Mellow in Europe, crazy in America

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Reed canarygrass is a bit like some people on vacation. At home, they stay on their side of the fence, and speak nicely with the neighbors. But jet them into Las Vegas and by week's end they are shoving other people out of the way in the casino.

Similarly, the reed canarygrass is well-settled in its native European range, not pushing out other species or expanding its terrain. But, introduced into the United States, it's running amok ecologically, choking out native plants in wetlands. Once praised as a fine forage crop, the grass is now considered an invasive pest in about ten states and its range is growing.

Studying this grass as a model, Jane Molofsky, associate professor of plant biology at the University of Vermont and her French colleague, Sebastien Lavergne, have discovered a novel mechanism to explain the surprising conversion of some plant species from quiet neighbor at home into expansive bully in new territory.

As they report in the February 27, 2007, edition of the *Proceedings of the National Academy of Sciences*, the invasive power of this grass, brought to America in the mid-19th century and many times thereafter, comes not from any one individual plant, but from this history of multiple introductions from different regions of Europe.

Over decades, US farmers and others have planted the grass as livestock feed, for erosion control, and for wastewater treatment—with plants taken from places as far apart as France, the Czech Republic and

Finland.

These multiple introductions, and subsequent interbreeding, create a kind of biological stacked deck: drawing on genetic variety from across the European continent, new strains have emerged in the US with higher genetic diversity and more potentially advantageous qualities than their species brethren across the Atlantic.

"It's not that you're taking the ones in France and moving them to the US and they're suddenly invasive," Molofsky said, looking over a green swath of reed canarygrass growing in a UVM greenhouse, "its that you move some plants, and then you move some from somewhere else and they recombine here to form something better, genetic superstars."

The result: in America, reed canarygrass has developed traits, like faster emergence in the spring and larger root biomass, that allow it to become a rapid colonizer. In short, the grass is still the same species, but it has quickly evolved to be invasive.

And this has significance far beyond the headache of reed canarygrass. A "fundamental implication of our paper is that not only do invasive species evolve but we show that they can evolve extremely rapidly," Sebastian Lavergne notes, striking a blow at the conventional view that evolution occurs at very slow rates.

"If you drive around in Vermont you'll see that it has taken over whole areas of wetlands, and out West it clogs waterways and takes over irrigation ditches," says Molofsky. "It's a big problem in Alaska: it's preventing salmon runs, its changing habitats. It's becoming a larger and larger problem."

Molofsky's greenhouse- and field-based study, funded by the US Department of Agriculture, shows why. Thanks to a large network of

European collaborators, she and her students collected plants from the both the center and edge of the native range in Europe, getting individuals from southern France and the Czech Republic. They also collected from the invasive range center in Vermont and the edge in North Carolina.

They discovered that the grass in its native Europe show a typical decrease of genetic diversity at the edge of the range, constraining its ability to adapt and expand into new conditions. But in the US invasive range, they found a different story. There, the invasive plants thrive on infusions of Europe-wide genetic material, allowing them to quickly adapt to new conditions and continue their quiet march into new fields and wetlands.

"The problem is that these invasive species at the range margin are maintaining all of the genetic diversity which represents a substrate for future evolution," Molofsky says, "so when climates begin to change we expect that some individuals from those populations will be able to grow in new conditions. But it is unlikely that native species have maintained enough genetic variability to move with rapid climate changes." Invaders persist, natives expire.

For land managers, farmers, nursery owners and others the implications of this study are also weighty. It seems likely that a considerable number of horticultural and agricultural plants that currently seem benign could become invasive by the same mechanism that affected reed canarygrass, and that climate change will increase the intensity of this problem.

"If people had stopped introducing the grass, we might not have this problem now," Molofsky said, "but it seemed fine then."

Other plants may soon follow this path. "Some in the nursery industry argue, 'well, we can have barberry here, because its not invasive in

Vermont,' My point is, 'yes, not now, but keep introducing it and let it mix and with climate change we'll have it later,'" Molofsky says. "Just keep planting it out there, and 20 years from now when it's 2 degrees warmer you're going to see it in the forest."

Source: University of Vermont