Climate change and land use impacts on wildlife habitat - SUMMARY

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Many projection models suggest ongoing impacts of climate change and land use on individual ecosystems. Although effects of land use change on wildlife habitat has been well studied, there is less observed information about how climate change affects wildlife directly or how interactions between climate change and land use change affect wildlife. Our objective was to assess the state of the science regarding the effects of land use and climate change as drivers of changes in wildlife habitat in response to a US Department of Agriculture request for information for evaluating climate policy options. Our synthesis recommends a policy analysis framework to evaluate effects of climate change on wildlife within a conceptual organization of impacts, mitigation, and adaptation, with land use changes and forest cover type changes as key disturbances.

Impacts focus on disturbances that drive changes in habitat. There is little information about the interactions between climate change and disturbance in a natural setting (Dale et al. 2000; Flannigan et al. 2000). Changes in climate may indirectly affect wildlife by harming community composition (Kurz et al. 2008; Popescu and Gibbs 2009), and influence pest outbreaks (Volney and Flemming 2000). Climate change also has been attributed to disease transmission among individual taxa (Blaustein et al. 2003).

Mitigation includes decisions that may influence land use decisions in a particular way that may affect habitat. Conservation programs that seek to retire agricultural land production may contribute to carbon sequestration (Feng and Kling 2005) and pollution (Plantinga and Wu 2003), that also will benefit wildlife by increasing the amount of available habitat. Other studies suggest that policies to maximize particular actions, such as carbon sequestration, do not maximize that ability to conserve wildlife (Nelson et al. 2008).

Adaptation refers to the adjustments that species and people make or will have to make in response to drivers of land use and climate, such as range shifts and changes in migratory routes. A number of studies have reported range shifts occurring for migratory species that may be attributed to climate variables, such as for birds (Thomas and Lennon 1999; Wilson 2007) and butterflies (Parmesan et al. 1999) that may have been further impacted by simultaneous changes in land use across their ranges (Warren et al. 2001; Valiela and Bowen 2003). Range shifts may also be affected by concurrent changes in resources on which a species depends, such as food (Both et al. 1996) or vegetative community (Harsch et al. 2009). Even for non-flying migratory species (e.g., pronghorn and other ungulates), climate and land use change can affect food resources (Harris et al. 2009) and movement patterns (Sawyer et al. 2002; Sawyer et al. 2005; Sharma et al. 2009). Such changes may lead to economic impacts in regions that depend on tourism revenue derived from observation of particular species (Harris et al. 2009). Although adaption strategies for wildlife have been identified (Mawdsley et al. 2009), it is unknown whether wildlife can meet impending challenges, particularly species with limited climatic ranges or restricted habitat requirements (Issac 2009).

We also will develop a structured conceptual model involving linkage of global circulation models, ecological process models, economic models, ecosystem services models (e.g., wildlife habitat), and attendant feedbacks. Although many climate models incorporate wealth of biogeographic information, scale, extent, and the complexity of human decision-making (see Agarwal et al. in press) may act as limitations for accurately applying broad scale models to evaluation of wildlife. Our analysis will allow for organized identification of scientific needs for addressing climate change and the presentation of available information to policymakers.