usually weakened to varying degrees during each legislative session, notably so since 2002. Additionally, the state rules that protect manatees and habitat are also attacked, often resulting in substantial weakening. For example, the state has recently made substantial changes to the rules governing the imperiled species listing process, a move that will probably result in the downlisting of manatees to "threatened" or "species of special concern" on the state level. The FWCC admitted at a public hearing on 14 April 2005 that approximately two thirds of state regulations involving permitting have a lesser standard for protecting threatened species than for endangered species. Species of special concern have virtually no protection in the permitting process. Several further examples of recent changes to state regulations are provided in the attached table.

Even very harmful projects are rarely denied permits by either federal or state permitting agencies, mitigation offered to offset negative impacts to manatees and manatee habitat are inadequate and inadequately monitored, compliance to permitting conditions are not consistently or regularly monitored, violators are not vigorously pursued or penalized (including too many after-the-fact consents), and cumulative impacts of projects on manatees and manatee habitat have not been addressed.

In particular, in section 7 consultations with the Service, the Army Corps of Engineers (Corps) and Service continue to fail to engage in any meaningful cumulative impacts analysis of the thousands of Corps-permitted projects approved in manatee habitat every year, although it is obvious that these projects are contributing to the degradation and loss of manatee habitat. Until and unless the Service and Corps – along with other governmental and private stakeholders – devise a scientifically supportable mechanism for getting a handle on the grave and increasing cumulative impacts problem, the Service cannot seriously maintain that regulatory mechanisms are adequate to even contemplate a change in the species' listing status from endangered to threatened.

A scientific paper entitled, "Improving U.S. Endangered Species Act Recovery Plans" Key Findings and Recommendations of the Society for Conservation Biology (SCB) Recovery Plan Project," recommends, among other things, the Service, "make threats the primary focus, specify adequate monitoring tasks for species status and recovery tasks, and ensure that data on species status are current, quantitative, and documented" The paper also highlight the importance of linking species biology, status, and threats to management actions. [Clark, J.A., J.M. Hoekstra, P.D. Boersma, and P. Kareiva. 2002.Improving U.S. Endangered Species Act recovery plans: Key findings and recommendations of the SCB Recovery Plan Project. Conservation Biology 13(6): 1510-1519.] (See Attachment 16.)

Importantly, the Plan also notes that several additional, specific actions under the existing laws must be accomplished before manatees will be considered for reclassification, particularly those listed pursuant to Factors A and E, which is discussed in those sections.

Listing/Recovery Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence

The Plan states that the most predictable and controllable threat to manatee recovery remains human-related mortality. The Plan further states, "In order to ensure the long-term recovery needs of the manatee and provide adequate assurance of population stability (i.e., achieving the demographic criteria), natural and manmade threats to manatees need to be reduced or removed." SMC concurs with both statements. Therefore, it is very concerning that in the most recent full 5-year period, 2000-2004, 396 manatee carcasses were recovered for which the cause of death was attributed to watercraft collisions. In the previous 5-year period, 1995-1999, 304 watercraft-related deaths were recorded. So even though human-related mortality has been identified as the most controllable threat to recovery, the number of human-related deaths from the largest contributor to human-related deaths has actually increased substantially (30%) in the last five years over the previous five years (see Attachment 17). A reduction in human-related

deaths from watercraft collisions has clearly not been documented as required by the Plan. There are no reliable data available on the level of human-related injury to manatees so there is no way to measure how sub-lethal take is affecting the species' recovery nor to measure whether risk of injury from watercraft has been reduced. However, the Service has previously stated that it could "assume[] that activities that result in the lethal take of manatees also have similar levels of sub-lethal effects on manatees and manatee habitat." 67 Fed. Reg. 69085. Assuming (without necessarily agreeing) that this is a valid assumption, the conclusion also follows that levels of sub-lethal take also increased during the most recent full five-year period. Once again, under these circumstances, the Service should redouble its efforts to reduce both lethal and sub-lethal take rather than trying to justify a change in species status that is simply not warranted by the available data.

Under Factor E, the Plan also lists three criteria necessary to accomplish recovery to the degree that manatees can be downlisted. Criterion "a" requires, for the purpose of manatee protection, that manatee refuges or safe havens "have been established by regulation and are being adequately enforced to reduce unauthorized watercraft-related take" in Duval, Volusia, Brevard, Indian River, Martin, Palm Beach, Broward, Dade, Monroe, Citrus, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Glades, and Collier counties. Clearly, while there are state speed zones and federal refuges in most of these counties (several of which were the result of SMC's lawsuits), watercraft-related take is still occurring at unacceptably high levels. The conclusion must be drawn that the protection measures are inadequate, boater compliance levels are inadequate, and/or law enforcement levels are inadequate. It is imperative that boater compliance is evaluated in a reasonable number of waterways where manatee mortality from boat collisions is highest in order to determine what more needs to be done to meet this criterion.

Of the counties mentioned in the Plan as priorities, no manatee protection zones exist in Monroe or Glades counties. As a result of the lawsuit settlements, new speed zones were implemented in Hillsborough, Manatee, Pinellas and Charlotte counties and amendments were made to Brevard, Lee, and Duval rules. Minor changes were made to the Volusia, Sarasota, Clay, and Indian River rules. Citrus County finally received a much-needed sanctuary/safe haven at Blue Waters on the Homosassa River. No changes were made in Martin, Palm Beach, Broward, Dade, and Collier despite recommendations from SMC for many areas in those counties.

In Lee County, FWCC has actually worked to undermine new federal refuges by, in some cases, overlaying them with weaker state protection zones and requesting that the federal government remove their more restrictive protections. No agency or government has addressed the need for a slow speed zone for the Area of Inadequate Protection identified by the Service around Bokeelia. In Duval County, the FWCC refused to enforce the federal refuge in the St. Johns River until recent modifications were made that they finally agreed to.

Criterion "b" requires that "One half of the water control structures and navigational locks listed as needing devices to prevent mortality have been retrofitted (Task 1.6)" The

Appendix F: Public Comments

Interagency Task Force for Water Control Structures has been addressing structure-related manatee mortality since the 1990s. The Corps and the South Florida Water Management District, the primary agencies charged with developing and implementing the technology needed to accomplish this task, have done an admirable job of late in meeting their "zero mortality" goal, but while most of the structures have been retrofitted with devices aimed at reducing structure-related mortality, some deaths are still occurring. Most recently, two deaths have occurred so far in 2005 at the Ortona Locks on the Okeechobee Waterway in Glades County.

Criterion "c" requires that "Guidelines have been drafted to reduce or remove threats of injury or mortality from fishery entanglements and entrapment in storm water pipes and structures (Task 1.7, 1.6.3)" To date, no such guidelines have been drafted so this criterion for downlisting has not been met.

Analysis of Selected Tasks of the Florida Manatee Recovery Plan, 3rd Revision, October 2001

In order to further substantiate our strong assertion that downlisting should not be considered at this time, the following analysis of selected recovery tasks reveals many of the shortfalls in accomplishing these tasks.

Objective 1: Minimize causes of manatee disturbance, harassment, injury, and mortality

Task 1.1 Promulgate special regulations for incidental take under the MMPA for specific activities.

Status: Incidental take has not been authorized for any of the four manatee subpopulations.

In March 2003, the Service published a Final Environmental Impact Statement on Rulemaking for the Incidental Take of Florida Manatees Resulting from Government Programs Related to Watercraft Access and Watercraft Operation in the State of Florida. (See Attachment 18) Despite the negative finding, the continuing occurrence of unauthorized take has not been addressed.

Task 1.2 Continue state and federal review of permitted activities to minimize impacts to manatees and their habitat.

Status: FWCC reviews projects that may affect manatees or manatee habitat; reviews for compliance with Manatee Protection Plans (MPPs); offers comments, including standards for culverts/pipes, blasting, and construction conditions. Generally, FWCC also recommends boaters guides, permanent educational signage, and boater's guides. How effective these general recommendations are in protecting manatees from direct and indirect impacts has not been assessed (although given the number of projects that go in and the number of counties/waterways that remain high-risk, an assumption can be made that these latter recommendations are not effective or adequate to mitigate negative impacts). FWCC also makes SAV and adequate depth recommendations. Rarely

does the FWCC recommend denial, including for some projects where the applicant is not in compliance with the MPP. The Service has a similar record for allowing projects to proceed without recommendations for modifications to better protect manatees. See discussion under Factor D (and Attachments 19 and 20).

Task 1.3 Minimize collisions between manatees and watercraft.

Status: This task has not been accomplished. See lengthy discussion under Factor E (and Attachment 21).

Subtask 1.3.1 Develop and refine state waterway speed and access rules.

Status: Most of these rules were established as a result of the settlement agreements. However, because the FWCC Commissioners had the final authority, most of the state's final rules were substantially weakened from the original proposals and some proposed zones were simply not approved by FWCC. Since the creation of the Local Rule Review Committees (LRRC) in 2002, the state's process for promulgating rules under 68C-22 F.A.C has been substantially burdened and lengthened.

The federal refuges established as a result of a stipulated settlement agreement in the Caloosahatchee River in Lee County, the Halifax River in Volusia County, and the St. Johns River in Duval County were also substantially weakened (to varying degrees) from the original proposals.

Task 1.4 Enforce manatee protection regulations.

Status: No criteria have been established to define, measure, and assess whether manatee protection regulations are "adequately being enforced." Regulatory mechanisms cannot be evaluated for effectiveness without effective law enforcement. SMC recognizes that on-water officers are overworked and underpaid and we have utmost respect for those officers who actively enforce manatee protection regulations. Goal should be established to accomplish maintained high compliance over the long-term. Enforcement details should be prioritized and guidelines established to trigger additional law enforcement effort when unusual mortality spikes occur. See discussion under Factor E.

It should be noted that FWCC allows exemptions from its zones for commercial fishermen and professional fishing guides. Incredibly, federal enforcement officers have issued multiple citations to some of the exemption holders, yet FWCC has not revoked the exemptions. Also, FWCC lost a legal challenge to its Lee County zones last year, which led to local law enforcement and the Service ceasing enforcement of the zones. Manatee mortality has increased since that time.

Subtask 1.4.1 Coordinate law enforcement efforts.

Status: Problems continue to occur when the FWCC do not agree with a federal zone or the Service's LE officers cannot enforce a state zone due to inadequacy of signage, such as in Duval and Lee Counties. Local governments currently do not

enforce federal zones. In some cases FWCC has taken an antagonistic posture toward the Service regarding enforcement of federal manatee refuges and sanctuaries and has become a major impediment in assisting with boater compliance of federal zones by not enforcing federal zones.

Subtask 1.4.4 Evaluate compliance with manatee protection regulations.

Status: While several compliance studies have been conducted in limited areas of the state, little has been done to follow up by developing management strategies related to compliance. This is of utmost importance in evaluating the success of speed zone protections.

Task 1.5 Assess and minimize mortality caused by large vessels.

Status: This task has not been accomplished.

Task 1.6 Eliminate manatee deaths in water control structures, navigational locks, and drainage structures.

Status: Initiated but not yet fully accomplished. See discussion under Factor E.

Subtask 1.6.1 Install and maintain protection technology at water control structures where manatees are at risk and monitor success.

Status: The Interagency Task Force for Water Control Structures reports that most Phase I (priority structures) have been retrofitted. Nine navigational locks and 17 water control structures representing 44 gates have been retrofitted. These structures accounted for 80% of structure-related deaths. Structure related mortality at these structures has decreased significantly since retrofitting but is still occurring. See discussion under Factor E, criterion "b."

Subtask 1.6.2 Install and maintain protection technology at navigational locks where manatees are at risk and monitor success.

Status: See Task 1.6, 1.6.1, and discussion under Factor E, criterion "b."

Subtask 1.6.3 Minimize injuries and deaths attributable to entrapment in drainage structures.

Status: Some structures, like Cocoa Beach outfalls in Brevard County that have been known to entrap manatees, have been opportunistically grated, many others still need to be addressed. There has been no comprehensive assessment of drainage structures to indicate the number and location of high risk structures.

Subtask 1.6.4 Assess risk at existing and future water control structures and canals in South Florida.

Status: The CERP project has assessed South Florida canals and has made recommendation for retrofitting and restricting access points. Their recommendations have been generally well received but have not yet been approved by regulatory agencies.

Task 1.7 Minimize manatee injuries and deaths caused by fisheries and entanglement.

Status: The Entanglement Working Group (EWG) has implemented a statewide monofilament fishing line recycling program including the placement of recycling stations in several coastal counties. SMC implemented the pilot project in Monroe County. Studies should be done to assess the effectiveness of monofilament recycling programs.

Subtask 1.7.1 Minimize injuries and deaths attributed to crab pot fishery.

Status: Rule language under 68B, F.A.C. has been implemented to allow derelict crab trap clean ups and limit the number of blue crab endorsements (however, the number of traps remains high). No rule language has been proposed to change commercial fisheries to reduce the risk of entanglement. Work needs to be done to assess the effectiveness of clean-up efforts.

Subtask 1.7.2 Minimize injuries and deaths attributed to commercial and recreational fisheries, gear, and marine debris.

Status: FWCC is failing in one important aspect of this subtask. Federal enforcement personnel have reported that FWCC speed zone exemption holders (commercial fishers, fishing guides, etc.) have repeatedly violated their exemptions but to date there has been no enforcement action/revocation of exemption permits by FWCC.

Task 1.10 (and all subtasks all fall under the rescue, rehabilitation, and release program)

Status: SMC is an active participant in these endeavors. We fully support this program in its existing form. We are, however, very concerned about recent attempts on the part of some of the oceanaria to obtain enhancement permits under the MMPA. This is utterly contrary to the purposes and goals of the program.

Task 1.11 Implement strategies to eliminate or minimize harassment due to other human activities.

Status: This task has not been accomplished. There has been no effort to date to implement a strategy to eliminate or minimize harassment. Current "strategy" is for SMC to provide manatee awareness sign that discourages feeding and other harassment. Current efforts by the Manatee Protection Working Group (MPWG) to address this issue have been delayed by the USFWS. due to internal policy discussions on harassment. The Service has only authorized limited discussion of this issue by the MPWG and is hampering accomplishment of this task. See full discussion under Factor B.

Subtask 1.11.1 Enforce regulations prohibiting harassment.

Status: While the issue of harassment may be addressed to some small degree in Crystal River, it is definitely not being accomplished in any other part of Florida. See discussion under Factor B.

Subtask 1.11.2 Improve the definition of "harassment" within the regulations promulgated under the ESA and MMPA.

Status: This subtask has not been accomplished

Objective 2: Determine and monitor the status of manatee population
Most of the tasks under this objective involve on-going research projects in various stages of completion. Notable exceptions include:

Subtask 2.5.7 Develop a better understanding of disturbance.

Status: This task has not been accomplished. A few studies of disturbance have been initiated or are ongoing. The understanding of the effects of disturbance on manatees and manatee recovery is in its infancy. See discussion under Factor B.

Subtask 2.5.7.2 Investigate, determine, monitor, and evaluate how vessel presence, activity, and traffic patterns affect manatee behavior and distribution.

Status: Limited research has been conducted into how vessels affect manatee behavior and distribution. Research is currently being conducted by Wildlife Trust in one area in Charlotte County. Having a good understanding of this relationship is essential in reducing take (lethal and non-lethal) and assessing the effectiveness of and need for additional manatee protection areas, specifically the potential impact of high speed corridors.

Subtask 2.5.7.4 Evaluate the impacts of human swimmers and effectiveness of sanctuaries.

Status: This subtask has not been accomplished. A couple of recent studies focusing on interactions at Crystal River National Wildlife Refuge have been conducted documenting harassment, manatee behavioral changes, and negative impacts to manatees. A broader assessment of the impacts of swimmers and the effectiveness of sanctuaries has not been completed. In spite of the recent published papers clearly documenting impacts, there has been no effective management policy implemented. See discussion under Factor B.

Subtask 2.5.7.5 Evaluate the impacts of viewing by the public.

Status: This subtask has not been accomplished.

Subtask 2.5.7.6 Evaluate the impacts of provisioning.

Status: This subtask has not been accomplished.

Objective 3: Protect, identify, evaluate, and monitor manatee habitats.
<u>Meeting the goals of this objective is vital for the long-term survival of manatees</u>.

Task 3.1 Convene a Habitat Working Group.

Status: This task has been accomplished, however the HWG is far from accomplishing its goals. See discussion under Factor A.

Task 3.2 Protect, identify, evaluate, and monitor existing natural and industrial warm-water refuges and investigate alternatives.

Status: The HWG and the WWTF are working to achieve this monumental task

but are way behind schedule (the deadline in the implementation schedule for this task was October 2002, and most of the work remains to be done. See discussion under Factor A, plus comments on selected subtasks.

Subtask 3.2.1 Continue the Warm Water Task Force.
Status: The task force continues ...

Subtask 3.2.2 Develop and implement an industrial warm-water strategy.
Status: In the short term, this task is being addressed. A plan for the long term has not been accomplished. The quest for alternative warm water sites is on-going but there does not appear to be any sense of urgency since the California debacle with deregulation put a damper on its inevitable move to Florida. Many of the corporate partners appear to be engaged and FPL has conducted some feasibility studies of alternative warm water options but these need to be put in place and field tested ASAP. See discussion under Factor A.

Subtask 3.2.3 Protect, enhance, and investigate other non-industrial warm-water refuges.
Status: Many thermal basins used by manatees have been identified but several important ones are not protected as safe havens or sanctuaries so in large part this task has not been accomplished. See discussion under Factor A.

Subtask 3.2.4 Protect and enhance natural warm-water refuges.
Status: A lengthy discussion of how poorly this is being handled is found under Factor A.

Subtask 3.2.4.1 Develop and maintain a database of warm-water refuge sites.
Status: This task has been accomplished.

Subtask 3.2.4.2 Develop comprehensive plans for the enhancement of natural warm-water sites.
Status: This task has not been accomplished.

Task 3.3 Establish, acquire, manage, and monitor regional protected area networks and manatee habitat.
Status: Much of this task has not been accomplished. See discussion under Factor A, particularly the discussion under criterion "b" and "c."

Subtask 3.3.1 Establish manatee sanctuaries, refuges, and protected areas.
Status: As a result of our lawsuits, several new sanctuaries, refuges and speed zones have been established, albeit many of these are not as protective as originally proposed. See discussion under Factor E. Sign posting was slow and remains unfinished in several areas, plus hurricane damage in 2004 has not been addressed in several areas.

Subtask 3.3.6 Assist local governments in development of county MPPs.

Status: Completion of this task is far behind schedule. Of the 13 Key Counties required to have MPPs in 1989, three (Volusia, Broward, and Palm Beach) still do not have approved plans. Of the counties with approved plans, several (Collier, Duval, Lee and St. Lucie) have boat facility siting elements (BFSE) that are inadequate to accomplish their legislatively mandated goal of reduction of manatee mortality. During a recent District Court of Appeals hearing, attorneys for FWCC successfully argued that MPPs only provide guidelines and therefore are not subject to legal action by affected parties. It is extremely problematic that development of strong MPPs is apparently not a legal requirement the FWCC must adhere to, especially in light of the fact that the Service has "bought into" the notion that MPPs will have a positive effect on manatee recovery and could effectively address their incidental take conundrum.

Subtask 3.3.7 Implement approved MPPs.

Status: There is the serious problem of MPPs so deficient that, even though they may be implemented according to the density requirements of the BFSE, no project, no matter how large, is egregious enough to trigger a curtailment or denial of the project. There have also been instances of projects being approved that are not in compliance with the local MPP.

Subtask 3.3.8 Protect existing SAV and promote reestablishment of NSAV.

Status: While there are state and federal laws to protect constituent elements of habitat such as SAV, there is also poor coordination between permitting agencies, no oversight of cumulative impacts of many different human activities and a burgeoning human population along Florida's coastlines. This translates into a net loss of habitat over time, including SAV losses. The FWCC has the authority to develop rules to protect seagrass beds and other manatee habitat from destruction by boats or other human activity, as authorized by 370.12(2)(n), F.S. To date they have not developed any such rules.

Subtask 3.3.10.1 Define response to changes in fresh water flow patterns in south Florida as a consequence of the Everglades' Restoration.

Status: Ongoing. This is a fascinating project being conducted by USGS Sirenia Project and it has our full support.

Subtask 3.3.11 Maintain, improve, and develop tools to monitor and evaluate manatee habitat.

Status: This task has not been accomplished.

Subtask 3.3.11.1 Maintain, improve, and develop tools to monitor and evaluate natural and human-related habitat influences on manatee ecology, abundance, and distributions.

Status: This task has not been accomplished.

Subtask 3.3.11.2 Maintain, improve, and develop tools to evaluate the relationship between boating activities and watercraft-related mortality.

Status: Research is on-going but manatee mortality remains unacceptably high. See discussion in Factor E.

Task 3.4 Ensure that minimum flows and levels are established for surface waters to protect resources of importance to manatees.

Status: This task has not been accomplished. On its face the language of this task is confusing since "flows" pertain to springs, not surface waters. While some minimum levels have been established for some waterways utilized by manatees, they were not established with protection of manatees in mind.

Task 3.5 Assess the need to revise critical habitat.

Status: This task has not been accomplished. See discussion under Factor A.

Objective 4. Facilitate manatee recovery through public awareness and education
The 3rd revision of the Plan marked the first time that public awareness and education has been separated into its own objective. For the most part this appears to be a successful approach. It appears the Education Working Group is making great strides toward identifying and coordinating outreach materials and efforts as well as identifying and prioritizing target audiences. We are also hopeful that participation in this group can lead to a promised policy change on the part of FWCC so that they will once again distribute SMC education materials.

Task 4.4 Develop consistent manatee viewing and approach guidelines.

Status: This task has not been accomplished. and would seem to be a requirement under the MMPA. See discussion of this under Factor B.

There is clearly no indication that significant threats to the species, including human-related mortality, injury, and harassment, and habitat alteration, have been reduced or eliminated. The manatee does not meet the criteria for downlisting and therefore must retain its endangered status under the ESA. Thank you for your serious consideration of the information provided in this letter. If you have any questions, please do not hesitate to contact either of us.

Sincerely,

Patti Thompson

Patti Thompson
Director of Science and Conservation
Save the Manatee Club

PJT for
Eric Glitzenstein

Eric Glitzenstein
Meyer Glitzenstein & Crystal

cc: Sam Hamilton, USFWS
Dave Hankla, USFWS

attachments

Hopping Green & Sams

Attorneys and Counselors

August 30, 2005

Ms. Elsa Haubold
FWC/ FMRI
100 8th Ave. S. E.
St. Petersburg, FL 33701

Re: Manatee Biological Review Panel

Dear Ms. Haubold:

Not too long ago the Commission appointed you as part of the scientific Manatee Biological Review Panel. Subsequently you published a request for scientific and other useful information that will help your Panel in its task of determining what level of endangerment the manatee currently faces. Although I am a lawyer, not a scientist. I have had an opportunity to participate over the years in the regulation and protection of manatees. Based on my lay observations and the data that has passed over my desk, including the information in the most recent federal Manatee Recovery Plan, I believe that there is considerable scientific evidence that manatees are making significant progress toward recovery. I base this view on the aerial counts over a long period of time; the best available data and the increased range of the manatee. The species' progress toward full recovery is being made, notwithstanding the fact that there are more boats registered in Florida and thus, from year to year, there may be more collisions between boats and manatees.

Existing Evidence of Manatee Recovery:

A number of years ago, in order to keep track of how the manatee population was progressing, I began to develop a population chart based solely on FWCC data. A copy of this chart is enclosed. Since aerial surveys began in 1991, the manatee population has generally increased year by year. Because some discount the value and accuracy of aerial counts, I would like to make a few observations with regard to their importance as evidence of the state of the manatee population:

1. Unless the aerial count numbers are improperly increased during the counting process, the counts themselves will always under-project the actual number of manatees that are in the water at any given time. This is because the counters are dependent on the limits of their location, visibility, weather, etc and thus are not able to count all the manatees in state waters. To illustrate, it is my understanding that during one or two years since 1991 no counts were made in the Thousand Island area of

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Southwest Florida, so none of those manatees are included in that year's count.

2. We should be able to develop a reliable estimate of how many more manatees are in the water than those that are actually counted in a given year. Modeling may be helpful in estimating this number.

3. Let's assume for this discussion that the counts are accurate and that no more than 10 - 25% of manatees were uncounted (10% would be an exceedingly low number of uncounted manatees). As you can see from the chart, in 1991 the actual count was 1465 and in 2005 it was 3,142. In other words, the counted population more than doubled in the 15-year period between 1991 and 2005. While the population doubled, the annual watercraft attributed deaths did not. In fact, if you will look at the far right hand column of the chart, you will see that watercraft deaths as a percent of total observed population has stayed in a relatively narrow range of between 2.1% and 3.6%, with the one outlier being 2002 when there was an admittedly an inaccurate count (See footnote 3). What these figures tell me is that the population is steadily increasing. When one takes out the red tide deaths, the annual watercraft deaths calculated as a percent of the total population has remained relatively constant and has not increased as one would have expected since a larger number of boats are in the water.

4. There is anecdotal evidence and observations that support the fact that the population is generally increasing. Up until a few years ago, we never saw manatees in the St. Marks River or in Apalachicola Bay. Recently, people have been reporting relatively large counts in the St. Marks River and more manatee observations along the Panhandle coast. These observations lead to the conclusion that the population range is expanding. The problem with this north and west expansion is that because manatees are extremely sensitive to cold, the further west, northwest that they go, the worse it will be for their winter survival.

Statement of Agency Understanding of Available Science and Management Implications (August 2005):

The FWCC's "Statement of Agency Understanding of Available Science" dated August 2005 has been reviewed and our comments on it are as follows:

- **Manatee Watercraft Injury** – No comment

- **Manatee Behavior (related to Watercraft)** – No comment

- **Boat Study Information** - With regard to the observed speed of boats being between 20 – 30 miles per hour before speed zones are established, I believe this is generally correct but the speed of boats are largely

dependent on the size of the boat, the depth of the water and traffic in the area. This broad statement needs to be qualified to take into account that most vessel operators, particularly of small boats, usually want to bring the boat up on plane so that they have better visibility in making a transit from one location to the next.

This statement also raises an interesting issue. Slow speed zones are generally defined at approximately 7 miles per hour. At that speed, few boats come up on plane and often boat operator views are obstructed because the bow of the boat is in the air. I would suggest that consideration be given to adopting an "on plane slow speed" as opposed to a "slow speed" for purposes of manatee speed zones. "On plane speeds" could be defined as the minimum speed a boat requires to be on plane. This will enhance water safety as well as boater operator visibility.

- **Effectiveness of Speed Zones** – This section raises an important issue. Do we have scientifically based data that shows that speed zones are in fact effective in reducing collisions between manatees and boats? It seems that very little data has been gathered on the effectiveness of speed zones in reducing these collisions. It is my suggestion that the FWCC pick 3 to 5 pilot areas where extensive studies could be done as to the effectiveness of speed zones. This would mean that we should have matching pilot areas where there are no speed zones so that results of the two areas can be compared. Too often in the manatee management business we seem to latch on to what is considered by some a good idea to slow boats down without having any real data to back up why we are moving in that particular direction.

  I have listened with interest and read a great deal about the debate over whether speed zones are effective ways of protecting manatee. I know that a 7-mile per hour speed limit that covers any distance will certainly invite boaters who are eager to arrive at where they are going to exceed those limits. It is difficult to insist that someone move his boat any great distance with minimum steerage.

  I would suggest that the FWCC's speed zone strategy be subjected to several tests:

1. Has a particular speed zone in fact reduce the number of manatee deaths or injury in the area? We should be able to calculate this with scientific certainty.

2. Is there science based data to support the location and length of a particular speed zone?

3. Do we have a program that calls for regular periodic review of adopted speed zones to ensure that changes in the manatee population or manatee's usage of the

area are recognized? In many cases where there are a year-round manatee speed zones there is evidence that they should be seasonal speed zones: in other cases where they are seasonal speed zones they may need to be year-round.

4. Can we design signage that allows for periodic changes?

5. Should we adopt a program that requires a regular periodic review of existing speed zones on a 7 – 10 year schedule?

- **Population** – This portion of the Statement provides in part:

  "Best available data indicates that the manatee population is increasing in the Northwest and upper St. Johns region and additional growth can be expected in those areas."

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  "The status of manatees in the Atlantic and Southwest regions is less certain. The most recently published analysis indicates the Atlantic subpopulation may be slightly increasing, although the data is difficult to interpret. Current analysis indicates that the Southwest subpopulation may be declining. However, data for this subpopulation is inadequate for certain areas of this region".

  To begin. I cannot find in any documentation on how the sub-regions were arrived at, particularly with regard to the Northwest and Southwest Gulf coast sub-regions. There does not seem to be a geographic or population divide that justifies splitting the west coast into two regions.

  If the west coast was not divided into two regions, would the population of the entire state meet the biological criteria for recovery?

  - Is there a possibility that by dividing the west coast into two regions we have accidentally skewed the results to make it look as if the overall population has not recovered?

  - What is the justification for considering the Southwest region's population a subpopulation different in kind, quality and nature from the Northwest population?

  - Aren't these the same specie, in the same general area, with no real differences?

  I believe that the regional division of the manatee population should be readdressed. Once the population as a whole has been looked at we may

well find that the best available scientific data indicates that the manatee population, as a whole, has recovered statewide.

The population portion of the Statement further indicates:

"The manatee Core Biological Model developed and being refined by Dr. Michael Runge and Dr. Chris Fonnesbeck, is the best available tool for evaluating the status of the manatee population."

Although this is an interesting statement of "fact", it seems that until the Runge/Fonnesbeck Model has been analyzed and all of its assumptions subject to careful scientific scrutiny, challenge and acceptance, the model can not be declared the "best available tool for evaluating the status of the manatee population".

Models are simply mathematical projections based on a series of assumptions. Until each and every assumption has been carefully tested and the final model has been tested using actual data input that proves when you feed it various kinds of data it will project both failure and success, the model is only a useful tool but certainly not the best available tool.

I am delighted to see that Dr. Runge is a member of your panel. I know that he is an advocate for modeling as a way to determine not only what the status of the existing population is but over a long period of time what we can expect as far as the size and health of that population. As a lawyer I have had the opportunity to question several modelers of national stature on such divergent subjects as a Clean Air Model and a Coastal Erosion Model. On each of these occasions I have found the modelers to be sincere, technically competent and thoughtful people. Nevertheless, because of the nature of modeling mathematics, modelers are compelled to make numerous numeric decisions at a variety of points in their model design, where, out of an abundance of caution, they most often select what they term "a conservative number" rather than a number that is in the middle of the range of possibilities. The effect of choosing a conservative number at each decision point is that their "conservative" designed models tend to over-predict dire circumstances.

Thus before we invest our hearts and minds in a particular model, we should assure ourselves that the model, if it had been applied to data available in 1991, would predict somewhere near the population being actually counted and estimated today. If the model does not do that, then there may be something wrong with the model's assumptions.

Secondly, we need to carefully analyze each and every assumption in the model. One such assumption may relate to whether or not coastal power plants will continue in operation in the future. I have recently returned from a national ExxonMobil presentation regarding future energy demands and sources through 2030. The energy needs projections discussed at this national conference, when coupled with information I have

garnered from compatriots in the law firm who do power plant siting and who are familiar with Florida's future power plant siting plans leads me to the conclusion that it is unlikely that coastal power plants will be closed in the next 50-75 years. Florida's population growth and our electric energy demands are increasing at such a rate that these plants will have to be kept in the mix and in many cases their capacity will need to be increased rather than being reduced.

Finally, we should be able to feed the model information and assumptions that will predict manatee recovery. If a model will not predict manatee recovery when you feed it greater numbers or greater growth rates, then there is something wrong with the model.

In your deliberations, I caution you about using models as if they in fact can accurately predict what is going to happen in the future. I am sure Dr. Runge will also caution you about other model limitations. Modeling is a tool but its use requires common sense and attention to scientific detail.

Management Implications:

"The agencies want to continue to work on determining the best numeric planing speed for boats using high speed corridors in manatee areas..."

I believe the agencies should also be looking at whether 7 miles per hour is the best numeric speed in "slow speed" corridors. 15 miles per hour, which is 5 miles per hour less that we use in active public school speed zones, would seem to be more appropriate than the current 7 mile per hour slow speed. This issue should be considered along with what the appropriate higher speed should be in high speed corridors.

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"The agency's plan to use the manatee Core Biological Model as a tool to assess the current status and future persistence of the manatee population and to assist with future management decisions".

I have previously commented on the limitations of models and will not repeat those comments here. The agency should use more tools than simply using the models. Models should be analyzed annually against aerial counts and other data surveys to determine whether or not the models are accurately predicting what is actually taking place in the state's waters.

Suggested Approach to Long Term Manatee Protection:

1. We should complete the adoption of Measurable Biological Goals defining various stages of manatee recovery so that we can have science driven recovery criteria. The current Measurable Biological goals for recovery should be carefully assessed to determine if they are based on the right criteria. In particular, the idea

that the population growth rate should either be zero or greater than zero may not work on a multiple year basis. The growth rate portion of the criteria needs to have a timeframe associated with it such as being based on 5-year cycles as opposed to an annual basis. In some years there may be no net population growth, while in other years the population growth may be significant. Again, if you turn to the footnotes on the enclosed chart you will see that the counted Atlantic coast 2005 population of 1594 is actually a population that grew during a one year period while other data indicates that region's population growth rate may be stable and perhaps even shrinking.

2. Once we adopt a science based measurable recover goal we need to determine a realistic carrying capacity for the manatee on a statewide basis. If the current counted population is 3,000, obviously we need to understand what would happen if there were 5,000 or 10,000 manatees in Florida's waters. Florida has a finite manatee carrying capacity driven by availability of food supply, water temperatures, warm water habitats, etc.

3. The next step would be to develop an appropriate FWCC Manatee Management Plan that recognizes the limits of the state's carrying capacity.

4. We should review the current four (4) region approach. As I understand it, the manatee is not considered on the road to recovery if one of the four regions is failing the recovery criteria even if the total population is exceeding the recovery criteria on a statewide basis. This fragmentation of populations does not serve a viable public interest. The question for the whole state is "What is the overall status of the manatee population?" not whether or not each individual region has recovered.

   I have heard it said that the reason the statistics on whether or not the Southwest Florida region's manatee population meets the biological criteria are based more on politics than science and that no one wants to complete the count there for fear that we will show a recovering specie. This may be an unjustifiable criticism, nevertheless many have wondered why the population break on Florida's west coast occurs in Pasco County and there is no similar county break on the Atlantic coast.

   If you simply joined the Southwest and Northwest Gulf population together, would there be recovery statewide? Cynically, it is hard for me to accept that the manatees are smart enough to know when they have crossed from one county to another on the Florida west coast since humans are unable to do so.

Avoidance Technology Suggestion:

I was pleased to have an opportunity to review your Avoidance Technology PowerPoint presentation. I thought it was well done. Being a boater who had a fish-finder on his boat as well as a mobile phone owner who has a GPS in his phone, and an automobile

owner who has a GPS in his car, it seems as if it should be feasible to develop a vessel mounted GPS based manatee avoidance device that could be sold at reasonable prices to boaters and even mandated if necessary. My 7-year old fish finder did look forward; it did see certain obstructions in the water; it did tell me how deep the water is, all with a reasonable degree of accuracy. How much effort would it take to develop something more sophisticated that specifically focuses on finding and avoiding manatees?

Final Comments:

I would hope that instead of using the Endangered Species Act and the Marine Mammal Protection Act as devices to limit the growth of boating in Florida that we would focus on a plan that would calculate with scientific certainty how many manatees Florida waters can support and proceed to develop a system to ensure that that number of healthy manatees share the waters of the state with Florida's responsible boaters.

If these comments raise any questions or need to be explained, please feel free to contact me.

Sincerely,

Wade Hopping
whopping@hgslaw.com

Cc: Ken Haddad

HISTORIC MANATEE MORTALITY STATISTICS

Percentage of watercraft-attributed deaths compared to total observed manatee population: 1991-2005

YEAR	AERIAL SURVEY COUNT [1]	ANNUAL WATERCRAFT-ATTRIBUTED DEATHS	WATERCRAFT DEATHS AS % OF TOTAL OBSERVED POPULATION
1991	1465	53	3.6%
1992	1856	38	2.1%
1993	N/A	35	–
1994	N/A	51	–
1995	1822	43	2.4%
1996[2]	2639	60	2.3%
1997	2229	55	2.5%
1998	2022	66	3.3%
1999	2353	82	3.5%
2000	2223	78	3.5%
2001	3276	81	2.5%
2002	1796[3]	95	5.3%
2003	3113	73	2.3%
2004	2505	69	2.7%
2005	**3142[4]**	**69[5]**	**2.2%**

[1] Aerial count figures consistently underestimate the actual manatee population because pilots and observers do not see all manatees. The counts may also vary from year to year depending in part on the coldness of the weather because manatees are easier to count when they congregate at warm water sites (e.g., in 1974, counts were as low as 850, with 1,000 as the maximum estimated population). No aerial counts were conducted in 1993 or 1994.

[2] After this winter count, in the summer of 1996, red tide was suspected of killing at least 151 manatees or about 12% of the entire Gulf Coast population. In 1982, a similar red tide outbreak caused at least 37 deaths.

[3] The Florida Fish & Wildlife Conservation Commission has expressed doubt about the validity of this count due to poor weather and flying conditions. Thus, this number reflects an admittedly low population count.

[4] A statewide synoptic survey was conducted to count the manatee population on January 26, 2005. This number reflects an Atlantic Coast population of 1,594 and a Gulf Coast population of 1,548 manatees for a total of 3,142 Florida manatees. However, the total number of Florida manatees counted in the January 26, 2005 aerial survey is classified as a preliminary result until the data from the survey is verified.

[5] This calculation uses 2004 watercraft related manatee deaths to determine a predicted percentage for 2005.

Appendix G: Core biological model parameters

This table shows the parameters in the core biological model, the estimated values for each, the range of uncertainty associated with them, and the method by which they were estimated. This information is taken from Runge *et al*. (in preparation).

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
Survival and Breeding	s1	AT	0.791	(.650, .885)	First-yr survival	based on US, proportional to adult survival	Runge et al. 2004
		US	0.810	(.727, .873)		CMR, known age	Langtimm et al. 2004
		NW	0.807	(.673, .895)		based on US, proportional to adult survival	Runge et al. 2004
		SW	0.765	(.616, .869)		based on US, proportional to adult survival	Runge et al. 2004
	s2	AT	0.893	(.712, .966)	Second -yr survival	based on US, proportional to adult survival	Runge et al. 2004
		US	0.915	(.827, .960)		CMR, known age	Langtimm et al. 2004
		NW	0.911	(.751, .972)		based on US, proportional to adult survival	Runge et al. 2004
		SW	0.864	(.654, .955)		based on US, proportional to adult survival	Runge et al. 2004
	s3 = s4	AT	0.936	(.923, .949)	Subadult survival	based on US, equal to adult survival	Runge et al. 2004
		US	0.961	(.915, .983)		CMR, known age	Langtimm et al. 2004
		NW	0.956	(.943, .969)		based on US, equal to adult survival	Runge et al. 2004
		SW	0.906	(.867, .944)		based on US, equal to adult survival	Runge et al. 2004
	sP = sA	AT	0.936	(.923, .949)	Adult survival	CMR, photo ID	Langtimm et al. 2004
		US	0.960	(.937, .982)		CMR, known age	Langtimm et al. 2004
		NW	0.956	(.943, .969)		CMR, photo ID	Langtimm et al. 2004
		SW	0.906	(.867, .944)		CMR, photo ID	Langtimm et al. 2004
	g4	AT	0.000	(.0, .3)	Breeding propensity for 4-yr olds	by comparison to NW	Runge et al. 2004
		US	0.208	(.071, .422)		binomial proportion, known-age breeders	Runge et al. 2004
		NW	0.000	(.000, .285)		binomial proportion, known-age breeders	Runge et al. 2004
		SW	0.000	(.0, .3)		by comparison to NW	Runge et al. 2004

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
	gP	AT	0.304	(.132, .529)	Breeding propensity for females > 4 that have not previously bred	by comparison to SW	Runge et al. 2004
		US	0.610	(.505, .709)		binomial proportion, known nonbreeders	Runge et al. 2004
		NW	0.381	(.181, .616)		binomial proportion, known nonbreeders	Runge et al. 2004
		SW	0.304	(.132, .529)		binomial proportion, presumed nonbreeders	Runge et al. 2004
	gB	AT	0.381	(.292, .470)	Breeding propensity for established breeders	CMR, photo ID	Kendall et al. 2004
		US	0.610	(.505, .709)		binomial proportion, known breeders	Runge et al. 2004
		NW	0.429	(.217, .541)		CMR, photo ID	Kendall et al. 2004
		SW	0.595	(.421, .752)		binomial proportion, known breeders, Sarasota Bay	Runge et al. 2004
Temporal Variance	σ(s1)	AT	0.104	(.000, .417)	Temporal variance of first-yr survival, on the logit-scale	based on adult variance; CV ~2x that for adults	Runge (2003)
		US	0.000	(.000, .263)		based on adult variance; CV ~2x that for adults	Runge (2003)
		NW	0.128	(.000, .518)		based on adult variance; CV ~2x that for adults	Runge (2003)
		SW	0.106	(.000, .851)		based on adult variance; CV ~2x that for adults	Runge (2003)
	σ(s2)	AT	0.233	(.000, .935)	Temporal variance of second-yr survival, on the logit-scale	based on adult variance; CV ~2x that for adults	Runge (2003)
		US	0.000	(.000, .589)		based on adult variance; CV ~2x that for adults	Runge (2003)
		NW	0.281	(.000, 1.124)		based on adult variance; CV ~2x that for adults	Runge (2003)
		SW	0.184	(.000, 1.472)		based on adult variance; CV ~2x that for adults	Runge (2003)

Parameter	Region	Estimate	Uncertainty	Description	Method	Source
σ(sA)	AT	0.000	(.000, .039)	Temporal variance of adult survial, on the nominal scale	Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Langtimm et al. (2004)
	US	0.000	--		Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Langtimm et al. (2004)
	NW	0.018	(.000, .048)		Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Langtimm et al. (2004)
	SW	0.000	(.000, .082)		Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Langtimm et al. (2004)
σ(g4)	AT	0.000	--	Temporal variance of breeding propensity of 4-yr-olds	Expert judgment	Runge (2003)
	US	0.000	--		Expert judgment	Runge (2003)
	NW	0.000	--		Expert judgment	Runge (2003)
	SW	0.000	--		Expert judgment	Runge (2003)
σ(gP, gA)	AT	0.000	(.000, .062)	Temporal variance of breeding propensity for older animals	Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Runge (2003)
	US	0.000	--		Expert judgment	Runge (2003)
	NW	0.076	(.000, .213)		Burnham *et al.* (1987) method for estimating temporal variance; based on CMR	Runge (2003)
	SW	0.076	(.000, .213)		by comparison to NW	
ρ(ss)	all	1	--	Temporal correlation among survival rates	Assumption	Runge (2003)
ρ(bb)	all	1	--	Temporal correlation among breeding rates	Assumption	Runge (2003)
ρ(sb)	all	0.5	--	Temporal correlation between survival and breeding rates	Assumption	Runge (2003)

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
Catastrophes	C1F	all	0.01	--	Frequency of Type 1 catastrophes (Emergent disease)	Expert judgment based on review of marine mammal literature	FWC (2002ab)
	C1S	all	0.25	--	Magnitude of effect of Type 1 catastrophe on survival rates	Expert judgment based on review of marine mammal literature	FWC (2002ab)
	C1B	all	0.20	--	Magnitude of effect of Type 1 catastrophe on breeding rates	Expert judgment based on review of marine mammal literature	FWC (2002ab)
	C2F	AT	0	--	Frequency of Type 2 catastrophes (Red tide)	Red-tide not observed	FWC (2002ab)
		US	0	--	7/45 of the SW frequency	Red-tide not observed	FWC (2002ab)
		NW	0.018	--		by comparison to SW (half the frequency)	FWC (2002ab)
		SW	0.2	(0.03,0.4)		Binomial estimate (1 in 28 yrs)	FWC (2002ab)
	C2S	AT	--	--	Magnitude of effect of Type 2 catastrophe on survival rates	NA	FWC (2002ab)
		US	--	--		NA	FWC (2002ab)
		NW	0.05	--		No justification given	FWC (2002ab)
		SW	0.06	(0.025,0.10)		Rough guidance from 1996 event	FWC (2002ab)
	C2B	AT	--	--	Magnitude of effect of Type 2 catastrophe on breeding rates	NA	FWC (2002ab)
		US	--	--		NA	FWC (2002ab)
		NW	0.05	--		Expert judgment	FWC (2002ab)
		SW	0.05	--		Expert judgment	FWC (2002ab)
Cold Stress Mortality	Mca	all	0.5	(.30, .75)	Additional mortality for adults outside refugia in cold years	Expert panel consensus	Runge (2003)

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
	Mcj	all	1.0	(.90, 1.0)	Additional mortality for juveniles (1,2 yr) outside refugia in cold years	Expert panel consensus	Runge (2003)
	Mna	all	0.01	--	Additional mortality for adults outside refugia in normal years	Expert panel consensus	Runge (2003)
	Mnj	all	0.05	(.025, .10)	Additional mortality for juveniles outside refugia in normal years	Expert panel consensus	Runge (2003)
Density Dependence	α	all	0.25	(.15, .50)	Decline in reproductive rates as density approaches carrying capacity	Reference to general literature values	FWC (2002ab)
	β	all	2	(1, 4)	Shape parameter affecting how close density needs to be to capacity before density-dependent effects are apparent	Exploration of values that produce plausible dynamics	Runge (2003)
Carrying Capacity	a	AT	3	--	Year (beyond current) that logistic decline begins	Expert panel consensus	Runge (2003)
	b	AT	50	--	Year (beyond current) that logistic decline ends	Expert panel consensus	Runge (2003)
	k1	AT	2000	(1200, 5000)	Current carrying capacity	Expert panel consensus	Mtg. Notes 7/23/2003
	k0	AT	750	(600, 2000)	Long-term carrying capacity	Expert panel consensus	Mtg. Notes 7/23/2003

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
	c	AT	15	(10, 20)	Years until mid-point of drop	Expert panel consensus	Runge (2003)
	m	AT	1	(0, 5)	Slope of logistic drop (0 = linear from a to b; 5 = near instantaneous drop)	Expert panel consensus	Runge (2003)
	s1	US	325	(150, 500)	Current carrying capacity	Expert panel consensus	Runge (2003)
	s0	US	0.71	(0.33, 0.89)	Long-term carrying capacity (as a fraction of the current capacity)	Expert panel consensus, derive from SJWMD UWWL	Mtg. Notes 8/26/2003
	t_{half}	US	20	(15, 30)	Half-life of exponential decline	Expert panel consensus	Runge (2003)
	s1	NW	1200	(750, 3000)	Current carrying capacity	Expert panel consensus	Runge (2003)
	s0	NW	0.7	(0.4, 0.85)	Long-term carrying capacity (as a fraction of the current capacity)	Expert panel consensus	Mtg. Notes 2/20/2004
	t_{half}	NW	20	(10, 40)	Half-life of exponential decline	Expert panel consensus	Runge (2003)
	a	SW	3	--	Year (beyond current) that exponential decline begins	Expert panel consensus	Runge (2003)
	b	SW	40	--	Year (beyond current) that exponential decline ends	Expert panel consensus	Mtg. Notes 8/4/02003
	kX	SW	600	(200, 800)	Other anthropogenic capacity that will be lost over time	Expert panel consensus	Mtg. Notes 8/4/02003
	k0	SW	850	(500, 1100)	Long-term carrying capacity	Expert panel consensus	Runge (2003)
	kM	SW	450	(400, 500)	Ft. Myers Plant carrying capacity	Expert panel consensus	Runge (2003)

Parameter		Region	Estimate	Uncertainty	Description	Method	Source
	kT	SW	540	(480, 600)	TECO Big Bend carrying capacity	Expert panel consensus	Mtg. Notes 8/4/02003
	cM	SW	25	(20, 30)	Years until loss of Ft. Myers	Expert panel consensus	Runge (2003)
	cT	SW	30	(10, 40)	Years until loss of TECO	Expert panel consensus	Mtg. Notes 8/4/02003
	m	SW	0.05	(0, 0.1)	Exponential rate of loss of other anthropogenic capacity	Expert panel consensus	Runge (2003)
	k1	SW	2440	(1580, 3000)	current carrying capacity	Calculation from other components	Mtg. Notes 8/4/02003
Initial Population Size	N	AT	1447	--	2001 population size, when needed	Synoptic survey, Jan 5-6, 2001	FWC-FWRI, pers. Comm. 10/21/05, Fonnesbeck & Edwards
		US	141	--		Seasonal total of unique individuals seen	Wayne Hartley, pers. comm.
		NW	377	--		Synoptic survey, Jan 5-6, 2001	FWC website
		SW	1364	--		Synoptic survey, Jan 5-6, 2001	FWC-FWRI, pers. Comm. 10/21/05, Fonnesbeck & Edwards

Appendix H: Estimates of population change and extinction probability.

This table shows estimates of various relevant results from the Core Biological Model (Runge et al., in preparation). The mean and several quantiles are shown for the proportional change in the population of mature animals over various lengths of time. The mean probability of extinction over several time periods is also shown. These results are based on 5000 replicate simulations.

Region	Metric	Mean	Lower 2.5%	Lower 5%	Lower 25%	Upper 2.5%
Southwest	Population change over 1 generation	-0.4372	-0.8842	-0.8281	-0.6372	0.1605
	Population change over 2 generations	-0.6821	-0.9863	-0.9687	-0.8654	-0.1545
	Population change over 3 generations	-0.8051	-0.9981	-0.9949	-0.9507	-0.3552
	Population change over 5 generations	-0.8934	-1.0000	-1.0000	-0.9930	-0.4555
	Population change over 100 years	-0.8959	-1.0000	-1.0000	-0.9933	-0.4553
	Probability of extinction over 3 generations	0.0172				
	Probability of extinction over 5 generations	0.1154				
	Probability of extinction over 100 years	0.1194				
Northwest	Population change over 1 generation	0.6398	-0.4412	-0.2609	0.2985	1.6989
	Population change over 2 generations	1.3085	-0.6260	-0.3388	0.5762	3.9350
	Population change over 3 generations	1.6507	-0.7193	-0.4298	0.6517	5.4438
	Population change over 5 generations	1.7823	-0.8543	-0.5555	0.6137	5.9752
	Population change over 100 years	1.7908	-0.8447	-0.5717	0.6203	5.8208
	Probability of extinction over 3 generations	0.0018				
	Probability of extinction over 5 generations	0.0056				
	Probability of extinction over 100 years	0.0062				
Upper St. Johns	Population change over 1 generation	1.4077	0.2367	0.3676	0.8889	2.8600
	Population change over 2 generations	1.5858	0.0704	0.2153	0.8128	3.8646
	Population change over 3 generations	1.4399	-0.0816	0.0656	0.6438	3.8205
	Population change over 5 generations	1.2839	-0.1893	-0.0609	0.5313	3.5502
	Population change over 100 years	1.2837	-0.1709	-0.0490	0.5276	3.4977
	Probability of extinction over 3 generations	< 0.0002				
	Probability of extinction over 5 generations	< 0.0002				
	Probability of extinction over 100 years	< 0.0002				
Atlantic	Population change over 1 generation	-0.0733	-0.5049	-0.4678	-0.2620	0.4484
	Population change over 2 generations	-0.3322	-0.6927	-0.6436	-0.5131	0.3443
	Population change over 3 generations	-0.3946	-0.7878	-0.7244	-0.5648	0.3018
	Population change over 5 generations	-0.4428	-0.8937	-0.8358	-0.6191	0.2741
	Population change over 100 years	-0.4448	-0.8954	-0.8345	-0.6216	0.2733
	Probability of extinction over 3 generations	< 0.0002				
	Probability of extinction over 5 generations	0.0004				
	Probability of extinction over 100 years	0.0004				
State-wide	Population change over 1 generation	-0.0799	-0.3913	-0.3449	-0.1960	0.2608
	Population change over 2 generations	-0.2089	-0.5480	-0.5082	-0.3531	0.2378
	Population change over 3 generations	-0.2525	-0.6210	-0.5758	-0.4180	0.2728
	Population change over 5 generations	-0.3004	-0.7001	-0.6469	-0.4775	0.2722
	Population change over 100 years	-0.3013	-0.6992	-0.6489	-0.4784	0.2623

APPENDIX I: Reviewer's comments

27 February 2006

Dr. Elsa Haubold
Program Administrator
Marine Mammal Research
Fish and Wildlife Research Institute
Florida Fish and Wildlife Conservation Commission
St. Petersburg, Florida

Dear Elsa:

As you requested in your letter of 12 January 2006, I am providing scientific review of the preliminary biological status review report (BSR) for the Florida manatee.

Specifically, I was asked to comment on 1) the completeness and accuracy of information and data analyses in BSR, and 2) the reasonableness and justifiability of assumptions, interpretations, and conclusions used to support the BSR. Below, I summarize my assessment of the BSR in these 2 areas, and provide some specific comments regarding the need for further refinement of estimates, gathering of new data, or both. Finally, I provide some specific comments on the text of the BSR.

Caveats: In this assessment, I specifically do *not* render any judgments as to the merits of the proposed change in listing. Rather, my purpose is to comment on the scientific merits of the data, analyses, and models that will be used to support the decision eventually reached. Additionally, most of my comments are directed at statement in the BSR itself, rather than about the individual studies cited in support of the BSR. I have endeavored to read the major cited studies, particularly those related to recent developments in population estimation and modeling (particularly of 'incidental take') that are most relevant to the BSR. However, my review should *not* be viewed as a peer scientific review or endorsement of any of the cited papers. Nonetheless, in a few cases I will mention specific, key papers, as these are particularly relevant.

SUMMARY ASSESSMENT

In general, the BSR is based on comprehensive and up-to-date synthesis of data, estimates, and model projections. The BSR is clearly building on previous PVA work (FWC 2002b), much of it based on VORTEX, with more recent and sophisticated analyses using stage-based models, that endeavor to incorporate major sources of uncertainty (Runge 2003, Runge et al. 2003, Runge et al. in prep.). This recent modeling in turn draws on recent advances in mark-recapture modeling that have now produced more reliable demographic estimates based on photoidentification data (Kendall et al. 2004, Langtimm and Beck 2003, Langtimm et al. 2004). In contrast to the VORTEX-based PVAs, the current modeling approach is customized to both the life history of manatees, and the peculiarities of the data that are available to parameterize the model. This combination of improved statistical modeling, and more realistic modeling of

population response, is enabling biologists to better characterize the likely response of manatee populations to environmental, demographic, and human impacts. While any model projection is simply that—a model projection- the current model projections and scenario evaluations seem to be supported by the best available data and scientific judgments, while honestly taking into account uncertainties—sometimes huge—in each.

Nevertheless, there remain critical areas where further work is needed. Also, because the BSR has been prepared while several advances in analysis and modeling have been underway, the report inevitably contains a mixture of 'the old' and 'the new'. In most cases, older, less-supported analyses and inferences are presented with appropriate caveats; in others, additional statements and warnings may be needed; and in others still, it may be past time to abandon the old for the new.

There are 3 specific areas that I think more work is needed in, for which further cautionary remarks are called for, or both. These are (1) inferences from carcass recovery data, (2) inferences from synoptic population counts, and (3) inferences from so-called PVA models.

Inference from carcass recoveries

Nearly all inferences on the relative contributions of mortality factors on manatees come from the carcass recovery program. Because these are pivotal for addressing the issue of 'incidental take' from boat strikes, it is important to fully appreciate their limitations. To date, the best synthesis (that I am aware of) and interpretation of these data, is that provided by Runge (2003). As I understand these data, they are comprised of year- and area- specific counts of carcasses (n) that are recovered, and that are classified post-mortem into 1 of several likely causes of death. Cause cannot be determined post-mortem for a substantial fraction (approximately half in some cases). If we focus on boat-induced vs. other forms of mortality, the data consist of

n – total carcasses recovered from all causes,

comprised of

x_b –carcasses determined to be from boat strikes,

x_o–carcasses determined to be from other causes'

x_u -carcasses where cause of death could not be determined

As pointed out by Runge (2003), these data cannot be interpreted as either absolute estimates of raw mortality, or of cause-specific mortality rates, without further data or assumptions. Runge (2003) invokes survival estimates based on photoidentification to obtain estimates of overall mortality, and then uses the carcass recovery data to apportion these into source-specific components. This is a good idea, since of course the carcass recovery data themselves say nothing about per-capita rates of mortality, except in the

crudest way (e.g., dividing *n* by estimates *N* from synoptic surveys to get a per-capita rate; but see issues with below with estimates of *N*).

However, as Runge (2003) notes, there remain issues in the carcass data that may bias interpretation. Leaving aside the (non-negligible) issue of misclassification of cause, there are at least 2 issues that must be addressed: 1) dealing with the x_u "unknowns", dealing with the fact that <100% of carcasses are recovered, and that the *probability of recovery may be confounded with cause of mortality*.

Issue 1) affects the validity of the estimates of proportional, cause-specific mortality, even if the frequencies in the sample from each cause accurately reflect the population (Issue 2, below). To deal with this, Runge (2003) assigned to the "unknowns" a fraction *f* that were boat-induced mortalities, with the values for *f* falling over a range of plausible values. A "naïve" estimate of *p*, the proportion of morality due to boats is

$$\hat{p} = \frac{x_b}{n}.$$

This is then adjusted to

$$\hat{p}_{adj} = \frac{x_b + fx_u}{n}.$$

From this, we can see that assumptions about *f* will be most important when x_u is large relative to x_b, and less so when most carcasses can be classified as to cause of death. I note that the proportion of unknowns in some cases is quite high, and appears to vary by region (O'Shea et al. 1985, Tables 1-2). Because the overall recovery rates (see below) can be low (<0.5), and also variable by region (Runge 2003, Table 7) varies significantly by region), this raises concerns about the use of these data, particularly for inferences about region-specific effects.

The second issue is that of recovery rate, or more generally, the probability that a manatee that dies is found and its carcass recovered. There appear to be no independent data from which this parameter could be estimated (as, for instance, trials where tagged carcasses are blindly placed in areas surveyed by biologists). However, Runge (2003) indirectly calculated this quantity, based on back-calculated (reconstructed) populations, followed comparison of projections of expected total mortalities (from all causes) to observed numbers of carcasses recovered. Estimates of *r* range from 0.4 (Northwest) to 0.86 (Atlantic) by regions. Recovery rates potentially have 2 uses in this context. In theory, one could take the carcass counts (total or cause-specific) and divide by *r* to get an estimate of total, raw mortality in the population.

However, note that the interpretation of cause-specific mortality depends strongly on the assumption that *r* is homogenous across sources. If it is not, then 1) extrapolations to raw

mortality are now biased by detection heterogeneity, and 2) estimates of cause-specific mortality *rates* (so, these rates applied to mortality estimates) will also be biased. In turn, these biases will be most severe when 1) *r* is low, and 2) *r* is related to the mortality cause. As already noted, *r* (based on model projections) may be <0.5 for some populations. *A priori*, it might be expected that the cause of mortality is non-independent of recovery. For instance, it may be more likely for a boat-struck manatee to be reported (and thence recovered), than for a manatee to be recovered that has succumbed to disease during migration. This could lead to serious under or overestimation of cause-specific mortality. For instance, if we take $\hat{p} = \frac{x_b}{n}$ as the "naïve" estimator of proportional boating, for now assuming that there are no unknowns, then the approximate expectation is

$$E(\hat{p}_b) \approx \frac{r_b p_b N}{r_b p_b N + r_o p_o N}$$

where *N* is total abundance p_b, p_o and r_b, r_o are, respectively, the true fraction of *N* succumbing to each source, and the source-specific recovery rates. If $r_b = r_o$ then

$$E(\hat{p}_b) \approx \frac{p_b N}{p_b N + p_o N} = p_b$$

so $\hat{p}$ is approximately unbiased. For all other cases bias will occur. In particular, if boat-struck manatees are α times more (or less) likely to be recovered, then the expected value of the naïve estimator is approximately

$$E(\hat{p}_b) \approx \frac{\alpha r_0 p_b N}{\alpha r_0 p_b N + r_0 p_o N} = p_b \left(\frac{1}{1 + p_0 / \alpha p_b} \right).$$

Thus, the bias could depend both on the actual, relative mortality rates (p_0 / p_b), as well as the relative rates of recovery (α), a recipe for complete confounding. Further, the lower *r* is the more serious is the potential for bias.

Thus, I think it's important that independent estimates be obtained of cause-specific recovery rates. I'm not sure how to do this. Perhaps the photo-id data could provide independent estimates of carcass recovery rates, much as do band recoveries for adjustments of differential vulnerability from waterfowl harvest surveys.

APPENDIX I: Reviewer's comments

Inference from synoptic population counts

Although there now exist much data from other sources, notably the photo-id and carcass recovery data sets, much inference still depends, directly or indirectly, on population estimates from the synoptic counts. I have previously commented extensively on these surveys and will not belabor the points here, as many of these problems have been duly noted by others (e.g., Lefebvre et al. 1995). There are 2 principal issues that affect the reliability of these data as either absolute or relative measures (indices) of abundance. First are concerns about the spatio-temporal design of the surveys. Problems in this area lead to aggregations of manatees being missed, which is not in itself a problem; however, no way seems to exist to properly extrapolate these data to a spatio-temporal population of interest. Second are concerns about detection probabilities at a given survey site (visibility bias), which is almost certainly heterogeneous over time, space, and among observers. These problems not only –most obviously—bias absolute estimates of abundance, they also render the surveys suspect even as trend indicators.

Some advances have been made in fitting models to account for this source of bias, e.g., via modeling of environmental and other covariates. Advances have also been made in alternatives to survey-based estimates, e.g., based on capture-recapture (Kendall et al. 2004). These and other advances, along with existing sample survey theory, need to be used to re-tool the synoptic surveys. Some specifics:

- Establish a sampling frame, perhaps involving adaptive cluster sampling, which allows for valid inferences from the spatial samples to the target population and takes into account logistical constraints, costs, etc.
- Conduct experiments to estimate visibility correction factors (VCF) and identify the most effective and efficient ways to estimate VCFs.
- Incorporate VCFs via double sampling into the survey protocol for a re-tooled survey.

Inferences from population projection modeling/ PVA

I am encouraged by the recent modeling efforts by Runge (2003), Runge et al (2004), and Runge et al. (in prep). These all seem to be based on the best use of available data, and generally do a good job of incorporating known and anticipated sources of uncertainty. However, some reports, including the BSR, still seem to rely on conclusions drawn from earlier modeling in VORTEX. In my opinion, these analyses were overly constrained by the limitations of VORTEX, and did not allow the development of models that were appropriate for the specifics of manatee life history, or the specific assumptions and uncertainties about parameter values. In general, the I strongly recommend that the BSR avoid, wherever possible, reliance on these earlier analyses, which were flawed and, in some cases, based on circular reasoning (e.g., estimates of $\lambda=1$ based on data where $\lambda=1$ is assumed; Marmontel et al. 1997 as cited in Runge et al. 2004).

APPENDIX I: Reviewer's comments

Specific comments on text:

- Page 7, par. 1- "…..have a long time series on causes of death…… mostly attributable to human-related causes". – This evidence is based solely on carcass recoveries, here uncorrected for recovery probability. As noted above, this could result in serious biases in proportion of mortality due to this causative factor.

- pg 7, par. 3—"…..approximately 25% of all manatee deaths" should perhaps be modified to "approximately 25% of all *documented* manatee deaths".

- Later in same par.: What is the evidence that reduced boat speed effectively reduces manatee mortality? Are there any data, either experimental or observational, on mortality rates in areas subject to different speed limits?

- Pg. 8, par. 1- It is obviously tricky here to make inferences about the general population, given that these data are by definition conditional on the individual having been struck at least once. Presumably, however, the scar data could be used via capture-recapture to estimate abundance, and thus (indirectly) the proportion of manatees bearing scarred (fraction of *N* that is marked). Has this been done?

- Page 9, *Previous trend:* "…counts are affected by numerous uncontrolled variables that limit their usefulness as reliable indices of population size (Lefebvre et al. 1995)." This is an absolutely essential point, with which I strongly concur.

- Page 9 (bottom)-pg. 10 (top): *Trends in counts vs. model projections*: Could some of the discrepancy be due to changes in the degree of aggregation around power plants, resulting in changes in availability/ detection rates?.

- Next Par: Presumably these are projections, not observed growth. Nevertheless, given the difficulties with surveys and detection issues, these projections (with caveats) may provide the best long-term view of population health.

- Page 10, *Future projections* .. "10.3 % increase per year in water-related deaths". Presumably, this is an increase in the *number* of manatees killed (assumptions about classification and recovery rates notwithstanding). If abundance is also increasing, this increase would be expected, even if mortality *rates* were level. Therefore, there is a need to express this as a per-capita rate, ideally looking at proportion of mortality rate accounted for by boating.

- page 12- *Population size and numbers* " Because detection probability varies greatly with weather conditions and across sites, population experts have consistently cautioned against using these data for trend analyses". It would be nice if, instead of continually having to apologize for this fact, appropriate surveys/ estimators were actually available!

APPENDIX I: Reviewer's comments

- Next par: “This is the only subpopulation with an independent set of data to assess abundance and trends”. Were these data independently collected, or just analyzed independently (via temperature corrections)?

- Next par- Age composition. Presumably, this is based on age-specific survival and recruitment estimates. If so, what's the source for these estimates (not VORTEX!)? Why not directly use a matrix projection model, instead of VORTEX?

- Page 12, last sentence: Lack of a precision estimate is a different issue. If detection =1, then we'd still assume that on average the synoptic count C represents N (but because of sampling variance any individual estimate might be < N or >N). If detection <1 (as it almost certainly is) then we expect on average C<N.

I have also taken the liberty to comment on certain statements made in the attached public comments.

- Page 80: “.. counts will always under-project [sic] the actual number of manatees”. There are 2 issues here, and they are confused in these remarks. First, the counts will not ‘under-project’ (i.e., underestimate) the manatees present at a given site by any consistent amount, due to changes in technology, observer differences, water turbidity, manatee behavior, etc. This is a different issue than the extent to which manatees that are available at all sites, are adequately represented in samples through time and space. Nevertheless, inadequacies in 1) spatial /temporal sampling inference and 2) corrections for availability and detection rates, will, unless addressed, continue to make the synoptic counts suspect, and provide plenty of ‘red meat’ for critics of all persuasions.

- Effectiveness of speed zones: Actually, I think this is a pretty good point. See my earlier comments.

- Page 85 Boat speed limits and school speed limits: This is an irrelevant comparison between land speed on roads and nautical speed of watercraft. By this logic, boats in the ICW ought to routinely be doing 75 knots (to keep up with trucks on I-75).

/s/ Michael J. Conroy

Michael J. Conroy
Adjunct Professor and Assistant Unit Leader
Georgia Cooperative Fish and Wildlife Research Unit

APPENDIX I: Reviewer's comments

School of Tropical Environment Studies and Geography
February 28 2006

Dr Elsa M.Haubold
Program Administrator
Marine Mammal Research
Florida Fish and Wildlife Commission
Fish and Wildlife Research Institute
elsa.haubold@myfwc.com

Dear Elsa

I write in response to your invitation to review the preliminary Biological Status Review (BSR) report for the Florida manatee. I would like to congratulate you and your team for the generally high standard of the documentation forwarded to me.

My comments follow. They are designed to:

- increase the comprehensiveness of the documentation and its alignment with IUCN processes
- make the documentation more accessible to a non-specialist audience, and
- reduce the impact of statements taken out of context.

The completeness and accuracy of the biological information and data analyses in the BSR

Overall comment

I found this section comprehensive and largely accurate (but see concerns below) but very uneven with respect to detail and inadequately referenced. I suggest that this section be revised more in the style of a scientific review. The revision need not be much longer that the present version but more accessible to the non-expert reader and more comprehensively referenced. These comments particularly apply to the Section headed BIOLOGICAL INFORMATION

Substantive comments and queries

1) **Page 8 paragraph 3:** What effect does the reduction in a manatee's buoyancy due to starvation have on its susceptibility to watercraft collision?
2) **Page 8 paragraph 4:** Dugongs emigrate in response to habitat loss associated with extreme weather events. However, there is no evidence that such emigration is permanent . See p.441: **Marsh H,** Lawler IR, Kwan D, Delean S, Pollock K, and Alldredge M. (2004). Aerial surveys and the potential biological removal technique indicate that the Torres Strait dugong fishery is unsustainable. *Animal Conservation* 7: 435-443. and references therein.
3) **Page 9 paragraph 3.** Suggest 'uncorrected ground and aerial counts'. Counts can be corrected to overcome many of the confounding influences.

4) **Pages 9, 10 and 12.** The proportion of the population in the various subpopulations seems to be based solely on the highest synoptic count. A more robust treatment would be to provide the proportions based on several high synoptic counts. The IUCN Guidelines (page 13) suggest that uncertainty should be represented by specifying a best estimate and a range of plausible estimates for a particular quantity.
5) **Page 11 paragraph 2.** What is the justification for transforming the point locations to circles with a radius of 325 meters for calculating the Area of Occupancy? The IUCN guidelines (pages 22- 27) outline an appropriate protocol of estimating the Area of Occupancy and warn that classifications based on Area of Occupancy may be complicated by problems of spatial scale. In particular, the finer the scale the smaller the area that the species of interest will be found to occupy. My advice from a spatial analyst suggests that the method used in the BSR is likely to have underestimated the Area of Occupancy of the Florida manatee. I appreciate that recalculating the scale using the IUCN methodology will not change the proposed state or regional listings but suggest that it would be preferable to use the established IUCN methodology or to justify why this was not done. The IUCN Guidelines 4.10.6. recommend using their methodology even for species with linear habitats such as the Florida manatee..
6) **Page 12 paragraph 3:** How reasonable is it to assume that the age distribution of the Florida manatee is stable? What is the effect on the conclusions is this assumption is not met?
7) **Page 12 paragraph 3:** It might be worth pointing out that even if the upper bound of the estimated proportion of mature individuals is used (69.2%), the estimate of mature individuals based on the highest synoptic count is still < 2500. In general, I think it would be more transparent if such uncertainty was presented in a table rather than as a single number. See also 4) above.
8) **Page 13:** The information about the Runge model provided in the assessment is inadequate. I suggest that a preprint of the paper detailing the model by provided as an appendix to the Biological Status Review or on the internet. The assumptions underlying the model, the justification for the generations times used and the justification for the number of life history stages need to be made explicit in this document.

The reasonableness and justifiability of our assumptions, interpretations of the data and conclusions

Overall Comment

I agreed with the rationale for and conclusions regarding the statewide assessment with two provisos:

- I am uncertain about the accuracy of the estimates of future decline in the absence of information on the assumptions underlying the Runge model, the justification for the generations times used and the justification for the number of life history stages need to be made explicit in this document. However, this model is not essential to the assessment as the forecast changes in population size could have been made based on qualitative information.
- I suspect that the Area of Occupancy will exceed the IUCN threshold for threatened if the established IUCN methodology is used. This approach will not change the overall conclusions.

- The substance of the debate as to whether there are fluctuations in the Extent of Occurrence would be an interesting addition to the assessment but will not change the outcome.

I was much less comfortable with the regional assessments as I considered that the rationale for the assumption that the impact of neighbouring populations would not change the assessment lacked detail. I assume that BRP formally worked through the process outlined in the IUCN documentation (see IUCN Guidelines Figure 2 and Table 1.). The document would be improved if details of this process were included.

I suggest leaving the regional assessments out of the Status Assessment. The regional assessments can be provided separately to the managers.

Substantive comments and queries

- **Criterion C for each subpopulation:** I am uncertain of what is meant 'by more than 95% of individuals are in the subpopulation' and corresponding statements for other sub-populations.

- Is ii reasonable to assume that the subpopulations included all of the population of the Florida manatee. Is there are remainder (sensu IUCN) in other states?

- Is the Area of Occupancy of the Upper St John's population inappropriately small given the mobility of individual manatees (See IUCN Guidelines page 4)?.

General comments

Substantive comments

- The lack of complete correspondence between the Florida, USA and IUCN Categories and Criteria is confusing, especially to a non-scientific reader. In my experience, members of the wider community fail to appreciate the significance and legitimacy of definitional differences. Moving Table 5 earlier in the document (suggest page 5) summarising the equivalences of the various categories as defined by Florida, USA and IUCN would be very helpful.

- The Introduction could also usefully mention that this process assesses 'Extinction Risk' not 'Conservation Priority', the implications of that distinction and the statutory requirement to develop a management plan once the listing process is finalised.

Stylistic comments

Imprecise statements should be avoided as they can be used emotively if taken out of context. Some examples follow:

Page 2*: 'The probability of extinction for the statewide population is low in the next hundred years'* (Page 2).

Page 4 Paragraph 1. To revaluate the endangered status of the West Indian Manatee……. suggest adding **'***under the Florida listing process'* **.** See also Page 4 Paragraph 2.

APPENDIX I: Reviewer's comments

Page 6 Paragraph 2: When water temperatures are ‘warm’. ‘Warm’ is unspecified.

The use of hanging pronouns – words like ‘this’ and ‘it’ when it is unclear which noun they are referring to reduces the clarity of the document.

References
I did not check the references against the text.

Figures and Tables

- The scales (km miles) are inconsistent in different figures.
- The y axes of the graphs need labelling. The Figure and Table Legends need to include an explanation for all abbreviations and should be accessible without reference to the text.
- I suggest that the figures and tables be embedded in the text rather than placed at the end of the document.

Please contact me if you have further queries.

Yours sincerely,

Helene Marsh

Professor of Environmental Science
James cook University

APPENDIX I: Reviewer's comments

Helene Marsh, PhD is Professor of Environmental Science at James Cook University, Australia. The central theme of her research over the last 30 years has been to establish a sound ecological basis for the management of marine and terrestrial environments in tropical Australia. Most of her research and that of her students has been in the field of mammalian population ecology with an emphasis on life history, reproductive ecology, population dynamics, diet, distribution, abundance and movements of dugongs, a close relative of the Florida manatee. She has published over 100 papers on dugongs and manatees and their habitats. She has been sponsored to attend international workshops on dugongs and manatees in Canada, Japan (seven times), Malaysia (twice), Netherlands, Papua New Guinea, Philippines, Saudi Arabia, Thailand Vietnam and the United States (three times). In 1995, she was one of four invited plenary speakers at the international marine mammal conference in Orlando Florida. More recently, she has been a plenary speaker in the Australia, Philippines, Malaysia, Vietnam, Thailand and Japan (three times). In 2002, she was the only expert from outside the United States invited to be an assessor at a workshop to review the population biology of the Florida manatee and the only international expert on a panel to review the status of the Florida manatee. In 2002, she led a group which reviewed the status of the dugong for United Nations Environment Program, in 2005 she reviewed the status of the dugong for International Union for the Conservation of Nature and was the technical expert on the Working Group to negotiate Memorandum of Understanding between dugong range states under International Convention for Migratory Species. She has been employed as a consultant to assess the status of the dugong and advise on dugong research in various overseas countries including India, Japan, Malaysia, New Caledonia, Palau, Papua New Guinea and Saudi Arabia as well as in the Northern Territory, Queensland, and Western Australia. She supervised 14 doctoral students and five postdoctoral fellows working on dugongs and or their habitats. She briefed the Global Oceans Conference on Oceans and Coasts UNESCO Paris 2001 on the challenge of conserving marine mammals in preparation for the 2002 World Summit on Sustainable Development in Johannesburg. Dr Marsh has been a member of the IUCN Sirenian Specialist Group since and chaired the Group from 1983 and chaired the group from 1985-2001.

APPENDIX I: Reviewer's comments

Biological Status Review of the Florida Manatee
Haubold et. al. (2005)
Reviewer Comments
Kenneth H Pollock
March 9, 2006

Comments
Executive Summary-

In paragraph 2 the estimate 2181 is presented without any standard error. In the next paragraph it says fewer than 2500. I think this page needs some tightening up on wording, terminology and consistency. It is also not reader friendly with its use of abbreviations (eg paragraph 3). I don't see why it cant be substantially longer?

Introduction- At the end of the introduction it would be useful to say what the review will consist of by section. A synopsis page would also be helpful to navigate the review.

Biological Information-

Concepts do not always appear to be presented in a coherent order and the section is very choppy to read.

For example, catastrophic natural events are mentioned first at the bottom of P 6 and yet anthropogenic factors are then listed first on the next page.

Also at the top of P7 out of the blue as part of the discussion of threats we are told the survival rates of certain sub populations are lower. Wouldn't it be better to give a summary of the subpopulation characteristics including survival on P6? There are many examples like this. Wouldn't it be helpful to have a list of threats in order of importance in a Table to help the reader?

Perhaps a list of important data sources early on would also be helpful. The salvage and necropsy program gets mentioned here but some other sources don't make it in until the next section.

Biological Status Assessment Information-

This is where the review got a bit frustrating for me to read! A lot of the material I would like is there or hinted at but it is not presented in enough detail to make a coherent "story" that brings the reader along with you.

Population trends can be calculated directly from various aerial survey results and indirectly from population models based on reproductive and survival estimates.

APPENDIX I: Reviewer's comments

Wouldn't it be a good idea to summarise the various aerial surveys, the photo id data and various other data sources first? With each one you could present the strengths and weaknesses of the data and the resulting estimates. Then one could present population estimates and trends based on different approaches and then discuss them. There are questions of both bias and precision in estimates from all the approaches used although some estimates are likely more reliable than others. Clearly despite the value of the Craig and Reynolds (2004) paper a major problem with estimating population sizes and trends is deficiencies in the aerial survey design. This has been known for many years and has been widely discussed by earlier review panels. I don't think you can or should avoid stating that. Also you say little about the strengths or weaknesses of the Runge et. al.(2004) model. I think it is a great approach—but –what are its strengths and limitations. Are their potential biases there due to the nature of the photo id capture-recapture analysis. By the way I don't see why low recapture rates per se would cause a bias (P9 6 lines from bottom). Heterogeneity could cause a bias? Are their weaknesses in the estimates of survival of subadults/juveniles? What about the estimates of reproductive rates that go in the model? What about stochasticity of parameters between years?

I realize this is for a general audience but I don't see how you can present estimates without detailed discussion of the uncertainty involved (possible bias, unknown or poor precision of estimates).

I don't understand what the Public Comment is doing on P10 at the bottom? Is there some legal requirement to have this in there?

Again the sections seem out of order as on P11 you switch to area estimates and then back to population estimates on P 12.

On p 12 Vortex is used and then another population viability is discussed on P13. Again I don't really understand the flow and how the ideas are linked?

Biological Status Assessment

I focused on the previous section in my review. My only comment is a trite one! Given all the weaknesses in the data used (previous section) then the status assessment is subject to great uncertainty. I did like the use of the precautionary principle.

APPENDIX I: Reviewer's comments

23 February 2006

Elsa M. Haubold, Ph.D.
Program Administrator
Florida Fish and Wildlife Conservation Commission
Fish and Wildlife Research Institute
100 8th Avenue SE
St. Petersburg, FL 33701

Dear Dr. Haubold:

This letter contains my evaluation of the preliminary biological status review for the Florida manatee, as requested in your letter of 12 January 2006. For the record, my qualifications to conduct this review are as follows. I have a doctorate degree in oceanography with a specialty in marine mammal population dynamics. The majority of my career has been focused on endangered marine mammals, including the Hawaiian monk seal and Steller sea lion. In my capacity as Scientific Program Director for the U.S. Marine Mammal Commission I have interacted with researchers and managers from the Florida Fish and Wildlife Research Institute, the U.S. Geological Survey, the U.S. Fish and Wildlife Service, and private research organizations (e.g., Mote Marine Laboratory) on matters pertaining to manatee conservation. I have reviewed numerous documents on manatee research and management (e.g., recovery plan, scientific manuscripts, *Federal Register* notices pertaining to management issues, and requests for funding support for manatee-related research). I serve on the Population Working Group for the Florida Manatee Recovery Team convened by the U.S. Fish and Wildlife Service. I believe that my familiarity with manatee research and management gives me a good working knowledge of the background material needed for and included in the biological status review.

I completed my evaluation with the understanding that I was to focus only on (1) the completeness and accuracy of the biological information and data analyses in the biological status review, and (2) the reasonableness and justifiability of the assumptions, interpretations of the data, and conclusions in the review. My understanding of the biological status review is that it is intended to provide a comprehensive, scientific basis for a determination of the status of the Florida manatee. To that end, the review should take into account all the data relevant to a determination of the status of the subspecies, as determined by the State of Florida's listing criteria. In addition, the review should analyze those data in a manner that is scientifically defensible, and it should provide a reasoned basis for final conclusions regarding the status of the species.

The conclusions of the preliminary status review do not surprise me. In aggregate, the available data provide good evidence that the total Florida manatee population has grown over recent decades and the increase in numbers appears to provide a buffer of sorts from the risk of extinction.

That being said, I do not believe the draft biological status review provides a sufficient scientific basis for its conclusions. The essence of the scientific method is that it seeks to provide an explicit basis for confidence in conclusions. All of the standard practices of science (e.g., clear statements of hypotheses, fully described methods and assumptions, thoroughly described statistical analyses, peer-review as a requirement for publication) are aimed at providing that basis. The benefits of this approach is that they allow close examination of the available data, methods of analysis, assumptions required, and foundation for conclusions. If reported correctly, results should be reproducible. In this important regard, I believe the biological status review is not yet complete.

The conclusion that the Florida manatee is "threatened" under the State of Florida's listing criteria depends almost entirely on projections of the subspecies' future trends. Those projections are derived from the core biological model by Runge et al. (in preparation). I am familiar with earlier

versions of this model and have participated in discussions about their development. As a scientist with a background in computer modeling of marine mammal population dynamics, I have a large degree of confidence in this core model. However, the preliminary biological status review does not provide an adequate description of the model; anyone reading the review would have to take its reported results for granted, which is not consistent with standard scientific practice.

As is reflected in the State of Florida's listing criteria, the status of a population is not just a function of the number of animals in the population at a given point in time (although that is an essential consideration). Importantly, status also is a function of expected future trends in the population. Analysis of data on past and current trends suggests that two of the subpopulations have been growing (Upper St. Johns and the Northwest subpopulations), the trend in the Atlantic subpopulation is not clear at present, and the Southwest subpopulation is declining. In contrast, projections of the population into the foreseeable future suggest these trends will be reversed. That projected reversal in trends is the key element of this review, and a full accounting of the model is necessary for assessing its scientific basis. Appendix G provides a listing of the parameters of the core biological model, but it does not provide a sufficient basis for reproducing the model or understanding the projected changes in trends. Thus, the scientific basis for the conclusions can not be evaluated.

Describing the basis for future trends is a difficult task. It involves not only projecting the status of the manatee population forward, but also projecting all those factors that will affect the manatee in the years to come. Those factors include human population growth; increased boating with associated boat strikes; hurricanes and the potential for increasing frequency and strength of storms; increasing frequency, geographic distribution, and potency of toxic red tides; loss of warm water refuges due to the closure of power plants; loss of natural springs and habitat due to coastal development; loss of foraging habitat due to increased runoff of suspended materials or bottom disruption due to boating activities; increased exposure to contaminants that may affect immune or reproductive function; increased potential for disease or the effects of introduced species; entanglement in fisheries gear; and entrapment in water management devices. Although describing the basis for modeling all those factors is difficult, it is essential – in my view – to keep within the bounds of normal scientific practice and to give managers and anyone interested in the review a more complete understanding of how conclusions were derived and whether the associated assumptions, interpretations, and conclusions were reasonable. Without this information, the analysis is more-or-less a black box that the reader must be willing to accept without an understanding of the underlying issues.

I believe that the information needed to describe these projections is largely available in the two additional documents you sent me for review (i.e., one describing the core biological model and the other describing the effects of changes in carrying capacity due to reductions in warm water refuges. That material should be incorporated in your status assessment, perhaps as an appendix. It must be available to readers who wish to understand all of the assumptions required for the modeling projections leading to the conclusion that the status of the Florida manatee should be changed to threatened under the State of Florida's listing criteria. By including the additional information described above, I believe that the review panel will provide not only a solid scientific foundation for that conclusion, but also will provide a basis for directing research and management to ensure its long-term conservation.

Please let me know if you have questions about my comments regarding your preliminary biological status review.

Sincerely,

Timothy J. Ragen, Ph.D.
Scientific Program Director