

# Florida LAKEWATCH



Dedicated to Sharing Information About Water Management and the Florida LAKEWATCH Program Volume 47 (2009)

## THE FLORIDA LAKEWATCH STORY

AND THE FUTURE FOR ENGAGING THE “CITIZEN SCIENTIST” IN ENVIRONMENTAL RESEARCH

All Floridians recognize that severe problems exist with the economy and that our elected officials had to and will have to make hard decisions regarding the allocation of tax revenues. Floridians, as a guiding principal, want their taxes to be used wisely and frugally. Taxpayers also typically urge funding of programs that can do more for less and leverage available dollars to obtain the biggest bang for the buck.

Florida LAKEWATCH has always tried to adhere to these guiding principals because LAKEWATCH began as a grass-root organization. Florida LAKEWATCH was established in 1986 when citizens from Lake Broward and Lake Santa Fe came to my office at the University of Florida seeking help with various water quality issues at their lakes.



A LAKEWATCH volunteer measuring water clarity on Lake Delevoe in Broward County.

Florida LAKEWATCH

information needed for the long-term sustainability of their lakes.

Public interest and involvement in the LAKEWATCH program grew to such a degree that the Florida Legislature in 1991 officially established Florida LAKEWATCH in statute (Chapter 1004.49 F.S.). The Legislature recognized that LAKEWATCH was monitoring more

Help was not available from state agencies because the agencies had limited resources to sample lakes. I became interested because I was working on the chemical and trophic state characteristics of Florida lakes and I needed credible data on as many lakes as possible. Working with trained volunteers became the “*match made in heaven*” to further my applied research objectives while helping the citizens obtain the

waters for less money than other state and local agencies as well as contributing to the education of undergraduate and graduate students who worked with the citizens. Consequently, the Legislature provided an annual appropriation from the Water Quality Assurance Trust Fund, a



fund where polluter fines are deposited, to operate the program.

LAKWATCH has been engaged with “Citizen Scientists” in lake and water quality monitoring for over 20 years. Our volunteers have demonstrated that a cooperative effort between UF’s research community and lake users provides reliable water quality data on a large number of Florida lakes for a fraction of the cost that professional monitoring requires. At the 2009 International Symposium of the North American Lake Management Society (NALMS), water quality experts from all over the world frequently acknowledged that Florida LAKWATCH is one of America’s premier Citizen Scientists programs.

By Florida statute, the primary LAKWATCH goal is to train, supervise, and coordinate volunteers to collect water quality data from Florida's lakes. Today, Florida LAKWATCH has almost 2000 volunteers and currently samples over 600 lakes,

130 near shore coastal sites, 125 river sites and 5 springs. Since LAKWATCH’S inception, water chemistry data have been collected on over 1000 aquatic systems located in or offshore of 50 Florida counties and the volunteer collected data now comprises over 40% of the nutrient data for Florida that is in the USEPA national STORET database. The information is also made available in an easily understandable format to everyone upon request and is used not only throughout Florida, but also worldwide.

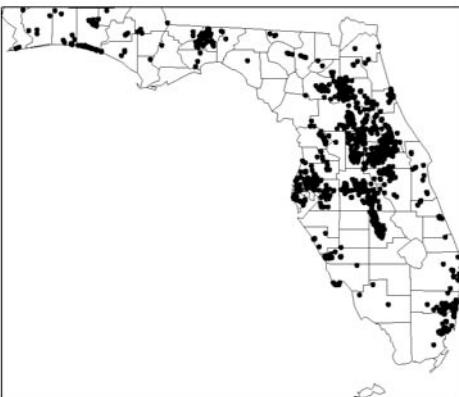
Every volunteer water quality-monitoring program currently in existence has, at one time or another, been challenged by professionals regarding the quality of the collected data. Scientific study after scientific study has shown the data are extremely reliable and USEPA acknowledged that fact in 1990. The data collected by LAKWATCH volunteers has proven to be so reliable that UF researchers have published over

30 peer reviewed scientific publications and three books to expand the limnological knowledge base for Florida. Florida LAKWATCH has also cooperated with scientists from around the world in Spain, Denmark, Canada and others by sharing data for comparative ecological studies. Taxpayer dollars expended in support of LAKWATCH have been leveraged to help establish and maintain a strong state, national, and international research component of the LAKWATCH program.

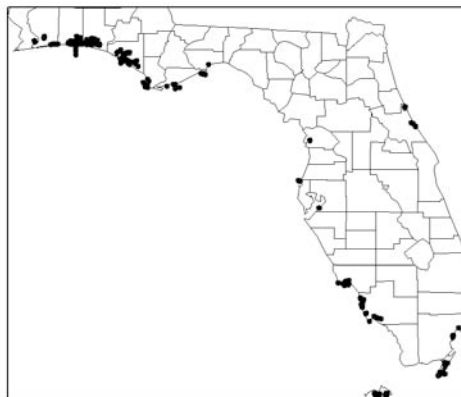
Funding to LAKWATCH has been and is leveraged to support education and work force development. Full-time LAKWATCH staff conduct educational programs for the Citizen Scientists and their neighbors and they work directly with undergraduate and graduate students. LAKWATCH supports graduate research and the students use the Citizen Scientists’ data for theses and dissertations. Many of these students, after graduation, enter the employ of state and local agencies, providing a well-trained Florida work-force for the aquatic sciences.

### **So what about the future?**

The United States National Science Foundation (NSF) issued a report this year from its Advisory Committee for Environmental Research and Education recommending that the scientific community engage the



All LAKWATCH lakes ever sampled.



All LAKWATCH coastal sites ever sampled.

public, the “Citizen Scientist”, in the many different aspects of their work to help find and implement solutions leading to long-term environmental sustainability. The Committee recognized the scientific community faces limitations in its human and equipment resources (i.e., the lack of money) and recommended that the public become involved in data collection and interpretation. The NSF Committee noted that “Citizen Scientists” represent one component of involving the public in science, and in the right situation can provide an incredible opportunity to



Florida LAKEWATCH

A LAKEWATCH volunteer collects a water sample on a lake in Santa Rosa County.



A LAKEWATCH volunteer filtering their chlorophyll sample.

complement by extension in space and time a more rigorous but limited research program. The Advisory Committee for Environmental Research and Education also stated that “Citizen Scientists” provide a means to help bridge the gap between basic and applied research.

Well, it is about time this Nation’s *Intellectual Elite* got the message!

So, every government agency should now be ready to engage “Citizen Scientists” to get the people to join what the NSF Advisory Committee for Environmental Research and Education called the great endeavor of understanding our planet. Besides volunteer monitoring programs are less expensive than professional monitoring programs and permit the sampling of a greater number of aquatic systems.

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## Well, don't hold your breath!

Many professionals do not support volunteer monitoring and often state that such programs are nothing more than “feel good” programs. When pressed as to their problem with volunteer monitoring, the professionals typically focus on the quality assurance/quality control aspects of environmental monitoring. Even the NSF Advisory Committee for Environmental Research and Education, that is advocating for engaging “Citizen Scientists,” states: “There are serious issues of quality assurance and control to consider when data is collected by many different people with various backgrounds of training and motivation.” Again these concerns have been refuted over and over. So is this a real concern or are professionals just fearful of losing “their” monitoring programs and being relegated to fixing the problem(s). What a scary thought!

Bottom-line, well-trained volunteers and laboratory staff following basic research QA/QC protocols with good clean techniques can provide environmental water quality data that are extremely reliable at far less costs. More importantly, it should now be clear to all professionals that the participation of “Citizen Scientists” can help find and implement solutions leading to

long-term environmental sustainability.

But enough about all the technical details! What makes Florida LAKEWATCH so strong is the thousands of volunteers donating their time and talents. The volunteers are the most dedicated and reliable samplers that a water quality-monitoring program could ever hope to recruit. LAKEWATCH volunteers have collected monthly water samples for total phosphorus, total nitrogen, and chlorophyll, as well as measured water clarity by use of a Secchi disc, for at least 15 years for 173 Florida lakes. Some lakes have more than 20 years of continuous measurement, making the Florida LAKEWATCH database ideal for assessing long-term trends in water quality.

Of course, the question that arises is why the volunteers are so committed. The answer may relate to the most common lake name in the world. No, it is not Clear Lake; it is *MY LAKE!*

Volunteers working on *MY LAKE* become great “Citizen Scientists” because they have a vested interest and a thirst to learn. Volunteers observe the

environment. They formulate hypotheses to explain their observations and they seek information from the professional community to determine if they are correct. With their thirst to learn, they read published papers, they attend regional and national lake meetings, they work with political leaders to insure the long-term sustainability of aquatic ecosystems.

The Florida LAKEWATCH story is the model that our elected officials can use for integrating the “Citizen Scientist” into Florida’s water quality programs. The Citizen Scientists can then help with detecting water quality trends in Florida’s waters as well as identifying problems that the professionals can eliminate or manage. Working together a well-formulated management plan for individual waters can be developed, but our elected officials need to be told the story. Today’s Citizen Scientists need to reach out to Florida’s elected officials and urge them to support volunteer monitoring so the water quality of “MY LAKE” will continue to be monitored cost-efficiently and funds can be freed-up to support other wise expenditures of tax dollars!



By Dan Canfield the  
Founder and Director  
of the Florida  
LAKEWATCH program

# Freshwater Turtles

By The Florida Wildlife Conservation Commission

Turtles are ancient shelled reptiles that have existed for 220 million years. Florida has more species of turtles than other states. Of the 26 types of turtle species found in Florida, the vast majority (18) are freshwater turtle species. Besides freshwater turtles, Florida is home to the gopher tortoise, box turtles, and five sea turtle species. Although all turtles are air-breathing reptiles, aquatic turtles can hold their breath for long periods of time. All freshwater turtles lay eggs on land in holes they have dug. When the eggs hatch, the baby turtles (hatchlings) return to water. While most freshwater turtles have hard boney shells, three species known as softshell turtles have fleshy shells adapted for swimming. Turtle shells provide protection from predators. Snapping turtles, such as the Florida snapping turtle and the alligator snapping turtle, can bite with great force and reach large sizes.

[Florida has approved stronger conservation measures for freshwater turtles.](#)

Concerned with increasing popularity of turtles and the potential for over-harvest, the Florida Wildlife Conservation Commission passed an interim rule in September 2008 to protect turtle species. A team of staff has developed a long-term turtle conservation strategy that will propose long term protection measures. New protections were approved by the Commission at



A Barbour's map turtle (*Graptemys barbouri*).

commons.wikimedia.org

the June 2009 Commission meeting.

"This is a legacy vote," said Brian Yablonski, FWC commissioner, as he made the motion to approve the rule. "This decision may be one of Florida's greatest conservation stories."

Twenty-four members of the public addressed the Commission as they prepared to vote on the rule. More than half of the speakers supported the rule.

"This is the right thing to do," said Rodney Barreto, chairman of the FWC. "Florida has become the leader with this vote."

Tim Breault, director of the FWC's Division of Habitat and

Species Conservation, presented the new rule to the Commission.

"Florida has such a rich diversity of turtles," Breault said. "It is fitting we have the most comprehensive set of protections and conservation measures for freshwater turtles in the United States."

"I'm proud of this Commission," Margaret Gunzburger, a Florida resident, told the Commission. "And I'm proud to be a Floridian today."



A Suwannee cooter (*Pseudemys suwanneensis*).

Lake Jackson Ecopassagel

The rule prohibits taking or possessing turtles from the wild that are listed on Florida's imperiled species list. These turtles are listed as imperiled:

**Alligator snapping turtles**  
*(Macrochelys temminckii)*  
**Barbour's map turtles**  
*(Graptemys barbouri)*  
**Suwannee cooters** *(Pseudemys suwanniensis)*

Also prohibited is taking species that look similar to the imperiled species, which include common snapping turtles and cooters.

**Cooters** *(Pseudemys sp.)*  
**Escambia Map Turtle**  
*(Graptemys ernsti)*  
**Snapping turtles**  
*(Chelydra serpentina)*

For all other freshwater turtles, take is limited to one turtle per person per day (midnight to midnight) from the wild for noncommercial use. The transport of more than one turtle per day is prohibited, unless the transporter has a license for sale or exhibition of wildlife, aquaculture certification from the Department of Agriculture and Consumer Services, or documentation that their turtles were legally obtained (proof of purchase).

"To the commercial fishermen who came today, I want to say your voice has been heard," said Commissioner Dwight Stephenson. "But we're charged

with protecting these species, and this new rule is necessary at this time."

Freshwater turtles can only be taken by hand, dip net, minnow seine or baited hook. Most freshwater turtles may be taken year-round. Taking turtles with bucket traps, snares, or shooting with firearms is prohibited. Softshell turtles may not be taken from the wild from May 1 to July 31. In addition, collecting of freshwater turtle eggs is



An alligator snapping turtle at the edge of the lake.

prohibited.

Some turtle farms depend on collection of wild freshwater turtles. With the new rule, certified turtle aquaculture facilities, under a tightly controlled permitting system, will be allowed to collect turtles to establish reproduction in captivity so that farms can become self-sustaining to lessen their dependence on collection of turtles from the wild.

"I believe this industry should be moved to aquaculture. That's the logical place for it to be," Barreto said.

Selling turtles taken from the wild is prohibited. Possession limits for the following turtle species and their eggs are as follows:

**Loggerhead musk turtles - two**  
**Box turtles - two**  
**Escambia map turtles - two**  
**Diamondback terrapins - two**

In addition, no one may buy, sell, or possess for sale alligator snapping turtles, box turtles, Barbour's map turtles, river cooters, loggerhead musk turtles, Escambia River map turtles, diamondback terrapins or parts thereof.

NEWSTEAM

If you had an alligator snapping turtle, Barbour's map turtles, or Suwannee cooters before July 20, 2009, you must apply for a [Class III Personal Pet License](#) to keep your turtles. The license will not be issued for more than one alligator snapping turtle or more than two Barbour's map turtles.

Buying, selling, taking, or possessing [gopher tortoises](#), or parts thereof, is prohibited except by [permit](#) from the FWC executive director.

[Additional regulations](#) apply for sea turtles.

For additional information, see the Wildlife regulation 68A-25.002(9) of the Florida Administrative Code at <https://www.flrules.org/Default.asp>.

# Horseshoe Crab Facts

By Florida Wildlife Conservation Commission



Horseshoe crabs on an east coast beach.

Four species of horseshoe crabs exist today. Only one species, *Limulus polyphemus*, is found in North America along the Atlantic and Gulf coasts from Maine to Mexico. The other three species are found in Southeast Asia. Horseshoe crabs are not true crabs at all; they are more closely related to arachnids (a group that includes spiders and scorpions) than to crustaceans (a group that includes true crabs, lobsters, and shrimp). Horseshoe crabs are often considered “living fossils” because fossils of their ancestors date back over 350 million years—long before the age of the dinosaurs. Furthermore, horseshoe crab body forms have changed very little over all of those years.

The strange anatomy of the horseshoe crab is one of this animal’s most notable aspects.

Unfortunately, the long, thin, spike-like tail of horseshoe crabs has given this species an unfavorable reputation. Many people view horseshoe crabs as dangerous animals because they have sharp tails. In reality, horseshoe crabs are harmless, and their tails are used primarily to flip themselves upright if they are accidentally overturned.

Horseshoe crabs are well known for their large nesting aggregations on beaches, particularly in Mid-Atlantic States such as Delaware, New Jersey, and Maryland. These nesting aggregations are commonly observed in Florida as well. During the nesting season, principally in spring and summer, male horseshoe crabs move parallel to the shoreline on sandy flats and intercept females as they pass by. A successful male attaches

himself to a female by using his specialized front claws, and together they crawl to the beach. Some males do not attach to females, but still have success in fertilizing the female's eggs. The male fertilizes the eggs as the female lays them in a nest in the sand. Males that do not find mates will often swarm mating couples and try to fertilize some of the females’ eggs. Most of this nesting activity takes place during high tides in the three days before and after a new or full moon.

Horseshoe crab larvae emerge from their nests several weeks after the eggs are laid. Juvenile horseshoe crabs resemble adults except that their tails are proportionally smaller. The young and adult horseshoe crabs spend most of their time on the sandy bottoms of intertidal flats and feed on

various invertebrates.

### **Why are horseshoe crabs important?**

Horseshoe crabs are an important part of the ecology of coastal communities. During the nesting season, especially in the Mid-Atlantic States, horseshoe crab eggs become the major food source for migrating birds. Over 50% of the diet of many shorebird species consists of horseshoe crab eggs. Many bird species in Florida have been observed feeding on horseshoe crab eggs. In addition, many fish species rely on horseshoe crab eggs for food.

Horseshoe crabs are currently exploited in three industries: the bait fishery, the marine live fishery, and the biomedical industry. Horseshoe crabs are used extensively as bait in the American eel and whelk fisheries along many parts of the Atlantic coast. The marine life fishery collects live horseshoe crabs for resale as aquarium, research, or educational specimens. Horseshoe crabs are important to the biomedical industry because components of their blood coagulate in the presence of small amounts of bacterial toxins, thereby providing a method to test for bacterial contamination in commercial drugs and medical equipment. Research on the compound eyes of horseshoe crabs has led to a better understanding of the human visual system.



marine-biology.popsugar.com

*Horseshoe crabs enjoying the sunset.*

### **Threats to horseshoe crabs and research efforts**

Horseshoe crab numbers are declining throughout much of the species range. Although scientists are unsure of the exact causes of this decline, it is probably due to a variety of factors, including the degradation of habitat.

In 1998, The Atlantic States Marine Fisheries Commission developed a Horseshoe Crab Fishery Management Plan that requires all Atlantic coastal states to identify horseshoe crab nesting beaches. Currently, with the help of the public, biologists at the Fish and Wildlife Research Institute are trying to document nesting sites of horseshoe crabs

throughout the state. If you are interested in becoming more involved with the horseshoe crab survey, please visit the Survey for Horseshoe Crab Nesting Beaches in Florida for more information.



Poundingtherock.com

*The underside view of a horseshoe crab*



# Volunteer Bulletin Board

## Notice to all Florida LAKEWATCH active samplers

Keep those samples flowing!  
Please be sure to deliver all  
frozen water and chlorophyll  
samples to your collection center  
as soon as possible. This will  
allow us to collect and process  
them in a timely manner.  
Thanks for you help!



## Collection Center News

### Putnam

St. John's River Water  
Management District  
4049 Reid Street  
Palatka, FL 32177

If you are having trouble getting into  
the water lab to drop off your samples  
and pick up new supplies please go to  
the reception desk for the District  
building and ask for Carl Wince or John  
Applewhite and they will be able to get  
you into the lab.

# *Happy Holiday's*

The Florida LAKEWATCH  
Crew would like to extend to  
all of our LAKEWATCH  
friends and family a very  
Happy Holiday Season and a  
prosperous New Year!



# Thank You!

We at LAKEWATCH would like to  
thank all our volunteers and friends who  
have supported us in 2009 in so many  
ways including the collection of samples,  
monetary gifts and contact of legislators  
to encourage funding support of our  
program. We look forward to serving  
you in 2010!

# LAB NOTES

From Florida LAKEWATCH Chemist

Claude Brown



David Watson

Claude Brown, Chemist

## Are You Seeing Color Changes in Your Lake?

Have you ever noticed how the water in some lakes appears to be tea-stained, while in other lakes it can be quite green in color? Ever wonder why?

Much of it has to do with the presence, or lack of, suspended and dissolved organic and inorganic matter in the lake. Most of this material is the result of natural biological, chemical, and physical processes that occur in the lake system and/or surrounding watershed. It's commonly defined in two ways:

**Apparent color** refers to the color of a water sample that has not had particulates filtered out. For instance, runoff from road construction or the use of limerock

near the water's edge may cause lake water's apparent color to be milky or even rusty, if it's in an area where the soil contains red clay. An abundance of phytoplankton (freefloating algae) can give water a greenish tinge and during certain times of the year, large amounts of pollen can even give lake water a yellowish hue.

**True color** is a measurement of the amount of dissolved substances (i.e., humic acids or tannins) that are released into the water from surrounding wetlands or wooded areas. For the purposes of this brief article, we'll concentrate on true color, as it is a measurement commonly used by lake scientists.

To determine a lake's true color, a water sample must first have all the particulates filtered out (i.e., algae, pollen, sediments, etc.). The water sample is then compared to a spectrum of standard colors. Each of the standard colors has been assigned a number on a scale of Platinum-cobalt units (abbreviated as PCU or Pt-Co units). Using the PCU scale, Florida lakes have shown true color values ranging from 0 to as high as 400. On a PCU scale, higher values represent water that is darker in color.

For lakes that are located in lowland marshy areas, rainfall, or the absence of it, seems to have the most noticeable impact on the true color of lake water. As rainwater collects and soaks into the surrounding vegetation, it can cause the runoff to darken to the color of freshly brewed tea.

Depending on the amount of rainfall the amount of color can increase and even appear to be almost black—hence the term for Florida's famous “darkwater” or “blackwater”

lakes. During periods of low rainfall or drought, these same lakes will tend to have very clear water, with little to no true color. (You may have noticed this on your own lake.) However, the minute rain returns, the water begins to darken.

## So why is the ‘true color’ of a lake so important?

A lake's true color can play a significant role in influencing the amount of phytoplankton (i.e., free-floating algae) and/or macrophytes (i.e., aquatic plants) in the system. For example, after periods of heavy rainfall, some darkwater lakes may experience more than simply an increase in true color: When water levels increase, submerged aquatic plants on the bottom may experience a critical reduction in the amount of sunlight that is able to reach them. This can lead to a plant die-off and subsequently result in greener water, as phytoplankton could become more dominant in the lake. Of course, if the lake's true color becomes dark enough, it can also prevent algae from growing and result in water that is darkly stained but “clear.”

True color measurements from LAKEWATCH lakes have also gone a long way to help us to learn more about the influences that a lake's surrounding geology and plant life can have on a lake system.

With your help, LAKEWATCH continues to collect and analyze supplemental water samples for *true color* so that we can learn more about this intriguing phenomenon.

# Outstanding LAKEWATCH Volunteer

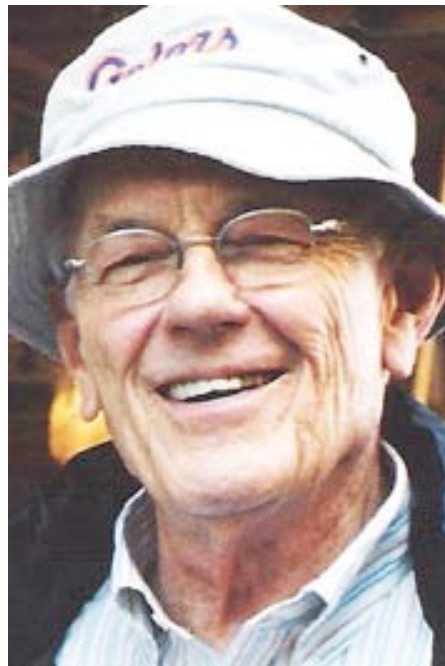
We are sad to acknowledge the passing of Dr. Bill Crass on October 11, 2009. He was a very dedicated Florida LAKEWATCH Volunteer. When Bill was trained to do the LAKEWATCH sampling on Lake Wauberg in Alachua County he was excited to learn more about the lake including its water chemistry and diverse wildlife. He was interested in the entire lake as an ecosystem with special emphasis on the nutrient/food web interactions in Lake Wauberg and how these nutrients provided the basis of the food chain.

Bill was born in Akron, Ohio on November 18, 1934. His family moved to Maryland where he attended high school and received both BS and MS degrees. He earned his PhD from Vanderbilt University in 1965 and continued as an instructor, post-doctoral, and research fellow at the University of Florida's College of Medicine.

Dr. Crass advanced through the academic ranks as a scientist and professor at the University of Nebraska's College of Medicine. He also made important contributions at Texas Tech University's Health Sciences Center/School of Medicine where he was named Professor Emeritus. His research and publications focused on cardiovascular function, parathyroid hormone, aging, and

the role of calcium-regulating hormones.

In 1995, Bill retired and moved to a new home on Lake Wauberg near Micanopy, Florida with Patricia, his wife for 49 years. But he could not just sit idle and watch life go by. For 10 years he continued to teach the Cardiovascular Technology Program at Santa Fe Community College in Gainesville, Florida.



We will miss Bill Crass and will always remember his enthusiasm, commitment, and smiling face.

Bill was also involved in volunteer activities that included sampling Lake Wauberg for the Florida LAKEWATCH Program and the St. John's River Water Management District for 15 years. He also volunteered at the Paynes Prairie State Park Visitors Center and was an active member of the Micanopy Historical Society

where he served as president of the Thrasher Warehouse Preservation Board for many years.

Some of us remember when Dr. Crass worked with a young and upcoming graduate student who was studying the feeding preferences of newly hatched black crappie. They were trying to determine why the black crappie populations in lakes varied so much, with some year classes producing enormous numbers of fish while other year classes were producing relatively much fewer numbers of fish. Of particular interest was their examination of the availability of adequate food resources for the newly hatched baby black crappie. Their work involved many hours of examining the stomach contents of very tiny fish under a microscope, a tedious and grueling task.

Bill was especially interested in the aquatic birds that lived at Lake Wauberg and he had questions about the bird population that used Lake Wauberg. He was curious why there were so many birds of certain species and fewer numbers of other species. To answer these questions, he did bird surveys along with his monthly water sampling for Florida LAKEWATCH and found some interesting trends. Over the years he compiled numerous bird surveys that documented many species and thousands of birds. Many of the most abundant birds were species

Florida



## LAKEWATCH

This newsletter is generated by the Florida LAKEWATCH program, within UF/IFAS. Support for the LAKEWATCH program is provided by the Florida Legislature, grants and donations. For more information about LAKEWATCH, to inquire about volunteer training sessions, or to submit materials for inclusion in this publication, write to:

Florida LAKEWATCH  
Fisheries and Aquatic Sciences  
School of Forest Resources and Conservation  
7922NW71stStreet  
Gainesville,FL 32653

or call

1-800-LAKEWATCH(800-525-3928)  
(352)392-4817

E-mail: [fl-lakewatch@ufl.edu](mailto:fl-lakewatch@ufl.edu)  
<http://lakewatch.ifas.ufl.edu/>

All unsolicited articles, photographs, artwork or other written material must include contributor's name, address and phone number. Opinions expressed are solely those of the individual contributor and do not necessarily reflect the opinion or policy of the Florida LAKEWATCH program.

that depended on fish as the main component of their diets.

Dr. Crass regularly attended the annual LAKEWATCH Meetings and always had interesting questions and observations about his lake. He was also interested in the effects of heavy boat traffic on his lake and the possibility that bottom sediments could be re-suspended by the waves and propeller agitation created by the boats.

Bill was always interested in having someone continue the sampling in the future, when he was no longer able to do it. He wanted young people to share his love of Lake Wauberg and make a commitment to the

continued gathering of data in the future. Maybe someone will be willing to pick up where he left off and continue to learn more about the lake.

Dr. Bill Crass will always be remembered by his many friends and colleagues. He was a cherished son, husband, father, brother, cousin, grandfather, respected scientist, professor, mentor, and above all a good friend. He enriched lives of many people. We will miss him and will always remember his enthusiasm, commitment, and smiling face. Thanks Bill for all you have done for us!