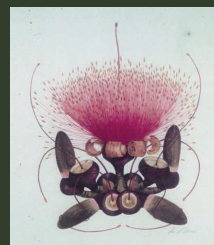


Gifford Arboretum Newsletter

Fall 2015

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End of the Road for the Arboretum?

By: Steve Pearson

Now that this ambiguous title has your attention, my expectation, and certainly my hope, is that the Gifford Arboretum will be here for the use and benefit of many generations to come. But the issue of a road (and/or more parking) in the Arboretum has haunted the Arboretum for too many years now, and it has twice been the source of renewed involvement from your present Director.

The history of an internal road goes back decades to when the University of Miami (UM) petitioned Coral Gables to close Miller Road on the west side of campus and to build Lake Osceola. Permission was granted, but on condition that UM build an internal, connected road within its campus to relieve anticipated traffic in residential areas. For whatever reasons, UM never built the road and, in the meantime, the school grew into a major university with many more programs and students. While that growth was an admirable achievement, the accompanying construction of supporting facilities also reduced the possibilities of where a road might be placed.

But the surrounding area and traffic patterns have also changed, and UM's position is that a road is not only not needed and would create no benefits, but it would also do egregious harm to important assets like the Arboretum. First, traffic circles in the area have greatly reduced the desirability of using the residential streets by UM related traffic as well as commuters. To its credit, UM has also taken effective internal measures to reduce traffic. For example, the prohibition against freshmen having cars and the zoned parking system where people must use their assigned lots have significantly reduced the amount of UM traffic that impacts adjoining residential areas.

Clearly, any road through the Arboretum would do very significant harm. Even with a plan that minimized the loss of botanical treasures as much as possible, any road would destroy the ambience and great beauty of the Arboretum. To destroy an area that is a great resource for education and research, as well as a community treasure for beauty and the peaceful enjoyment of nature, for a road that would be of little, if any, benefit would be a travesty that should never be allowed.

I am pleased to report that at a community meeting held on October 7, 2015, the room was packed with Arboretum supporters. It was wonderful to see so many turn out, particularly during rush hour on a rainy afternoon. Even the one person who spoke in favor of the road indicated that she didn't want to harm the Arboretum. Many people, including UM neighbors and other Coral Gables residents, have also written to the Coral Gables Commission to oppose any road through the Arboretum and most, if not all, of the Commissioners have indicated their opposition to same.

A subsequent hearing before the Coral Gables Planning Board had to be postponed, but I just learned that it has now been rescheduled for **Wednesday, December 9th at 6 pm.. The hearing will take place in the Commission Chambers at Coral Gables City Hall, which is located at 405 Biltmore Way. City Hall is located just west of the intersection of LeJeune Road (SW 42 Avenue) and Miracle Mile (Coral Way/SW 24 Street).** While there seems to be lots of opposition to a road through the Arboretum, nothing should be taken for granted and I hope that many of you will join me at this hearing to show support for the Arboretum. Particularly since next week starts final exam week, it will be difficult for UM student to attend and therefore the presence of others is even more important.. I will keep you posted, but I believe that if the Planning Board opposes the road, then the full Commission will follow that recommendation. Hopefully we can soon "break out the champagne" and finally celebrate a future where no road in the Arboretum will ever be required. I have appreciated the efforts of all of you who have supported the Arboretum respecting this issue. Together, we can and will slay this dragon!

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The Impacts of Florida Agriculture on Sulfates, Sulfides, and Mercury in the Everglades

By: Thomas E. Lodge, Ph. D.

Sulfur is naturally found in rain, surface water, and aerobic groundwater as sulfate, an oxidized form. In anaerobic waters and soils, sulfur occurs in a reduced form as hydrogen sulfide, which has the characteristic aroma of rotten eggs. Everglades surface water levels of sulfate are naturally less than 1 ppm. However, increases in sulfate caused by agricultural releases of sulfur should be of great concern to all of us because of its deleterious effects on the ecosystem. Two main problems result from sulfate enrichment: 1) biomagnification of toxic mercury in Everglades wildlife and consequent human exposure; and 2) formation of hydrogen sulfide in Everglades soils at levels toxic to wetland vegetation and aquatic animals, particularly burrowing species like crayfish.

In the Everglades Agricultural Area (EAA), and in particular as part of the sugar industry's practices, sulfur is widely used to combat increasing soil alkalinity caused by the underlying limestone as EAA soils subside from decades of agricultural use. For sugar cane, a recommended annual application of sulfur is 500 lbs./acre. Aerobic soil bacteria then oxidize the sulfur, which acidifies the soil, making phosphorus more available to crops. However, this process converts the sulfur to sulfate and sulfate levels in waters released from stormwater treatment areas (STAs) are often as high as 80 ppm, which is more than eighty times its natural level!

Mercury is also a naturally occurring element, but it forms chemical compounds of various toxicities. The most dangerous of these is an organically bound form, methylmercury, which is a powerful teratogen (i.e. can disturb fetal development), endocrine disruptor, and neurotoxin. While other forms of mercury are also toxic, they do not as readily enter living organisms. Methylmercury, however, is readily absorbed, and it can then also be biomagnified through the food chain so that it causes mutations, abnormal growth, neurologic/behavioral disorders, and even death at high concentrations. In humans, embryonic development through infancy is most susceptible to mercury toxicity because of its interference with tissue differentiation, even at mercury levels not dangerous to adults.

Unfortunately, an understanding of the linkage between sulfate and mercury in Everglades wildlife has been slow in developing. Problems with mercury were first reported in 1974 when high levels of mercury were discovered in largemouth bass and other predatory fish. Especially surprising were levels dangerous for human consumption found in fish in remote locations inside Everglades National Park's Shark River Slough. The USEPA standard for allowable mercury (expressed as 0.3 milligrams per kilogram), **2** in edible fish tissue is 0.3 ppm but levels in largemouth bass were



commonly at one ppm (about 3 times the standard) in the central and southern Everglades. Consumption warnings were posted in 1989 and, adding greatly to the concern, a Florida panther was found dead in the Everglades that same year. Samples of its liver revealed 110 ppm of mercury, high enough that mercury poisoning was considered the probable cause of death. In mid-1991, the last two panthers then inhabiting Everglades National Park died. Their mercury levels were lower than in the 1989 case, but mercury poisoning was still regarded as a probable contributor to the death of at least one of the panthers.

With these deaths, it became clear that mercury was bioaccumulating in the region's fauna. This was supported by expected trophic-level results: applesnails had low levels, mosquitofish were intermediate, but alligators, raccoons, and wading birds all had high levels, in fact far higher than even the levels that had been observed in largemouth bass. Research and soil analyses showed that, between 1900 and 1990, the rate of mercury accumulation increased at least five fold, with most of the increase occurring after 1950. With this knowledge, regulatory reforms were implemented that greatly reduced local mercury sources, especially from incinerators, and significant reductions of mercury were soon found in wildlife. For example, levels of mercury in largemouth bass in the water conservation areas fell from a high of 1.6 ppm in 1991 to 0.55 ppm in 2010. While those recent levels were a substantial improvement, they were still almost twice the recommended US edibility limit. In addition, little to no improvement occurred in Everglades National Park, where the Shark River Slough wildlife in particular continue to have high mercury levels.

While regional mercury sources were being identified and abated, other research determined that mercury was getting into the food chain because for decades, and continuing today, elevated sulfur (mostly as sulfate) has been passing into the Everglades from the EAA. In descending order of amounts, the major sources have been: 1) release of legacy sulfate from the EAA due to soil oxidation/subsidence, 2) Lake Okeechobee waters passing through the EAA via canals, and 3) ongoing agricultural applications of sulfur in the EAA. For more than a decade, sulfate from these sources has passed through the EAA stormwater treatment areas, but STAs were designed to remove phosphorus, not sulfate, and most of the sulfate passes through into the Everglades.

Wherever sulfate occurs, sulfate-reducing bacteria in anaerobic soils convert it to hydrogen sulfide. The conducive environment for this conversion exists under the algal mat covering submerged soils. In a process called methylation, dissolved organic matter and mercury are converted into methylmercury in connection with the sulfide production. A key finding was that the conversion is optimized not where sulfate in surface water is high, but where it is between one and 20 ppm, provided that there is sufficient dissolved organic matter (which is present in all waters coming from the EAA). Below this range, there is too little sulfate to support much methylation, and above it, so much hydrogen sulfide is produced that available mercury is converted into insoluble mercury sulfides. Under anaerobic conditions, mercury sulfide remains in the soil where it is "locked away" from biological uptake. However, upon drying and entry of air into the upper soil as occurs naturally with our weather cycles, some of this sulfide-

bound mercury is released, as well as sulfide oxidized back to sulfate, both again then available for forming methylmercury.

Extensive water-quality monitoring in the Everglades has shown the locations where methylation was occurring. The worst areas moved with changing rainfall and canal routing of water, but most commonly occurred in WCA-3A and in the Shark River Slough. The distribution of mosquitofish with high concentrations of mercury showed that these areas coincide with the moderate to low sulfate levels, not where sulfate was high. Despite monitoring results showing that Everglades National Park actually has less inorganic mercury than the central and northern Everglades, the conditions for methylation have remained optimal, apparently because of the sulfate routed there via canals from the EAA, and then exacerbated by wet and dry cycles as methylation increases during the dry periods. Because of the wet-dry methylation enhancement, it is critical that STA's not be allowed to dry as they are potentially large sources of methylmercury. Specific current concerns about mercury in the Everglades include:

- * Largemouth bass of edible size continue to have high levels of mercury, with median levels of 0.56 ppm and some specimens as high as 2.7 ppm, significantly higher than the USEPA recommended upper limit for consumption of 0.3 ppm. The Florida Dept. of Health has a continuing "Do Not Eat" advisory for women of childbearing age and young children for larger bass from the Everglades.

- * Wading birds: Mercury is deposited in the growing feathers of birds, thus nestling wading birds are protected from high tissue levels until their feathers stop growing. However, research has documented that great egret nestlings raised on a diet containing 0.5 ppm mercury (which is in the higher limit of Everglades mosquitofish), began to exhibit abnormal behavior, and at diet levels of 5ppm caused severely disoriented behavior. When white ibis ate fish with mercury concentrations of 0.05 to 0.3 ppm, it led to substantially decreased breeding success, including 55% of males exhibiting male-male pairing (obviously without egg production!).

- * Pythons have been found to harbor excessive mercury in their muscle tissue, to the extent that researchers are puzzled about their survival. Python mercury levels have been found three to four times higher than in alligator meat, previously thought to be the highest in the ecosystem. The mean mercury level measured for pythons is 4.3 ppm, and a high value of nearly 40 ppm has been recorded. If someone challenges you to try a bite of python, keep it very small!

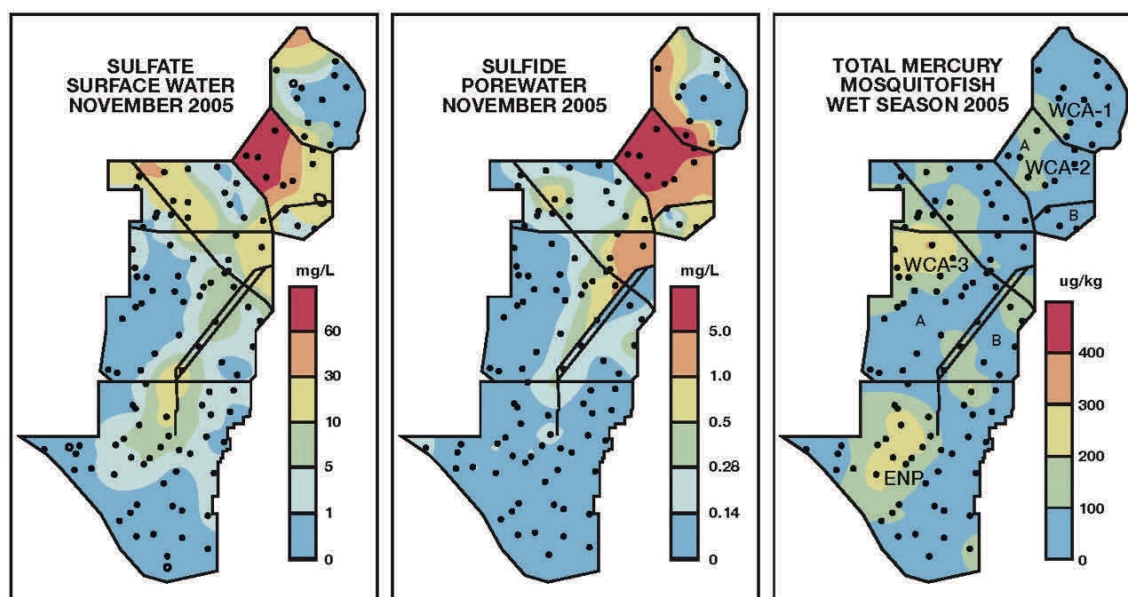
- * Sulfate concentrations coming from the EAA stormwater treatment areas continue unabated so that downstream locations inside Everglades National Park are still experiencing methylation.

- * A focus of CERP is to increase water flow through the ecosystem. However, without source reductions in sulfate, restoration will likely elevate sulfate concentrations in Everglades National Park and in turn, mercury methylation.

Space does not permit an in-depth review of how increased sulfides are also negatively impacting Everglades flora and fauna, but research has supported the hypothesis that it is increased sulfides rather than phosphorus that is causing the replacement of

native sawgrass by southern cattail in large areas of the northern Everglades. Again, burrowing organisms are also facing the high risks.

Given the pervasiveness of mercury poisoning in some areas, it should be obvious that we are in need of sulfate regulation. However, there are currently no enforceable numeric standards for releases of sulfates into the Everglades or in any other environment in Florida. The USEPA has a recommended limit for the Everglades of 1 ppm, which has been adopted for CERP. But that level merely stands as a target without any enforceable means of achieving it. The provisions of Florida Administrative Code sections 62-302.500 (1), 62-302.530 (47)(b), and 62-302.530 (61) contain provisions that should apply to sulfate releases, but the current state administration has not shown any inclination to take any action to regulate or curtail sulfates going into the Everglades. Although mercury resulting from sulfates certainly appears to present a “clear and present danger” to wildlife and humans, the complexity of sulfur transformations in the environment, including their interactions with mercury, is allowing governments to continue with business as usual, much as is also occurring with climate change. However, this is poor stewardship and governance, and we should demand better.



Concentrations of sulfate in surface water (left) sulfide in soil porewater (center) and total mercury in mosquitofish (right) in the Everglades Protection Area in 2005. There is an obvious correlation between surface sulfate and porewater sulfide, e.g. very high sulfate and sulfide shown widely in WCA-2A (see right frame for location labels). However, mercury levels in mosquitofish differ substantially, occurring where sulfate elevation is only slightly above background (the latter shown as dark blue at left). It was occurrences like this that lead to an understanding of the relationship between surface-water sulfate levels and mobilization of methylmercury into the food web. Dots are sampling locations; WCA = water conservation area; ENP = Everglades National Park. Source: Scheidt, D.J. and P.I. Kalla. 2007. Everglades ecosystem assessment: water management and quality, eutrophication, mercury contamination, soils and habitat: monitoring for adaptive management: a R-EMAP status report. USEPA Region 4, Athens, GA. EPA 904-R-07-001.

Note – The foregoing is primarily a summary of some of the information contained in Ch. 22 of the upcoming (late 2016) 4th edition of *The Everglades Handbook: Understanding the Ecosystem* by Thomas E. Lodge, Ph.D. Please see the text for further information.

New Catalog, Plot Maps and Signage for the Arboretum!

It has been a long and arduous process, but we are very close to completion of our new online catalog and signs for the Arboretum. While I had hoped to have this work fully completed by now, it is clear that, in spite of my best efforts, that will not occur in time for this publication. However, new signs have been installed on the trees in most of our Exhibits and the catalog is complete except for three Exhibits, with the underlying work for them also being basically finished. At our picnic, parts of the catalog and the new signs will on display, and use of the QR codes will be demonstrated.

For each of our 14 exhibit areas, the catalog will contain a general introduction describing the exhibit; a plot map showing the locations of all trees and other plants located in that exhibit; and a grid of information that is divided into three sections. The first section lists those species planted in that exhibit's area that fit the parameters of the title for that exhibit. For example, for Exhibit 1 - The Arecaceae, this would be a list of (and information about) all the palms planted in the exhibit. To aid in identification of those plants that belong in a given exhibit while in the Arboretum, section 1 plants are numbered from 1 to 99. The second section is a list of all plants that fit the exhibit's parameters, but are located in other areas of the Arboretum. For Exhibit 1, this would be a list of palms planted in other exhibit areas, together with an indication of the specific exhibits where they are located. Thus, someone who wants to determine all the palms in the Arboretum and their locations could ascertain that information from these two sections. Finally, section three is a list of all plants that are NOT within the parameters of an exhibit's name, but are nevertheless planted there. For Exhibit 1, this would be a list of plants that are not palms, but are located in Exhibit 1. Since planting of the Arboretum started in 1947, long before our current exhibit system was created, none of our exhibit areas except for Exhibit 3—The Gymnosperms, consists only of species for which the exhibit is named. Again, for example, Exhibit 1 includes a magnificent and very large specimen of *Enterolobium cyclocarpum* (the Guanacaste or Ear Pod Tree) that, for purposes of exhibit purity, should be planted instead in Exhibit 6 -The Fabaceae. But it would be impractical, if not impossible, to move such a large tree. While we strive to plant new specimens in the exhibit to which they belong, horticultural requirements are a reason why this may not occur. For example, to expand our cycad collection, we have planted *Encephalartos ferox*. But due to its need for shade, it was planted in Exhibit 13 - What is a Tree?, rather than in the botanically correct, but very sunny, Exhibit 3—The Gymnosperms. Again to aid in identification while in the Arboretum, all section 3 plants are numbered sequentially from 100 so that three digits indicates that a tree does not belong within the parameters of the exhibit's name where it is planted.

Species are listed alphabetically in each of these sections by their botanical names and, for each species, there is also information on its order, family, subfamily, common name(s), and origins, as well as a comment with information that was deemed significant or of general interest. At first, we were constrained by space to keep the comments very short, but later it was determined that a link could be provided for the information and this allowed the comments to be expanded. While the comments for the first 5 Exhibits are fairly terse, we were able to expand the comments for the subsequent exhibits when this space constraint was removed. We will now return to those initial



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Flacourtia indica

Exh 9 - Basal Angiosperms

Plant 101

Common Name : Governors Plum

Area of Origin : Africa, temperate Asia

Comments : This shrubby, small tree produces round, one-inch fruit that are deep purple to reddish black when ripe. The white to yellow flesh is sweet and mildly acidic, but quality is variable and sometimes astringent. Although often eaten fresh, the fruit can also be processed into jams and jellies. They can also be dried. Flacourtia indica produces inconspicuous greenish-white flowers, usually in the spring after the tree has dropped its leaves. Pink or red young leaves emerge to become deep green, glossy and somewhat leathery as they mature. The very hard wood of the trunk and branches is finely textured and straight grained. It is used for tool handles, spoons, arrows, walking sticks, posts and turned items, although the small diameters limit its usefulness. All parts of Flacourtia indica have been used in folk medicine. Leaves and roots are used to treat snakebites, and an infusion of bark is used for cough, pneumonia and as a gargle. Bark extract is also used on skin sores, and a tonic of leaves is used for asthma, malaria, and pain relief. Root extracts are used as a diuretic. Because the fruit are eaten by birds, seeds can be widely dispersed and Flacourtia indica is invasive in some areas, wide planting is not encouraged.

The Arboretum Loses a Good Friend

I am saddened to report that Susan M. Hangge died on May10, 2015. Susan was one of the first women to have been graduated from UM with a degree in engineering, and she was a longtime supporter of the Arboretum and the Lowe Art Gallery. Susan loved the trees of the Arboretum, but her favorite was Black Sapote (*Diospyros digyna*). She would often bring in and share the delicious, sweet bread that she made from its fruit. Prior to her demise, Susan made a gift to the Arboretum to help maintain "her tree," and her recipe for Black Sapote bread is printed below. I will miss Susan and her optimistic, cheerful outlook.

Beat 3 eggs and mix with $\frac{3}{4}$ cup oil and 2 $\frac{1}{2}$ cups of sugar. Add 2 cups of Black Sapote puree and 2 Tsp. of Vanilla. Combine 3 cups of flour and 1 Tsp. each of baking soda, salt, cinnamon, and cloves, and then add to mixture. Add 1 cup of raisins that have been soaked in rum. Pour into greased pan(s) and bake at 350 degrees for about 60 minutes.

where appropriate.

The comments correspond to the information provided by the QR codes in the Arboretum. Now, someone with a smart phone that has a QR reader can do self-guided tours and learn about the trees while in the Arboretum. Although the catalog contains additional information, the box to the left is a random example of what one would see with a QR reader. If you don't already have a QR reader app, then I urge you to get one as they are available free at your smart phone store.

Please look for the new catalog under a link on the Arboretum's website home page which is <http://www.bio.miami.edu/arboretum/>. The catalog should be available online very soon, most likely before year end. My goal was to create a tool that could be continuously improved and that would take interpretation of our Arboretum to a new level. It undoubtedly has some errors, so if you see any mistakes, please let me know via email at sdpearson@bio.miami.edu.

A big THANK YOU is extended to all who helped with this project. Julie Dow was specially helpful in gathering information for the comments in 2 exhibits, and Lenny Goldstein helped with Exhibit 1. Chris Blackman, John Cozza, Tod Landess and Tiffany Chambers were a big help in installing our new signs. Finally, Arboretum curators Anuradha Gunathilake and Luis Vargas helped in many ways with this project.

Please Plan to Join Us for Some Great Programs During the Spring Semester!

February 3, 2016 - **Leonard H. Goldstein** will present "Palm Care and Culture, Including Some Important Differences of Which You May Not Be Aware"

March 2, 2016 - **Jeffrey S. Block, M.D.**, will present "Insights into the Use of Botanical Medicines in Modern Patient Care"

April 7, 2016 - Annual Gifford Lecture by **Helene Muller-Landau, Ph. D.** on a topic to be determined. A reception in honor of Dr. Muller-Landau will follow.

May4, 2016 - **Kathleen Sullivan-Sealey, Ph. D.** will present a topic to be determined

All events are free and open to the public. All events will take place at 7:00 pm and, except for the Gifford Lecture, will be in Room 166 of the Cox Science Center on the University of Miami's main campus. The location of the 2016 Gifford Lecture will be announced later..

Please Donate to the Gifford Arboretum

Mailing Address: John C. Gifford Arboretum, Rm. 231 Cox Science Center
University of Miami, 1301 Memorial Drive, Coral Gables, FL 33124-0421

Website: <http://www.bio.miami.edu/arboretum>

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☐ Please keep me informed of activities at the Gifford Arboretum.

☐ Please find enclosed my tax-deductible donation to the University of Miami-Gifford Arboretum. (Tax deduction excludes value of benefits)

☐ Please send me information about including the University of Miami in my estate plans.

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- ☐ Student friends \$5
- ☐ Friends \$25
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- ☐ Donors \$1,000
- ☐ Benefactors \$5,000

Benefits

- newsletter and discounts
- newsletter and discounts
- all above plus t-shirt
- all above plus special luncheon
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T-shirt size (circle one): S, M, L, XL

Make your donation by check: Total amount enclosed \$ _____

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LEAVE A LEGACY FOR TOMORROW, TODAY

Through tax and estate planning techniques and incentives, planned gifts allow you to meet your personal financial objectives while ensuring the future of the Gifford Arboretum. Planned giving options include bequests, trusts, and charitable gift annuities.

PLAN YOUR GIFT

To learn more about planned giving opportunities that can benefit you and the Arboretum, contact Kyle Paige, JD '89, director of estate planning and giving, at kpaige@miami.edu or 305-284-1527.

Please make a gift to the Gifford and/or include Gifford Arboretum in your estate plans to help support the ongoing work of caring for the trees and to enable the Arboretum to remain a central feature of the UM campus for generations to come.

HELP US GROW

