

Climate Change and Adaptive Conservation in North Carolina: Utilizing Assisted Migration

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I. Introduction

Climate change arguably poses one of the most difficult challenges to current conservation planning. Climate change will have a widespread effect: it is estimated that 22% to 52% of the world's species will have to relocate to survive habitat transformations caused by climate change.¹ In addition to the challenge of accommodating and preparing for these range shifts, conservation managers are often presented with general climatic trends that encompass wide regional areas.² These are difficult to utilize in a practical manner as planners would likely be better served with more localized data. Actual climatic changes vary widely within regions making it difficult to evaluate ecological responses within smaller conservation areas.³ To meet the challenges of conserving biodiversity in response to climate change, North Carolina must apply adaptive management practices and remain open to more controversial solutions such as assisted migration.

II. Climate Change in North Carolina

The Southeastern part of the United States, including North Carolina, is one of the fastest growing regions in the United States and faces unique challenges in responding to climate change.⁴ According to the U.S. National Climate Assessment, this region is particularly

¹ Jessica Kabaz-Gomez, *Rules for Playing God: The Need for Assisted Migration & New Regulation*, 19 ANIMAL L. 111, 113 (2012).

² Gian-Reto Walther et al., *Ecological responses to recent climate change*, 416 NATURE 389, 389 (2002).

³ *Id.*

⁴ AMY MORSCH, NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS, STATE OF THE SOUTHEAST: HOW CITIES ARE ADDRESSING CLIMATE CHANGE 4 (2010).

vulnerable to sea level rise, extreme heat events, hurricanes, and decreased water availability.⁵ The U.S. National Climate Assessment lists drought, rising temperatures, sea level rise, and flooding as some of threats that North Carolina specifically will face as a result of climate change.⁶ Although these are all serious threats to human life and wellbeing, climate change also poses significant risks to North Carolina's vulnerable native species.⁷ In addition to working towards mitigating the human-felt impacts of climate change North Carolina must also move towards flexible conservation strategies that allow it protect and manage wilderness areas and native species for the future.

III. The Effect of Climate Change on Species Ranges

Climatic change can both directly influence species distributions through events such as floods or droughts or indirectly through changing conditions characterized by temperature and changing patterns of wildfire.⁸ Historically, these climatic shifts happened over longer periods of time, allowing species to naturally shift their ranges in response to unfavorable habitat conditions.⁹ However, human induced climate change occurs much more rapidly, raising concerns that some species may not be able to keep pace with the current rate of change.¹⁰ Additional stressors such as habitat destruction, invasive species introductions, and disease may further limit species' ability to adapt and respond to shifting climatic conditions.¹¹

⁵ THE WHITE HOUSE, *Fact Sheet: What Climate Change Means for North Carolina and the Southeast and Caribbean* (May 6, 2014), https://www.whitehouse.gov/sites/default/files/docs/state-reports/NORTHCAROLINA_NCA_2014.pdf.

⁶ *Id.*

⁷ DEF. OF WILDLIFE, *UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE ON FISH AND WILDLIFE IN NORTH CAROLINA 2* (2010), http://www.defenders.org/sites/default/files/publications/executive_summary_understanding_the_impacts_of_climate_change_on_fish_and_wildlife_in_north_carolina.pdf.

⁸ Louis Iverson & Don McKenzie, *Climate Change and Species Distribution*. U.S. FOREST SERVICE, CLIMATE CHANGE RESOURCE CENTER (Feb. 2014), www.fs.usda.gov/ccrc/topics/species-distribution.

⁹ *Id.*

¹⁰ *Id.*

¹¹ Scott R. Loss, Lauren A. Terwilliger & Anna C. Peterson, *Assisted colonization: Integrating conservation strategies in the face of climate change*, 144 *BIOLOGICAL CONSERVATION* 92, 94 (2011).

IV. Conservation in the Face of Climate Change in North Carolina

Conservation biologists and others charged with management planning, are tasked with the challenge of both predicting and planning for as well as mitigating the effects of climate change.¹² Conservation management is particularly challenging in the face of climate change because climate change fundamentally alters the time frame of traditional management practices. Historically, conservation planning was based on the fact that the environment is relatively stable over the standard time frame of management planning.¹³ However climate change alters these times frames.¹⁴ Therefore, to protect its native species, North Carolina must apply a conservation strategy that is flexible and incorporates uncertainty into its planning process. Crucial elements to this type of conservation strategy include: predictive models of species responses to climate change, planning for alternative climate scenarios, and an adaptive rather than static approach to biodiversity management.¹⁵

Adaptive management is an approach to conservation planning that enables managers to experiment with and evaluate ideas and strategies progressively.¹⁶ Adaptive management can be differentiated from other conservation frameworks because its major drivers of change are generated internally and frequent adjustments are not only acknowledged as necessary but are desirable.¹⁷ Adaptive management can be further divided into active or passive styles.¹⁸ Passive adaptive management involves the creation of predictive models, making policy decisions based

¹² Terry L. Root & Stephen H. Schneider, *Conservation and Climate Change: The Challenges Ahead*, 20 CONSERVATION BIOLOGY 706, 707 (2006).

¹³ Joshua Lawler, James Watson, & Edward Game, *Conservation in the Face of Climate Change: Recent Developments*, 1158 F100RESEARCH 1, 3 (2015).

¹⁴ *Id.*

¹⁵ Root, *supra* note 12.

¹⁶ L. Hannah, G. F. Midgley & D. Millar, *Climate Change-integrated Conservation Strategies*, II GLOBAL ECOLOGY & BIOGRAPHY 485, 486 (2002).

¹⁷ George F. Wilhere, *Adaptive Management in Habitat Conservation Plans*, 16 CONSERVATION BIOLOGY 20, 22 (2002).

¹⁸ *Id.*

on those models, and revising models as more data becomes available.¹⁹ In contrast active adaptive management is very similar to an experiment in that conservation strategies are implemented and evaluated through statistically valid experimental designs.²⁰

The flexibility of adaptive management practices make it an essential approach in responding to the uncertainties of climate change and its impact on biodiversity.²¹ However, while adaptive management strategies are certainly essential, it is also possible more “extreme” measures may need to be taken. Assisted colonization, or assisted migration, is one such measure. Assisted colonization is “a conservation strategy that has been proposed to mitigate the effects of climate change on biodiversity” and “refers to the physical relocation of a species to a location outside its existing or historical range that is predicted to be favorable for persistence under future climate projections.”²² Assisted migration in essence is the deliberate movement of an organism outside of its native range to avoid extinction.²³ There is a great deal of disagreement of whether assisted colonization is a viable or even advisable strategy when it comes to species conservation.

Opponents of assisted migration argue that the potential for creating invasive species and the resulting damage to ecosystems is too high.²⁴ In their paper titled, “Assisted colonization is not a viable conservation strategy” Ricciardi and Simberloff argue that “even if preceded by careful risk assessment, [assisted colonization] is likely to produce myriad unintended and unpredictable consequences.”²⁵ They argue that the impacts of introduced species may vary over time and therefore it might not be possible to accurately assess at the time of the introduction and

¹⁹ *Id.*

²⁰ *Id.*

²¹ Hannah, *supra* note 16, at 486.

²² Loss, *supra* note 11, at 94.

²³ Lawler, *supra* note 13, at 4.

²⁴ *Id.*

²⁵ Anthony Ricciardi & Daniel Simberloff, *Assisted Colonization Is Not a Viable Conservation Strategy*, 24 TRENDS IN ECOLOGY & EVOLUTION 248, 248 (2009).

this could lead to loss of native species in the introduction area and other ecological risks.²⁶ Cost is also often cited as a significant obstacle in assisted colonization projects and implementation. While cost may be an impediment for large vertebrates because of the expense of captive breeding, there are many less involved species for which assisted colonization may be at least as cost-effective as other strategies.²⁷

In contrast proponents argue that assisted colonization may be the only way to prevent permanent extinctions for certain species.²⁸ A study conducted in 2009 demonstrated the successful assisted colonization of two species of butterflies in the United Kingdom.²⁹ “Species-climate” models were used to predict suitable introduction sites beyond the current range of the two species before they were subsequently introduced to the new ranges.³⁰ Both populations grew and expanded their ranges suggesting that the use of assisted colonization can be a successful strategy.³¹ Additionally, specific traits associated with species that require translocation differ from those associated with invasive species, which suggests a decreased likelihood of a species introduced through assisted colonization of becoming invasive.³² Due to its manipulative nature, assisted colonization is not generally considered as a primary strategy in addressing conservation in the face of climate change.³³ However, it could be an important tool in North Carolina’s varied arsenal.

Assisted migration could be an essential component in addressing several specific conservation challenges that North Carolina currently faces in light of climate change. The

²⁶ *Id.*

²⁷ Stephen G. Willis, Jane K. Hill, Chris D. Thomas, David B. Roy, Richard Fox, David S. Blakeley, & Brian Huntley, *Assisted Colonization in a Changing Climate: A Test-study Using Two U.K. Butterflies*, 2 CONSERVATION LETTERS 45, 45 (2009).

²⁸ Lawler, *supra* note 13 at 4.

²⁹ Willis, *supra*.

³⁰ *Id.*

³¹ *Id.*

³² Lawler, *supra* note 13 at 4.

³³ Loss, *supra* note 11 at 1.

IUCN Red List of Threatened Species is a comprehensive and objective compilation of the conservation status of plant and animal species across the globe.³⁴ The IUCN Red List includes ten vulnerable, endangered, or critically endangered species native to North Carolina that are specially threatened by climate change and severe weather.³⁵ The following two case studies illustrate the importance of adaptive management strategies and the potential for a possible future utilization of assisted colonization.

A. *Case Study: The Yellow-banded Bumblebee*

The Yellow-banded Bumblebee (*Bombus terricola*), a native North Carolina species, is listed as vulnerable for several reasons including its sensitivity to climate change.³⁶ The Yellow-banded Bumblebee occupies a specialized climatic niche which makes it particularly vulnerable to climate change.³⁷ Climatic shifts change the environment making once appropriate habitat unsuitable for the Yellow-banded bumblebee. In general, climate change may adversely affect bees in primarily three ways: (1) life history changes including changes in the length of the nesting season as well as increased over-winter mortality; (2) changes in ecosystem interactions involving alterations in timing, availability, quantity, and quality of floral resources; and (3) habitat structure changes and range shifts.³⁸ Climatic shifts can effect bumblebees either directly through exposure to increasingly cool and warm climatic extremes or indirectly through their food plants or nesting sites.³⁹

³⁴ IUCN RED LIST OF THREATENED SPECIES, <http://www.iucnredlist.org> (last visited Oct. 16, 2016).

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

³⁸ *Id.*

³⁹ Paul H. Williams & Juliet L. Osborne, *Bumblebee Vulnerability and Conservation World-wide*, 40 APIDOLOGIE 367, 371 (2009).

Bees are important pollinators that substantially contribute to the economy of the United States.⁴⁰ In 2009 native wild pollinators benefited crops at a value estimated at more than 9 billion dollars.⁴¹ Although shifting species ranges are a less visible result of climate change they pose a significant financial risk to the state and warrant specialized consideration in planning for climate change.

B. Case Study: The Georgia Oak

The Georgia Oak is another native species that is particularly threatened by climate change and is already listed as endangered.⁴² Georgia Oaks are confined to irregular “soil islands” on granite outcrops, which means they are isolated from other populations.⁴³ In addition to their limited distribution, Georgia Oaks have slow reproductive rates and restricted dispersal ability, traits which are linked with increased vulnerability to climate change.⁴⁴ These traits are associated with increased vulnerability to climate change because they hamper the ability of the Georgia Oak to adapt to changing conditions and make it difficult for the tree to colonize new habitats without assistance.

The ability of tree migration to keep pace with climate change is already a major concern of the U.S. Forest Service.⁴⁵ The Georgia Oak likely falls into the category of trees and other organisms that will not “be able to migrate fast enough to keep up with the rate of climate change, without human assistance.”⁴⁶ Therefore, the Georgia Oak may require specialized management tools including assisted colonization.

⁴⁰ THE WHITE HOUSE, *Fact Sheet: The Economic Challenge Posed by Declining Pollinator Populations* (June 24, 2014), <https://www.whitehouse.gov/the-press-office/2014/06/20/fact-sheet-economic-challenge-posed-declining-pollinator-populations>.

⁴¹ *Id.*

⁴² IUCN, *supra* note 34.

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ Iverson, *supra* note 8.

⁴⁶ *Id.*

V. Legal and Policy Challenges

Although much of the controversy surrounding assisted migration has focused on the manipulative nature, potential success rates, and unpredictable consequences it's also likely controversial because the human translocation of species poses challenges to the underlying principles of conservation management.⁴⁷ Conservation management has historically focused on the preservation of existing systems.⁴⁸ However, in the “21st century [conservationists] will likely find [themselves] pressed into a very different role: makers of novel ecosystems for stressed populations, including animal, plant, and human,”⁴⁹ in part through assisted colonization.

As a result of this paradigm shift, natural resource law is currently not structured to facilitate the relocation of species threatened by climate change⁵⁰ and as a consequence assisted migration faces legal challenges. The movement of species outside of their current ranges may violate legal restrictions and state and federal directives.⁵¹ Current legal restrictions primarily focus on the release of potentially dangerous nonnative species. For example, in North Carolina the release of a “nonnative venomous reptile, a large constricting snake, or a crocodilian” is classified as a Class A1 misdemeanor.⁵² Although this appears intended as public safety measure it could have implications for assisted colonization of certain species.

When evaluating the legality of assisted colonization there are four factors to consider. The four primary factors that affect the legality of employing assisted migration for non-native species are: (1) the type (flora or fauna); (2) classification of species (invasive or rare); (3) the

⁴⁷ Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change*, 27 YALE J. ON REG. 171, 176 (2010).

⁴⁸ *Id.*

⁴⁹ Ben A. Minteer & James P. Collins, *Move it or lose it? The ecological ethics of relocating species under climate change*, 20 ECOLOGICAL APPLICATIONS 1801, 1802 (2010).

⁵⁰ *Id.*

⁵¹ Mary I. Williams & R. Kasten Dumroese, *Preparing for Climate Change: Forestry and Assisted Migration*, 111 J. FOR. 287, 288 (2013).

⁵² N.C. Gen. Stat. Ann. § 14-422.

party or agency undertaking the translocation; and (4) the classification of the site (private, public etc.) where the species are currently located and the classification of the destination site.⁵³ Each of these factors influence the legality to a varying degree depending on applicable state and federal laws and illustrate the fragmented nature of natural resource management when it comes to assisted migration.⁵⁴ Despite the current fragmented legal framework and the increasing need for adaptive management strategies, no federal agency has created or developed any regulation concerning assisted migration.⁵⁵

In order to utilize assisted migration as a conservation tool, regulations need to be developed. Although there are several agencies with the authority to issue such regulations, the Fish and Wildlife Service (FWS) is best suited to do so because of its mission and obligations under the Endangered Species Act (ESA).⁵⁶ In the U.S. the ESA is the primary source of protection for at-risk species and aims to “recover” these species to the point at which they no longer require protection.⁵⁷ Following the identification and listing of at at-risk species the FWS is the agency tasked with creating a recovery plan for that species.⁵⁸ The FWS’s mission, as quoted in part from their statement, is “to conserve, protect, and enhance fish, wildlife, plants, and their habitats.”⁵⁹ FWS is the ideal agency to develop regulations for assisted migration because of its mission and its acknowledgment of the need to shift away from historical preservation paradigms as the result of climate change.⁶⁰ Although a legal framework for assisted migration would be most beneficial coming from a federal agency, North Carolina should still

⁵³ Camacho, *supra* note 47, at 188.

⁵⁴ *Id.*

⁵⁵ Kabaz-Gomez *supra* note 1 at 111.

⁵⁶ *Id.*

⁵⁷ J. Michael Scott et al., *Recovery of Imperiled Species Under the Endangered Species Act: The Need for a New Approach*, 3 FRONTIERS IN ECOLOGY AND THE ENVIRONMENT 383, 383 (2005).

⁵⁸ *Id.*

⁵⁹ U.S. FISH AND WILDLIFE SERV., *FWS Fundamentals*, <https://www.fws.gov/info/pocketguide/fundamentals.html> (last updated July 16, 2013).

⁶⁰ Kabaz-Gomez, *supra* note 1, at 111.

work towards incorporating adaptive strategies into its conservation management plans as well as working with federal agencies to develop comprehensive assisted migration regulations.

One way in which North Carolina can begin to incorporate assisted migration into its regulatory framework is through its current Wildlife Action Plan. This plan is a comprehensive tool developed by the N.C. Wildlife Resources Commission that supports planning for conservation efforts to conserve the state's native species and their habitats.⁶¹ North Carolina incorporated climate change into its 2015 revisions for the Wildlife Action Plan, which is clearly a step in the right direction. However, North Carolina should evaluate and consider increasingly drastic tools to address the loss of species due to climate change such as assisted migration. Simply noting the possibility of climate induced habitat changes is not enough to combat the increasing threat climate poses to biodiversity.⁶² North Carolina must adopt and incorporate regulatory approaches to utilizing assisted migration if it is going to preserve species such as the Yellow-banded Bumblebee and the Georgia Oak for generations to come whether it is through its own Wildlife Action Plans or collaboration with federal agencies.

VI. Conclusion

Currently, assisted migration faces a number of challenges both from a scientific standpoint as well as from a legal one. This makes it a controversial adaptive conservation strategy with most of the controversy centering on three main concerns: ecological risks, costs, and uncertainties.⁶³ While these do pose significant concerns, the permanent loss of species unable to adapt to changing climatic conditions is also a significant concern. North Carolina should work towards incorporating assisted migration, as a worst-case scenario tool, into its

⁶¹ N.C. WILDLIFE RES. COMM'N, *2015 Wildlife Action Plan* (Oct. 2016), <http://www.ncwildlife.org/plan#6718619-2015-downloads>.

⁶² *Id.*

⁶³ Aliénor L.M. Chauvenet, et al., *Maximizing the success of assisted colonizations*, 161 ANIMAL CONSERVATION 1, 3 (2012).

framework for addressing conservation in the face of climate change. Although the scientific challenges and controversy will remain disputed for years to come, a flexible legal and regulatory framework would make the utilization of assisted migration possible when conservation managers need it most.