

## Risk Assessment for Two Bird Species in Northern Wisconsin

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Species distribution models for 147 bird species have been derived using climate, elevation, and distribution of current tree species as potential predictors (Matthews et al. 2011). In this case study, a risk matrix was developed for two bird species (fig. A2-5), with projected change in bird habitat (the x axis) based on models of changing suitable habitat resulting from changing climate and tree species habitat. Risk was evaluated for three time steps (2040, 2070, 2100) and based on two climate models and two emission scenarios (Hadhi vs. PCMlo).

To assess the y-axis of the matrix (fig. A2-5), we used the System for Assessing Vulnerability of Species (SAVS) (Bagne et al. 2011, Davison et al. 2011) to estimate species adaptability to future changes, including disturbances. The SAVS tool is based on 22 traits that represent potential areas of vulnerability or resilience with respect to future climate change. Each trait forms the basis of a question that is scored according to predicted effect (reduced, neutral, or increased population). By selecting responses for each question, a user creates a score that represents relative vulnerability to climate change effects, with higher positive values indicating higher vulnerability. Scores are calculated considering all 22 traits and divided among 4 categories: habitat, physiology, phenology, and biotic interactions. To calculate a baseline that could be used to compare current versus future vulnerability, we zeroed out individual questions for traits relating to exposure to future conditions and calculated a score based on the intrinsic characteristics of a species that reflect its sensitivity to population declines as a result of stochastic or other events.

Northern Wisconsin is near the edge of the distribution of the northern cardinal (*Cardinalis cardinalis* L.) and offers relatively limited habitat opportunities owing to the effects of current winter climatic conditions. However, with

projected increases in temperatures for northern Wisconsin, the habitat for the northern cardinal is projected to double by the end of the century (future:current habitat ratio of 2.2). The northern cardinal uses habitats ranging from shrublands to forests, has a broad diet, and has been shown to be positively associated within an urbanizing landscape (Rodewald and Shustack 2008). The SAVS baseline scores indicate less vulnerability (-0.91) and that the species does not show increased vulnerability risk under climate change (-1.82). Characteristics such as adaptability of nesting locations and flexibility in reproductive time contribute to the less vulnerable score.

In contrast, the mourning warbler (*Oporornis philadelphia* A. Wilson) shows higher risk based on its more specialist nature, specificity to breeding habitats, and Neotropical migration life history. These innate traits make the mourning warbler more susceptible under current conditions (SAVS +3.64) and is also considered at an increased risk of exposure to negative effects of climate change (+5.45). The mourning warbler is primarily a boreal species and despite its use of early successional habitats and a positive response to some human disturbances such as timber harvest (Hobson and Schieck 1999), its occurrence in northern Wisconsin declined over a recent 16-year interval (Howe and Roberts 2005). Moving beyond contemporary changes, its habitat is projected to decrease by two-thirds of its current status by the end of the century (future:current ratio as low as 0.13 or 0.33, depending on climate model). These potential changes in habitat are attributed to higher temperatures and loss of boreal forest habitat (Iverson et al. 2008). In addition, the premontane and montane tropical life zones inhabited by the mourning warbler during winter are predicted to be highly sensitive to climatic affects (Enquist 2002). Therefore, when viewed together, the likelihood and magnitude of projected climate change suggest high risk for this species, and an increased opportunity for the northern cardinal, whose habitat will expand into northern Wisconsin.

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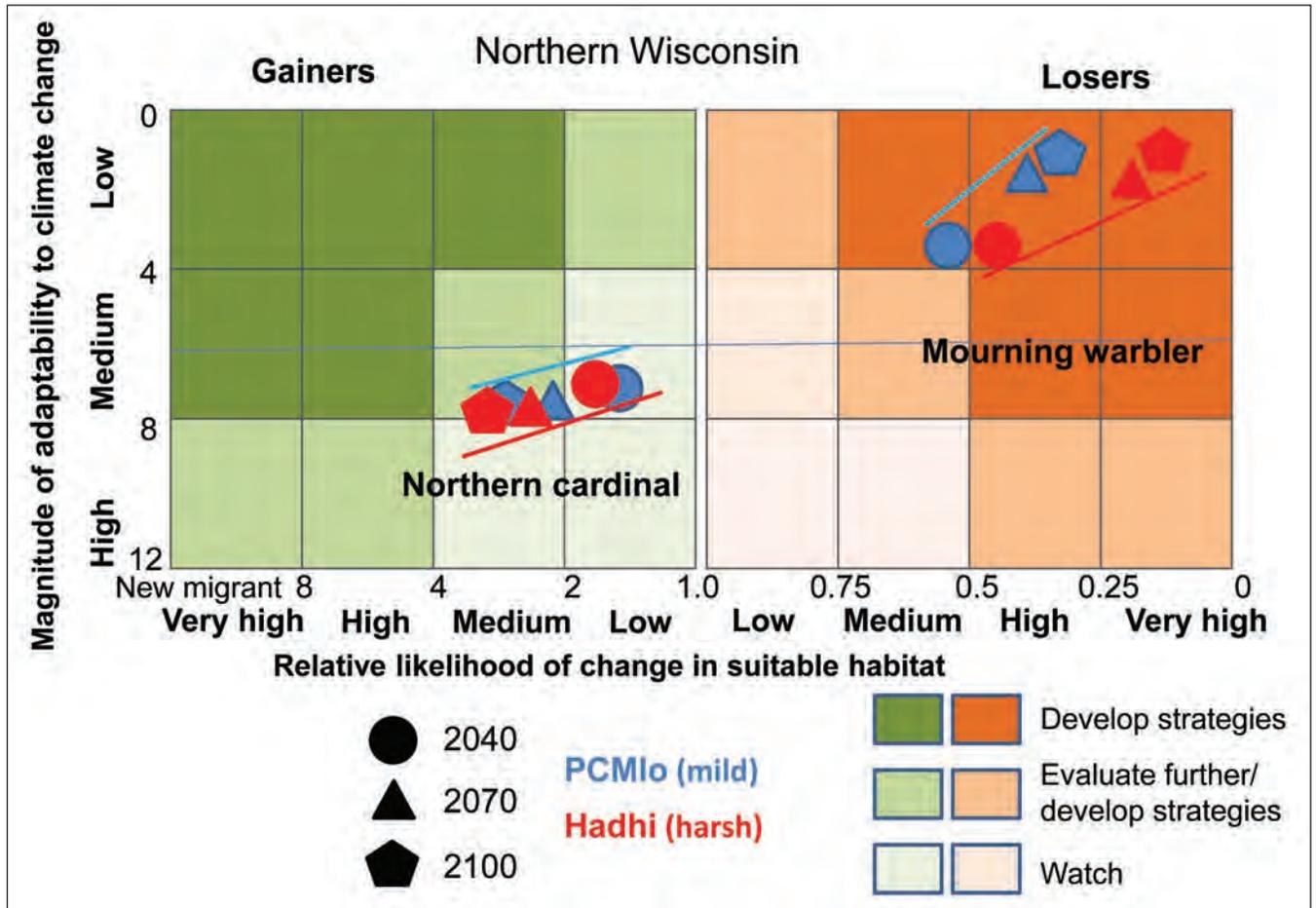


Figure A2-5—Risk of the effects of climate change on the northern cardinal and mourning warbler, expressed as a combination of likelihood of habitat change (x-axis) and magnitude of adaptability (y-axis). Values are rescaled from calculations that used the approach in the System for Assessing Vulnerability of Species (Bagne et al. 2011, Davison et al. 2011).

In this case study, we focused on two species with contrasting responses to climate change, but the general approach can be applied to a wide range of species, using either quantitative information or qualitative logic. The empirical statistical models used here provide insights on the broad-scale determinants of species distributions, but with some limiting assumptions. Models derived from mechanistic relationships that explore processes regulating population dynamics also demonstrate the importance of local climatic conditions on avian populations (Anders and Post 2006,

Rodenhouse 1992), but they are available only for a limited number of species. The detailed parameterizations of mechanistic models also have important assumptions and can be difficult to apply across a broad array of species. Thus, more refined inferences on how climate change may affect avian populations will require careful consideration of both empirical and mechanistic approaches to modeling species distributions, especially the influence of ecological disturbances on habitat, as well as threshold values for minimum habitat quantity and quality.

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