Family tree could identify species vulnerable to invaders, climate change

October 19 2010, By Chris Barncard

Change has been the norm for Wisconsin's forests over the last 50 years, and the next 50 are unlikely to pass quietly.

Invasive species have flourished, while native plants species have disappeared from some areas. These shifts in biodiversity can often be tagged to changes like expanded numbers of browsing animals, the loss and fragmentation of habitat, and accelerating climate change, all changes not confined to Wisconsin.

Four University of Wisconsin-Madison researchers will take advantage of the state's variable landscape and vegetation as well as a treasure trove of data from surveys conducted more than 50 years ago to explore the roots of plant biodiversity and its role in allowing plant communities to respond to global change.

"We're trying to assemble a complex puzzle about why certain sites are losing more species than others, and why some species are declining while others increase." says Don Waller, a UW-Madison botany professor. "How do plant traits affect how plant species respond to changes in landscapes and climate across Midwestern landscapes?"

With a five-year, $2.93 million grant from the National Science Foundation, Waller and fellow UW-Madison botany professors Ken Cameron, Thomas Givnish and Kenneth Sytsma will develop a far more complete picture of Wisconsin's plants' evolutionary history, their physical traits, and how these affect the way plant species respond to shifts in landscape structure, neighboring species, and climate change.

Key to their project are records of extensive surveys of sites across Wisconsin collected by UW-Madison ecologist John Curtis and his students starting in the 1940s. The team has re-surveyed more than 350 forest and prairie plots, providing an exceptionally detailed picture of ecological change.

"Here in Wisconsin, we have the luxury of being able to track plant species dynamics for hundreds of species across more than 350 sites." says Cameron, director of the Wisconsin State Herbarium. "Comparing the past and present and using some genetics, we will try to predict where biodiversity is going in the future."

The researchers are using genetic bar-coding — sequencing several key genes — to construct a phylogenetic ("family") tree for all 2,500 native and introduced plant species growing in Wisconsin. The tree will contribute to a wider "tree of life" for all North American plants and give the Wisconsin team a tool to analyze how genetic connections and diverging physical characteristics affect the distributions of plant species over sites. Several hundred species are being scored on up to 50 significant traits, allowing the researchers to judge their relative importance in determining plant distributions and changes in abundance.

"We also want to understand how genetic diversity is distributed within and among plant populations and how this structure may be changing," Givnish says. "Are shrinking populations losing genetic diversity? And do patterns of genetic diversity reflect how these plants are dispersed?"

Better understanding these patterns of genetic variation will also help ecologists judge which characteristics leave plant populations vulnerable to further changes in landscapes and climate.

"Will our plants be able to adjust to changes in the climate, either by adaptation or by extending their ranges north?" Waller asks. "Wisconsin's climate has already changed and is predicted to change more — can our plants keep up?"

That knowledge may be useful around the globe.

"Wisconsin is a unique place for studying plant diversity in that we have three of the world's major biomes converging here," Cameron says. The deciduous forests stretch east into New England, prairies roll west to the Rockies, and coniferous forests extend up to Minnesota and Canada.

"We are eager to see how our results from Wisconsin will match up with data collected elsewhere in the world. Our work may be useful for predicting change far outside the Midwest," Waller says.

Provided by University of Wisconsin-Madison