Bioenergy decisions involve wildlife habitat and land use trade-offs

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The yellow-breasted chat (left) and prothonotary warbler (right) thrive in different habitats. Meeting bioenergy goals means making trade-offs about which wildlife species -- like these -- will be most impacted. Photo credit: U.S. Fish & Wildlife Service. Images retrieved via Flickr and shared under a Creative Commons license.

New research from North Carolina State University and the U.S. Geological Survey (USGS) finds that choosing how to meet bioenergy

goals means making trade-offs about which wildlife species and ecosystems will be most impacted. The work focuses on the southeastern United States, but yields general insights that could inform bioenergy policy globally.

"Bioenergy can refer to wood pellets burned to generate electricity or to liquid biofuels, and bioenergy sources range from crops like switchgrass and sweet sorghum to cultivated pine forests and natural pine and hardwood forests," says Nathan Tarr, lead author of one paper on the work. "There are questions about how renewable energy targets that promote bioenergy may affect wildlife habitat and forest ecosystems. We wanted to better understand the potential impacts of bioenergy demand in North Carolina and, by extension, in the Southeast and beyond." Tarr is a research associate in the North Carolina Cooperative Fish and Wildlife Research Unit at NC State.

To address these questions, the researchers first developed models that allowed them to translate bioenergy demand into projections of changes in the size and characteristics of ecosystems. The researchers found that the specific mix of biomass sources used to meet demand could play a significant role in shaping ecosystems, especially in forests that contain high biodiversity.

"Our model results show that meeting bioenergy demand by harvesting biomass from forests retained more forest on the landscape, but the remaining forest contained less of the mature floodplain forests and longleaf pine forests that harbor biodiversity," says Jennifer Costanza, lead author of a second paper on the work and a research assistant professor of forestry and environmental resources at NC State. "On the other hand, using agricultural crops to meet demand reduced overall forest area, but spared more of the high-biodiversity forest land."

"Each of the biomass sources we looked at caused substantial land use

change, especially in the coastal plain region, which is known for its high biodiversity and was recently designated a global biodiversity hotspot," Costanza says.

The researchers then used the projected forest changes to model habitat gains and losses for 16 wildlife species.- They were also able to assess what the use of different biomass sources might mean for various wildlife species.

The researchers found that realistic levels of bioenergy demand are large enough to cause large gains or losses of habitat for some species, and the specific mix of biomass sources used to meet demand resulted in tradeoffs regarding wildlife habitats.

"None of the biomass sources that we looked at were good or bad for all species, nor was a single mix of biomass sources consistently the best or worst for all species," Tarr says.

"For example, sourcing biomass by increasing the amount of forests harvested in the state resulted in projected losses of habitat for the prothonotary warbler (Protonotaria citrea), which prefers mature, floodplain forests," Tarr says. "But harvesting forests increased habitat for the yellow-breasted chat (Icteria virens), which thrives in regenerating forests, and had little effect on the amount of habitat for the mole salamander (Ambystoma talpoideum), which inhabits upland forests."

"While the models used data from North Carolina, this work highlights four general principles that need to be considered when evaluating the wildlife implications of bioenergy demand," Tarr says:

- Species that inhabit newly regenerating forests may benefit from bioenergy demand;

- Species that rely on a single, mature type of habitat – such as bottomland hardwood forests – are at risk if that type of habitat is harvested for bioenergy;
- Bioenergy demand could exacerbate habitat loss for species that are losing habitat to urbanization; and
- Species with small ranges deserve special consideration because they can be more sensitive to landscape changes related to bioenergy harvesting.

"This highlights the importance of setting priorities for wildlife conservation," says Matt Rubino, co-author of the paper and a research associate in the North Carolina Cooperative Fish and Wildlife Research Unit at NC State. "Because any mix of biomass sources is likely to benefit some species and harm others, it is important to identify which species are priorities for conservation so that policies can be designed to minimize negative impacts on those species."

The papers, "Projected Gains and Losses of Wildlife Habitat from Bioenergy Induced Landscape Change" and "Bioenergy Production and Forest Landscape Change in the Southeastern United States" are published in the journal *Global Change Biology Bioenergy*.

More information: "Projected Gains and Losses of Wildlife Habitat from Bioenergy Induced Landscape Change" DOI: 10.1111/gcbb.12383 "Bioenergy Production and Forest Landscape Change in the Southeastern United States" DOI: 10.1111/gcbb.12386

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