EXECUTIVE SUMMARY

INTEGRATING CLIMATE CHANGE VULNERABILITY ASSESSMENTS INTO ADAPTATION PLANNING

A case study using the NatureServe Climate Change Vulnerability Index to inform conservation planning for species in Florida

A Report Prepared for the Florida Fish and Wildlife Conservation Commission

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DEFENDERS OF WILDLIFE

Defenders of Wildlife is a national, nonprofit, membership organization dedicated to the protection of all native wild animals and plants in their natural communities.

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Most natural resource planning, management and monitoring methodologies in place today are based on an assumption that species distributions and ecological processes will remain relatively stable over time. This fundamental assumption has been challenged, however, in the face of rapid climatic changes that are altering temperature, precipitation, sea level and ocean chemistry processes. Increasingly, wildlife and natural resource agencies are being challenged to address the impacts of climate change on the resources they strive to protect. In the context of wildlife conservation and management, the emerging field of "climate change adaptation" refers to the process of identifying strategies to prepare for or reduce the impacts of climate-related threats and stresses to biological systems.

Climate change adaptation requires an understanding of how climate change may impact a given biological system so that appropriate management strategies can be identified. Vulnerability to climate change refers to the degree to which an ecological community or individual species is likely to experience harm as a result of changes in climate (Schneider et al. 2007). Vulnerability is a function of exposure to climate change – the magnitude, intensity and duration of the climate changes experienced, the sensitivity of the species or community to these changes, and the capacity of the system to adapt (IPCC 2007, Williams et al. 2008). A vulnerability assessment can help to identify which species or systems are likely to be most strongly affected by projected changes in climate and provides a framework for understanding why particular species or systems are likely to be vulnerable (Glick et al. 2011). Such an assessment informs conservation planning by identifying climate-related threats and resulting stresses, which then become part of the decision-making process undertaken to identify and prioritize conservation strategies. When integrated into a conservation planning framework, adaptation does not replace current conservation practices and standards, but expands the applicability of these tools to better address the realities of a changing world.

Integrating Climate Change into Florida's Wildlife Legacy Initiative

In 2005, the Florida Fish and Wildlife Conservation Commission (FWC) released Florida's Wildlife Legacy Initiative (FWC 2005), the state's wildlife action plan or SWAP, which identifies conservation threats impacting species of greatest conservation need (SGCN) and their associated habitats, and actions proposed to mitigate those threats. As FWC moves towards the 2015 revision of the SWAP, they are actively expanding their efforts to address new threats emerging as a result of climate change. Defenders of Wildlife assisted FWC with a pilot exercise using an existing vulnerability assessment tool, the NatureServe Climate Change Vulnerability Index (CCVI) (Young et al. 2010) to identify factors contributing to vulnerability to climate change for a set of species occurring in Florida. The results of this assessment were used in

combination with a scenario-based modeling approach developed by a team from MIT (Flaxman and Vargas-Moreno 2011) to identify potential adaptation strategies as part of an integrated planning framework. This combined approach was implemented through a pair of workshops held in January and April 2011.

In conducting this assessment, we sought to:

- Evaluate the applicability of the NatureServe Climate Change Vulnerability Index as a tool for understanding the impacts of climate change on wildlife in Florida
- Identify ways in which this tool might be adapted and/or modified to better capture factors influencing vulnerability of species and habitats in Florida
- Understand how this tool might inform and be integrated with other approaches to vulnerability assessment
- Identify methods for incorporating these tools into processes for developing effective adaptation strategies

Assessing Vulnerability to Climate Change

We conducted assessments for 21 species that reflected diverse ecological and management attributes of interest: five native birds, four native reptiles, three native amphibians, four native mammals[1], two native invertebrates and three non-native, invasive species. Many of the native species investigated are identified in the SWAP as species of greatest conservation need. The NatureServe Climate Change Vulnerability Index (CCVI) evaluates vulnerability for each species based on projected exposure to climate change within the species' range and various species-specific factors associated with vulnerability to climate change, such as dispersal ability, dietary and habitat flexibility, and breadth of suitable temperature and moisture requirements. Species experts were identified by FWC and invited to participate in the assessment by individually filling out a worksheet module developed by Defenders staff to elicit the information required to assign scores for the indirect exposure and sensitivity factors identified in the CCVI. After completing the worksheet module, species experts participated in a phone call to discuss their responses. Defenders staff parameterized the CCVI analysis based on the information provided by the species experts and the guidance provided by NatureServe.

The CCVI generates an index score that corresponds to one of five categorical ranks ranging from "Extremely Vulnerable" to "Not Vulnerable" (Figure ES-1). These relative ranks can provide information regarding which species are most vulnerable to climate change, however, it is understanding why a particular species is vulnerable that provides the basis for developing appropriate management responses. This information is derived from the analysis of the factors contributing to vulnerability rather than the overall rank. By using a facilitated process with species experts, we were able to use the CCVI as a framework to (1) identify factors contributing to vulnerability, (2) elucidate hypothesized relationships among these factors and the potential impacts on species and their habitats, and (3) differentiate among sources of uncertainty. This structured process provided a foundation for integrating adaptation planning into the existing planning framework used in the Florida SWAP.

[1] In addition, bonneted bat is included in the species accounts in Appendix A but is not addressed in the main report.

Integrating Vulnerability into an Adaptation Planning Process

After completing the vulnerability assessment, we involved species experts, managers, and other conservation practitioners in a facilitated workshop in which we undertook a conceptual modeling exercise intended to help participants better understand how target species and habitats are affected by existing threats, such as land-use change, while examining how regional changes in climate may interact with or exacerbate existing threats. This facilitated session was intended to provide participants with a framework to understanding how the results of a vulnerability assessment can be incorporated into climate adaptation planning, with a goal of demonstrating a process by which the existing SWAP could be broadened to address climate change drivers and adaptation strategies. We carried out this exercise for six of the assessed species: short-tailed hawk, least tern, Atlantic salt marsh snake, American crocodile, Florida panther, and Key deer.

For each species, workshop participants started with an initial set of potential threats and drivers drawn from the SWAP and brought in the elements identified in the vulnerability assessment. Participants were asked to review and modify these basic components as needed and use them as the starting point to begin building a conceptual model, with particular emphasis on incorporating climate drivers and interactions with other drivers. Participants were asked to rank the top three to five threats, focusing on those threats either directly or indirectly related to climate change, and identify specific management actions that could be taken to mitigate those threats. Each group identified a set of priority strategies based on their conceptual model. As an example, the conceptual model developed for American crocodile is shown in Figure ES-2.

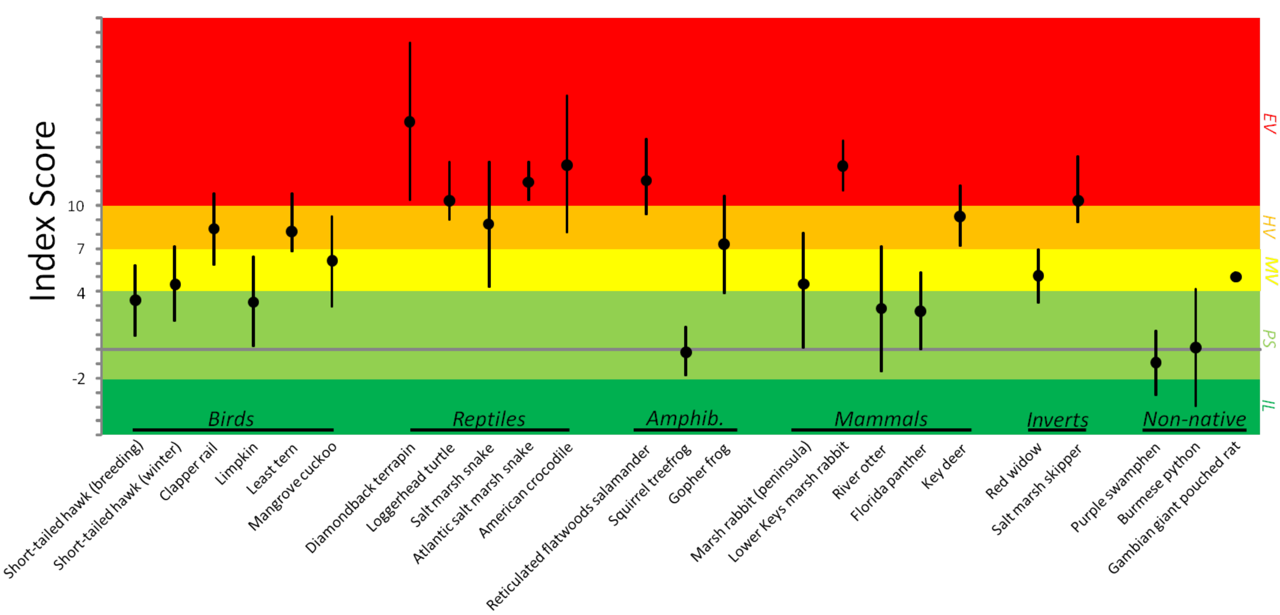

Figure ES-1. CCVI Index scores for the indicated species within their ranges in Florida. The index score (black circle) is shown along with the range of scores produced by the Monte Carlo simulation*. Categorical ranks are coded by color: "Extremely Vulnerable" (red), "Highly Vulnerable" (orange), "Moderately Vulnerable" (yellow), "Not Vulnerable/Presumed Stable" (green), "Not Vulnerable/ Increase Likely" (dark green).

*The Monte Carlo simulations provide an estimate of sensitivity to the range of values associated with the input parameters in cases where more than one score is assigned to one or more factors.

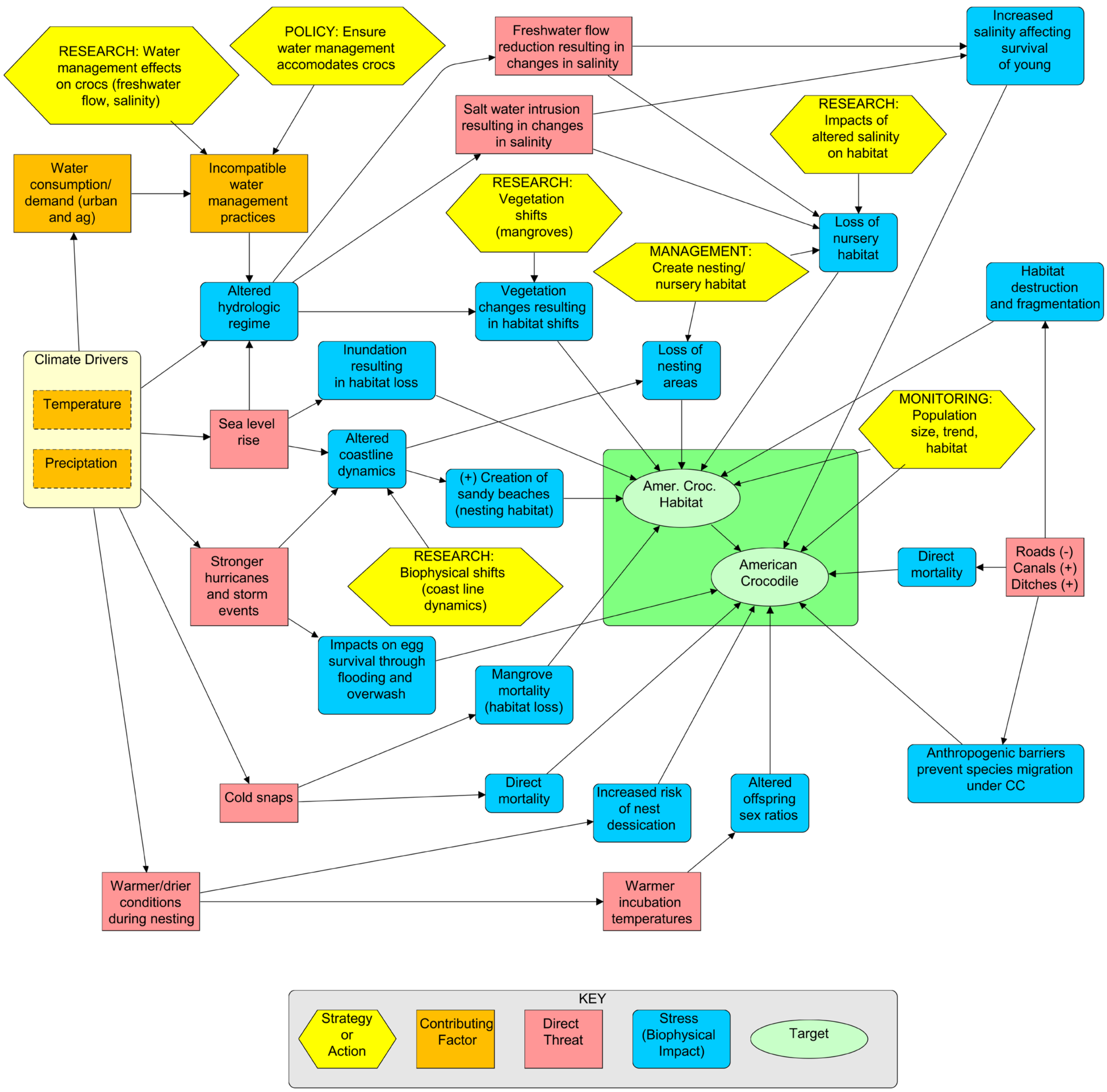

Figure ES-2. Workshop participants developed a conceptual model describing climate-related threats and interactions with other threats affecting American crocodile within its range in Florida. The model was used to identify intervention points where actions could be implemented to improve the condition of the target by ameliorating a particular threat.

Incorporating the Spatial Context

This process was conducted in parallel with a spatially-explicit vulnerability assessment approach developed by a team from the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (Flaxman and Vargas-Moreno 2011). The "Alternative Futures" are a set of future land use scenarios that incorporate climate change (primarily sea level rise), public policy options and financial conditions to model land use changes. By overlaying these scenarios with current habitat models, potential conflicts can be examined, including the location and degree of impact across a species' habitat under future conditions. Participants were able to incorporate the mapping exercises and land use scenarios produced as part of MIT's Alternative Futures approach into their conceptual models. For example, they had a better idea of potential scope of land use changes associated with sea level rise, such as increased demand for interior development, and where those changes were more likely to occur relative to the species' habitat. In addition, the Alternative Futures scenarios provided a spatial context within which participants could translate the adaptation strategies identified through the conceptual modeling process into spatially-explicit actions that could be visualized on the landscape.

Lessons Learned: Important Considerations When Conducting a Vulnerability Assessment

A vulnerability assessment should provide a framework for assessing vulnerability to climate change by unpacking vulnerability into its constituent parts. The CCVI provides one such framework for assessing species' vulnerability. Other causal models of vulnerability could be identified that would address climate-related threats and stresses at additional scales (e.g., habitats or landscapes) or that might capture additional threats and stresses unique to particular geographies or systems.

Recognize that a priori assumptions about which species will be most vulnerable may not be accurate. For example, range-restricted species or rare species did not necessarily rank as more vulnerable than widely distributed or common species. Nor did existing conservation status rankings necessarily correlate with vulnerability to climate change.

Consider the appropriate unit of analysis prior to conducting the assessment. A species-level assessment may not capture differences in exposure and/or sensitivity among subspecies or populations, or where there are differences in exposure and/or sensitivity during different parts of the year or life cycle. For example, mainland populations of marsh rabbit had very different indirect exposure scores than the Lower Keys marsh rabbit and consequently had very different vulnerability ranks.

Understand the limitations of any particular approach. In some cases, there were difficulties capturing complex system dynamics, such as vegetation shifts or responses to seasonal changes in temperature or moisture regimes, in the causal model of vulnerability used in the CCVI. For some species, reviewers identified factors that were not captured in the model or were not well-defined.

Recognize that factors may be interpreted or scored differently by individual experts. Discussing differences among species experts and providing extensive documentation supporting individual scoring decisions is essential to ensuring the repeatability and transparency of any vulnerability assessment.

Differentiate between uncertainties associated with the different components of vulnerability. We found that the CCVI factors associated with the largest amount of uncertainty were those that required a combined evaluation of both sensitivity and exposure. In these cases, the uncertainty was often associated with projecting the magnitude or direction of the exposure factor and its associated impacts rather than the species' sensitivity.

Interpret outputs appropriately. Many vulnerability assessments, including the CCVI, are designed to be used in combination with other assessments of conservation status. For example, the CCVI does not capture factors included in conservation status ranks, such as population size, range size, and or demographic factors. These factors may magnify or interact with species vulnerability to climate change. For place-based tools, such as the CCVI, different management considerations may be required for species that are vulnerable in only a portion of their range versus those that are vulnerable across their entire range.

Consider involving multiple experts and stakeholders. We found benefits to engaging species experts in combined individual-group assessments, although it was a fairly time-intensive approach. Involving multiple experts and allowing them to work through the assessment individually before discussing it as a group elicited multiple viewpoints and additional considerations that may not have been emerged from other elicitation formats.

Adaptation as Part of a Comprehensive Planning Process

Incorporating vulnerability into a comprehensive planning process requires understanding the factors, as well as the strength of interactions between the factors, contributing to vulnerability. A vulnerability assessment informs the conservation planning process by identifying climate-related threats and resulting stresses. Understanding the context within which a vulnerable species or habitat exists, and identifying the relationships among climate threats and other stressors, lays out the context in which to develop goals, strategies and objectives, and lay out key assumptions and uncertainties. Through this process it may become apparent that some existing strategies will become a higher priority or that new strategies may be required to achieve conservation and management goals under climate change. A decision-making process that accounts for the impacts (i.e. threats and stresses) related to climate change on a species or system is what we refer to as "adaptation planning." The case study presented here illustrates a process for integrating the information obtained from a vulnerability assessment into a planning process to identify adaptation strategies and management opportunities for species likely to be vulnerable to the impacts of climate change.

Recommendations and Next Steps

1. **Assess future needs and identify suitable assessment targets.** Vulnerability assessments are flexible and can be tailored to specific situations and purposes. Before deciding on any particular approach, it is important to first identify the decision problem and the applicability of any particular tool to the problem at hand. For example, a species-level approach (such as the CCVI) may not be the most appropriate unit of analysis for land management, and other methods may be needed to address management at different scales.

2. **Integrate multiple approaches for assessing the vulnerability of species to climate change.** Complementary methodologies, including ecophysical modeling, population models and direct observation, are likely to inform our understanding of the potential impacts on species and habitats. Understanding the conceptual linkages connecting climate threats to the stresses affecting a conservation target provides the context within which to evaluate current priorities, strategies and responses, and whether these still make sense under climate change.

3. **Identify the current decision-making process for developing and implementing wildlife management strategies.** Assess whether the current process has the flexibility incorporate climate change response strategies, and if needed define a process for revising current practices and management actions to achieve conservation goals under climate change.

4. **Implement actions and monitor effectiveness as part of a comprehensive planning framework.** Formulate specific "theories of change" regarding the expected results and outcomes for adaptation strategies and monitor the effectiveness of conservation and management activities employed to achieve these results.

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