Date: February 26, 2007

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RE: Merritt Island National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment

Dear Ms. Ehrhardt,

Thank you for the opportunity to comment on the Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA) for the Merritt Island National Wildlife Refuge. Defenders of Wildlife is a non-profit, public interest institution with over 500,000 members nationwide dedicated to the protection of all native wild animals and plants in their natural communities. Defenders has been a long-time advocate for the Refuge System and continues to take a special interest in the Refuge System planning process. Defenders published the *Citizen's Wildlife Refuge Planning Handbook* in 1999 to help the public understand the refuge planning process. Defenders also publishes an annual report on the state of the Refuge System, ***Refuges at Risk.*** Last year's report featured the impacts global warming is having, and will have in the future, on Merritt Island National Wildlife Refuge.

The Merritt Island National Wildlife Refuge CCP/EA puts forth numerous management objectives that will improve the wildlife resources existing on the refuge. Defenders has the following comments to strengthen the CCP/EA and the management of the refuge:

1. The CCP/EA must consider the threat of global warming and take appropriate actions to mitigate its effects.
2. The CCP/EA must improve the refuge's management of non-climate stressors including roads and boats.
3. The CCP/EA must comply with refuge compatibility law, regulations, and policy and eliminate beekeeping and citrus groves.

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1. THE CCP/EA MUST CONSIDER THE IMPACTS OF GLOBAL WARMING

The threat of global warming is given only scant treatment in the CCP/EA. Sea level rise (SLR) is described as a threat in the "Ecological Threats and Problems" section of the document (CCP/EA at 17). Though this section states that SLR could negatively impact the refuge with increased flooding, beach/ dune habitat loss, saltwater intrusion into freshwater habitats, and inundation and accretion deficit, as well as exacerbate erosion and transform upland areas into coastal wetlands and high marsh into low marsh, the CCP/EA proposes no actions to address this threat.

SLR is given a one sentence treatment in the discussion of management of the southeastern beach mouse: "The refuge beach and dune systems transition quickly into coastal scrub, which would be impacted by sea level rise" (CCP/EA at 81). Again, the CCP/EA proposes no actions to address this threat.

The CCP/EA actually includes a section titled "Climate Change" which rightly points out that the "U.S. Department of the Interior requires agencies under its direction to consider potential climate change impacts as part of long-range planning" (CCP/EA at 184). The CCP/EA, however, explains that "carbon sequestration constitutes the primary climate-related impact to be considered in planning" (CCP/EA at 184). We are baffled by this statement which is in fact counter to Department policy, Congressional directives, and common sense.

In short, these scant references to global warming will not adequately address this serious threat to the refuge. The CCP/EA fails to consider that global warming could increase storm intensity (Erwin et al 2004), negatively change the refuge's ecologically important diverse plants species (Browder et al 2005), alter the spread of invasive species (Ogden et al 2005), increase drought-induced fires (Twilley et al 2001), transition intertidal marshes into subtidal marshes (Galbraith et al 2002), shift marshes and beaches inland (Field et al 2001), and further imperil already threatened and endangered species, including the West Indian manatee, Southern beach mouse, Florida scrub- jay, and sea turtles.

Through the planning process, the Fish and Wildlife Service (FWS) has an opportunity to assess what is known about global warming and the species and ecosystems that depend on the refuge, what issues need further study, and how this information can be incorporated into management of the refuge. This assessment is a central and required element of refuge planning.

Through the comprehensive conservation planning (CCP) process, the FWS is required 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). In administering the refuge system, the FWS is also required to "ensure that the biological integrity, diversity, and environmental health of the System are maintained." 16 U.S.C. §668dd(a)(4)(B). As we will outline below, global climate change is a significant problem that will adversely affect wildlife and habitat and threaten the biological integrity, diversity, and environmental health of the refuge.

The FWS is under specific guidance to 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...

In addition, 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 global warming and sea-level rise into the comprehensive conservation plans for coastal national wildlife refuges, and for other purposes." The resolution states that:

> (1) the United States Fish and Wildlife Service should incorporate consideration of the effects of global warming 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 global warming 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 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 global warming and sea-level rise on coastal national wildlife refuges.

By not sufficiently addressing global warming in the CCP/EA, we believe FWS will not be able to adequately manage and protect Merritt Island NWR, and therefore fulfill the Refuge's specific legislative purpose, "conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon," (*16 U.S.C. 644 Fish and Wildlife Coordination Act*).

To assist the FWS in the identification of issues to address in the CCP/EA, we have the following comments on how coastal Florida habitats, mammals, birds, reptiles, fisheries, and invasive species could be affected by global warming. We also include recommendations for management of the refuge based on these findings.

Upland Plants

Global warming should be included when determining the appropriate matrix of upland vegetative communities necessary to support native wildlife diversity.

Woody/ Oak species

Global warming throughout the next 100 years is expected to have serious negative effects on native woody plant species (Crumpacker et al 2001). Many woody plant species in the Florida Upper Peninsula, including Merritt Island NWR, are at their southern range boundaries in the eastern United States. Populations of Southern red oak and other woody species could suffer immense loss with only a 1 degree Celsius temperature increase, especially if the increase is greater in winter than other seasons or accompanied by a 20% decrease in annual precipitation (Crumpacker et al 2001). As global warming decreases temperate woody plant species' fitness, invasion by aggressive native and nonnative plant species could become increasingly problematic (Crumpacker et al 2001).

It is not likely that subtropical species will move the necessary distance over the next 100 years without human assistance (Crumpacker et al 2001). Future research is necessary since plants should only be translocated into conservation areas following rigorous experimental design, monitoring, and analysis (Crumpacker et al 2001).

Fire Management

If dry conditions and time between rainfalls increase as expected with global warming, the risk of fires will increase (Twilley et al 2001). Also, if conditions become drier, savannahs and grasslands may expand and take over forests (Twilley et al 2001). As temperature rises, trees will lose some of their capacity to absorb and store carbon (Twilley et al 2001). Ironically, the CCP/EA (page 184) notes that absorbing carbon is the most important thing the refuge does to mitigate climate change.

Freshwater habitats and Interior Wetlands

Freshwater habitats will likely be affected by SLR and rising temperatures. Increased temperature could increase evaporation of freshwater habitats (Twilley et al 2001). If saltwater invades freshwater habitats due to SLR, vegetation with low salt tolerance, such as the Sabal palm would be decimated (Twilley et al 2001). Interior wetlands should be managed with SLR in mind, especially since restoring natural hydrology to the wetlands could help mitigate the effects of climate change (Parkinson et al 2006).

Estuarine Wetlands

SLR may alter the depth and width of estuaries (Kennedy et al 2002). Bottom friction is important in controlling hydrodynamics in shallow estuaries that are strongly wind-driven, so changes in bottom area (width or depth) will have negative effects on the estuaries' energy dissipation (Kennedy et al 2002). Further research is necessary concerning SLR and the estuaries within Merritt Island NWR.

Sea Grass

Seagrasses are marine flowering plants that provide crucial ecological services, including carbon production and export, nutrient cycling, sediment stabilization, enhanced biodiversity, trophic transfers to adjacent habitats, essential habitat for a variety of marine wildlife, and food sources for green sea turtles and manatees (Orth et al 2006). High light requirements and low taxonomic diversity make seagrasses especially susceptible to global warming and anthropogenic influences that directly alter their physical attributes, such as boat propellers, or change water clarity, such as sediment runoff, invasive species and algal blooms (Orth et al 2006).

Sensitive temperate and tropical seagrass populations decreased almost tenfold over the last 40 years (Orth et al 2006). This was likely due to a combination of biological, environmental, and extreme climatological events (all of which are expected to increase due to global warming), including dune migration, sediment deposition, SLR, increased temperature, and eutrophication (Orth et al 2006). The CCP/EA should include climate change as a stressor where it discuss threats to seagrass beds (CCP/EA at 94).

In some cases, restoration projects could be feasible, but many seagrass species can not be successfully transplanted and restored (Orth et al 2006). Since seagrass loss is a symptom of larger problems, conservation plans must identify and solve problems at local scales (Orth et al 2006). Increased research and modeling should be utilized to identify the most vulnerable areas so that conservation and management can determine the most cost-effective ways to conserve seagrass.

Manatees

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, Florida 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).

Southeastern Beach Mouse

The section of the CCP/EA discussing management of the southeastern beach mouse is one of the few places in the document that acknowledges SLR. SLR, erosion, and storms have already altered, and could continue to transform Southeastern beach mouse habitat (CCP/EA page 81). However, we are concerned that the Service does not suggest any plans that could mitigate the impacts of SLR on Southeastern beach mouse habitat. We recommend further research as well as a consultation with USFWS Ecological Services and other partners to develop appropriate management actions to conserve the species in the face of rising sea levels.

Florida Scrub- jays

Breininger et al (1999) found that hurricanes increase the extinction risk of coastal Florida scrub- jay populations. Global warming could further endanger Florida scrub-jays with increased storm intensity and frequency.

In wild areas without supplemented human food sources, scrub- jays eat many energy rich acorns (Fleischer et al 2003). Fleischer et al 2003 hypothesize that individuals that forage and handle more food breed earlier, suggesting that foraging efficiency might be a perceptual cue for breeding. Scrub- jay breeding schedules rely heavily on nutritious food, so it will be necessary to determine through further research whether climate change will negatively affect their food sources (mainly acorns, lizards, and frogs).

Florida scrub- jays are susceptible to inadequate fire management and fire suppression (Breininger et al 1999, Breininger et al 2006). Further research is necessary regarding the best scrub fire management as global warming increases drought and fluctuating fire regimes as expected.

According to Root (1998), present habitat will not support Florida scrub-jay populations for the next 60 years, especially since the populations are currently small and unlikely to survive a major epidemic or catastrophe. The best ways to overcome future population declines are to increase connectivity between populations and acquire and/or restore additional scrub habitat to optimal conditions (Breininger et al 1999, Root 1998). Further research should determine how global warming could affect scrub habitat, since it characteristically occurs on well-drained sites with low nutrient levels and periodic fires, all of which could be affected by climate change (Mumme et al).

Sea Turtles

Sea turtles may suffer losses due to many consequences of global warming (other than hurricanes that are discussed in the CCP/EA page 79), including beach erosion, SLR, and rising temperatures. Loss of nesting habitats caused by beach erosion could further endanger the Kemp's Ridley, hawksbill, and loggerhead sea turtles (Twilley et al 2001; Wood et al 2000). Loggerhead sea turtle hatchling success decreases when inundation from rising sea water and/or extensive rainfall increase sand moisture levels above 25% (Wood et al 2000).

Warmer sea surface temperatures have been correlated with earlier and shorter loggerhead sea turtle nesting periods, which will likely lead to fewer egg clutches oviposited per nesting season (Pike et al 2006). Since there is no evidence that oviparous species such as loggerhead sea turtles will adapt to the warmer temperatures, climate change will likely continue to contribute to the their decline (Pike et al 2006).

Biologists link rising air temperatures to the greater incidence of female hatchlings observed in loggerhead and green turtle populations in recent years, a dangerous reproductive trend for the threatened species (Morreale et al 1982, Mrosovsky et al 1992). Southern United States loggerhead sea turtle populations are predicted to suffer from further female- biased sex ratios as temperature increases 1 degree Celsius and extreme levels of egg mortality with an increase of 3 degrees Celsius (Hawkes et al 2007). Increased emphasis should be placed on preserving suitable nesting habitats that are important for male hatchling production (Hawkes et al 2007). For example, since dark sand is typically warmer than light sand, beach nourishment projects, the majority of which utilize darker sand, should be ceased in areas that sea turtles use to nest (Hawkes et al 2007).

Change detected at Merritt Island NWR may not be enough to inform management decisions. A comprehensive program throughout refuges along the Atlantic coast will be able to discern population level changes in abundance or distribution of sea turtles. The FWS should work closely with other owners and managers of coastal habitat on the Atlantic, particularly the National Park Service. This will help fulfill the FWS requirement "to monitor the status and trends of fish, wildlife, and plants in each refuge" (16 U.S.C. §668dd).

Eastern Indigo Snake

Eastern indigo snakes are found in the vicinity of xeric pine-oak sandhills inhabited by gopher tortoises and are listed under the Endangered Species Act (ESA) as threatened species (Stevenson et al 2003). Possible increased loss of pine habitat, due to increasing hurricanes and drought-induced fires could further decrease populations (Gibbons et al 2000, Gilliam et al 2006).

While the CCP/EA mentions that Eastern indigo snakes are frequently killed by vehicles, the chosen alternative (page 164) provides "no active management". This is a glaring oversight. As climate change alters snake habitat, additional protection and management of current controllable threats will be necessary. Alternative B in the CCP/EA (page 164) would help decrease snake road mortality by working with the Kennedy Space Center (KSC) to shift traffic times to coordinate with snake movement, increase law enforcement, decrease illegal poaching, and conduct additional research and monitoring. We find Alternate B more appropriate than the selected alternative to manage the non-climatic stressors affecting this threatened species, including road mortality and illegal take.

American Alligators

American alligators are vulnerable to high levels of water salinity (Davis et al 2005). Since SLR could cause saltwater influx into freshwater areas, global warming impacts should be incorporated into the evaluation that will be used to decide whether alligator hunts will be feasible on Merritt Island NWR (CCP/EA at 173).

Fisheries

The CCP/EA (page 96) discusses declining horseshoe crab numbers and the migratory birds that rely on their eggs for sustenance. We recommend further research about climate change's affects on timed ecological events (such as horseshoe crab

spawning and shorebird migration) as well as the effects of a horseshoe crab harvest on population numbers.

Invasive Species

Exotic species have already invaded Florida. Climate change will exacerbate the issue, either directly or indirectly favoring these highly opportunistic species (Twilley et al 2001). Frequent disturbance from fires and storms could weaken native species and favor the spread of invasive species already present on Merritt Island NWR, such as Australian pine, paper bark melaleuca, Brazilian pepper, water hyacinth, and the Southern pine bark beetle (Ogden et al 2005, Twilley et al 2001).

Building Design

Development planning involving elevated buildings has been successfully implanted in New Jersey and South Carolina (Neumann et al 2000). We recommend that all attempts be made to incorporate global warming into the refuge office building plans that are described in the CCP/EA page 127. In addition, refuge infrastructure should be planned and designed to anticipate increased hurricane frequency and intensity. Infrastructure design and equipment procurement should emphasize the most energy efficient option available to reduce greenhouse gas emissions.

Environmental Education

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."

The CCP/EA discusses environmental education curriculum objectives that are import to Merritt Island NWR on page 118. As described above, global warming poses a significant threat to the biological integrity and mission of the refuge. It is incumbent upon the FWS to ensure the public is informed about the climate-driven changes occurring to the wildlife they have come to enjoy and learn about at Merritt Island NWR. The FWS should develop brochures, interpretive panels, websites, and education programs that include the vulnerabilities of the refuge's resources to climate change.

For example, mangroves, salt marshes, and coral reefs receive 3- fold to 100- fold more media coverage in the New York Times, National Geographic and New Scientist, even though the ecological services provided by the combination of seagrass and algal beds is greater (Costanza et al 1997). To help overcome a large disconnect between available information and public awareness, Merritt Island staff should raise the public's awareness by incorporating seagrass issues into educational programs.

Summary Recommendations for Incorporating Global Warming in the CCP/EA

- The impacts of global warming on the refuge's wildlife and habitat must be included throughout the CCP/EA.
- The FWS should consider the present and future impacts global warming when developing objectives and management actions in the CCP/EA. In the face of uncertainty, the FWS should building natural resilience to global warming by focusing resources to reduce non-climate related ecological threats.
- FWS should convene a panel of experts to assist Merritt Island NWR and other coastal refuges in developing adaptation strategies for coastal marshes and other habitats.
- FWS should establish a sea turtle monitoring and research network with other Atlantic coast refuges and other agencies to detect population changes associated with global warming.
- The CCP/EA should include comprehensive research on and monitoring of the impacts of global warming and their relation to non-climatic stressors to ecological systems and management actions including:
    - Upland habitat shifts
    - Changes in fire regime
    - How fresh and saltwater marshes respond to global warming
    - Changes in seagrass habitat and the relationship to manatee populations
    - How southeastern beach mouse responds to sea level rise
    - Changes in the timing of ecological events, including horseshoe crab spawning and shorebird migration
- Global warming should be incorporated into refuge infrastructure design and planning.
- Global warming should be incorporated into the refuge's environmental education and interpretation programs.

2. NON-CLIMATIC STRESSORS

Global warming exacerbates the problems associated with habitat loss and other non-climatic negative stressors (Ross et al 1994). Extra consideration should be given to decreasing or eliminating these stressors, including roads and boats, on the refuge.

Roadways

The CCP/EA (page 106) mentions that road mortality severely impacts wildlife in the refuge. We would like to point out that road mortality is a non-climatic stressor that will require additional attention as global warming occurs. Florida scrub-jays and Eastern box turtles both suffer from road mortality and are expected to experience extensive losses due to global warming, so mitigating road mortality will become even more pertinent in the future. In addition to the road mortality solutions listed in the CCP/EA on page 106, traffic management that would benefit all species include diversions, stop signs, and speed bumps (Mumme et al 2000). These speed reduction strategies should be incorporated into the CCP/EA.

Boats

Boat wakes are non-climatic ecological stressors that could negatively add to the erosion caused by global warming. Studies found that boat wakes can contribute to perimeter marsh loss, especially since waves caused by boats and storms undercut root mats (Erwin et al 2004, Hartig et al 2002). Boats also physically alter seagrass (Barnes 2005). It is more feasible to limit this non-climatic stressor than decrease global warming that is also destroying seagrass and marshes.

The use of boats for waterfowl hunting is described as a compatible use on page 247 of the CCP/EA. The CCP/EA notes that the largest negative impact from waterfowl hunting is associated with the boats in the refuge, but that there are "currently no restrictions on the type of boat, horsepower, or motor type". This is unacceptable. The FWS must limit boating if it causes impacts to refuge resources. Future research is essential to determine whether boat- use in the refuge could add to the negative effects incurred by climate change.

3. INCOMPATIBLE USES

Beekeeping

Permitting the practice of beekeeping on the refuge for the purposes of citrus pollination or honey production is incompatible with the purpose of the refuge, which is primarily to serve as "...an inviolate sanctuary...for migratory birds," as written in the Migratory Bird Conservation Act. Further, the CCP correctly acknowledges that beekeeping contributes to the spread of exotic and invasive plant species on the refuge, which is also listed as one of Merritt Island's greatest ecological threats. Specifically, allowing beekeeping for the stated purpose of pollination of Brazilian pepper plants for honey production is clearly incompatible, given that Brazilian pepper has been known to invade and colonize lands outside the cultivation area. The Merritt Island NWR CCP/EA fails to adequately address these compatibility issues by proposing to sunset the practice of beekeeping in 2018.

Citrus groves

The jurisdiction and management of citrus groves on the refuge has a long and complicated history. However, the continued practice of maintaining citrus groves for the possible benefit of additional "citrus research" is incompatible with the refuge's purpose and the Refuge System's mission. The practice of citrus farming materially detracts from and interferes with the purpose of the refuge by facilitating the introduction and spread of exotic plants such as Brazilian pepper, occupying vast tracts of land intended to be restored to native habitat, and through environmental damage and water pollution resulting from the foliar applications of pesticides and fertilizers.

CONCLUSION

We hope this letter helps the FWS to identify and assess the significant problems facing the refuge as a result of global warming. These problems are extremely complex, and involve interactions throughout the refuge ecosystem and food chain. Understanding climate-driven changes in real-time will be essential to allow the FWS to adapt management strategies to conserve the wildlife resources the refuge was established to protect. The FWS should incorporate adaptive management strategies based on research and monitoring into the CCP that will help alleviate the effects of global warming.

We hope our comments have been helpful in the development of the Merritt Island National Wildlife Refuge CCP/EA.

Sincerely,

Noah Matson
Director, Federal Lands Program

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