Adaptation Strategies and Impacts of Climate Change on Bird Populations in The Great Dismal Swamp National Wildlife Refuge

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1. INTRODUCTION

The Great Dismal Swamp National Wildlife Refuge was founded in 1974. The refuge consists of over 112,000 acres of forests and marshlands. The Great Dismal Swamp provides habitat for 210 birds identified on the refuge (FWS, 2012). Effects of climate change such as impacts from greenhouse gases, extreme weather events, changes in vegetation, wildfires and biodiversity loss can play a negative role on the bird populations in the Great Dismal Swamp. As an indicator species, birds indicate overall health of an ecosystem and how well it is functioning through population trends (Hill, 2017). By analyzing prior data from the former refuge biologist, as well as monitoring current populations for specific bird species in the refuge we can determine a potential relation to climatic events. By evaluating the foresight of the refuge in regards to climate change we can develop adaptation and mitigation strategies for a stable bird population in the future.

2. HAZARDS TO BIRD POPULATIONS IN THE GREAT DISMAL SWAMP

Hazards to bird populations in the Great Dismal Swamp generated by climate change include; extreme weather events such as heat waves, droughts, floods, cold spells, precipitation, hurricanes and tornados. Other Hazards that may or may not be in relation to climate change affecting bird populations on the refuge are habitat loss, changes in vegetation, food chain disturbances, wildfires, water level and different management practices. Water management practices including rewetting the swamp can potentially disturb ground nesting and ground foraging birds if the ground is too wet or inundated by water, making their habitat less suitable (FWS, 2006). Effects of heat waves and cold spells on bird populations can negatively impact birds that have limited temperature variation as well as birds having low basal metabolic rates. Bird species may experience a series of physiological events due to heat waves and other climatic events (Şekercioğlu et al., pg.1-18, 2012). Wildfires as well as controlled burns along with droughts can cause the swamp habitat and nesting sites to be hazardous because of the dry previously burnt flora on the ground. The flora can easily catch fire in events of extreme heat and drought as witnessed the lightning strike that caused the 2011 burn in the refuge. As the refuge contains underlying peat soil it can take centuries to replenish this soil and it contains 3000 years of accumulation (Lindsay Renick Mayer, 2017). Hurricanes can have severe impacts on the refuge as well as its bird population, In 2003 hurricane Isabel destroyed 90% of the 3,600-acre stand and flattened 80% of the refuges purest cedar stands, home to many bird species (Virginia Places,. 2017).

These disturbances can cause changes in vegetation and impacts on food chains causing direct impact to the population of bird species in the refuge.

3. VULNERABILITIES OF BIRD SPECIES IN THE GREAT DISMAL SWAMP

Bird species in the Great Dismal Swamp are vulnerable because of nesting site locations and specificities, habitat specificities, as well as other biological limitations that may be affected by climatic events. Because of habitat loss from wildfires, hurricanes, flooding and other extreme weather events related to climate change, ground and tree nesters are greatly impacted. Habitat specific limitations for birds such as the red-cockaded woodpecker (an endangered bird species found on the refuge) require live mature pines that range from 80-120 years old, to colonize and begin to excavate cavities. An example of a biological limitation would be the red-cockaded woodpecker which is monogamous, making them more vulnerable to producing a successful mating pair. (FWS, 2008)

4. FORESIGHT OF BIRD POPULATIONS IN RELATION TO CLIMATE CHANGE IN THE GREAT DISMAL SWAMP

The foresight for the bird species of concern in the refuge with the “business as usual” approach is a rapid decline, migration to a more suitable habitat or local extinction. The projections provided by the IPCC state that the average global temperature will rise by 0.2°C per decade. If the temperature rises 3.5 °C by 2100, this may result in 600-900 bird species extinctions (Şekercioğlu et al., pg.1-18, 2012). With active management and development of adaptation strategies the species of bird populations have a more likely outcome of a stable or increased population in the Great Dismal Swamp.

5. STAKEHOLDERS AND DECISION-MAKING FOR BIRD SPECIES IN THE GREAT DISMAL SWAMP

US Fish and Wildlife Services are the main stakeholders of the adaptation and mitigation strategies in regards to bird species populations. Other stakeholders include the bordering state park , Great Dismal Swamp State Park, as well as the surrounding cities and public inhabitants of Suffolk, Chesapeake, and neighboring North Carolina counties, as well as private landowners, “birders” and hikers. Other potential agencies such as the Army Corps of engineers and Virginia Department of Game and Inland Fisheries may also have an effect on the bird populations. In the interest of management, USFWS has an agreement with the Army Corps on the water levels, USFWS makes the decision of the levels based on the health of the ecosystem (Chris Lowie, personal communication). Controlled burns and water management practices made by USFWS have different impacts on different species of birds (FWS, 2006). USFWS must work with stakeholders within the public and neighboring cities to regulate hunting, boating and other activities that can potentially affect any species of bird on the refuge. Decisionmaking is made not only in the interest of bird species but for the ecosystem as a whole (FWS, 2006).

6. OPTIONS FOR THE MANAGEMENT OF BIRD POPULATIONS IN THE GREAT DISMAL SWAMP

- **Actively monitor and apply adaptation and mitigation strategies**
- **Translocation**
- **Allow natural migration or extinction with "hands-off" approach**
- **Captive breeding**

Actively monitoring the populations of declining bird species on the refuge will provide us data enabling us to apply the necessary adaptation and mitigation strategies to keep a stable and potentially increasing population for the future with applied effects from climate change. Translocation as well as creating artificial cavities have been known to be successful for the red-cockaded woodpecker (FWS, 2008). Allowing natural migration of birds who may no longer find the habitat suitable is an option. With the rate of climate change as well as the rate of human development, wildlife refuges are many times the most suitable option available for these species, there for natural migration or a "hands-off" approach may lead to not only local extinction but potentially global extinction. Captive breeding is a last resort option that can be used when bird numbers are extremely low, although the rate of survival when released back into the wild can be low. Because of physiological and biological limitations natural migration and captive breeding may not be entirely successful (nrcs.usda.gov 3-4).

7. RECOMMENDATIONS FOR THE HEALTH AND POPULATION OF BIRD SPECIES IN THE GREAT DISMAL SWAMP

Short term:

Analyzing the data on bird populations in the refuge from recent years and determining which effects are caused by climatic and other events will provide a better understanding of the patterns and relationships of the bird populations trends to these events in the refuge. Determining which management practices have positive or negative events on specific species of birds will better determine which practices in the interest of birds as indicators should be done in a specific time and place within the refuge. By applying the developed adaptation and mitigation strategies developed at the conclusion of the internship there is a better chance of creating a more stable bird population for the future.

Long term:

By continuing to monitor and collect data for bird species in areas of the refuge with the applied adaptation plans, we can determine the success of the strategies as well as how the species continue to respond to future climate changes. Applying the impacts of climate change in relation to the health of the bird species will allow us to determine other aspects of health in the ecosystem. Working with the neighboring state park to create a plan would also benefit the surface space of suitable habitat for bird species of concern. Educating the public, bird watchers, hikers, school groups, private landowners, etc., with our reach programs and educational events on climate change and how it affects the refuge and its biodiversity as a whole would greater engage and peak the interest of those who enjoy nature. Education also prompts these stakeholders to potentially donate funds or volunteer when needed.

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