National Headquarters
1130 17th Street, N.W. | Washington, D.C. 20036-4604 | tel 202.682.9400 | fax 202.682.1331
www.defenders.org

March 6, 2008

Joyce Kleen,
Crystal River National Wildlife Refuge
U.S. Fish and Wildlife Service
1502 SE Kings Bay Drive
Crystal River, Florida 34429

Sent Via Electronic Mail to joyce_kleen@fws.gov

Dear Ms. Kleen,

Thank you for the opportunity to provide scoping comments for the Comprehensive Conservation Plan (CCP) at Crystal River National Wildlife Refuge (NWR). Defenders of Wildlife (Defenders) is a national, non-profit, public interest conservation organization with over one million members and supporters, more than 185,000 of whom are in Florida. Defenders has long been an advocate for the Refuge System and takes a particular interest in the refuge planning process and endangered species management. We published the *Citizen's Wildlife Refuge Planning Handbook* to encourage the public to become more involved in refuge planning. Defenders also publishes an annual report on the state of the Refuge System entitled *Refuges at Risk.* Our 2006 report featured the current and foreseeable impacts of climate change on Crystal River NWR.

One of the most profound issues facing the refuge and indeed, the world, is climate change. The CCP planning process provides the U.S. Fish and Wildlife Service (FWS) with an important and required opportunity to assess what is known about climate change and its anticipated impact on the habitats and species that depend on the refuge, what issues require further study, and how such information can be incorporated into the management and acquisition strategies of the refuge. In addition to addressing how climate change will affect Crystal River NWR, the CCP process also provides the opportunity to reassess how and if current permitted activities are appropriate and compatible with the needs of the endangered West Indian manatee. Defenders believes that current viewing and swimming opportunities, given the extremely limited oversight capacity from refuge staff and the proven and regular incidences of manatee harassment on the refuge, are inappropriate (as they directly conflict with the purpose of the refuge) and therefore warrant reexamination. Until a workable solution can be found that fully protects endangered manatees, it may be necessary to place a moratorium on tour boat operators entering Crystal River NWR.

To assist Crystal River NWR in the identification of issues germane to its CCP, Defenders has provided the following comments on how western Florida ecosystems and wildlife, specifically West Indian manatees, will be affected by climate change. In addition, we have included comments and recommendations on manatee management that, if implemented, can ensure that all activities on Crystal River NWR are compatible with its unique purpose of

protecting manatees and their habitat. Notably, protections afforded the manatee, an umbrella and flagship species, will provide benefits to the entire ecosystem.

I. Climate Change

A. Relevant policy and directives

An analysis of the effects of climate change is a central and required element of refuge planning under the National Wildlife Refuge System Improvement Act of 1997 ("Improvement Act"). For example, the FWS is required during the CCP process to identify and describe the "significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants within the planning unit and the actions necessary to correct or mitigate such problems." 16 U.S.C. §668dd(e)(2)(E). The Improvement Act further requires the Department of the Interior (DOI) Secretary, in administering the refuge system, to "ensure that the biological integrity, diversity, and environmental health of the System are maintained." *Id*. §668dd(a)(4)(B).

In addition, DOI policy specifically requires that FWS address climate change in its management planning. Interior Secretarial Order 3226, issued January 19, 2001, states that:

> Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview. Departmental activities covered by this Order include, but are not limited to… management plans and activities developed for public lands...

Similarly, in May 2006, Congress passed House Concurrent Resolution 398 "expressing the sense of the Congress that the United States Fish and Wildlife Service should incorporate consideration of climate change and sea-level rise into the comprehensive conservation plans for coastal national wildlife refuges, and for other purposes."[1] As outlined below, because global climate change is a significant

[1] The resolution states in full that: (1) the United States Fish and Wildlife Service should incorporate consideration of the effects of climate change and sea-level rise into the comprehensive conservation plan for each coastal national wildlife refuge; (2) each such comprehensive conservation plan should address, with respect to the refuge concerned, how climate change and sea-level rise will affect--(A) the ecological integrity of the refuge; (B) the distribution, migration patterns, and abundance of fish, wildlife, and plant populations and related habitats of the refuge; (C) the archaeological and cultural values of the refuge; (D) such areas within the refuge that are suitable for use as administrative sites or visitor facilities; and (E) opportunities for compatible wildlife-dependent recreational uses of the

problem that will adversely affect wildlife and habitat and threaten the "biological integrity, diversity, and environmental health" of Crystal River NWR, the anticipated effects of climate change and prudent management responses should be carefully considered and described during the CCP process.

B. The Refuge's current and predicted climate conditions

Due to its location on the west coast of Florida, Crystal River NWR is highly vulnerable to the impacts of climate change. Florida is already showing the early effects of climate change: eroding shorelines, dying coral reefs, saltwater intrusion into aquifers, increasing number of forest fires and warmer air and sea surface temperatures (NRDC 2001). The average temperature in Florida during the last century has increased by 2 degrees Fahrenheit (USEPA 1997). The Intergovernmental Panel on Climate Change (IPCC) and the U.K.'s Hadley Centre's climate change model predict that by 2100, temperatures in Florida could increase by 3-4 degrees Fahrenheit (USEPA 1997), while other models predict an increase of 4-10 degrees Fahrenheit over the same period (NRDC 2001). Some models have predicted a difference in temperature increase that will vary by season, with a predicted 3-10 degree Fahrenheit rise in winter lows and a 3-7 degree Fahrenheit rise in summer highs (UCS 2005). Other climatic changes include sea level rise, increased rates of evaporation and more extreme wet and dry periods (NRDC 2001). Although Florida has historically gone through periods of climate change and related sea level changes, temperature increases cited above are predicted to occur 15 to 40 times faster than the rate of these past changes (NRDC 2001). The seas around Florida's coast are already rising by 7-9 inches per century, and are predicted to rise by 18-20 inches by 2100 (USEPA 1997). After considering land subsidence, sea level could rise by as much as 30 inches in certain areas of Florida by 2100 (NRDC 2001). Rising temperatures will also likely increase rates of evaporation which would result in lower river and stream flows. In southern Florida, evaporation already exceeds precipitation in some years, even though this area of Florida receives an average of 60 inches of rain per year. Increased evaporation rates in the future would further threaten precious water resources (USEPA 1997).

C. The CCP should incorporate information on how western Florida coastal habitats are impacted by climate change

i. Sea Level Rise

Low-lying coastal areas are especially vulnerable to sea level rise. The most significant impacts of sea level rise to coastal areas are inundation and displacement of wetlands, coastal erosion, increased vulnerability to storm damage and flooding, and salt water intrusion into surface and ground water (Neumann et al 2000). As

---

refuge; and (3) the Director of the United Fish and Wildlife Service, in consultation with the United States Geological Survey, should conduct an assessment of the potential impacts of climate change and sea-level rise on coastal national wildlife refuges.

noted above, the sea level of Florida's coast is already rising by 7-9 inches per century and is predicted to rise by 18-20 inches by 2100 (USEPA 1997). Loss of land structures and habitat, accelerated rates of erosion, increased flooding, increased salinity of rivers, bays and aquifers, and increased vulnerability to storm damage are likely results of higher sea levels (USEPA 1997). While coastal areas have long been developed with sea level in mind, most levees, seawalls and other coastal structures have been built to withstand only 100-year flood levels. Climate change induced sea level rise, however, could result in a future 50-year flood event being higher and more severe than today's 100-year flood event (Scavia, et al 2002). Estimates range from a 20 to 38% increase in the 100-year flood plain (Neumann, et al., 14, NRDC 2001, 6). This is due to the fact that the horizontal advance of the ocean can be 150 to 200 times greater than the vertical sea level rise, especially in areas with gently sloping shorelines (NRDC 2001). For example, a 15-inch vertical rise in sea level would result in the sea advancing inland up to 250 feet. The result would be coastal erosion, inundation, and changes in wetlands, marshes and mangrove ecosystems (McMahon 2006).

As water levels rise, salt water moves further inland, often threatening freshwater streams, springs and groundwater aquifers (Neumann et al 2000, Scavia et al 2002, NRDC 2001, McMahon 2006). These freshwater sources can become contaminated if too much saltwater is introduced (NRDC 2001). This places additional stress on freshwater systems and remaining natural habitat as residential, agricultural and natural areas compete for a limited resource (USEPA 1997).

A SLAMM (Sea Level Affecting Marshes Model) analysis completed for the FWS at several refuges in southern Florida notes that Florida's coasts and its coastal refuges are likely to be negatively impacted by sea level rise. Specific results of this analysis at Egmont Key National Wildlife Refuge, approximately 100 miles south of Crystal River National Wildlife Refuge, indicate that there will be loss of dry land, tidal flats and estuarine open water and an increase in open ocean and ocean beach (McMahon 2006). A similar analysis should be completed to assist in the preparation of the Crystal River CCP.

ii. Increased Hurricane Intensity

Some studies have shown that an increase in sea surface temperature may result in more intense storms (Real Climate 2005, NRDC 2001, Scavia et al 2002, Neumann et al 2000). It should be noted that the current increase in frequency of hurricane events that has been observed in the past decade fits with the documented patterns of hurricane frequency since the 1900s (Pielke, et al 2005) and that we are currently in a period of increased frequency (NRDC 2001).

With a 3.96 degree Fahrenheit increase in sea surface temperature, it is estimated that a 5-10% increase in hurricane wind strength is possible (Scavia et al 2002). Pielke, et al, cite similar predictions noting that a 3.6 degree Fahrenheit increase in sea surface temperature could result in wind strengths 10% greater (Pielke, et al, 1573). It is

unclear what impact this will have on Florida's coasts. Using the predictions above, one study suggests that such changes in sea surface temperature and wind strength would result in a 25% increase in the destructive force of a hurricane (Scavia et al 2002). Other studies found that such increases would result in "relatively small" changes in hurricane intensity in comparison to observed variability (Pielke et al 2005). Yet, "Regardless of potential changes in frequency and intensity, coastal storms and resulting storm surges will be riding on a higher sea level, increasing the vulnerability of shorelines…" (Scavia et al 151).

D. The CCP should incorporate information on how manatees are affected by climate change

Crystal River NWR was created specifically to protect endangered West Indian manatees and the refuge now protects approximately 12% of the state's manatee population (USFWS). Climatic changes described in detail above will likely have an impact on manatees. In addition, it is presumed that marine mammals that require particular water temperatures to survive, such as manatees, will be directly impacted by climate change. Because manatees require warm water for survival during winter months, preliminary research indicates that their ranges may increase as water temperature rises. However, sea level rise and resulting salinity changes could impact manatees by affecting aquatic vegetation that manatees consume, such as sea grasses (Learmonth, et al 2006). Increased hurricane intensity may also impact manatees. Langtimm and Beck found that in years with storms, adult manatee survival rates were lower than in years without storms. With the likelihood that increasing water temperatures will increase storm intensity, manatees could be adversely impacted. Marine mammals such as the manatee have historically adapted to environmental changes but it is uncertain if they are able to adapt as fast as the rate of predicted climate change (Learmonth, et al 2006).

Scientists believe that a widespread bloom of the dinoflagellate red tide organism *Gymnodinium breve* killed 39 manatees in the lower Caloosahatchee River and nearby waters of southwestern Florida in 1982 (O' Shea et al 1991). The abnormally large number of deaths could have occurred because manatees arrived in the area from a nearby winter aggregation site earlier than normal and unusually high salinities could have facilitated inshore spread of the red tide bloom (O' Shea et al 1991). An unusual number of manatee deaths in 1996 and 2003 were also linked to red tides (Barnes 2005). Toxic algal blooms and other events caused by eutrophication and runoff could increase with global warming and flooding. Along with increased runoff, warmer water could contribute to the intensity, duration, and extent of toxic algal and cyanobacteria blooms (Twilley et al 2001).

Manatees are not as specialized as dugongs (who depend on seagrass for nourishment) and have adapted to a diverse herbivorous diet of freshwater and marshy vegetation, including seagrass (MacFadden et al 2004). Even though they are not entirely dependent upon seagrass, West Indian manatees primarily rely on the seagrasses they undoubtedly coevolved with, particularly *Syringodium filiforme*,

Halodule wrightii, and *Thalassia testudinum* (Lefebvre et al 2005). Further research is necessary to understand the relationship between seagrass ecology and manatee behavior so that the carrying capacity of important feeding sites does not decline as a result of lower seagrass population numbers (Lefebvre et al 2005).

The CCP should identify these potential conservation challenges and propose management actions to reduce threats to manatees, water quality, and possible food sources.

II. Manatee Management

A. The CCP should address non-climatic issues affecting manatees

i. Current Status of Manatees

Manatees that utilize Crystal River NWR are part of the Northwest Florida manatee subpopulation and Crystal River NWR is considered the "hub" of this subpopulation. Although the manatee population in Northwest Florida is currently growing at healthy levels (USGS 2004), there are a number of factors that still threaten the population. Because the West Indian manatee is an endangered species under state and U.S. federal law, as well as a protected species under the Marine Mammal Protection Act, any factors that negatively impact manatee health should be addressed by the CCP.

ii. Boats

> "The most immediate threat to [manatees'] survival is collisions with boats. In recent years, watercraft have caused between a quarter and a third of all annual manatee deaths," (Laist & Reynolds, 2005).

Boating occurs year-round in waters in and around Crystal River NWR. In Kings Bay, boat speeds are regulated from September 1st through April 30th and there is evidence that lower boat speeds reduce manatee mortality (Laist & Shaw, 2006). However, there have been at least four watercraft-related manatee deaths in the period from 1999 to present, and serious injuries from boats continue to be seen in manatees during the period when speed restrictions are in effect. This suggests that compliance with regulations is an important issue that needs to be addressed.

Crystal River NWR receives more than 102,000 visitors annually (USFWS). The majority of these visits occur during peak manatee season; generally between mid-November and early March. Because the refuge is only accessible by water, the spike in visitation dramatically increases boat traffic in the area each winter. Dive shops conduct as many as three tours per day, seven days per week, with some tours carrying up to 34 people per trip. Visitors may also rent boats and kayaks from local marinas. All these tour boats and individuals are headed straight for locations where manatees are concentrated and often resting. During daylight hours, these boats and

people are a constant presence around the manatee sanctuaries, particularly in the Three Sisters Spring area where the water is shallow and particularly clear.

In light of the many documented cases of manatee harassment and the recognition that years of woeful federal appropriations have severely reduced the Refuge Complex's law enforcement capability, Defenders believes this level of boating activity in a national wildlife refuge specifically established to protect the endangered West Indian manatee is incompatible with the refuge's purpose and does not allow Crystal River NWR to fully contribute to the broader mission of the National Wildlife Refuge System.

iii. Swimmers and snorkelers

Most visitors to the refuge, whether on formal tours or personal boats, end up swimming with manatees. Although the refuge currently issues guidelines on appropriate interaction with manatees, there have been many incidences of manatee harassment by visitors that have included petting, hugging, holding, chasing, feeding, blocking escape routes, riding and even separation of cow and calf. The guidelines issued by the refuge, while calling on visitors to avoid harassing manatees, do state that touching a manatee that approaches a visitor is acceptable. Unfortunately, many visitors are unaware or uncaring about the seemingly subtle differences in permissible behavior. It is easy to see how explicit permission by refuge management for a particular type of touching could easily be misconstrued and lead to the inappropriate, egregious behaviors that harm manatees. The permitted touching of endangered manatees at Crystal River is at odds with policies of no human interaction at other manatee sanctuaries throughout the state and may cause confusion among visitors if they are allowed to touch manatees at Crystal River NWR but not elsewhere.

Although swimming or snorkeling with manatees provides a unique experience and educational opportunity, the absolute number of visitors to manatee sanctuaries and the harassment that sometimes occurs, undermines the refuge's purpose to protect this endangered species. Similar to addressing the excessive boating activities now ongoing, we believe the CCP should consider reducing or otherwise better managing swimming and snorkeling opportunities on the refuge. Crystal River NWR must never lose sight of the fact that its stated purpose and overarching mandate is to protect endangered West Indian manatees.

iv. Groundwater extraction affecting the springs

The Refuge Improvement Act requires that FWS "assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the System and the purposes of each Refuge." 16 U.S.C. § 668dd(a)(4)(B). The spring-fed waters of Kings Bay, of which Crystal River NWR is a part, comprise the second largest spring system in Florida. The current discharge measurements at Kings Bay indicate that spring flow has been reduced to 75% of the long-term average flow. This is likely due

to decreased rainfall and increased groundwater withdrawal for human use (SWFWMD 2001).

The water quality and level of the Kings Bay springs are strongly impacted by tides and the water level of the aquifer. However, springs at Kings Bay and throughout Florida depend on the groundwater aquifer and spring flows throughout the state are currently threatened by increased groundwater withdrawals as development spreads (NRDC 2006). Groundwater in Florida is primarily used for direct human use and agriculture, with 43% of the state's total groundwater going to public use and 35% of the total groundwater going towards agriculture (SWFWMD 2001).

Manatees are dependent on the springs throughout Kings Bay to provide a source of warm water essential for their winter survival. Manatees congregate at warm water sources when water temperatures begin to fall below 68 degrees Fahrenheit. Loss of these reliably warm springs poses a serious threat to long-term population stability; arguably posing a threat greater than boat collisions (Laist & Reynolds 2005).

There are two types of warm water sources available to West Indian manatees: 1) warm water discharge from natural springs or power plants; and 2) thermal basins. Most manatees use sources of warm water discharge, either from natural springs or power plants. There are 14 primary warm water sources that manatees use in winter. Ten of those 14 are power plant discharge sites, and all ten of those plants were built between 1940 and 1970. Due to costs associated with upgrading these power plants to meet current operating standards, most, if not all, will likely be “retired” in coming years. This will eliminate the majority of warm water sources used by manatees and makes protection of natural warm springs all the more important. As noted above, these natural springs are currently under threat by increasing groundwater withdrawals as development and population increase, decreasing the spring flows (Laist & Reynolds 2005).

To maintain the natural springs for manatee habitat, it is crucial that managers identify and maintain minimum flow rates necessary to support water temperature needed for manatee survival and recovery (Laist & Reynolds 2005, NRDC 2006). Additionally, human activities that harm springs that support endangered manatees should be reduced or eliminated whenever possible (Laist & Reynolds 2005). Crystal River NWR has a legal obligation, and a public trust, to minimize the human-induced stressors that manatees must face today. To increase resilience and minimize stress, the CCP should outline a plan for protecting the freshwater springs that sustain life in Kings Bay and its manatee population. This should include working with the Ecological Services branch of the Fish and Wildlife Service to ensure that groundwater withdrawals and other uses affecting the springs are appropriately evaluated under the Endangered Species Act.

III. Recommendations

Defenders requests that the FWS include the above information in the description of the refuge's resources and resource challenges in the draft CCP. We also appreciate consideration of the following recommendations:

1. The CCP should outline a plan to research and monitor the ongoing and emerging ecosystem changes induced by climate change

Though there is overwhelming scientific consensus that the earth is warming and that the primary cause of this warming is human-caused increases in greenhouse gas emissions, much less is understood about the complex effects that a rapidly changing climate will have on ecosystems and wildlife. We believe the Refuge System, and Crystal River NWR in particular, should develop a comprehensive research and monitoring program to function as an early warning system for climate-induced changes. Only through careful and thorough monitoring can the Refuge System be prepared to detect changes and respond using the principles of adaptive management.

Long-term field studies and modeling are required to determine the impacts of global climate change (Wolters et al 2005). A comprehensive program throughout western Florida would best equip stakeholders to discern changes in species' abundance or distribution. Because regional coordination and data accumulation and analysis is requisite, the FWS should work closely with other agencies and stakeholders in Florida, particularly the National Park Service, the U.S. Geological Survey, the U.S. Forest Service, state agencies, universities, ecologists, local land-owners, and climate change scientists (Hannah 2003, Scott et al 2002). A coordinated approach will also help fulfill the FWS requirement "to monitor the status and trends of fish, wildlife, and plants in each refuge". 16 U.S.C. §668dd. The studies and monitoring will be of benefit for understanding and responding to changes throughout the region.

2. The CCP should discuss and consider the impacts of climate change on the Crystal River ecosystem and explore opportunities for inclusion of such information in the refuge's environmental education programs

Environmental education and interpretation are priority public uses of the refuge system and when compatible, support the refuge system's mission by building public understanding and support for wildlife conservation. According to the FWS General Guidelines for Wildlife Dependent Recreation (605 FW 1, *Service Manual*), recreational uses should provide "an opportunity to make visitors aware of resource issues, management plans, and how the refuge contributes to the Refuge System and Service mission." Crystal River NWR should incorporate information about how climate change is altering the area ecosystem and wildlife into its education and interpretation programs, and materials. The FWS is well positioned to educate and inform the visiting public about the climate-driven changes occurring to refuge and its wildlife, and measures the public can take to help protect Crystal River NWR. The FWS should develop brochures, interpretive panels, websites, and educational programs that address the vulnerabilities of Crystal River and Kings Bay resources to climate change.

3. The CCP should take steps to increase plant and wildlife resiliency by working to reduce non-climatic stressors on manatees and other wildlife

Managing for climate change and sea level rise will require balancing multiple, and sometimes competing, demands (Neumann et al 2000). Natural systems and organisms are normally able to adapt to environmental changes so it is imperative that human activities do not interfere with the system's natural ability to adapt. In the case of sea level rise, it is recommended that development in vulnerable areas be prevented or discouraged, or that rolling easements should be used to allow adaptation as the landscape changes (Scavia et al 2002). Scavia et al observe that…"While the ability of these ecosystems to cope with or adapt to climate change or variability is compromised by extant stresses, the inverse is also likely to be true – ecosystems will be better suited to deal with climate variability and change if other stresses are significantly reduced." Accordingly, the CCP should initiate a process to define and then work to minimize any foreseeable and manageable factors impacting manatees, their health, habitats and food sources, and water quality and quantity.

4. The CCP should consider adopting the following recommendations to ensure Crystal River NWR fulfills its stated purpose of protecting endangered West Indian manatees

A. Conduct an inventory of existing conditions to acquire necessary baseline information on wildlife, vegetation, spring flows, manatee temporal and spatial distribution, visitor use (including personal and rental boats, dive shop operator and other boat traffic), land acquisition efforts, funding and future funding needs, and law enforcement and management capacity.

B. Ensure greater protection for manatees by:

- Continuing to enforce speed limits but also more severely limiting the number of boats on Crystal River NWR when manatees are present;

- Implementing the slow and idle boat speed restrictions on waters surrounding Crystal River NWR year-round, rather than only for the season from September 1st – April 30th. We believe such a rule would not only protect any manatees using the refuge during warmer months but also serve to remind boaters that manatees may be present in the bay at any time and as a general awareness tool.

- Eliminating the summer water sports zone;

- Providing adequate law enforcement of boating regulations. Defenders recognizes that budget constraints have limited the refuge's capacity to enforce its own regulations, which is exactly why more stringent access rules should be created. Economic uses, such as for-profit manatee tours operated by private dive shops, are held to a high standard; they must "contribute to the achievement of national wildlife refuge purposes or the National Wildlife Refuge System mission." 50 C.F.R. § 29.1. It is difficult to see how facilitating

the economic use of operating manatee tours “contributes” to the purpose of protecting manatees on Crystal River NWR. Educating the public about manatee life history is undeniably a reasonable goal, but not if it undermines the overarching mandate to protect these endangered marine mammals. The refuge should not facilitate an economic use that it cannot properly manage.

C. Address inappropriate human-manatee interaction by:

- Implementing new policies on visitor interaction with manatees such that

  a) No initiated touching of manatees is allowed or encouraged. It cannot be reasonably argued that touching or holding a manatee may somehow lead to a greater educational experience than simply viewing them from a respectful distance. These are federally and state endangered marine mammals, protected by the Endangered Species Act of 1973, the Marine Mammal Protection Act of 1972, and the Florida Manatee Sanctuary Act, and therefore demand our full protection and management capability;

  b) Swimmers should always remain at the surface of the water and should stay at least 50' away from all manatees. If the manatee approaches the swimmer, the swimmer should remain still and not be encouraged to initiate contact. A wide berth is necessary so that manatee movements or attempts to breathe are not altered by swimmers. The prohibition on actively pursuing manatees should be strictly enforced.

D. Hold tour operators accountable for harassment of manatees by their clients. Refuge brochures describe the Manatee Watch Volunteer Program, ongoing since 1983. One suggestion for meeting this goal is to enhance and expand the Program by implementing a volunteer-based, "manatee boat watch" program, in which volunteers participate on licensed boat tours throughout the season and report what they experience to appropriate Fish and Wildlife Service personnel. Another way to hold boat tour operators accountable is to improve the Special Use Permit requirement by adding a certification system by which responsible boat tour operators can advertise their "manatee-friendly" tours, and the refuge and other area business associations can direct visitors to only those operators that meet certification requirements. Of course, the threat of permit or certification revocation should always remain on the table as a strong incentive for compliance. If tour operators are known or proven violators, their permits should immediately be revoked.

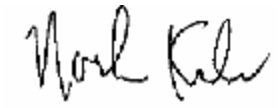
E. Increasing visitor education at the refuge visitor center and on the tour boats to include new regulations. The refuge should work to create a community culture that abhors manatee harassment and works to aid Crystal River NWR in its pursuit to protect manatees. Creating such a dynamic would effectively create a community that polices itself and works to safeguard manatees, much as people who litter are immediately admonished by others in the community.

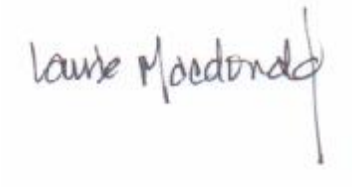
F. The CCP should expand the boundaries of the Three Sisters Spring sanctuary to include, at a minimum, the area around the mouth of the spring run. Other sanctuaries should be evaluated for possible expansion. In addition, the refuge should actively seek to acquire the property around the Three Sisters Spring sanctuary; there are many sources of possible funding including the Land and Water Conservation Fund, seeking private or corporate donations, working with interested stakeholders to fundraise, etc.

Defenders of Wildlife appreciates this opportunity to comment on the future management direction and priorities of Crystal River NWR. We hope that our input helps the FWS to identify, assess and take action on important issues such as manatee management and climate change. Because climate change, human development, and reductions in water quality and quantity all burden endangered West Indian manatees with additional stress, it is imperative that non-climatic stressors like boat traffic and harassment be reduced immediately. In fact, it is with this intent that Crystal River NWR even exists.

We look forward to participating in the remainder of the CCP process.

Sincerely,





Noah Kahn
Federal Lands Associate

Laurie Macdonald
Director, Florida Program

References

Hannah, L. 2003. Regional biodiversity impact assessment for climate change: a guide for protected area managers. In Hansen, L., Biringer, J., Hoffman, J. (eds). *Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems.* WWF Climate Change Program.

Laist, D.W., Reynolds, J.E., III. 2005. Florida Manatees, Warm-Water Refuges, and an Uncertain Future. *Coastal Management,* 33:279-295.

Laist, D.W., Shaw, C. 2006. Preliminary evidence that boat speed restrictions reduce deaths of Florida manatees. *Marine Mammal Science,* 22(2):472-479.

Langtimm, C.A., Beck, C.A. 2003. Lower survival probabilities for adult Florida manatees in years with intense coastal storms. *Ecological Applications,* 13(1):257-268.

Learmonth, J.A., Macleod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P., Robinson, R.A. 2006. Potential Effects of Climate Change on Marine Mammals. *Oceanography and Marine Biology: An Annual Review,* 44:431-464.

McMahon, S. 2006. Rising Tides: A Summary of Projected Impacts of Sea Level Rise on Florida's Coasts and Ding Darling, Egmont Key, Pine Island and Pelican Island National Wildlife Refuges. Prepared for Dr. Brian Czech, U.S. Fish and Wildlife Service. Independent study project at Virginia Technical University.

Natural Resources Defense Council (NRDC). 2006. Florida's Coastal and Ocean Future: A Blueprint for Economic and Environmental Leadership. Accessed 25 February 2008 at http://nrdc.org/water/oceans/florida/flfuture.pdf.

Natural Resources Defense Council (NRDC) and Florida Climate Alliance. 2001. Feeling the Heat in Florida: Climate change on the Local Level. Accessed 8 February 2008 at http://www.nrdc.org/globalwarming/florida/florida.pdf.

Neumann, J.E., Yohe, G. Nicholls, R., Manion, M. 2000. Sea Level Rise and Global Climate Change: A Review of Impacts to U.S. Coasts. Pew Center on Global Climate Change, Arlington, VA. Accessed 11 February 2008 at http://www.pewclimate.org/docUploads/env_sealevel.pdf.

Pielke, R.A., Landsea, C., Mayfield, M., Laver, J., Pasch, R. 2005. Hurricanes and Climate change. American Meteorological Society. Accessed 25 February 2008 at http://www.aoml.noaa.gov/hrd/Landsea/pielkeetalBAMS05.pdf.

Real Climate. 2005. Hurricanes and Climate change – is there a connection? Accessed 27 February 2008 at http://www.realclimate.org/index.php?p=181.

Scavia, D., Field, J.C., Boesch, D.F., et al. 2002. Climate Change Impacts on U.S. Coastal and Marine Ecosystems. *Estuaries* 25(2):149-164.

Scott, D., Malcolm, J., Lemieux, C. 2002. Climate change and modeled biome representation in Canada's national park system: implications for system planning and park mandates. *Global Ecology and Biogeography*, 11:475-484.

Southwest Florida Water Management District (SWFMD). 2001. The Hydrology and Water Quality of Select Springs in the Southwest Florida Water Management District. Accessed 26 February 2008 at http://www.swfwmd.state.fl.us/documents/reports/springs.pdf.

Union of Concerned Scientists (USC). 2005. Climate change – Climate Projections. Accessed 27 February 2008 at http://www.ucsusa.org/gulf/gcstateflo_cli.html.

USEPA. 1997. Climate Change and Florida. EPA 230-F-97-008i.

USFWS. n.d. Crystal River National Wildlife Refuge. Accessed 27 February 2008 at http://www.fws.gov/crystalriver.

USGS. 2004. Manatee Population Rising in Some Regions, Likely Stalled or Declining in Others. Accessed 3 March 2008 at http://soundwaves.usgs.gov/2004/09/research.html.

Wolters, M., et al 2005. Saltmarsh erosion and restoration in south-east England: Squeezing the evidence requires realignment. *Journal of Applied Ecology*, 42:844-851.