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Palmetto



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Left to right: Yaupon leaf and fruit details (photos by William Mark Whitten). Yaupon in bloom (photo by Peg Urban).

Yaupon Redeemed

“What’s in a name? That which we call a rose by any other name would smell as sweet”

ACT II, SCENE II, ROMEO AND JULIET, WILLIAM SHAKESPEARE

Francis E. “Jack” Putz

A buckeye butterfly nectaring on yaupon flowers.
Photo by Peg Urban.



In my ethnobotanical novella entitled *Timucuan Tea* (available from the author upon request), the 12-year old protagonist is accused of providing his school’s football team with a controlled substance that miraculously converts them from losers into champions. Just as his fate seems sealed by the combined forces of the D.E.A. and the defeated team’s irate coach, his father, a shabbily dressed but brilliant biochemist, saves the day. The father reports that his son’s secret brew is yaupon tea. He also reveals that the tea contains unheralded concentrations of antioxidants, lots of the anti-tumor agent ursolic acid, plus a big dose of the methylxanthine alkaloids caffeine and theobromine. With those revelations, the boy looks more like a hero than a teenaged villain. Those revelations also make some entrepreneurial representatives of the local university worry about intellectual property rights and royalty sharing if they incorporate yaupon extract in their already famous CrocJuice Energy Drink.

Yaupon is a common understory shrub over much of the southeastern coastal plain, sometimes growing in densities that are problematic for plantation foresters who treat it as a weed. It’s also a familiar yard hedge species, with a weeping form (“pendula”), a small-leaved form (“nana”), and dozens of other named horticultural varieties. On the University of Florida (UF) campus and around Gainesville, it’s the most commonly planted shrub. Pounds of leaves can be hand-stripped from the branches

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of planted or wild-grown shrubs in a matter of minutes. Yaupon holly leaves brew up into a tasty cocktail of stimulating alkaloids and health-conferring antioxidants. Yaupon tea was a daily pleasure for the Timucuan Indians of North Central Florida and the Seminoles and Crackers who followed them.

The claim that yaupon tea is tasty was recently supported by the results of a blind taste test conducted by UF undergraduate Alisha Wainwright. Alisha compared an infusion she brewed from yaupon leaves with yerba mate, a tea made from the leaves of a closely related but commercially available *Ilex* species from South America. To her surprise, most subjects, including confirmed yerba mate drinkers, preferred yaupon. This result is compelling given that yerba mate is exported from Argentina and Paraguay by the hundreds of tons each year whereas yaupon is currently under-appreciated as a beverage.

I can no longer hold off acknowledging that the scientific name for yaupon is *Ilex vomitoria* and that it was indeed used by Amerindians in ritual purification ceremonies. I also need to stress that biochemical analysis of yaupon foliage shows that it is no more emetic than coffee, tea, or any other caffeinated beverage. I suspect but cannot prove that this nomenclatural affront resulted from a well-placed bribe to a prominent Scottish plant taxonomist by unscrupulous Ceylon tea merchants in England who wanted to crush competition from this Native American product.

Early English chroniclers of life in our region were apparently more fascinated by ritual vomiting than about the sterling qualities of yaupon as beverage. Perhaps I reveal my Celtic roots, but I suspect those rich Anglo-Saxons were a prim bunch. There were indeed special occasions when Timucuan and later Seminole warriors vomited after drinking huge quantities of an especially strong brew of yaupon, referred to as “black drink,” but that was only after fasting for days and many nights of singing, dancing, and generally carrying on – Koolaid would have had the same effect. And what’s the big deal about vomiting? As a child, the mere mention of Sunday school or lima bean ingestion could induce that response. A few minutes after my performance, I would be ready to go out to play baseball or eat ice cream, options seldom granted by my not-so-easily-fooled parents. I should add that ritualistic vomiting is practiced in cultures all over the world – even dogs recognize the benefits of an occasional purge.

The people first encountered by Spaniards in Florida exuded good health and towered over the Europeans. The Timucuan of North Central Florida, in particular, impressed those gold-crazed, pox-laden, Inquisition-fleeing, and otherwise tormented newcomers by their size and grace. Timucuan did enjoy more protein than the Old World city-bred bread-eaters, but a heretofore unrecognized advantage of the Timucuan and many of their trading partners all over eastern North America was daily consumption of antioxidant packed yaupon tea.

Much of what we know about the chemistry of yaupon tea

is based on the research of Matt Palumbo, a UF graduate student who worked in the lab of Professor Steve Talcott in UF’s Department of Food Science and Human Nutrition. With Steve’s Waters 2695 Alliance HPLC System with a Supercosil LC-18 Column and PDA Detector (an elaborate chromatographic machine that works in what are to me mysterious ways to generate data that are interpretable only by biochemists), Matt discovered that in addition to caffeine, theobromine, and other alkaloids, yaupon contains high concentrations of antioxidants including various isomers of chlorogenic acid, coumaric acid, and a cocktail of flavonoids. Concentrations of these compounds are highest in plants grown in full sun whereas psychoactive alkaloid concentrations are especially high in young leaves from female plants fertilized with nitrogen. Females can be distinguished by their stamen-lacking flowers and later by the presence of little, round, red, and juicy fruits favored by brown thrashers and bluebirds. Matt also found that leaves of the “pendula” variety contain higher concentrations of caffeine than “nana,” but that nitrogen fertilization boosts caffeine several fold in both wild types and cultivars.

Steve Talcott, now at Texas A&M University, has continued to explore the chemistry of yaupon, especially its exceptionally high concentrations of antioxidants. In a recent study from his lab, for example, yaupon extracts were shown to have anti-inflammatory and various other chemo-preventive effects.

As pointed out by C.M. Hudson in his classic (and recently re-printed) book *Black Drink*, yaupon tea was widely marketed through the 18th and into the 19th Centuries in the Carolinas as “cassina,” in England as “Carolina tea,” and in France as “Appalachina.” Use of that vernacular name “cassina” caused some confusion about the tea source because *Ilex cassine* (dahoon holly), which was the only local species recognized initially by Linnaeus, also grows on the southeastern coastal plain. That confusion was cleared up by research in the lab of botanist Brad Bennett at Florida International University. Based on its high caffeine concentration and high caffeine:theobromine ratio, the researchers concluded that *Ilex vomitoria* was the likely source of the tea that enjoyed such widespread favor. Those vibrant local and international markets for yaupon crashed after the Civil War at least partially due to its association with indigenous people and the poor. The scientific name conferred on yaupon in 1789 by Scottish botanist William Aiton certainly did not help its reputation.

While ceremonial uses of the “Black Drink” are described ad nauseam in even the scientific literature, milder brews of yaupon were widely consumed as a daily beverage by settlers and Amerindians alike. I suspect strongly that during the Seminole Indian Wars, the effectiveness of native warriors was enhanced by yaupon consumption. Note that the “asi” in “cassina” is the Muskogee name for *I. vomitoria*. “Asi Yahola,” which means “Black Drink Singer,” comes to us as the familiar name “Osceola,” the famous Seminole leader. Hundreds of

years before those bloody wars and hundreds of miles north of the species' natural range, other Amerindians were enjoying yaupon tea. This evidence for an extensive trade network in North America more than 500 years before the European onslaught was only recently discovered by a team of chemically savvy archeologists excavating in Greater Cahokia, the massive pre-Columbian ruins near current day St. Louis.

After various failed attempts over the past century to revive the yaupon market, a new day has dawned for this delicious and healthful local beverage. Not less than four companies are now marketing yaupon products, all easily found through the wonders of the world-wide-web. You can now purchase either green or black yaupon tea, concentrates, and blends. You can also go out in the yard, grab some leaves, and make your own.

To make a quick cup of yaupon tea, pan roast a handful of fresh leaves until they are mostly black. Crunch up the crispy leaves and brew them as you would any other tea. If you have more time, air dry the leaves for a few days and then dry them thoroughly in a warm oven. Timucuan reportedly boiled their teas for hours, but I suspect that this procedure was used only for occasional ritual cleansing with "black drink." For daily consumption, they apparently preferred "white drink," a weaker brew with a froth raised by blowing into it through a hollow reed – Timucuan cappuccino. Paraguayans cool smoke their yerba mate leaves before crushing and brewing.

Unfortunately, given the ritual captured by yaupon's scientific name, I worry that the species will continue to be used primarily as an ornamental shrub in suburban gardens and sprayed with herbicides in pine plantations where it grows wild. Although Alisha's study showed that on the basis of taste, even yerba mate drinkers preferred yaupon, she also found that knowledge of yaupon's scientific name would keep many people from purchasing it. In other words, the Shakespearean quote with which this article commenced apparently does not apply to beverages. This finding is unfortunate given that for millions of people who live within its native range, yaupon could provide a local, caffeinated, antioxidant-rich, and otherwise healthful alternative to imported tea, coffee, and other caffeine crops. Let's hope that the fledgling yaupon industries flourish and prove the Bard correct.

But what if yaupon becomes an overnight market sensation? Will exponential rise in demand for yaupon tea result in excessive resource mining followed by domination of the trade by agribusiness? Will consumers purchase yaupon tea made from genetically engineered clones grown in noxious chemical slurries of inorganic nutrients? I am actually not too worried. Given the ease with which yaupon is cultivated as a hedge, I envision neighbors joining together to grow their own leaves in the shade of restored pine savannas. And rather than roller chopping and herbiciding yaupon, plantation foresters might begin to treat it as a valuable non-timber forest product, which will have numerous environmental and financial benefits.

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About the Author

Francis E. "Jack" Putz is a professor of biology and forestry at the University of Florida. His collection of essays about local natural history, some of which will be familiar to readers of the *Palmetto*, was recently published on Kindle and is available through Amazon: *Finding Home in the Sandy Lands of the South: A Naturalist's Journey*.



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The Origin of Florida Scrub Plant Diversity

John J. Schenk

One cannot help but to be amazed by the biological diversity of the Florida scrub habitats. These striking ecosystems host many species of plants and animals found nowhere else in the world and contribute to the biological importance of Florida.

Given the region's unique diversity and the constant threat of habitat loss, we need to understand how these communities formed, what species call these habitats home, and how they can be preserved for future generations. Because much has been written on preserving and managing these habitats (for example, Weekley 2006), here I discuss more fundamental questions regarding the origins of Florida scrub plant diversity, such as how did the scrub habitats form, why are they so different than the surrounding areas, and where did the unique assemblage of plant species come from?

Geological events have shaped the Florida scrub habitat over millions of years. The sandy soils that define these habitats have their origins in the eroding southern Appalachian Mountains and southeastern coastal plains, where sedimentation moved southward over millions of years and ultimately covered the Florida Platform (Scott 1997). Sea levels have also fluctuated over time, shaping and reshaping Florida's coastline (Scott 1997). As climates changed and prehistoric ice sheets melted, sea levels rose as high as 20 meters above our present level, covering most but not all of modern day Florida. It was during this time that the current sand ridges began forming as the seas carved ridges and sand washed ashore to form dunes (Schmidt 1997). At the sea's highest level, the central inland ridges (for example, the Lake Wales Ridge) formed – these are the highest and oldest sand ridges in Florida (U.S. Fish and Wildlife Service 1999). When the seas were at their highest, this area formed island chains that were likely a refuge for species that inhabited Florida before the seas rose and available habitats disappeared. As the sea level lowered, additional north-south orientated sand ridges were later formed outward from the central ridge by the same process. This process continues today, where the coastal dunes are reminiscent of the early inland dunes.

One feature that makes the Florida scrub so interesting is that despite it being located in a subtropical region, it really is a xerophytic (= species adapted to desert-like environments) flora that is dominated by dwarfed oaks and conifers. The sandy soils



Figure 1: Scrub and sandhill communities in Florida. **A.** Atlantic coastal scrub **B.** sand pine scrub **C.** oak scrub **D.** sandhill habitat of the Brooksville Ridge. Note the lack of a continuous tree canopy and continuous ground cover that defines scrub habitat and that all of these habitats have been fire-suppressed.

that are common to these habitats are low-nutrient soils that hold little water due to a lack of clay and organic compounds. Despite substantial rainfall within this region, it is the soil properties that are responsible for the xerophytic vegetation, creating a habitat that favors species adapted to being water-stressed. Florida scrub plant species often have thick leathery leaves that are narrow and can be covered in hairs or a thick waxy coating. These morphological traits are common adaptations to prevent water loss from evaporation and are found in xerophytic plants worldwide.

It is the scrub plant species that give this habitat its unique appearance (Figure 1), where the evergreen scrub species contrast vibrantly against the white sands. Species that are common to Florida scrub and make up a large percentage of the biomass include oaks (*Quercus geminata*, *Q. myrtifolia*, *Q. inopina*, and *Q. chapmanii*), sand pine (*Pinus clausa*), scrub rosemary (*Ceratiola ericoides*), palmettos (*Sabal etonia* and *Serenoa repens*), and a host of more rare herbaceous and shrubby species (see Weekley [2006] for a detailed account of these species). Over 40 species of plants are considered endemic to these habitats, and about half of these species are threatened or endangered. Scrub habitats

B



D



also host numerous endemic animal species, such as the Florida scrub jay, many of which share similar evolutionary histories as plant species and are also threatened or endangered due to the same reasons outlined below.

Not all Florida scrub habitats are the same in soil conditions, history, or species composition. Florida scrub has been divided into inland, coastal, and panhandle scrub (Myers 1990), although numerous other regions can and have been subdivided even further (for example, “rosemary scrub” that is dominated by *Ceratiola ericoides* and “sand pine scrub” that is dominated by *Pinus clausa*). There is a clear relationship between the Florida scrub habitats and the sandhill habitats, which share many of the same species or relatives, in addition to ecological properties. Indeed, these habitats are remnants of the Gulf Coast corridor, a thorn-scrub and savannah habitat that spanned from western North America to peninsular Florida (Emslie 1998). Some ecologists regard sandhill and scrub habitats as being the same, although contemporary ecological properties and species composition differ among them. Sandhill habitats often include species such as *Pinus palustris*, *Quercus laevis*, *Q. laurifolia*, and *Q. geminata*. These habitats can also contain species that are close relatives to inland and coastal scrub, suggesting habitat connections are important to species diversity. The genus *Paronychia* (nailworts; Caryophyllaceae; Figure 2) is a good example of a

group of plants that has close relatives on the interior, coastal, and panhandle scrub, as well as the numerous sandhill ridges that occur throughout the state. The island-like distribution of these ridges appear to be important in *Paronychia*, and may have been responsible for historically isolating populations of plants that have since evolved to become species.

Some Florida scrub species occur nowhere else in the world, but where did their ancestors come from? Three areas seem the most likely. Species could have come from desert areas in western North America, spreading into Florida along the Gulf Coast corridor during the Pleistocene as glaciers expanded and sea levels lowered. Such a pattern is found with many species of birds and reptiles (Morgan and Emslie 2010). On the other hand, perhaps scrub species originated from eastern North America and have adapted to these habitats from temperate or subtropical ancestors, as is common with many mammal species (Morgan and Emslie 2010). Species could have alternatively

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A



B



Figure 2: *Paronychia* diversity in scrub habitats. **A.** *Paronychia chartacea* is a Florida scrub endemic that occurs only along the Lake Wales Ridge. Its closest relative, *P. chartacea* ssp. *minima*, occurs in sandy soils along karst lakes in the Panhandle. **B.** *Paronychia hemiarioides* occurs in looser sandy soils on the Lake Wales and Mount Dora Ridges.

dispersed from areas outside of North America, such as from the Caribbean, as is common with tropical birds and bats (Emslie 1998, Morgan and Emslie 2010). To answer this question, we must investigate the genetic and geographic patterns of scrub species and their relatives for clues of how and where these species evolved. Some studies have pointed to scrub species being derived from eastern North American species. We have found that *Paronychia*, for example, appears to have had its roots in eastern North American soils before colonizing peninsular Florida. Lewton's polygala (*Polygala lewtonii*) and scrub holly (*Ilex opaca* var. *arenicola*) also evolved onto scrub from eastern progenitors (Germain-Aubrey et al. 2014). Lewton's polygala was estimated to be in Florida by the Pliocene, supporting the idea that high elevations in central Florida were a refuge for plant lineages as sea levels rose (Germain-Aubrey et al. 2014). The jury is still out on the majority of species that call the Florida scrub home. Species like *Ziziphus celata*, *Eriogonum longifolium* var. *gnaphalifolium*, and *Nolina brittoniana*, for example, all have close western relatives (Weekley 2006), suggesting some past connections. The biogeographic origin of other species, such as scrub plum (*Prunus geniculata*) and scrub bay (*Persea borbonia* var. *humilis*), were inconclusively identified, although they were determined to have been in Florida before the sea levels rose (Germain-Aubrey et al. 2014). It is likely that scrub species diversity is from an eclectic mix of regions that have diversified into peninsular Florida at different times over millions of years, but we must wait for additional studies to shed light on the origins of other scrub species before we have a complete picture of its complex history.

It is quite common to find “for sale” signs posted in front of remnant scrub habitat that is nested among developed or otherwise modified land. We are quickly selling off our scrub habitat, which is why areas that have been set aside for preservation like the Ocala National Forest, Archbold Biological Station, Tiger Creek Preserve, Jonathan Dickinson State Park, and others are so important to the persistence of scrub endemic species. Private, local, state, and federal agencies have taken a community conservation approach, setting aside tracts of land in order to preserve the entire scrub ecosystem. The importance of this endeavor in preserving the many different types of scrub and sandhill habitat cannot be overstated.

Another major threat to scrub communities is fire suppression (U.S. Fish and Wildlife Service 1999, Weekley 2006, Menges 2007). Fire naturally occurs in these communities, helping to shape species composition, which have adapted to the naturally occurring fires every 10 to 100 years (U.S. Fish and Wildlife Service 1999). Fire management has shown great promise in preserving and promoting threatened and endangered scrub species by encouraging seed release, seed germination through the seed bank that amasses in the soil, removing large woody plants, and by opening new areas for plants to grow (Menges 2007). Botanists have also been hard at work studying the genetics

of the plants in order to manage plants in a way to optimize the success of generating offspring by controlled breeding or planting (Gitzendanner et al. 2012). All of these efforts are important and will determine whether future generations will also be able to appreciate the unique and inspiring Florida scrub habitats.

Scrub habitats are unique not only at the worldwide scale, but also at the local level. These habitats have formed over millions of years through many different geological and biological events, all of which have contributed to the uniqueness of the flora. Scrub and sandhill habitats coincide with sand ridges, many of which have very different histories and ecological properties, suggesting that we not only need to be concerned with studying and protecting these habitats as a whole, but we also need to be cognizant of the diversity within and among the subregions and recognize the importance of each and every one.

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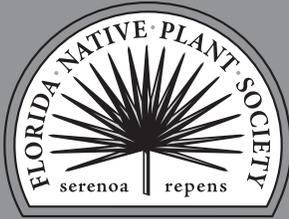
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For most purposes, the phrase Florida native plant refers to those species occurring within the state boundaries prior to European contact, according to the best available scientific and historical documentation. More specifically, it includes those species understood as indigenous, occurring in natural associations in habitats that existed prior to significant human impacts and alterations of the landscape.



The Palmetto

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