The discovery in 2007 of five new populations of Florida ziziphus is the most important development for the recovery of this critically endangered Lake Wales Ridge endemic since its initial rediscovery more than 20 years ago. New populations and experimental introductions have boosted the recovery prospects of this state- and federally listed shrub. To appreciate the significance of these recent developments, it helps to know something about the unusual history and biology of Florida ziziphus.

Carl W. Weekley
Once thought to be extinct and later seemingly destined for extinction, is there new hope for one of Florida’s rarest and most imperiled plants?

The rediscovery of a long-lost plant and Pleistocene refugee

When a 37-year old specimen of a thorny plant with little yellow-green flowers demurely occupying an herbarium drawer at the University of Florida was given the scientific moniker *Ziziphus celata* by Walter Judd and David Hall in 1984, they had every reason to believe that the specimen represented a plant long-ago extinct (Judd and Hall 1984). The specimen had been collected by amateur botanist Ray Garrett in 1948, but apparently no one had seen the species since. In 1987, however, Kris Delaney, a self-described “botanical explorer”, rediscovered Florida ziziphus a few inches outside a newly-acquired state property (Delaney and Wunderlin 1989). By 2001, eight other small populations had been found, all along a 40-mile stretch of central Florida’s Lake Wales Ridge.

A fascinating footnote to the scientific naming of Florida ziziphus is that its closest living relative appears to be *Z. parryi*, endemic to Baja California (Mexico) and southern California.

Like the Florida scrub-jay, several reptiles, and some other plants, the ancestor of Florida ziziphus seems to have arrived in Florida a few million years ago when arid habitats stretched eastward across the Gulf states from the Sonoran Desert. Subsequent climate changes stranded these species on the xeric uplands of Florida’s central ridges, which remained high and dry during Pleistocene sea level rises.

Although the rediscovery of Florida ziziphus was good news, its prospects for survival seemed bleak. The one population on a publicly protected site was in catastrophic decline. Most populations occupied privately owned pastures, where they could be wiped out by landowners subject to none of the rules that safeguard federally listed animals. Even robust populations produced no fruits, suggesting that plants were reproductively impaired, genetically depauperate, or both. The question seemed inescapable: had Florida ziziphus been named for science only as the prelude to its extinction?

A species teetering on the brink of extinction

Florida ziziphus, a thorny, multi-stemmed clonal shrub to 6 feet in height, is narrowly endemic to yellow sand xeric uplands on the Lake Wales Ridge. The pasture sites occupied by most populations once supported endemic-rich longleaf pine-wiregrass sandhills. Early on, genetic research showed that remnant populations of Florida ziziphus generally comprise single genetic individuals (Godt et al. 1997, Weekley et al. 2002), although each clone may be represented by dozens of separate plants.

Mature plants flower profusely. The tiny flowers – four would fit neatly on the face of a nickel – are bisexual, with both male and female reproductive structures. On a bright January morning – the height of flowering season – you can smell the flowers from several feet away and plants hum with visiting insects. To no purpose, however, since hundreds of experimental hand-pollinations have demonstrated that Florida ziziphus is self-incompatible (Weekley and Race 2001). Because most populations comprise a single genetic individual, they are incapable of producing viable seeds.

In addition, research has shown that many genotypes are also cross-incompatible because they belong to the same mating type (Weekley et al. 2002). The number of mating types is genetically determined by the number of self-incompatibility (S-) alleles. To date, only three S-alleles have been confirmed for Florida ziziphus, the minimum number a species can have and still be capable of sexual reproduction. The isolation of remnant...
The discovery of five new populations of Florida ziziphus in 2007 radically transformed its recovery prospects by tripling the number of wild genotypes.

Populations and their lack of genetic diversity are major obstacles to the recovery of Florida ziziphus.

A key attribute of Florida ziziphus’ mating system is that for each new S-allele the number of mating types increases dramatically. For example, if the number of S-alleles doubles from the currently known three alleles to six, the number of mating types will quintuple from three to 15, thereby increasing the genetic variability of resulting offspring. Increased genetic variability provides a significant hedge against extinction and allows populations to adapt to changing environmental conditions. The discovery of populations representing novel genotypes and mating types is thus critical to the recovery of Florida ziziphus.

Prior to 2007, only a dozen genotypes and two S-locus mating types had been identified in the nine known wild populations of Florida ziziphus. Fortunately, by the mid-1990s, a captive population at Bok Tower Gardens, which includes most of the wild genotypes, began producing a large fruit crop annually. This meant that the species retained the capacity for sexual reproduction. It also meant that viable populations could be created by planting compatible genotypes in close enough proximity to permit outcrossing.

Genetic advances

Dr. Matt Gitzendanner and his colleagues at the Florida Museum of Natural History’s Laboratory of Molecular Systematics and Evolutionary Genetics have recently identified additional genetic variation within some of the pre-2007 populations and confirmed the existence of the third S-locus mating type, long hypothesized on theoretical grounds. The Genetics Lab has now shown that the only pre-2007 wild population that produces viable fruit contains at least four distinct genotypes. Earlier evidence suggesting that this population comprised a single genetic individual did not square with Florida’s ziziphus’ self-incompatible mating system.

Recent genetic results also show that some of the plants in the captive population in the Bok planting beds are seedlings rather than clonal root shoots of nearby plants, as previously thought. High stem density within the Bok beds makes it difficult to collect fruits and to ascertain the origin of new recruits. The appearance of seedlings in the Bok planting beds is welcome news because seedlings increase the genetic diversity of the captive population and provide an opportunity for investigating backcrosses between offspring and their parental plants.

In addition, Matt and his co-workers have now confirmed that some of the flowering plants in the captive population constitute a third S-locus mating type. This finding was not surprising since half of the offspring from crosses between the two known wild mating types should result in genotypes representing a third mating type. The third mating type has not been found in the wild, but it is a satisfaction to get its existence confirmed. Mating type III plants should be able to backcross with both parental mating types and will play an important role in the recovery of Florida ziziphus.

Creating new populations

The establishment of genetically diverse and sexually reproductive populations on appropriate conservation lands is the central goal of the Florida ziziphus recovery plan (USFWS 1999). Since 2002, plant conservationists from several agencies and institutions (including Archbold Biological Station, Bok Tower Gardens, the Florida Division of Forestry, and The Nature Conservancy) have collaborated on six translocation projects. Three projects were genetic augmentations involving the addition of new genotypes.
to sites occupied by a uniconal population. The goal of these augmentations is to provide enough genetic variation that the population becomes capable of sexual reproduction. Three other projects were introductions, the translocation of plants representing multiple genotypes to sites not previously containing a Florida ziziphus population. Altogether, these projects included over 600 potted plants and almost 6000 seeds.

The first hurdle in the translocation of species is transplant survival. Florida ziziphus transplants have handily met the challenge. In most of the six projects, cumulative transplant survival is greater than 70% after several years, and introduced populations are persisting in the face of the usual vagaries of Florida’s climate, including the severe droughts of the last two years (winter-spring droughts of 2007 and 2008). The ultimate measure of the success of these translocations is the production by introduced plants of viable offspring.

New discoveries brighten future for Florida ziziphus

The discovery of five new populations of Florida ziziphus in 2007 radically transformed its recovery prospects by tripling the number of wild genotypes from 12 to 38. The two largest populations, comprising over 600 plants and at least 21 new genotypes, were discovered in pasture sites near Lake Wales by Cindy Campbell, Curator of Endangered Plants at Bok Tower Gardens. Together, these two populations, which are separated by only a few hundred yards, more than double the number of plants – and, more importantly, the number of genotypes – known from the wild. A few weeks later, three other new populations were discovered. Plant conservationists Roy Stewart and Brett Miley independently found two new populations on state lands and researchers from Archbold Biological Station found a third. Although these three populations encompass fewer than 40 plants, they represent at least four additional genotypes.

Plants in all five of the new populations flowered heavily in 2008, but only one produced a significant fruit crop. Over a third of the plants in the Lake Wales South Pasture site flowered, yielding a combined crop of over 1800 fruits, thereby indicating that the site contains at least two cross-compatible mating types. The relationship of these mating types to the three previously confirmed mating types has not yet been determined. It is likely, however, that at least some of the new genotypes also represent novel mating types.

Conservation of the 21 new genotypes encompassed by the two large Lake Wales Ridge pasture populations is critical to the recovery of Florida ziziphus. This goal can be accomplished either by public acquisition of the sites or by clonal propagation of the genotypes for inclusion in captive population at Bok. Both routes are currently being pursued.

Although it is too soon to fully assess the impact of these recent discoveries on the recovery of Florida ziziphus, they inspire a renewed confidence that this ancient shrub will have a future as fascinating as its past.

Literature cited


