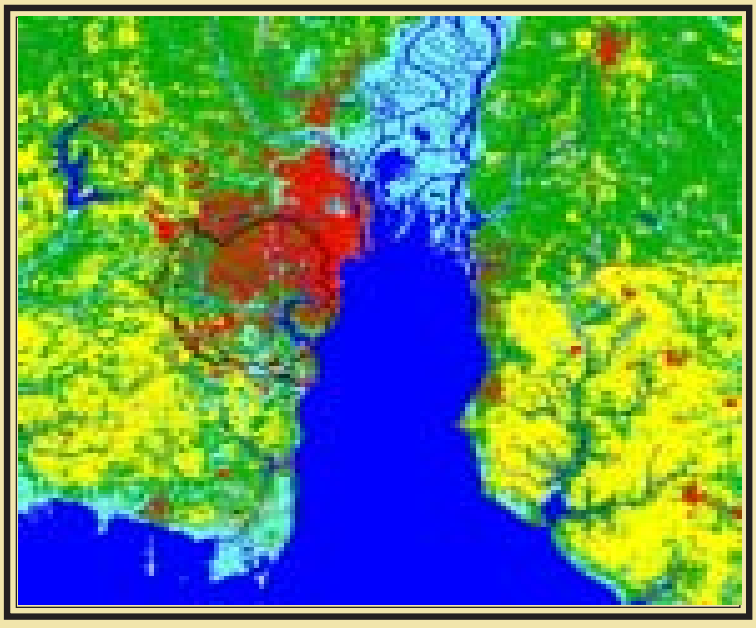
Citizen Volunteer Water Quality Monitoring on Alabama's Coast



...protecting unique estuaries and streams

Dog River

Alabama Water Watch

August 2004

Introduction to the Alabama Water Watch Coastal Series

Alabama's coasts are priceless in terms of the ecological, economic and social benefits they provide. Our vast coastal wetlands serve to naturally filter and purify water, and they provide essential habitat for a tremendous variety of plants and animals. Estuaries are where "the rivers meet the sea," and these brackish water environments are nursery areas for many fishes, shrimp, crabs and other organisms. Alabama's beaches are the source of millions of tourist dollars as people seek the rich recreational, historical and aesthetic qualities of our coast.

The benefits of living near the coast have attracted many new people, and the rapid increase in population and accompanying land use changes have resulted in major challenges for planners and coastal resource managers. Such growth underscores the importance of understanding and protecting our coastal environments before they are irreparably damaged.

Much of the scientific information that is essential for the protection and restoration of Alabama's coast is incomplete or is in technical reports that are not readily accessible to the general public and key decision makers. Since 1994, however, many citizen groups have been voluntarily collecting coastal water quality data as part of the Alabama Water Watch program. Their findings have already begun to provide valuable trend data that have been used to correct local problems and establish a baseline for assessing change. The AWW database has some of the most extensive and consistent water quality information for an increasing number of coastal sites.

The purpose of this report series is to feature AWW coastal groups, describe their activities and concerns, document the importance of their water data and invite you, the reader, to join in community-based action strategies for coastal management and protection.

Current Titles:

Volume 1 Weeks Bay
Volume 2 Wolf Bay
Volume 3 Dog River

Future Titles:

Mobile Bay
...and others!

Striped mullet
Mugil cephalus

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Abbreviations:

AU (Auburn University)
AWW (Alabama Water Watch)
DO (Dissolved Oxygen)
ADEM (Alabama Department of Environmental Management)
AUMERC (Auburn University Marine Extension Research Center)
MAWSS (Mobile Area Water and Sewer Systems)
DRCR (Dog River Clearwater Revival)
EPA (Environmental Protection Agency)
USA (University of South Alabama)
DRWP (Dog River Watershed Project)

Cover Images: Top-left: Volunteers participate in the Dog River Coastal Cleanup. Top-right: Typical scene on Dog River's waterfront. Bottom-left: 1992 land use map of the Dog River watershed and Mobile Bay; Bottom-right: American alligator, *Alligator mississippiensis.*

Dog River...Facts and Figures

- The Dog River watershed is located on the northwest side of Mobile Bay and covers about 95 square miles (note: a watershed is the total land area that drains to a common point such as a river or bay).

The Mobile River watershed in Alabama with the Dog River watershed circled.

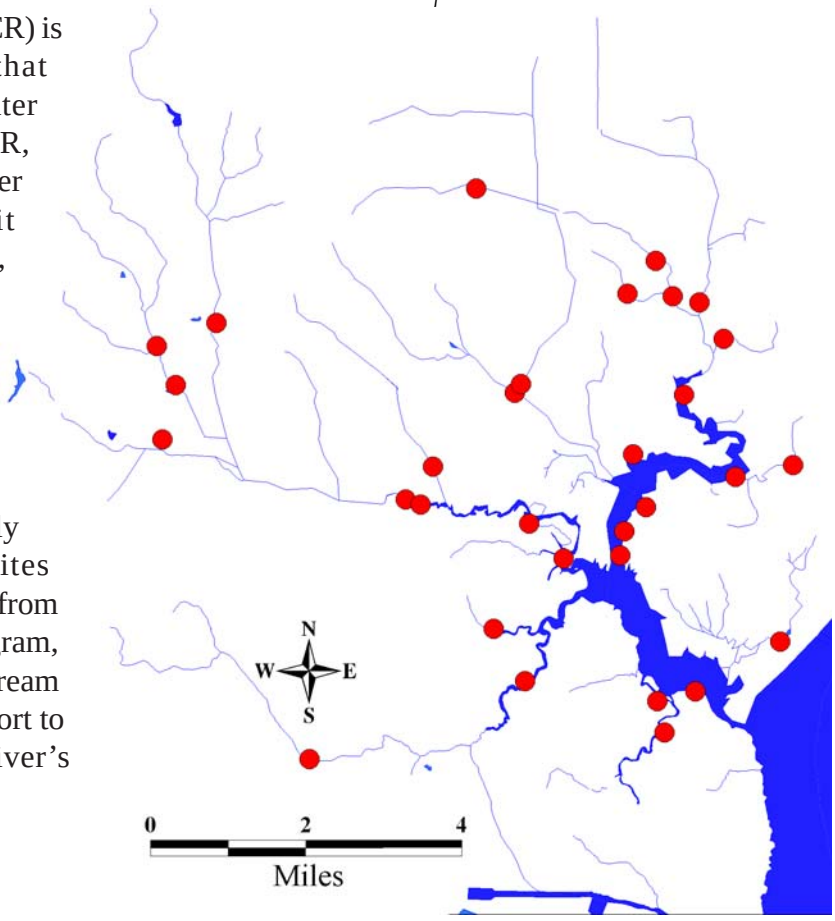
Watershed signs sponsored by Dog River Watershed Project

- About 60% of the watershed is located within the City of Mobile with the remainder in suburban and rural areas of Mobile County. The river and its tributaries drain most of the city and they function as important recreational waterways.

Blue crab
Callinectes sapidus

- Dog River Clearwater Revival (DRCR) is the only grassroots organization that concentrates solely on improving water quality in Mobile's Dog River (DRCR, 2004). The group formed in December 1994 as an incorporated, nonprofit association of property owners, recreational users, commercial interests and other stakeholders concerned with the condition and future development of the watershed.

- DRCR volunteers have strategically located water quality monitoring sites throughout the watershed. With support from the Mobile Bay National Estuary Program, DRCR purchased signs to label major stream crossings within the watershed in an effort to improve public awareness of Dog River's tributaries.



Dog River Clearwater Revival sampling sites (●)

What Do Volunteers Do?

Gaye and Mark Hadley monitoring the DRCR site on Spring Creek

- Citizen volunteers attend one or more Alabama Water Watch (AWW) workshops to become certified monitors of water quality. In the workshops, participants learn simple techniques for measuring chemical, physical and biological characteristics of water, such as dissolved oxygen (DO) and bacterial concentrations (AWW 1998). All monitors attend refresher courses to maintain proper sampling techniques, replenish their test kits and follow EPA-approved quality assurance protocols (Deutsch and Busby, 1999; Deutsch and Estridge, 2004).

- DRCR publishes a quarterly newsletter and coordinates citizen input to public hearings and other policy issues that potentially affect the river. They cooperated with AUMERC's Dog River Watershed Project (DRWP), funded by the Alabama Coastal Zone Management Program, to develop a watershed management plan. DRCR participates in public awareness programs such as the Dog River Watershed Guardian Awards with AUMERC's DRWP. This program encourages enforcement and compliance with environmental regulations. Another partnership between DRCR, AUMERC, and the Mobile Area Water and Sewer System (MAWSS) resulted in the distribution of a brochure about the Dog River watershed to all MAWSS customers.

- DRCR hosts the annual *Dog Paddle* kayak and canoe race. Residents from local communities participate in six different events: Men's One Mile, Women's One Mile, Juniors Half Mile, Parent-Child Half Mile, Novice Third Mile and Open Two Mile. There are "dog biscuit" awards in all categories.

- At the DRCR-sponsored Coastal Cleanup site, volunteers walk the shorelines or use boats to collect trash, old appliances and garbage from the Dog River. DRCR hosts a picnic lunch for those who participate in the event.

In addition to water quality sampling, several of the AWW monitors on Dog River are active in educational outreach and advocacy for greater awareness of coastal issues.

What Have Volunteers Found?

Rob Nygren monitoring one of his sites in the Dog River watershed

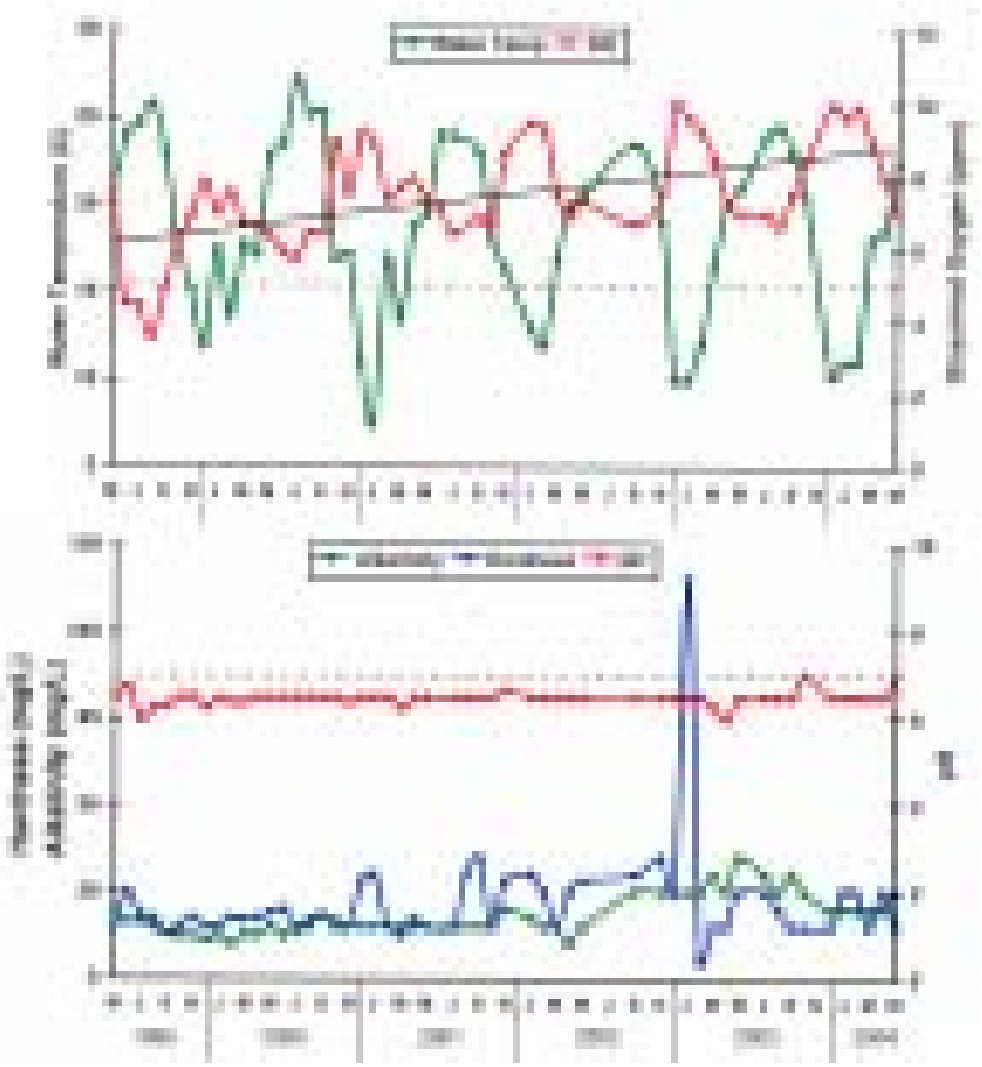
- Consistent monitoring of a particular site yields a valuable record of water quality conditions and trends. DRCR has collected almost 1,300 chemistry records from about 30 sites over the last five years (AWW, 1999-2003). All of this information has been entered into the statewide AWW database and is available to the general public, educators and policy makers via the AWW website.

- The graphs on pages 6-8 document both seasonal and multi-year changes in water quality at three DRCR sampling sites (see map on p. 7). Each data point on a graph represents the average of one to several measurements per month.

- The water temperature of Halls Mill Creek (Site 9) ranged from about 27 C (81 F) in the summer to about 7 C (45 F) in the winter. Dissolved oxygen (DO) concentrations varied inversely with temperature (as expected) and ranged from about 4 parts per million (ppm) in the summer of 1999 to 10 ppm in the winter of 2004. As indicated by the black trend line, the DO at this site seems to be increasing over the last five years and is now well above the minimum Fish and Wildlife standard (5 ppm, gray dashed line) for supporting aquatic life.

- The pH at Site 9 was stable and mildly acidic (slightly below the gray dashed line which indicates a neutral pH of 7), typical of many coastal streams. Alkalinity and hardness were also relatively stable and ranged from 10-40 mg/L, except for a spike in hardness of 120 mg/L in January 2003. The sharp increase in hardness followed a heavy rain and was probably caused by polluted runoff to the stream.

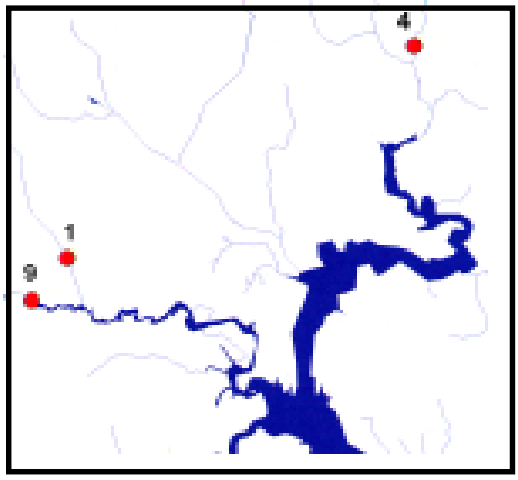
Site 9 (06005009) - Ken MacRae and Rob Nygren
Halls Mill Creek at Halls Mill Road



- The water quality of Eslava Creek (Site 4) was quite different from that of Halls Mill Creek. Eslava Creek had higher water temperatures (14-30 C or 57-86 F).

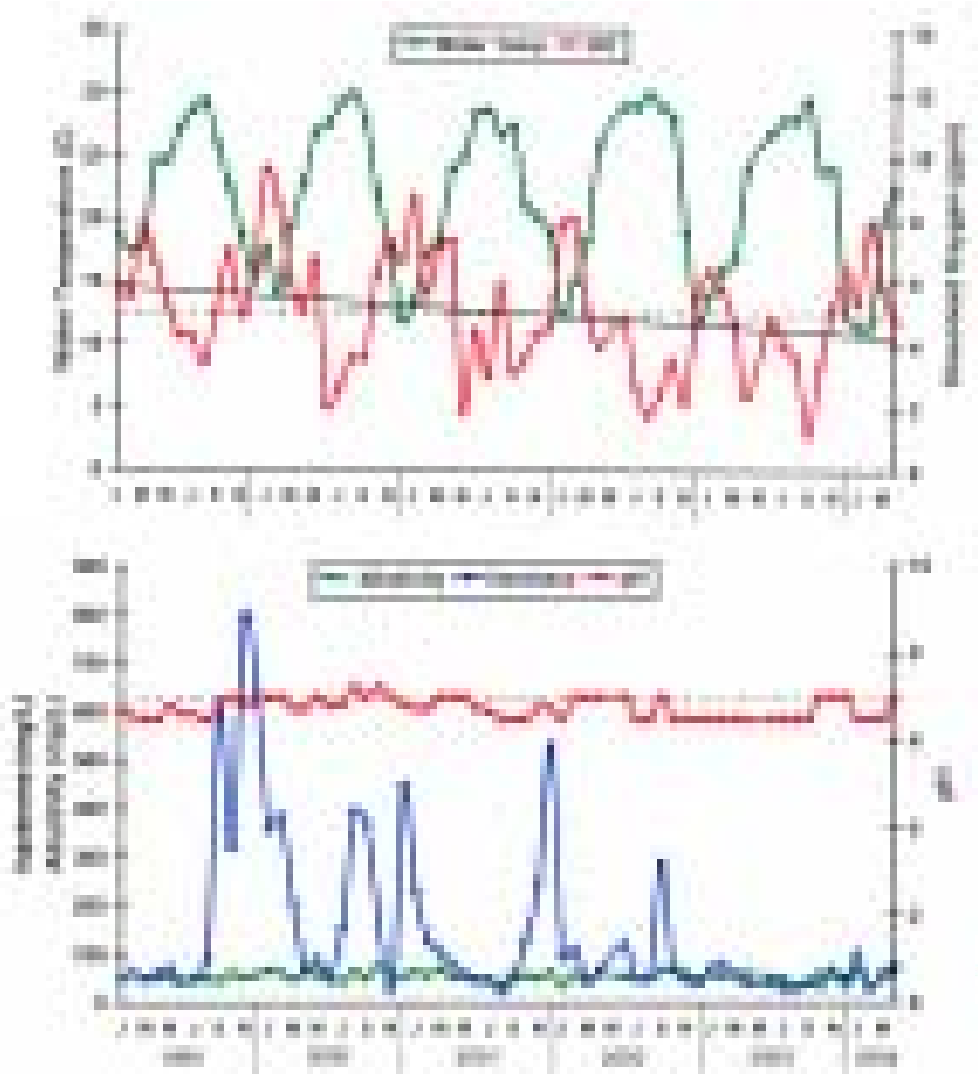
- DO levels (black trend line) in Eslava Creek had the opposite trend of Halls Mill Creek and have steadily declined to values that are detrimental to fish and other aquatic life.

- Because the stream is of a lower quality than its use classification (Fish and Wildlife), it is a candidate for an ADEM and EPA registry of impaired streams called the 303(d) List. Low DOs and higher temperatures are probably because the subwatershed is more urbanized, the headwaters have been diverted, and the stream is often stagnant.



DRCR sites 1, 4 and 9 in the Dog River watershed

Site 4 (06005004) - Mimi Fearn
Eslava Creek at McVay Road

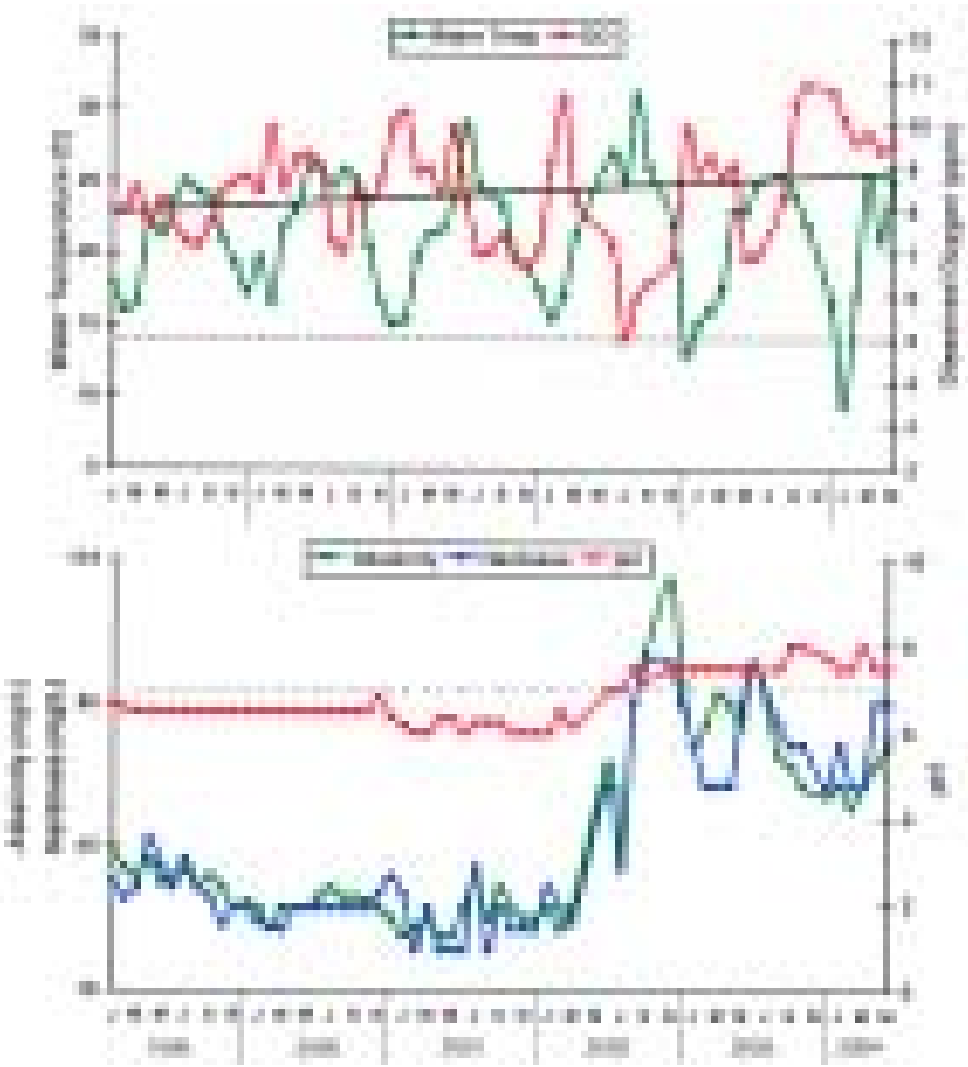


- The pH of Eslava Creek was similar to Halls Mill Creek, mildly acidic. Alkalinity was also generally similar, but hardness values at Site 4 had abrupt peaks with monthly averages that reached 400-800 mg/L. The highest single-date value for hardness at site 4 was about 2,000 mg/L on September 26, 1999! The hardness peaks occurred during dry periods (especially during the drought years of 1999-2001) and were caused by brackish water intrusion (high in calcium and magnesium) from the bay. Alkalinity remained low while hardness peaked because brackish water is not high in carbonates and bicarbonates.

Spotted gar
Lepisosteus oculatus

A channelized section of Spring Creek with streamside vegetation removed

Site 1 (06005001) - Mimi Fearn, Rob Nygren and Gaye Hadley
Spring Creek at Halls Mill Road



- The water temperature of Spring Creek (Site 1) over the last five years seems to have an increasing annual range (higher in summer, lower in winter). This is probably because the streamside vegetation has been removed, exposing the stream to more sunlight and a wider range of air temperatures. The site also has had greater seasonal fluctuations in DO (black trend line) over time that may be related to changes in the streamside cover or flow. However, the DO has remained equal to or above 5 ppm.

- Alkalinity, hardness and pH values at Site 1 were all within expected, natural limits from 1999 through early 2002. Then, the values abruptly increased and alkalinity and hardness more than doubled. This appears to be a result of major channelization of Spring Creek, when natural, riparian vegetation was replaced with extensive limestone riprap. Limestone is calcium carbonate, which increases both alkalinity and hardness of water when it dissolves.

- Overall, the regular monitoring of sites in the Dog River watershed indicated changes over time and location that were the result of both natural (drought, brackish water intrusion) and human-induced (urbanization, clearing of natural vegetation) events.

- Sites 1, 4 and 9 each had unique characteristics, underscoring the importance of testing water quality in several places to gain an overall understanding of a watershed.

Sheephead
Archosargus probatocephalus

A Watershed Overview...

- AWW water monitors act as detectives that "sleuth out" causes and effects of water pollution, stream alterations or other changes that affect a waterbody. By overlaying graphs of DRCR water data on a map of Dog River, it is easier to understand what is happening to water quality throughout the watershed.

- A comparison of average water hardness values (concentration of calcium and magnesium) of four tributary streams and Dog River (a brackish water bay) reveals major differences within the watershed. Graphs are based on 940 hardness measurements at 12 DRCR sites (Sites 4 and 18 on Eslava Creek; Sites 2 and 3 on Moore Creek; Sites 1, 9 and 10 on Halls Mill Creek; Site 17 on Rabbit Creek; and Sites 6, 19, 20 and 27 on Dog River), collected from 1999 to 2004.

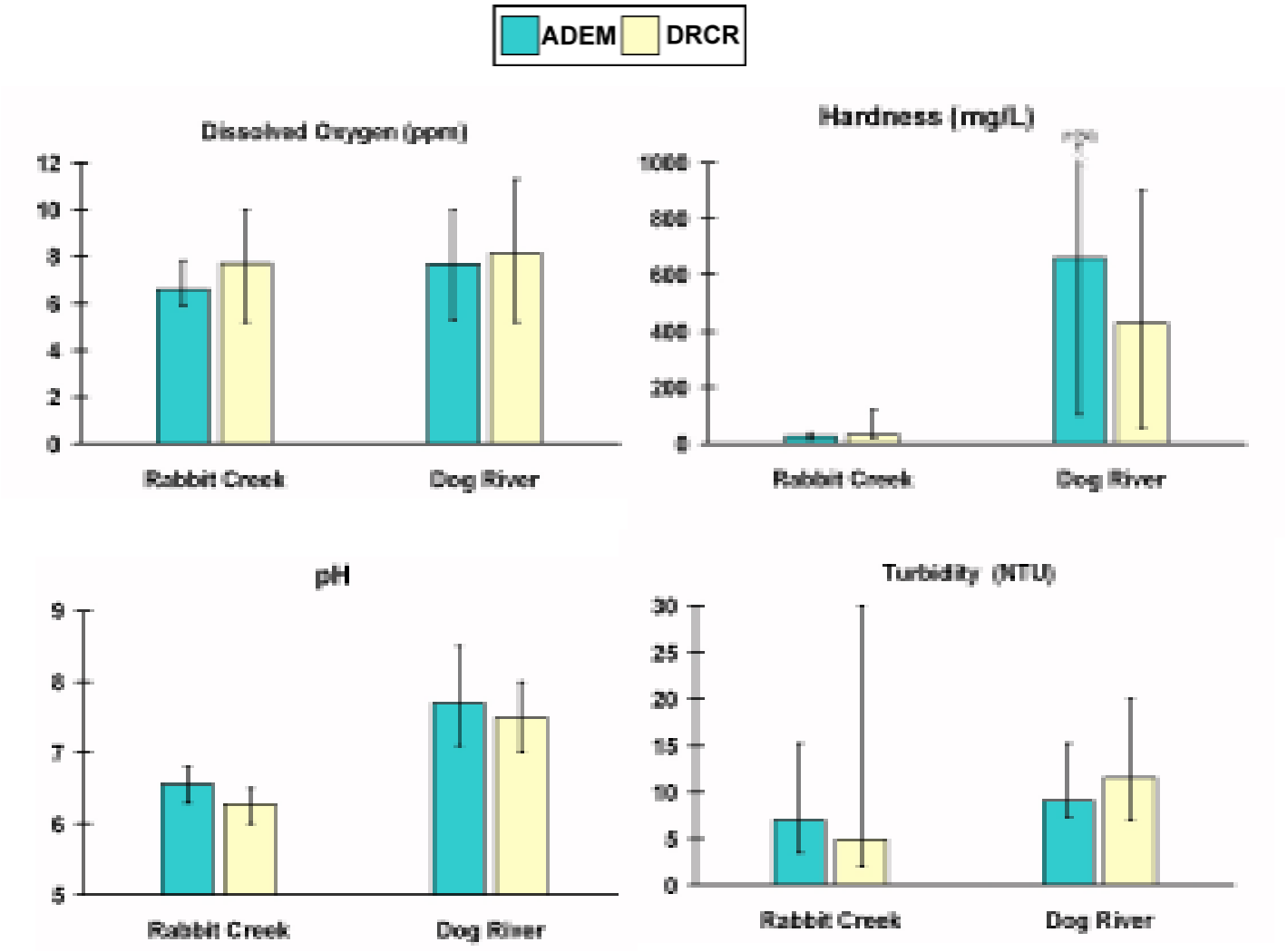
- Three of the tributary streams, Moore, Halls Mill and Rabbit creeks, had average hardness values of 28-43 mg/L, typical of "soft" waters of coastal areas. Dog River had a hardness that was about 10-times higher than these tributaries because it is tidally influenced and moderately brackish.

- The average hardness of two sites on Eslava Creek was more than 3-times higher than the other three creeks. The construction of Interstate 65 in the 1960s severed the headwaters from Eslava Creek and diverted them into Montlimar Canal. Because the stream is usually stagnant, it is more tidally influenced by high- hardness, brackish water of Dog River.

Bluegill
Lepomis macrochirus

- The physical alterations and polluted runoff that characterize many urban streams have a profound impact on water quality and quantity, and aquatic life. It is a challenge for citizen groups, local governments and other stakeholders to protect and restore streams in these environments.

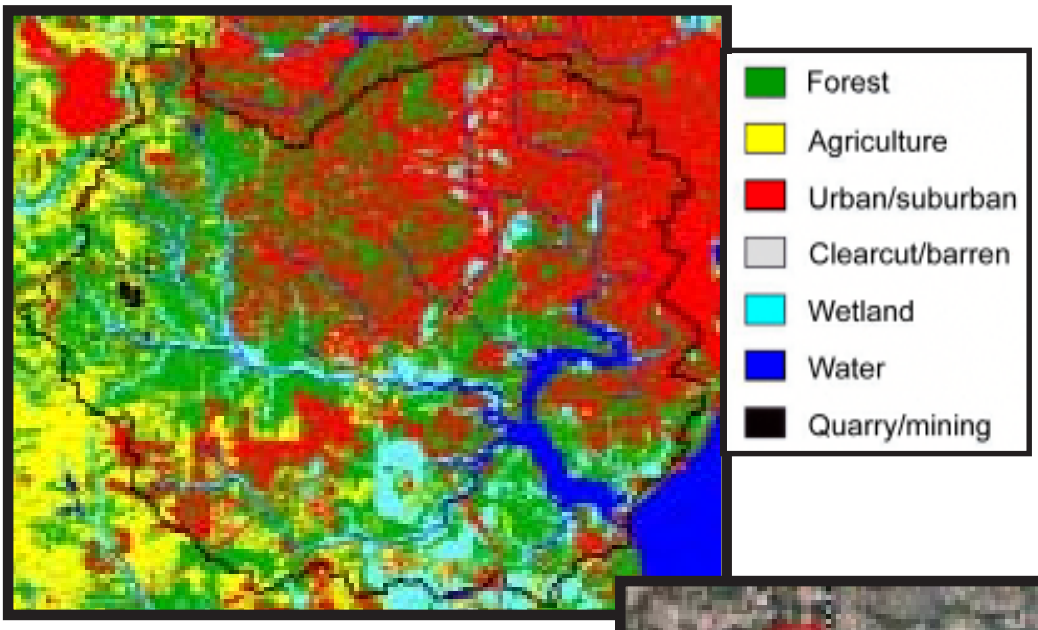
Is the Citizen Information Reliable and Useful?



DRCR Sites 17 (06005017) and 8 (06005008) with ADEM sites RBTM-3 and DGRM-2 (ADEM 2003). Bars represent the average value of a parameter. Lines within bars represent the range of values.

- By comparing DRCR water chemistry data to professional data collected at about the same time and place, the credibility of the citizen data can be evaluated. In the graphs above, 41 records of DRCR from 1999-2003 were compared to 12 data records of the Alabama Department of Environmental Management (ADEM) from 2001.

- The two data sets were generally comparable and revealed water quality differences between Dog River and Rabbit Creek. Average dissolved oxygen, hardness, pH and turbidity were all higher in Dog River than in Rabbit Creek, as documented by both DRCR and ADEM. DRCR had more than 3-times the data records to substantiate these conditions, and they also are the only group collecting data from several other sites in the watershed.



A land use map generated from 1992 Landsat satellite imagery of the Dog River watershed (delineated with black line)

An aerial photograph taken in March 2002 of the Dog River watershed (delineated with red line) and Mobile City limits (delineated with dashed line). The City of Mobile GIS Department used color orthophotos to create this image.

- A comparison of these two watershed images indicates significant land use changes over a 10-year period. The 2002 image (right) shows evidence of increasing urbanization in the western and southern portions of the Dog River watershed.

- Relatively open, forested areas have decreased and developed plots have increased in the upper Halls Mill Creek and Rabbit Creek watersheds. Such development tends to decrease water infiltration and increase runoff that transports sediment, nutrients, pathogens and other pollutants to tributaries of Dog River.

- Given this trend of increased urbanization, it is important to continue monitoring the water quality of the creeks and bayous of the Dog River watershed and to put the DRCR information to use in environmental education, stream restoration and improved policies for protecting the watershed.

A Summary of Key Water Quality Issues

Stakeholder meetings with residents of the Dog River watershed were conducted by DRCR in partnership with AUMERC. A Watershed Management Plan was written to help address key issues. The Executive Summary of the plan is posted on the Internet (AUMERC 2000).), and the full plan is available through the Alabama Department of Conservation and Natural Resources Coastal Programs.

Commercial construction site in the Dog River watershed with minimal soil erosion control

AUMERC staff help USA students experience Dog River as an amenity for all Mobilians

Watershed Development

- How can stream banks and shorelines be preserved with buffer zones of natural and planted vegetation to protect habitat and water quality?
- How can comprehensive planning for urban development expand natural areas, greenways and other features to conserve and restore the watershed?

A sediment curtain on Moore Creek catches more litter than silt

Stakeholder Action

- How can Best Management Practices (BMPs) be improved for building and road construction, waste disposal and other land management activities?
- How can existing environmental regulations be enforced?
- How can concerned citizens effectively educate and persuade the public to take ownership of the watershed?

Litter

- How can litter and trash be kept from streams?
- What policies and enforcement are most effective to prevent littering?
- How can “reduce, reuse, recycle” programs be improved to minimize littering?

Stormwater Runoff and Sedimentation

- How can rain gardens, catchment basins, constructed wetlands and other structures be strategically placed throughout the watershed to collect sediment and contaminants in runoff before they enter streams?
- How can sewage overflows, runoff of pet wastes and contamination from faulty septic tanks be minimized to reduce pathogenic bacteria counts in tributaries and the bay?
- How can soil erosion be minimized and soil conservation measures implemented on commercial, residential and government development projects?

Aerial photograph, taken by Gerritt Carver in 1998, showing a sediment plume entering Dog River after heavy rainfall associated with Hurricane Georges.

Changes in an Urban Stream

- This series of photos is of Moore Creek, an urban stream that has undergone extensive alterations.

1999

2000

- The City of Mobile has straightened and armored much of the channel to more efficiently convey stormwater runoff and prevent flooding and erosion.
- These changes protect homes and infrastructure from water damage, but essentially destroy much of the natural stream habitat and its aquatic life.

2000

2004

- As in other urban settings, the question remains: What is the best way to manage growth and economic development while protecting the environment so that adequate amounts of high quality water are available for today and the future?

Why is Volunteer Monitoring Important?

Many watershed residents want to be personally involved with water monitoring and development decisions that determine water quality near their homes or favorite swimming and fishing sites.

Advantages of Local, Citizen-Based Water Monitoring

- large number of sampling sites
- frequent and consistent sampling
- "eyes and ears" for waterbody changes and pollution...early warning system or first alert
- neighbor-to-neighbor persuasion to stop pollution
- local awareness and public outreach
- fast response time to detect and measure polluted runoff, invasive aquatic weeds and other changes
- important data supplement to agency and research studies
- leads to science-based, citizen-involved action plans

Mission Statement:

"Dog River Clearwater Revival's mission is to improve water quality in Dog River and its tributaries by raising public awareness throughout the watershed, by educating Mobilians about water quality, by administering a water quality monitoring program, and by encouraging enforcement of environmental regulations."

Members of the Dog River Clearwater Revival Board of Directors

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Sailboats at the mouth of Dog River

Alabama Water Watch

Alabama Water Watch is a citizen volunteer water quality monitoring program based at Auburn University that provides training, data management, information exchange and other means of support for the public to become personally involved in water issues. The Alabama Water Watch Association is a nonprofit affiliation of water monitoring groups and other interested citizens, that promotes the AWW Program as well as advocates better water quality and water policy in Alabama.

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