LAKEWATCH

Dedicated to Sharing Information About Water Management and the Florida LAKEWATCH Program

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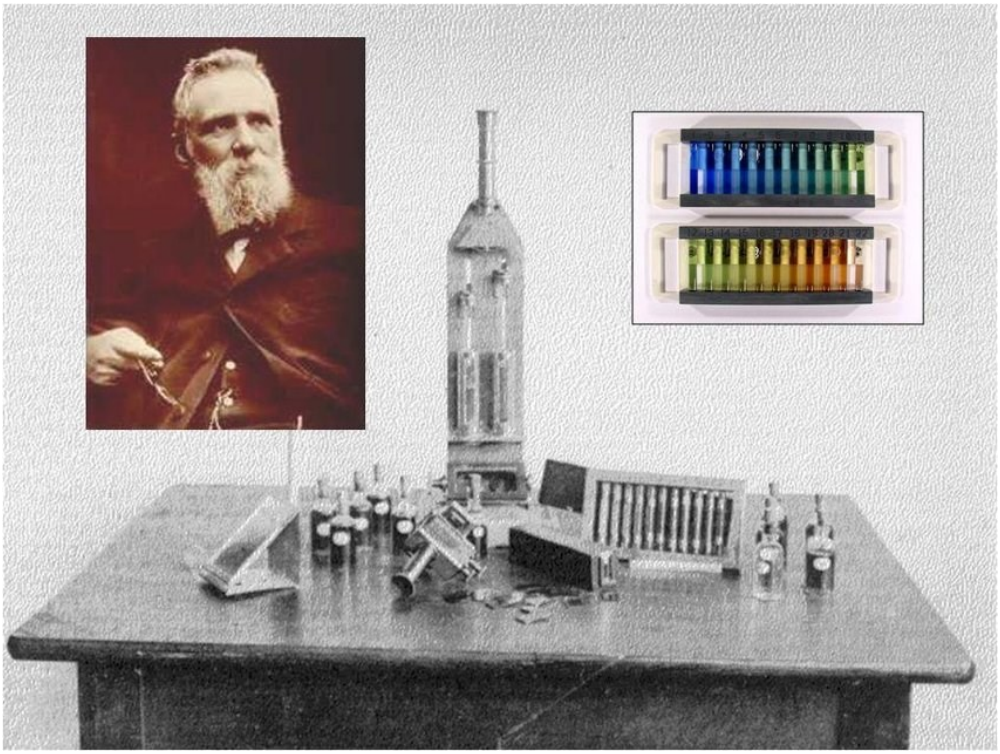
UF IFAS UNIVERSITY of FLORIDA

SCHOOL OF FOREST, FISHERIES, AND GEOMATICS SCIENCES

A LITTLE HISTORY: LIMNOLOGY, TROPHIC STATE, AND EUTROPHICATION

BY MARK HOYER

Most scientists consider François-Alphonse Forel (February 2, 1841 – August 7, 1912), a Swiss physician and scientist who pioneered the study of lakes, to be the founder and father of limnology. Simply stated, limnology is the study of inland freshwaters, which was derived from Greek word límnē meaning "standing water, pool, marshy lake". Not so simply, limnology in the 21st century incorporates many scientific, sociological, and political disciplines that impact inland waters including, but not limited to, geology, hydrology, chemistry, biology, physics, human dimensions and others. As technology advances, the disciplines used in limnology continue to expand. For example, geomatic sciences are now used by limnologists incorporating satellite/drone imagery to monitor and understand water clarity and algal blooms in lake systems. In fact, LAKEWATCH is currently attempting to develop models to estimate water clarity and chlorophyll from satellite imagery (stay tuned for more information).



While limnology continues to evolve, lake trophic status and eutrophication are core concepts that underlie or are related to most limnological investigations and aquatic system management programs including core LAKEWATCH measurements. Einar Naumann

(13 August 1891 – 22 September 1934), a Swedish limnologist, first developed what is now thought of as the trophic state concept. Naumann's concept of trophic state can be summarized by the following four statements:

- The amount of algae (production) in a lake is determined by several factors, primarily by the concentration of phosphorus and nitrogen.
- Regional variations in algal production correlate with the geological structure of the watershed with lakes in agricultural, calcareous regions being greener than lakes in forested, granitic watersheds.
- The amount of production in a lake affects lake biology as a whole.
- There are certain evolutionary (ontological) connections between lakes of the various types; lakes become more productive as they age.

Naumann also developed the common trophic state terminology based on quantitative production of phytoplankton that is still used today. Oligotrophic lakes are those with low nutrients and algal production and eutrophic lakes have high nutrients and high algal production. While Naumann's primary classification system was based on algal/plant production he understood factors other than nutrients (temperature, light, and chemical factors such as calcium, humic content, iron, pH, oxygen, and carbon dioxide) could also impact algal production, thus he added additional classification terminology (lake types) to account for these factors.

It is important to clarify distinctions between the terms trophic status and eutrophication, which are often used interchangeably by both professionals and lay persons. Defining a lake's trophic state is a static exercise, placing a lake somewhere along Naumann's gradient of lake production from low production (oligotrophic) to high production (eutrophic). Eutrophication, on the other hand, is the movement from a lower trophic state to a higher trophic state. There is a natural long-term eutrophication process due

to continued accumulation of particulate organic matter and an anthropogenic accelerated eutrophication due to increased additions of nutrients to aquatic systems. One of LAKEWATCH's long-term goals is to determine when a lake is suffering from anthropogenic eutrophication above and beyond natural eutrophication so management efforts can be implemented.

I have shared a little Limnological history with you because it is interesting to me (especially as I slowly become history) and it is still very relevant today. History is also important to LAKEWATCH as we finish our 35 year of life and move into the future. I want to thank everyone for your years of service helping to make LAKEWATCH one of the best, largest, long-term volunteer water quality monitoring programs in the country if not the world!

Have a Merry Christmas and a Happy New Year!
Mark Hoyer

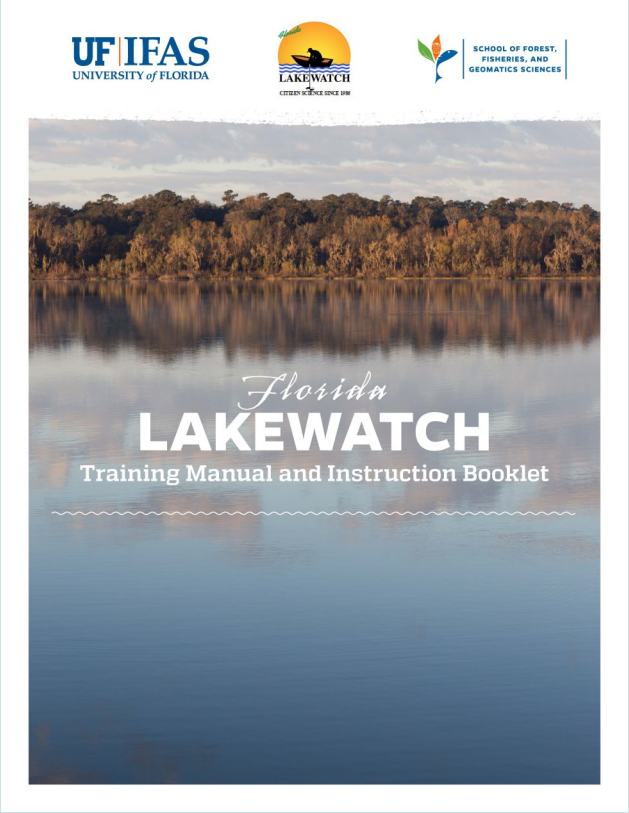
We have updated our training materials! In accordance with our new standard operating procedures (read more on that in Volume 88)

https://lakewatch.ifas.ufl.edu/extension/newsletters/

We have given our training manual a fresh new look. You can download a new copy from the Lakewatch website

https://lakewatch.ifas.ufl.edu/for-volunteers/training/

or reach out so we can mail you one. Happy Sampling!



THE LEE COUNTY MOSQUITO CONTROL DISTRICT: PROTECTING PUBLIC HEALTH FOR OVER SIXTY YEARS

BY ERIC JACKSON

Deputy Director
Lee County Mosquito Control District
jackson@lcmcd.org

The Lee County Mosquito Control District (LCMCD) was established in 1958 by an act of the Florida Legislature. For over sixty-years, the District has provided uninterrupted mosquito abatement for the residents and visitors of Lee County in Southwest Florida. At the time of its inception, there were generally two primary methods for controlling the enormity of salt-marsh mosquitoes that plagued coastal Florida: Source reduction by mechanically altering the environment to produce less mosquitoes, and chemical control. T. Wayne Miller, a civil engineer who was commissioned to lead the newly formed district, recognized that the most effective way to manage Lee County's mosquito problems was the latter.

Over the next three decades, Miller built one of the most robust mosquito control programs in the country. Leaning heavily on aerial larvicide and adulticide programs, he acquired a number of military surplus aircraft and created a 'Mosquito Air Force' that was based at the Buckingham Army Airfield (purchased by the District in 1968). **[Figure A]** With this aerial arsenal, Miller was able to keep the mosquitoes at bay while the county's residents continued to grow in population. By adding applied research, incorporating the use of more target-specific materials, and standing up a world-class school-based education program, LCMCD became the gold-standard for how mosquito control should be when provided the resources and public support.

Figure A - LCMCD Headquarters in Buckingham, FL

At LCMCD all things begin with surveillance. The District's primary goal is to eliminate mosquitoes in the larval stage, and locating specific breeding sites allows for more effective treatments. LCMCD biologists monitor rainfall and the tides when mapping out the areas producing mosquitoes. Traps are also deployed to determine which species are more prevalent. Because certain species prefer different habitats along with different hosts, a simple CDC Light Trap or BG trap can pinpoint the species and steer the biologist to where they may be breeding.

Larviciding is the bread and butter of the operation. When implemented to maximum effectiveness, much of the nuisance and public health issues caused by mosquitoes is abated – simply because the insects never have the opportunity to become biting adults. Most of LCMCD's operations are conducted with this in mind: Larviciding is simply more target-specific and more efficient. Hand-held back- pack sprayers, ground-based truck treatments, and aerial applications by helicopter are all used to preempt an adult mosquito emergence. **[Figure B,C]** LCMCD is also fortunate to partner with its sister-district, the Lee County Hyacinth Control District, which controls aquatic vegetation known to host mosquito production.

Figures B , C - LCMCD ditch truck treating mosquito larvae and LCMCD Airbus H125 conducting an aerial larvicide mission

If too many adult mosquitoes manage to come off from a breeding area, the District deploys technicians to address the problem through ground based treatments using Ultra-Low Volume (ULV) trucks. The trucks are assigned an area to treat which immediately reduces the biting pressure from these pests. If a larger area needs to be covered, aircraft are used. All materials used by the District are EPA approved, and the label rates are strictly followed as required by law. Additionally, District biologists frequently validate the effectiveness of the materials used by conducting lab bioassays and field-based trials.

Because a number of mosquito species in Southwest Florida are capable of spreading dis-

ease, early arbovirus detection is of utmost importance. The District conducts in-house testing of sera collected from sentinel-chickens to detect antibodies of West Nile virus, St. Louis encephalitis, and other viruses harbored in birds. LCMCD biologists also analyze the DNA of mosquitoes caught in the field to determine if they are carrying any known viruses of concern. The results of these tests can also warrant a mosquito treatment in a particular area of the county.

Aside from operational mosquito control, the District puts maximum effort into another crucial component of Integrated Pest Management (IPM): Education and Public Outreach. LCMCD is the only District in Florida to fund teaching positions within the local school district to exclusively provide science-based public health and environmental education programs. Public and private school students from kindergarten through 12th grade are taught grade-appropriate lessons that cover everything from insect life-cycles and biology to performing bioassays on mosquito larvae. **[Figure D]** The education program continues to expand, and currently over 20,000 students participate in mosquito programs each school year.

Figure D - Andrea Miller, Education Coordinator teaching 5th graders

For more information on the District's school-based education program, visit http://MosquitoEd.com.

Over half a century since its creation, the Lee County Mosquito Control District still has an innovative spirit. While much of the day-to-day operation is very similar to the best practices years ago, new technologies have emerged that have allowed mosquito control to be more precise. From regular field validation exercises to the implementation of a Sterile Insect Technique (SIT) program, the first of its kind in the U.S. to sterilize mosquitoes with X-rays, the District continues to push ahead to provide the most efficient and effective mosquito control for its residents.

There is more to learn about the Lee County Mosquito Control District at http://lcmcd.org.

COLLEGE OF AGRICULTURAL AND LIFE SCIENCES

WHAT IS A LAND-GRANT INSTITUTION?

A land-grant college or university is an institution designated to receive the benefits of the Morrill Acts of 1862 and 1890. The original mission of these institutions was to teach agriculture, military tactics and the mechanical arts in addition to classical studies so members of the working classes could obtain an education.

Main building of the Florida Agricultural College campus in Lake City, Fla. taken in 1892. (Source: UF)

The Beginning

During the Civil War, President Abraham Lincoln signed the first Morrill Act, establishing the land-grant university system and initiating what could be defined as "The Education Revolution" that thrives to this day. Some of the most highly regarded universities in the nation are land-grant institutions.

The Land-Grant Vision at UF

UF is one of only six universities in the country with colleges of law, medicine, engineering, agriculture and veterinary medicine on one central campus. UF is also one of only 17 universities in the country to share the distinction of land-grant, sea-grant and space-grant status.

The UF/IFAS Tradition

The University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) is a federal-state-county partnership dedicated to developing knowledge in agriculture, human and natural resources, and the life sciences, and enhancing and sustaining the quality of human life by making that information accessible.

The College of Agricultural and Life Sciences (CALS) administers the degree programs of UF/IFAS, preparing students to address the world's critical challenges related to agriculture, food systems, human wellbeing, natural resources and sustainable communities.

McCarty Hall D, current home to IFAS and CALS on the UF campus. (Source: Tyler Jones, UF/IFAS Photo)

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cals.ufl.edu
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Historic UF Moments

1853
The East Florida Seminary in Ocala is created in response to public funds being used to support higher education.

UF traces its founding to this date.

1884
The Florida Agricultural College at Lake City is established under the Morrill Act, becoming the first land-grant institution in the state.

In 1903, the Florida Legislature changed the school's name to the "University of Florida."

1887
The Hatch Act provides for the establishment of an agricultural experiment station at each of the land-grant colleges.

The Florida Agricultural Experiment Station was established in 1888 as a part of the Florida Agricultural College at Lake City.

1906
The University of Florida in Gainesville opens its doors.

Under the Buckman Act of 1905, Florida consolidated its higher education institutions segregated by race and gender into what are now known as UF, FSU, FAMU and the Florida School for the Deaf and Blind.

1911
The alligator is selected as the University of Florida mascot. The orange and blue colors are believed to be a combination of the colors from the former Lake City and Ocala schools.

1914
The Smith-Lever Act passes, providing federal support for land-grant institutions to offer educational programs for the public through cooperative extension efforts.

Each of Florida's 67 counties is served by a dedicated UF/IFAS Extension office.

1924
The Florida Legislature permits women to enroll during regular semesters at UF for programs unavailable at the Florida State College for Women (now FSU).

*Lassie Goodbread-Black became the first women to enroll at UF in 1925 in the College of Agriculture, now **College of Agricultural and Life Sciences**.*

1944
The G.I. Bill is introduced, providing for the higher education of veterans.

In the 1950s, the university underwent rapid expansion of campus buildings due to the large influx of students.

1958
UF integrates and allows African-American students to enroll.

1985
UF becomes a member of the Association of American Universities, an organization made up of the top 62 public and private research universities.

2001
UF is labeled a "Public Ivy League" and continues to rise in U.S. News & World Report college and university rankings.

Currently, UF is ranked as a Top 10 public university, according to U.S. News & World Report.

TODAY
UF has seized the land-grant opportunity and established itself as the state's flagship university. Those who graduate from the University of Florida enjoy greater opportunities than their peers at many other universities.

*UF/IFAS alone has 12 Research and Education Centers in 20 locations throughout Florida, 14 departments, two schools, portions of the College of Veterinary Medicine, the Florida Sea Grant program, international programs, and the **College of Agricultural and Life Sciences**.*

Reprinted from the College of Agricultural and Life Sciences, University of Florida

SPOTLIGHT ON AN EMERGING TECHNOLOGY

BY JASON 'MO' BENNETT

Identifying and monitoring the presence and range of species is important work for managing their spread and effects within natural systems. This has traditionally been accomplished through tracking and surveys[1]. As plants, animals, and microbes go about their lives of feeding, migrating, reproducing, and dying they leave small traces of themselves behind. As cells are shed, they breakdown and release their DNA into the surrounding environment. This free-floating genetic material is referred to as environmental DNA (eDNA) and searching for it in water samples can help detect the presence of target organisms[2]. Due to the current sensitivity and capabilities of the molecular detection methods, eDNA is most useful for identifying and tracking invasive species. This is because when plants, animals, or microbes are introduced into a new environments they are usually genetically different when compared to the native populations. This means their unique genetic markers are more likely to stand out from the background, thus increasing the likelihood of detection provided there are enough individuals present for current testing capabilities[3].

Figure 1: collecting water samples to test for eDNA. Credit: USGS (public domain)

Residents of Florida are no strangers to invasive plants. The growing conditions here are favorable for many introduced species. Northern latitudes have fewer aquatic plant invaders, but are not completely spared. Eurasian watermilfoil (*Myriophyllum spicatum*) can have many of the harmful, system wide effects that are seen in other invasive aquatic plants. With its aggressive growth it can outcompete native species leading to interference of the operation and maintenance of hydroelectric dams as well as recreational ac-

Figure 2: Topped out Eurasian watermilfoil.

tivities such as boating, fishing, and swimming. Northern states could benefit from using eDNA monitoring as a strategy for identifying Eurasian watermilfoil early spread, thus allowing managers to use smaller scale eradication actions[4].

Silver and bighead carp. Credit: USGS (public domain)

Bighead and silver carp, collectively known as Asian carp, were introduced in the Mississippi river basin two decades ago. Since then their steady movement north has been met with much concern and with increasingly innovative actions to try to prevent further spread. Asian carp are large herbivores that have been shown to cause significant changes to ecosystems they invade. They compete with native fish for food, change plant and algae communities, and alter water conditions. They can even harm boaters by jumping when disturbed[5]. Elimination efforts have ranged from physical removal, to sound and bubble barriers, to attempts to disrupt spawning. As eDNA technology has improved it has become an important tool for monitoring carp lifecycle, movements, and spread into new areas[6].

In South Florida one invader gets a lot of attention; Burmese pythons. These animals have been shown to be detrimental to native species from wading birds to alligators. With their choice of habitat and their elusive behavior many traditional methods of detection (search dogs, air surveys, attractant traps) can have low rates of success. Managers use eDNA to search for areas with high concentrations of the snakes to target for removal. They also use eDNA sampling to keep track of potential northern spread of the snakes during periods of warmer temperature[7].

Two Burmese pythons hiding in mangrove trees. Caption: USGS (public domain)

A wastewater sampling device on the UF campus. Credit: UF News

Waste water and sewage contain the waste and fecal remains of the people that live nearby. This includes the COVID-19 virus. By using eDNA sampling labs and equipment, the CDC has developed protocols for local areas to monitor the presence and spread of the virus through the community; allowing for earlier detection outside of the public health testing system[8]. Here at UF, the GatorWATCH program was created to help track the presence of COVID-19 on campus. Wastewater from dorms and fraternity/sorority houses are tested before the water enters the campus treatment infrastructure. This gives campus officials another way to track potential spread of COVID-19 through UF[9].

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Have a great photo from a day out on the water?

An inspiring story to share?

A fun fact or recipe?

We would love to see what you've got. Send your submissions to:

FL-LAKEWATCH@UFL.EDU

Florida LAKEWATCH

CITIZEN SCIENCE SINCE 1986

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Florida LAKEWATCH
Fisheries and Aquatic Sciences
School of Forest Fisheries and Geomatics Sciences
PO Box 110600
Gainesville FL 32611-0600
or call
1-800-LAKEWATCH (800-525-3928),
(352) 392-4817,
E-mail: fl-lakewatch@ufl.edu
Website: http://lakewatch.ifas.ufl.edu/