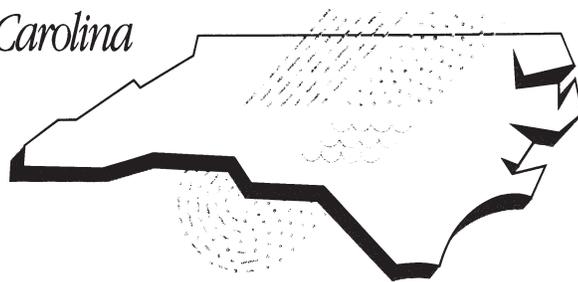


Water Resources Research Institute News

of The University of North Carolina



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Drought threatens mountains and Piedmont

On Oct 29, the North Carolina Drought Monitoring Council issued a warning that if below-average rainfall continues, as forecast, through the spring of 1999, the result could be a drought equaling or exceeding the drought of record at Piedmont water supply reservoirs B. Everett Jordan, Falls, and John H. Kerr.

The N.C. Drought Monitoring Council (DMC) is a group of federal and state agencies, chaired by the N.C. Division of Water Resources, that is responsible for monitoring emerging drought conditions and activating the state's drought response plan if conditions warrant.

The DMC's Oct 29 bulletin also said that streamflows in the mountains are approaching record low-flows and that 14 public water supply systems in the mountains have enacted water conservation measures to reduce system demand. Seven public water supply systems in the Piedmont, including Greensboro, have also put water conservation measures into effect.

La Niña said to increase risk of drought

Below normal precipitation in North Carolina is being attributed to a current cold phase in sea-surface temperatures across the eastern tropical Pacific—a La Niña. The now infamous El Niño and La Niña are extreme phases of a naturally occurring climate cycle referred to as El Niño/Southern Oscillation (ENSO).

During an El Niño the steady westward blowing trade winds weaken, or even reverse direction, and a large mass of warm water normally located near Australia moves eastward along the equator until it reaches the coast of South America. The displacement of so much warm water affects evaporation, causing the formation of rain clouds and altering the typical atmospheric jet stream patterns around the world. During such an El Niño event, the jet stream over the United States is oriented from west to east over the northern Gulf of Mexico

and northern Florida. El Niño produces winters that are generally mild in the northeast and central United States and wet over the south from Florida to Texas.

During La Niña the easterly trade winds strengthen, and cold ocean upwelling along the equator and the west coast of South America intensifies. Sea-surface temperatures along the equator can fall as much as 7 degrees Fahrenheit below normal. The jet stream over the United States extends from the central Rockies east-northeastward to the

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PLUS ... Digest ... Publications ... Conferences and Workshops ... Websites ... MORE.

PLEASE NOTE: Because of space limitations some material prepared for this issue of the *WRRI News* had to be severely edited or left out. Longer versions of several articles as well as summaries of some legislation can be read on the web version of this issue of the *WRRI News* at <http://www2.ncsu.edu/ncsu/CIL/WRRI/news/314.html>.

Director's Forum

Kenneth H. Reckhow, Director, Water Resources Research Institute

What is meant by "objective, rigorous science"?

Is nitrogen runoff from agriculture responsible for algal blooms, fishkills, and outbreaks of *Pfiesteria piscicida*?

How might additional controls on nitrogen discharges from municipal wastewater treatment plants affect estuarine eutrophication in North Carolina?

What will be the impact of alternative forested buffer rules on nitrogen loading to rivers?

The answer to each of these questions requires scientific analysis and assessment, and this ultimately contributes to decision making. Given the consequences of these decisions on the economy and the environment, scientists have an important responsibility to be rigorous in their analysis and objective in their assessment. What does this mean?

First, objective assessment is to some degree an ideal. Very little, if any, science is truly objective. As scientists, we make choices about hypotheses we choose to test (and choose not to test), we select the metrics for the study, and we draw the conclusions. All of these require judgment. In most cases, these judgments are either non-controversial or accepted practice. When they are not, we have the responsibility to identify biases, reveal judgments, and discuss the basis for conclusions.

To define the basis for conclusions from studies, we must consider the rigor in scientific analysis. Many of the top scientists in North Carolina are truly experts in their fields and have international reputations. To achieve this stature requires significant contributions to the science, and to make those contributions, scientists use the latest technology or methods of analysis in their respective fields.

For example, recent proposals to WRR I addressing water quality issues properly emphasize the latest thinking on appropriate analytical methods. From

sample preservation, to nutrient analysis, denitrification, sediment oxygen demand, community composition characterization, and other analytic issues, researchers discuss the latest literature, equipment, and techniques. All of this assures the scientific community (and, indirectly, the public) that the best science is involved in the study. This is as it should be.

Yet all of these studies produce data, and it is the analysis of those data that ultimately leads to inference and conclusions. Should there not be corresponding rigor for the statistical analysis? Would we attach the same weight to water chemistry data if they were based on state-of-the-art laboratory analysis as we would to water chemistry data obtained from a portable kit and

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colorimeter? Of course not. Then why should we not expect that state-of-the-art statistical methods have been examined and selected in consideration of the underlying data generation methods, sampling approaches, and study objectives, with the same thoughtfulness and rigor demanded in the choice of laboratory techniques?

Consider a research proposal that contains a detailed description of state-of-the-art laboratory and field techniques intended to yield a wealth of interesting data but largely dismisses the statistical analysis by simply indicating that stepwise regression will be performed. Aside from the need to consider the implications on statistical inference from stepwise choice of a model, this proposal severely shortchanges the important choices for methods of statistical (as opposed to chemical) analysis.

Likewise, consider the final scientific report of an important water quality investigation on, for example, nutrient/phytoplankton relations. In this report, a wealth of data is graphically presented, scientific inferences are drawn, but no statistical analysis is performed linking data to conclusions. The result is a scientific study that poses interesting hypotheses, summarizes a strong monitoring and experimental program, yet lacks a rigorous scientific analysis from data to conclusions. Can we depend on the conclusions from this study to serve as a basis for policy recommendations?

When scientific studies have the potential to influence major decisions, all methods employed should be rigorous and state-of-the-art. The consequences of bad decisions based on poor science should force that degree of meticulousness on us. For WRRR supported research, we owe nothing less to ourselves, our colleagues, and to the public who provide the funds and depend on our scientific objectivity and rigor in the development of sound environmental policy.

Drought *continued*

eastern Great Lakes, making severe weather more likely further north and west than during an El Niño.

In many locations, La Niña produces the opposite climate variations from El Niño. During a La Niña year, winter temperatures are warmer than normal in the Southeast and cooler than normal in the Northwest. La Niña often features drier than normal conditions in the Southwest in late summer through the subsequent winter, in the Central Plains in the fall, and in the Southeast in the winter.

According to the Southeast Regional Climate Center (SERCC), oceanographic conditions in the Equatorial Pacific Ocean that drive the two extremes of the El Niño-Southern Oscillation (ENSO) process began shifting from the extreme warm phase to the extreme cold phase in May 1998, and atmospheric reaction to La Niña cold water began sometime during that period. SERCC says that it is somewhat unusual to see the two extreme ENSO conditions following back-to-back, but that the swing from the El Niño condition to the La Niña phase is now sufficiently pronounced that the likely climate impacts during the winter of 1998-99 can be extrapolated from historical analogues. The prediction is that drier conditions will persist through spring 1999.

SERCC reviewed the historical precipitation records during La Niña episodes for the Southeast region for the 20th Century. It found that the five previous most "extreme" La Niñas in this century have resulted in winter/spring droughts throughout the region. A worst-case composite for these five episodes shows North Carolina receiving 8 inches of rain in the December through April time period, when precipitation normally equals about 19.35 inches. SERCC says this is a highly unlikely scenario, but that it is "sufficiently concerned about the impacts of this climate outlook for our rain-fed agricultural sector, forestry, and water storage providers that this climate outlook should be given widespread dissemination to all possible sectors."

SERCC says, "We are currently experiencing a 'moderate' La Niña cold phase. If it deteriorates into a more severe condition during the winter of 1999, planners should be fully aware of the worst case conditions and potential impacts. We urge planners to heed the NOAA Climate Outlook for a La Niña dry period through the Spring of 1999 quite seriously."

The N.C. Drought Monitoring Council recommends that all communities closely monitor and assess their current water supply and their ability to meet demand with below normal amounts of rainfall. Communities should review and update their drought response plans and ordinances for adequacy. In the absence of a drought response plan, the council recommends the following:

- Systems with water supply reservoirs should request voluntary conservation when less than 80% of storage remains and require mandatory conservation when 60% or less remains.
- Systems with run-of-river intakes should require mandatory conservation when demand exceeds 50% of the estimated streamflow above their intakes.
- Groundwater systems should regularly check water levels and number of hours pumped daily to tell if supply is decreasing. Declines should trigger mandatory water conservation.
- Systems that depend on purchased supplies should coordinate closely with suppliers.

Community planners should stay abreast of drought conditions in North Carolina and recommendations for handling water supply systems during drought by checking bulletins posted on the N.C. Drought Monitoring Council website at <http://www.dwr.ehnr.state.nc.us/drought/index.htm>, or by calling the N.C. Division of Water Resources at (919) 733-4064.

Development of the current La Niña episode can be monitored through the SERCC web site at http://water.dnr.state.sc.us/climate/sercc/products/la_nina/info.html.

October action of the N.C EMC

Following is action taken by the N.C. Environmental Management Commission at its regular October meeting. The EMC normally does not meet in November, but a November 12 meeting was scheduled to take action on reclassification of the Randleman Reservoir for water supply. That action will be reported in the next issue of the *WRR I News*.

- Adopted amendments to air quality rules incorporating emission guidelines for hospital, medical, and infectious waste incinerators.
- Adopted amendments to ambient air quality standards for ozone and particulate matter, to the transportation conformity rules, and to the indirect heat exchanger rules.
- Adopted amendments to air quality monitoring, recordkeeping, and reporting rules. These proposed amendments generated quite a bit of discussion, with Air Quality Committee Chairman Marion Deerhake attempting to revise the proposed amendments to make monitoring of air toxics (mercury, arsenic, nickel, dioxins) by electric utilities mandatory. The rules that were adopted make monitoring of air toxics by electric utilities discretionary (at discretion of the Director of the Division of Air Quality). Referring to a recent EPA report, Deerhake said that she wants "to raise awareness of hazardous pollutants in connection with utilities." She said, "These issues will be coming before us in the next few years." (The report Deerhake referred to is *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress*, which is available on the EPA web site at <http://www.epa.gov/airlinks/>.)
- Adopted amendments to Air Quality Title V permitting procedures and requirements.
- Approved revisions to the WS-IV water supply classification for the City of Morganton (Catawba River), Town of Wilkesboro (Yadkin River) and City of Winston-Salem (Yadkin River).
- Approved reclassification of Harris Lake and Mayo Reservoirs (Carolina Power & Light Company reservoirs) to Water Supply-V and of Hyco Lake (CP&L reservoir) to Water Supply V and B. CP&L is already using these reservoirs to supply drinking water to employees in the power plants. This after-the-fact reclassification of water supply sources raised questions from some commissioners about the coordination between the Commission for Health Services (CHS), which approves water sources for drinking water supply, and the EMC, which reclassifies water supply sources for purposes of implementing watershed protection measures. Division of Water Quality Director Preston Howard told the EMC that there is no legal requirement that water supply sources be reclassified by the EMC before they can be approved for use for drinking water by the CHS. However, according to N.C. Public Water Supply officials, their rules (15A NCAC 18C.0202) have required since 1977 that water bodies must be classified by the EMC for water supply before they can be approved for public water supply by CHS.
- Approved reclassification of Armstrong Creek in McDowell County (Catawba River Basin) to High Quality Waters. The waterbody had been classified for water supply.

- Approved application of appropriate critical area and protected area boundaries for Lookout Shoals Lake and its tributaries to accommodate a new water supply intake for the City of Statesville. (Part of the lake lies within the watershed boundaries of Lake Norman and was already classified for water supply. This action will change boundaries.)

- Approved a major variance for the City of Belmont from the Water Supply Watershed Protection rules' stream buffer requirements.

- Approved a variance from the Neuse River Nutrient Sensitive Water Management Strategy Riparian Area Protection and Maintenance Rule for a 25-acre recreation project south of Roxboro on U.S. 501 in a 100-acre watershed that eventually drains to Lake Michie.

- Adopted a resolution supporting the Clean Water Bond referendum.

EMC Committee issues

At their meetings on Oct 7, EMC standing committees discussed a number of items including the following.

- **Form for requesting a variance from Neuse buffer rules.** The Water Quality Committee reviewed a draft form for requests for variances from the Neuse River Riparian Area rule. Some commissioners expect that requests for variances will be numerous and have not been satisfied with the level of engineering detail in previous requests. They had asked for a mechanism to make sure future requests contain sufficient information for analysis of equal protection, and staff had drafted a request form. There was discussion about an item on the form which requested an estimate of nutrient removal by stormwater BMPs. Some commissioners expressed concern about whether such information is available. Water

Quality Section Chief Coleen Sullins said that the section is working on a review of pollutant removal efficiencies of various BMPs and treatments so that information can be made available in one place for consultants and others who prepare engineering plans.

■ CRC shoreline protection initiative.

The Water Quality Committee also heard a presentation from Bill Crowell of the Division of Coastal Management about the Coastal Resources Commission's (CRC) shoreline protection initiative (see Sept/Oct 1998 *WRR I News* for description). While commissioners praised the CRC initiative, some expressed concern about possible overlap with EMC rules and resulting confusion among the regulated communities. Commissioner Douglas Boykin wondered if there is a corresponding effort to review "arbitrary" boundaries and definitions in existing regulatory packages worked out between the Division of Marine Fisheries and the CRC.

■ Groundwater monitoring at animal operations.

The Groundwater Committee heard a report from Groundwater Section staff on a groundwater monitoring study conducted at animal waste lagoons and sprayfields. According to the Carl Bailey of the staff, the study was designed to characterize animal operations where regular groundwater monitoring is needed. Bailey told the committee that the Department of Environment and Natural Resources intends to begin designating individual animal operations where groundwater monitoring is required by the end of the year. (According to Groundwater Section Chief Arthur Mouberry, the General Assembly recently approved 12 new staff positions for the Groundwater Section to conduct groundwater compliance activities at animal operations and municipal waste land application sites.)

■ Odor control at animal operations.

The Air Quality Committee discussed proposed approaches to controlling odors from animal operations. The General Assembly has required the EMC to adopt odor controls for animal waste systems. Division of Air Quality (DAQ) staff presented to the committee options for implementing odor controls, and the committee chose an option that would initiate mandatory controls only if a complaint was received and an odor problem subsequently identified. According to Tom Allen with DAQ, under the committee's preferred approach, an operation where DAQ or DWQ identified an odor problem would be required to install best management practices. If the problem persisted, the operation would be required to install more conventional control technology, such as manure incineration.

Digest

New septic tank rules. Legislation passed by the N.C. General Assembly during the 1998 "short session" requires that septic tank systems permitted after Jan 1, 1999, must have an approved effluent filter and at-grade or visibly marked access to each compartment. To implement this law, the N.C. Commission for Health Services (CHS) must put a temporary rule into place by Dec 1, 1998. Proposed temporary rules were distributed by the N.C. On-Site Wastewater Section in September, and a public hearing on the proposed temporary rules was held on October 28, 1998. The CHS was scheduled to take action on the temporary rule and initiate the process to adopt a permanent rule at its November 13, 1998, meeting. These rules affect septic systems permitted after Jan 1, 1999 and systems for which a new septic tank is installed for which an operation permit is issued on or after April 1, 1999. They change the standards and requirements for design, construction, and installation of septic tanks, and they

establish requirements for approval of effluent filters. For a copy of the rules, contact the On-Site Wastewater Section at (919) 733-2895 or email: steve_steinbeck@mail.enr.state.nc.us

Durham stormwater suit. In July the N.C. Supreme Court upheld the City of Durham's authority to impose fees to operate its stormwater program, reversing a decision by the State Court of Appeals. The suit was brought by Smith Chapel Baptist Church, Fellowship Baptist Church, Layman's Chapel Baptist Church and Calvary Baptist Church of Durham. These plaintiffs contested the program established by the City of Durham to comply with the Clean Water Act NPDES stormwater permitting program. The City of Durham adopted an ordinance and created the Durham Stormwater Utility to receive fees, based on the impervious areas of assessed lands, to operate a stormwater program. The plaintiffs alleged that the city did not have the authority to impose fees to operate its stormwater program, that the method by which fees were to be calculated is unlawful, that the rates set by the city were discriminatory, and that a fee for utility service must be commensurate with services rendered while evidence showed there was virtually no benefit to them. With Lake and Orr dissenting, the Justices rejected all the plaintiffs' arguments and remanded the case for entry of a judgment for the defendant. In the slip decision, the court found that it is not discriminatory to set fees based on the amount of pollution caused by a lot and that it is not arbitrary and capricious to require those who cause a stormwater problem to pay for it. The slip decision can be read on the Supreme Court of North Carolina web site. Direct address is <http://www.aoc.state.nc.us/www/public/sc/slip/slip98/250-97-1.htm>

Division of Water Quality policy changes. The N.C. Division of Water Quality, Non-Discharge Branch, has issued public notification of the following proposed policy changes: Effective

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Additional environment-related legislation passed during the 1998 "short session" of the N.C. General Assembly

In addition to legislation listed in the Sept/Oct 1998 *WRR I News*, the following environment-related legislation was passed by the N.C. General Assembly prior to adjournment of the 1998 "short session" on October 29.

HB 577 An act to strengthen the registration requirement for foresters.

HB 661 An act to extend the time for the resolution of claims to land under navigable waters, as recommended by the Environmental Review commission.

HB 900 An act to appropriate funds for federal matching funds for [a number of purposes including] wastewater and water supply matching funds for the Department of Environment and Natural Resources . . . [and] . . . to provide for water resources development projects. Appropriates to N.C. Department of Environment and Natural Resources \$7,432,412 for state match for federal wastewater assistance and water supply assistance and \$11,150,000 for matching for federal water resources civil works projects, channel widening/deepening at the Wilmington Port, and repayment of State cost-share funds for federal funds previously expended for the B. Everett Jordan Lake Water Supply.

HB 1114 An act providing that certain local governments maintain the Swift Creek Management Plan (Wake County) as agreed to by those jurisdictions.

HB 1260 An act to restore the authority of local governments to adopt floodplain management ordinances.

HB 1402 An act to disapprove 15A NCAC 2B.0233 (The Neuse River Nutrient Sensitive Waters Management Strategy) as a permanent rule, to continue 15A NCAC 2B.0233 in effect as a temporary rule, to specify how the temporary rule is to be implemented, to require the Environmental Management Commission (EMC) to adopt rules to provide alternatives to maintaining riparian buffers and to establish compensatory mitigation fees, to establish the Riparian Buffer Restoration Fund, to require the EMC to adopt rules to provide for delegation of the Riparian Buffer Program to units of local government that seek such delegation, to recognize vested development rights, to require the EMC to revise the temporary rule continued in effect by this act and to adopt a revised permanent rule with the assistance of a stakeholder advisory committee, to provide that erosion control plans will be consistent with riparian buffer requirements, to require the EMC to establish a riparian buffer maintenance and restoration goal, to authorize the Department of Environment and Natural Resources to accept donations of real property, to provide for periodic review of the implementation of the Neuse River Nutrient Sensitive Waters Management Strategy and reports to the Environmental Review Commission, and to authorize the EMC to adopt temporary rules to implement Part 1 of this act; to authorize temporary rules governing coastal energy facilities; to provide that Federal Conservation Reserve Enhancement Program or other available funds may be used to pay assisted farmer's share of the cost of certain practices under State's Agriculture Cost Share Program for Nonpoint Source Pollution Control; and to revise reporting requirements.

HB 1480 An act to provide for the registration of swine operation integrators by swine growers, to extend by six months the moratoria on construction or expansion of swine farms and on lagoons and animal waste management systems for swine farms, and to clarify exceptions to the statewide moratorium

HB 1483 An act to expedite the closure of low-risk leaking petroleum underground storage tank cleanups by allowing the cost of obtaining the additional information required to assess the risk of releases reported prior to the effective date of the risk assessment rules to be paid from the commercial fund or the noncommercial fund under certain circumstances, to provide that the cost of connecting third parties to public water systems may be paid from the commercial fund or the noncommercial fund under certain circumstances, to make landowners eligible for reimbursement of cleanup costs from the noncommercial fund under certain circumstances, to authorize the Environmental Management Commission to require that assessment and cleanup tasks and costs be preapproved before work proceeds, to make petroleum commercial underground storage tank operating permits subject to additional federal requirements applicable in 1998, to provide for assignment of payments from the commercial fund and the noncommercial fund, to establish a *de minimus* reporting requirement for petroleum underground storage tank spills and overfills of less than twenty-five gallons that are cleaned up within twenty-four hours, to provide that federal limitations on lender liability apply to the leaking petroleum underground storage tank cleanup program, to provide that rules applicable to commercial underground storage tanks do not apply to certain tanks, and to make related conforming and technical amendments.

SB 1285 An act to exempt the transportation of certain agricultural products from various requirements in conformity with federal regulations and to authorize the Soil and Water Conservation Commission to adopt temporary rules to implement the Conservation Reserve Enhancement Program.

SB 1299 An act to amend the laws regarding the withdrawal and transfer of surface waters and the state water supply plan

SB 1366 1998 State Budget/Tax Relief. Among the provisions of the "budget bill" are the following:

- Transfers \$47.4 million to Clean Water Management Trust Fund Reserve
- Changes the Conservation Easement Tax Credit as in HB 1491
- Allocates \$200,000 to the Institute of Marine Sciences at the University of North Carolina at Chapel Hill to study the potential for sustainable oyster aquaculture of triploid *Crassostrea sikamea* (Kumamoto), triploid *Crassostrea ariakensis* (Suminoe), triploid *Crassostrea gigas* (Pacific), and triploid *Ostrea edulis* (European flat). Research is to include evaluation of oyster growth of each type of oyster in polluted waters and the ability of each type of oyster to purify polluted waters.

- Appropriates \$250,000 to the North Carolina Farmland Preservation Trust Fund, established in G.S. 106-744 and administered by the Commissioner of Agriculture, to be used for a farmland preservation pilot program to purchase agricultural conservation easements pursuant to The Farmland Preservation Enabling Act. Requires report on program by March 1999.
- Appropriates funds to the Department of Agriculture and Consumer Services for the 1998-99 fiscal year for animal waste management equipment grants to farmers of family-owned dairies (fewer than 300 dairy cows in operation prior to Jan 1, 1998) for the purchase of equipment that is a component of an animal waste management system. Provides that funds may not be used to enlarge anaerobic lagoons or for the maintenance of anaerobic lagoons. Provides for guidelines for use of funds.
- Appropriates to the Department of Agriculture and Consumer Services for the 1998-99 fiscal year \$50,000 to provide assistance to farmers who operate small, family farms. Requires report on use of funds by March 1, 1999.
- Provides that funds appropriated to the North Carolina Rural Rehabilitation Corporation within the Department of Agriculture and Consumer Services for the 1998-99 fiscal year shall be used to make loans to farmers of small, family-owned farms having financial difficulty as shown by their inability to obtain affordable conventional loans from other sources. Specifies size of farms eligible and terms of loans.
- Provides that beginning in November 1998, the Marine Fisheries Appeals Panel shall rotate the location of its meetings among its three districts.
- Allocates funds for Grassroots Science Program and appropriates \$200,000 to Department of Environment and Natural Resources (DENR) for environmental education grants.
- Directs DENR to study the feasibility of including that portion of the Cullasaja River that borders Nantahala National Forest in the North Carolina Natural and Scenic River System. Requires report by March 15, 1999.
- Amends state statutes to provide that any water-supply well that is removed from service as a potable water supply source may be used for other purposes, including, but not limited to, irrigation, commercial use, or industrial use.
- Establishes the Beaver Damage Control Advisory Board to develop a statewide program to control beaver damage on private and public lands.
- Provides that the Environmental Management Commission shall establish a schedule of dates between Jan 1, 1998, and Jan 1, 2003, by which existing wastewater treatment plants must comply with nitrogen and/or phosphorous limits in the Clean Water Responsibility Act (HB 515, SL 1977-458 passed in 1997). Provides that the EMC may extend the compliance date required by this provision for facilities where nitrogen is not the nutrient of concern, under specific circumstances. Makes other provisions concerning implementation of nutrient limitations under the Clean Water Responsibility Act.
- Provides that members of the Neuse and Tar-Pamlico Rapid Response Teams assist in routine water monitoring when they are not responding to emergencies or citizen complaints. Mandates evaluation of use of rapid response teams.
- Provides that the Partnership for the Sounds, Inc. shall use a portion of its appropriated funds to expand activities to promote nature-based tourism and environmental stewardship and education in Pamlico county.
- Allocates \$300,000 from the DENR budget to the Upper Neuse River Basin Association to aid in development of a cooperative, comprehensive, and integrated State-local watershed management plan for the Upper Neuse River Basin to serve as a model watershed management approach for river basins and sub-basins in North Carolina.
- Provides for transfer of funds from DENR to UNC Board of Governors for continuation of Neuse ModMon Project by WRRRI.
- Mandates reporting to the legislature by principal investigators on the Neuse and Cape Fear isotope studies, alternative animal waste technology studies, and the Neuse ModMon Project.
- Revises the fee schedule for water quality permits and amends the authority of the Environmental Management Commission to provide for assessment of additional fees for services related to water quality programs. Also make revisions in fees for Air Quality permits. Provides for use of fees.
- Allocates funds from DENR budget for the following water resources development projects: Morehead City Harbor Turning Basin, Wilmington Harbor Maintenance Dredging, Wilmington Harbor Long-term Disposal, Beaufort Harbor Maintenance Dredging, Manteo Shallow Bag Bay Maintenance Dredging, Rollinson Channel Maintenance Dredging, Pine Knolls Shores Protection, Tar River Road Streambank Protection, Battery Island Bird Habitat Restoration, Dare County Beaches Feasibility Study, Deep Creek Watershed Project, North Channel Maintenance Dredging and Disposal Site, Aquatic Plant Control Statewide and in Lake Gaston, B. Everett Jordan Lake Water Supply. Also allocates funds for the following state-local projects: Frisco Ditch Snagging, Moccasin Creek Restoration, Avery Pond Jetties and Dredging, High Rock Lake Dredging Feasibility Study, Northwest Creek Dredging, and other stream restoration projects.
- Provides funds for the detoxification of the Warren County PCB landfill. Sets out standards for residual contaminant concentrations and specifies detoxification technology to be used.
- Provides that New Hanover County may undertake a project to relocate the channel of Mason's Inlet, with the concurrence of the Division of Water Resources of DENR. Provides no State funds can be used for channel realignment.
- Creates the Oregon Inlet Stabilization Study commission to continue investigations related to stabilizing the Oregon Inlet. Provides for an interim or final report to the 1999 session of the General Assembly.

More detailed summaries of some of this legislation and links to the bills on the General Assembly web server are provided on the web version of the WRRRI-News: <http://www2.ncsu.edu/ncsu/CIL/WRRRI/news/314.html>.

National strategy for animal feeding operations would target largest operations and groups of operations contributing to watershed impairment

In September, the U.S. Department of Agriculture (USDA) and the U.S. Environmental Protection Agency (EPA) published a Draft Unified National Strategy for Animal Feeding Operations. The document lays out the agencies' proposed approach to minimizing water quality and public health threats from concentrated animal feeding operations. Joint "listening sessions" on the proposed strategy were being scheduled for cities around the country.

The proposed strategy is based primarily on authority granted EPA under the Clean Water Act to regulate "concentrated animal feeding operations" as point sources of pollution through the National Pollutant Discharge Elimination System (NPDES) permitting program. Permitting and enforcement efforts would focus on "high risk" operations as follows:

- Those that because of size produce quantities of manure that are a risk to water quality and public health whether the facilities are well managed or not. The threshold size for these "concentrated animal feeding operations" (CAFOs) is proposed to be 1,000 animal units.
- Those that have a man-made conveyance that discharge animal waste to waters or have a direct discharge to waters that pass through the facility or come into direct contact with animals.
- Those that individually or as part of a group of facilities have been shown by monitoring to significantly contribute to or be likely to contribute to impairment of a waterbody and nonattainment of a designated use. EPA and USDA would encourage States to use existing watershed assessment processes to determine whether a collection of animal feeding operations—regardless of size—is contributing to watershed impairment and list these watersheds

on their Clean Water Act Section 303 (d) lists.

Permitting approach

To address water quality and public health threats from "high risk" animal feeding operations, USDA and EPA propose to work with states to develop and issue NPDES General Permits in two rounds. In round 1, General Permits would be issued under EPA's existing concentrated animal feeding operations regulations. Statewide General Permits would be developed for operations with more than 1,000 animal units and those with unacceptable conditions. In addition, Watershed General Permits would be developed for facilities of any size in watersheds with aggregate water quality impacts from animal operations. Watershed General Permits would tailor permit requirements to the manure production and wastewater management practices in a given locality and would promote more effective public participation than would a Statewide General Permit. Watershed General Permits would be written to reflect any TMDL developed for the watershed.

Round 1 permits would be issued beginning in the spring of 1999 and would be good for a period of five years.

In round 2, General Permits and individual permits would be reissued at the end of the permit term of round 1 (about 2005) and would incorporate new requirements resulting from revisions to EPA's concentrated animal feeding operations regulations and NPDES permitting regulations. EPA will revise effluent limitation guidelines for poultry and swine by December 2001 and for beef and dairy cattle by December 2002. New effluent guidelines are expected to consider new practices and technologies that can minimize the transfer of pollutants from one medium (such as land or water) to another (such as air)

and that do not involve storage of liquid manure. Round 2 permits would also incorporate requirements of State water quality nutrient criteria, which are to be adopted by 2003.

According to Dennis Ramsey with the N.C. Division of Water Quality, the State's management requirements for animal operations should, with a few changes, be able to meet or exceed requirements proposed by USDA/EPA. The major issue yet to be resolved, according to Ramsey, is the type of permits that should be issued. North Carolina currently implements its regulation of animal waste systems through "non-discharge" individual and General Permits rather than through the NPDES permitting program, as the federal agencies propose. Ramsey said that DWQ is currently working with EPA and hopes to resolve the issue in the near future.

Ramsey also said that the federal agencies' proposal for watershed-based permitting is a strategy to encourage targeting of resources by states that do not currently regulate animal operations. He said that North Carolina's permitting effort is well underway and that the State has committed to completing permitting of animal operations by 2001. Watershed-based permitting is not a strategy currently used for animal operations in North Carolina.

A more detailed version of this article, including USDA/EPA recommendations for research related to animal operations can be read on the WRR I website at <http://www2.ncsu.edu/ncsu/CIL/WRR I/news/314.html>.

Digest continued

Mar 1, 1999, an individual 401 Water Quality Certification will be required for the construction of any intake structures in the Neuse River Basin for purposes of water withdrawal. This activity was formerly allowed under a Section 401 Water Quality General Certification. Written notification to DWQ and public notice are required before any certification is issued. Also effective Mar 1, 1999, DWQ will begin to implement its

existing wetland standards (15A NCAC 2B .0231) with respect to wetland ditching and draining as well as stream dredging. Implementation had been scheduled to start Oct 1, 1998. For additional information, contact Wetland/401 Unit at (919) 733-1786 or Division of Water Quality Regional Offices.

Farmland preservation in Forsythe County.

In September Vice President Al Gore announced that USDA will provide \$17.2 million in matching funds to programs in 19 states to purchase development rights and keep productive farmland in use. Among the local governments receiving farmland preservation funding is Forsythe County, NC. Forsythe—the only county in the state which has a farmland preservation program with offers to farmers pending, as required for the federal match—received \$300,000. The Federal Farmland Protection Program was established in the 1996 Farm Bill and provided \$35 million in funding. According to the Natural Resources Conservation Service, which administers the program, all funds available through the program have now been obligated.

Environmental Finance Center at UNC-Chapel Hill.

The U.S. Environmental Protection Agency has awarded a \$65,000 grant to establish an Environmental Finance Center at the University of North Carolina at Chapel Hill. Environmental Finance Centers provide finance training as well as educational and analytical services designed around the “how to pay” issues of environmental compliance. The new UNC-CH center is one of a network strategically located at major universities throughout the country. It will be jointly administered by the Department of City and Regional Planning (DCRP) and the Institute of Government (IOG). Co-directors are Michael Luger of DCRP and Richard Whisnant of IOG. The UNC-CH Environmental Finance Center will focus on regionalization issues. For additional information, contact Richard Whisnant at (919) 962-9320.

Reports link soil and water quality stewardship to small, diversified farms

Two recent publications assert that continued loss of small, diversified farms could lead to further decline in soil and water quality, as well as a continuing decline in the economic base and social fabric of rural communities.

One of the publications is the U.S. Department of Agriculture (USDA) National Commission on Small Farms' report on its 18-month study. N.C. State Senator Charles W. Albertson is a member of the commission.

The small farms commission report says that in farming systems that mix crop and livestock production—as small farms traditionally have done—the rotation of forage and grain crops enhances soil quality, controls erosion, and cycles nutrients locally by utilizing livestock manure as crop nutrients.

By contrast, large-scale animal operations import feed and produce excess quantities of manure that concentrate nutrients and other materials in soil and water.

The findings of the National Commission on Small Farms are reinforced by a group of studies collected by anthropologists at the University of Iowa into the recently published volume *Pigs, Profits, and Rural Communities*. (Kendall M. Thu and E. Paul Durrenberger, editors. Albany: State University of New York Press. vii + 208 pps., photos, notes, bibliography, index.)

In this volume, University of Northern Iowa assistant professor of biology and agroecology Laura Jackson says that science has not yet produced a broad enough framework for understanding the impacts on water quality of large-scale animal production or for comparing these impacts to those of scattered small-scale facilities.

Says Jackson, “If we decide without due consideration that the environmental problems large-scale livestock systems cause are no more severe than the problems caused by small, dispersed systems, and we are wrong, we will have committed a serious, potentially irreversible error.”

She says it is likely policymakers are committing this error because research continues to “focus narrowly on the specifics of lagoon design and manure management without stepping back to acknowledge the bigger picture.”

*A more detailed review of the report of the National Commission on Small Farms and a review of Pigs, Profits, and Rural Communities by East Carolina Professor David Griffith can be read on the web version of the WRRRI News at <http://www2.ncsu.edu/ncsu/CIL/WRRRI/314.html>. The USDA report, *A Time to Act*, can be downloaded in WordPerfect or PDF format from the USDA web site at <http://www.reeusda.gov/agsys/smallfarm/ncosf.htm>.)*

The City of Wilson seeks candidates for Water Treatment Operations Manager.

Salary range: \$37,300 to \$55,900.

Performs professional and administrative work in the management and operation of the City's Water Treatment Division.

Must have combination of education and experience equivalent to a bachelor's degree in natural or physical science or business administration and 2 years experience in operation of a water facility. Must have certification as a N.C. Grade A Level Water Treatment Operator.

Applications must be received by 5:00 pm Dec 1, 1998, at the City of Wilson Personnel Dept, 112 North Goldsboro St, Wilson, NC 27893 (252/399-2246). For more information check the city's web site at <http://www.wilsonnc.org/jobs.htm>

UNC-Wilmington publishes *Environmental Assessment of the Lower Cape Fear River System, 1997-1998*

The Lower Cape Fear River Program is a science and education program with the mission of developing an understanding of processes which control and influence the Cape Fear River and providing public information and education on the scientific findings. The scientific aspects of the program are carried out by investigators at the University of North Carolina at Wilmington, Center for Marine Science Research. Based on more than three years' worth of consistent sampling, the investigators have recently published an environmental assessment of the lower river, with emphasis on the period June 1997 through May 1998.

Following are some of the principal conclusions of the UNC-W researchers:

- Low dissolved oxygen (DO) continued to remain a problem in the system. Hypoxic conditions (DO <5 ppm) occurred at a number of stream stations throughout the watershed from June through October. Along the river mainstem there was distinct summer oxygen sag which reached its minimum at Horseshoe Bend. Summer DO levels at Station NC 11 (representing water entering the lower basin) were about 5.5 ppm but fell to 3.5 ppm in the sag area. One cause of the sag is BOD loading from industrial point sources, and a second cause is low DO blackwater entering the system from the Black River.

- Fecal coliform bacteria levels remain a periodic problem as levels in the tributary stream stations often exceeded the state recreational contact water standard following rain events. Fecal coliform sampling also indicated that effluent from selected municipal and industrial point sources exceeded standards periodically.

- Generally high levels of turbidity (>25 NTU) were often present at Station NC 11 and nearby stations, indicating a considerable turbidity load coming downstream from the Piedmont area. Turbidity in the estuary was statistically correlated with river flow and with total nitrogen and phosphorus.

- High levels of nitrate enter the system at Station NC 11, probably from agricultural nonpoint source runoff. Phosphate loading to the mainstem is somewhat lower than that of the Neuse and Pamlico Rivers, resulting in generally high inorganic nitrogen-to-phosphorus ratios.

- Chlorophyll *a* concentrations were generally low to moderate in the lower system. However, during low flow conditions dense algal blooms did occur at several tributary stations. For the three-year period 1995-1997, there was a highly significant inverse correlation between chlorophyll *a* and both river flow and Piedmont rainfall.

Data produced by the Lower Cape Fear monitoring efforts are posted at website: <http://smec.uncwil.edu/glaxo/cfrp/index.htm#testing>.

For information on obtaining *Environmental Assessment of the Lower Cape Fear River System, 1997-1998* (CMSR Report No. 98-02) contact Michael A. Mallin, Project Coordinator, at mallinm@uncwil.edu or (910) 256-3721 Ext 275.

1998-99 Water Resources Research Seminar Series

Tuesday, November 17, 1998, 3 pm. 1132 Jordan Hall, NCSU Campus. "Ponds and Wetlands for Water Supply Protection." *Associate Professor Robert Borden, Department of Civil Engineering, North Carolina State University.*

Tuesday, January 19, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Two Approaches to Modeling the Neuse River Estuary: Mechanistic and Network Analysis Models." *Assistant Professor James Bowen, Department of Engineering Technology, University of North Carolina at Charlotte, and Professor Robert Christian, Department of Biology, East Carolina University.*

Tuesday, February 23, 1999, 3 pm. 1132 Jordan Hall, NCSU Campus. "Microbial Impact from Animal Waste." *Professor Mark Sobsey, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.*

Monday, March 22, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Water Quality Trends in the Neuse and Pamlico Basins." *Professor Donald Stanley, Institute of Marine and Coastal Resources, East Carolina University.*

Tuesday, April 20, 1999, 3 pm. 1132 Jordan Hall, NCSU Campus. "Effect of Management Practices on Land Application of Swine Waste." *Assistant Professor Steve Whalen, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.*

Monday, May 24, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Optimizing Buffers to Reduce Pollutants in Runoff." *Associate Professor Richard McLaughlin, Department of Soil Science, North Carolina State University.*

People

Martha E. Cardona is the new Non-point Source Coordinator for the On-Site Wastewater Section of the Division of Environmental Health. Contact her at (919) 715-0141 or Martha_Cardona@deh.enr.state.nc.us.

Beth McGee, who formerly handled nonpoint source issues for the N.C. Division of Water Quality, has left the division and joined the staff of the Clean Water Management Trust Fund.

Nancy White is the NCSU School of Design's first extension professor and program leader. The new faculty position was created by the N.C. Cooperative Extension Service and the School of Design to conduct research and outreach on using land-use planning as a tool for preventing and mitigating water pollution on a watershed basis. Read about her current research projects in the September 1998 issue of *NWQEP Notes* published by the NCSU Water Quality Group. Request the newsletter by calling (919) 515-3723.

Publications

Estimating the Bankfull Event in Small Watersheds of the Southern Appalachian Mountains by Mickey B. Henson, Lloyd W. Swift, Jr., and David VanLear. This paper (as yet unpublished) describes a study undertaken as a graduate project between 1992 and 1993 to characterize the bankfull event on nine gaged streams at the Coweeta Hydrologic Laboratory in Otto, NC. For eight of the nine study watersheds the recurrent probability for bankfull flows on the Annual Maximum Series was found to be 1.03 to 1.26 years. Alternatively on the Partial Duration Series, the recurrence probability was found to be 0.20 to 0.30 years or 3 to 5 times per year. For a copy of the report, contact Mickey Henson at (828) 586-1973 or by email: mbhenson@gte.net.

Nutrient Imports to the Cape Fear and Neuse River Basins in Animal Feeds is a paper presented at the Manure Management Conference in Ames, Iowa, in February 1998 and published on the Conservation Technology Information Center's web site. Written by Lawrence B. Cahoon, Jill A. Mikucki, and Michael A. Mallin of UNC-Wilmington, the paper estimates that at least 87.2% of feed grains and 94.5% of soybeans used as animal feed in the Cape Fear Basin and 60.6% of grains and 73.6% of soybeans used as feed in the Neuse River Basin in 1995 were imported. Feed imported to the Cape Fear Basin represented 92,000 metric tons of nitrogen and 32,000 metric tons of phosphorous. Feed imported to the Neuse Basin represented 24,400 metric tons of nitrogen and 10,400 metric tons of phosphorous. The paper says that essentially all of the nutrients excreted by swine and poultry in the Cape Fear Basin and a large majority of nutrients excreted by animals in the Neuse Basin were imported as opposed to being grown (and potentially providing nutrient uptake) in the basin. Based on feed conversion rates, the paper estimates the amount of nutrient loading attributable to swine operations. You can read the paper at <http://kyw.ctic.purdue.edu/FRM/ManureMGMT/Paper59.html>.

Publications continued page 14

NOTICE OF PUBLIC MEETINGS

The Public Water Supply Section of the N.C. Department of Environment and Natural Resources has scheduled public meetings to present and take comments on its draft Source Water Assessment Program (SWAP). Four public meetings are scheduled:

Dec. 8, 1998, 2:00 p.m.
Asheville - Arboretum, Visitor Educational Center in auditorium

Dec. 9, 1998, 2:00 p.m.
Winston-Salem - Hall of Justice, Rm 701, 200 N. Main Street

Dec. 10, 1998, 1:30 p.m.
Washington - Regional Office Hearing Room, 943 Washington

Dec. 14, 1998, 7:00 p.m.
Raleigh - Archdale Bldg., Hearing Room, 512 N. Salisbury St.

You may obtain a copy of the draft Source Water Assessment Program (SWAP) and be placed on the list to receive future information on the SWAP by contacting Linnette Weaver [Phone (919)715-2633; Fax (919)715-4374].

Technical questions and comments on the document should be addressed to R.W. "Bob" Midgett at: Protection & Enforcement Branch, N.C. Public Water Supply Section, P.O. Box 29536, Raleigh, NC 27626-0536 or by e-mail to robert_midgett@mail.enr.state.nc.us. [Phone (919)715-3224; Fax (919)715-4374]. **Comments will be received until December 31, 1998.**

Background: In 1996, the amendments to the federal Safe Drinking Water Act (SDWA) required states to establish Source Water Assessment Programs (SWAP), and submit a plan to the Environmental Protection Agency (EPA) by February 6, 1999 detailing how they will:

- delineate source water protection areas
- inventory significant contaminants in these areas
- determine the susceptibility of each water supply to contamination for each public water system intake.

North Carolina has convened a Citizen's and Technical Advisory Committee and held three meetings in Raleigh to ensure broad representation and wide public involvement in the development of the SWAP plan. The State received the full ten percent of its Drinking Water State Revolving Fund allotment for development and implementation of a SWAP and has completed an "Intended Use Plan - Phase I: Set-Aside Accounts," that describes the use of the funds for development and implementation the SWAP plan. North Carolina has been progressive in its approach toward source water protection. The State's SWAP will use the work of existing programs and activities to the fullest extent possible to avoid any duplication of effort and ensure the SWAP will integrate into ongoing Department of Environment and Natural Resources (DENR) activities. The SWAP is a non-regulatory program with no new requirements for public water systems.

WRRR reports available

WRRR has recently published peer-reviewed reports on projects for which it provided funding. Single copies of WRRR reports are available free to federal/state water resource agencies, state water resources research institutes, and other water research institutions with which exchange agreements have been made. Single copies of publications are available to North Carolina residents at a cost of \$4 per copy prepaid (\$6 per copy if billed) and to nonresidents at a cost of \$8 per copy prepaid (\$10 per copy if billed). Send requests to WRRR, Box 7912, NCSU, Raleigh, NC 27695-7912 or call (919) 515-2815, or Email: water_resources@ncsu.edu.

Denitrification Dynamics of an Estuarine Headwater Creek Receiving Agricultural Runoff Report 317, July 1998

Suzanne P. Thompson, Hans W. Paerl, and Malia C. Go;
Institute of Marine Sciences, University of North Carolina at Chapel Hill

Nonpoint-source nutrient pollution from agricultural runoff has been identified as a major constituent of watershed nitrogen (N) loading. Denitrification is thought to be a substantial sink for N inputs to estuaries and is believed to account for sizable losses of field-applied N fertilizer in agricultural watersheds.

The goal of the current study was to quantify denitrification in an estuarine creek receiving agricultural runoff, with an emphasis on environmental control of this process.

Denitrification (simulated *in situ* and potential rates), dissolved inorganic nitrogen concentrations (IN) and water column parameters were measured on both seasonal and short-term (runoff event) time scales in Culvert Creek. In addition, nitrification and primary productivity were measured to examine the interaction of these processes with denitrification. Finally, the effectiveness of several water control structures at N removal from surface waters via denitrification was evaluated.

Spatial-temporal patterns of simulated *in situ* denitrification and IN showed an elevated response to runoff of field-applied fertilizer at the farm stations, but denitrification rates were low in middle portions of the creek except during fertilizer runoff in the winter. Statistical correlations indicated that denitrification in Culvert Creek is regulated most directly by inorganic nitrogen, with rates enhanced at the upper transect stations by runoff. At the mid-creek and estuarine stations, regulation appeared to be more complex, as dynamic hydrological conditions affected microbial processing of N through nitrification-denitrification and assimilatory pathways.

Potential denitrification rates ranged to an order of magnitude higher than simulated *in situ* rates and exhibited a wider temporal and spatial distribution. Potential denitrification showed a similar seasonal/spatial pattern to that of nitrification at the most estuarine stations, with lower rates at the mid-creek

stations where nitrification was inhibited during periods of anoxia. The magnitude and timing of denitrification and IN determined during rain events suggests that nitrate (NO_3^-) in runoff was rapidly denitrified in creek headwaters while ammonium (NH_4^+) processing appeared to be limited by nitrification during spring/summer periods of anoxia. Comparisons of denitrification and primary production during rain events indicate that after initial peaks in denitrification, assimilation dominates 1-2 weeks after moderate flow events.

To optimize N removal, management should focus on water controls that enhance denitrification at farm sites. A comparison of IN up- and downstream of flashboard risers indicated that N concentration was reduced in downstream waters following some runoff events, but this pattern was not consistent. Denitrification rates (*in situ*) were highest upstream of flashboard risers in the spring when NO_x concentrations were elevated. Potential denitrification rates did not show a clear pattern in relation to flashboard risers, but rates peaked upstream of risers in the fall, likely in response to deposited organic matter and remineralized N. For most effective N removal, management of flashboard risers should be intensive during spring/summer when cycling of IN in headwater creeks through the nitrification-denitrification pathway is inhibited by anoxia and by competition with primary producers. Comparison of denitrification rates in a vegetated ditch, flashboard risers, and marsh sediments showed the greatest potential for denitrification in the latter. The investigators conclude that wetland buffers are the most effective sites for N removal and should be given management priority.

Annual N removal in Culvert Creek was estimated at 1.27% (*in situ*) or 68.70% (potential rates) of inputs. An estimated 11% of N inputs were removed via the nitrification-denitrification pathway in Culvert Creek assuming that rates were closely coupled. Mean annual (1995-1997) creek denitrification rates of $2.17 \text{ Kg} \cdot \text{ha}^{-1} \cdot \text{yr}^{-1}$ (*in situ*) and $90.52 \text{ Kg} \cdot \text{ha}^{-1} \cdot \text{yr}^{-1}$ (potential) fall in the range of rates measured in various freshwater wetland systems receiving agricultural drainage.

An In Vitro Test for Estrogenicity Combining Cultured Hepatocytes and an Enzyme-linked Immunosorbant Assay (ELISA) Report 318, September 1998

George H. Monteverdi and Richard T. Di Giulio, Nicholas School of the Environment, Duke University

The potential threat of endocrine disrupting compounds in aquatic systems has garnered a great deal of attention from both the scientific community and the public at large. The ubiquitous nature of many of these compounds, and the fact that many of them enter our waterways as components of complex industrial or municipal waste streams, has fostered the desire for effective methods of screening for endocrine effects. One such effect, that of xenobiotic-associated estrogenicity

(xenoestrogenicity) has received particular attention, primarily because of the important role estrogen plays in early life-stage development and reproduction.

The goal of this project was to develop a reliable screening assay that would afford the opportunity to examine the estrogenicity of a wide range of environmentally relevant chemicals and chemical mixtures.

The researchers developed an *in vitro* assay to screen for estrogenic activity of single chemicals or complex mixtures. Their method combines primary hepatocyte cultures from the channel catfish (*Ictalurus punctatus*) with an enzyme-linked immunosorbant assay (ELISA) to detect and quantify the production of vitellogenin (VTG), a liver-derived, estrogen-induced lipoprotein. They tested a variety of environmentally relevant chemicals and chemical mixtures, including the polyaromatic hydrocarbon benzo(a)pyrene (BaP), the alkylphenolic surfactants 4-*tert*-octylphenol (OP) and *p*-nonylphenol (NP), the chlorinated insecticide *o,p'*-DDT, stigmastanol (a plant derivative commonly found in pulp mill effluents), and a number of waste waters from pulp and paper mills. They also examined, the effects of estradiol (E2), the synthetic estrogen diethylstilbestrol (DES) and the antiestrogens trans-1-(4- β -dimethylaminoethoxyphenyl)-1,2-diphenylbut-1-ene (tamoxifen) and 7 α -[9-(4,4,5,5,5-pentafluoropentylsulfinyl)nonyl]estra-3,17 β -diol (ICI-182,780).

The major findings of the studies were as follows:

1. E2, DES, OP, NP, and *o,p'*-DDT all induced detectable levels of vitellogenin synthesis in cultured channel catfish hepatocytes. The relative potencies of the compounds were:
DES > E2 >> OP > *o,p'*-DDT > NP
2. The VTG-induction associated with each of these treatments was significantly ($\geq 60\%$) inhibited by the presence of the antiestrogen tamoxifen. These data indicate that these compounds elicit their effect through the estrogen receptor.
3. Stigmastanol, the polyaromatic hydrocarbon benzo(a)pyrene, a number of waste waters from pulp and paper mills, and the antiestrogens tamoxifen and ICI-182,780 exhibited no, or undetectable, estrogenic activity.
4. Stigmastanol and the pulp mill effluents were also tested for anti-estrogenic activity in cells incubated in media containing both DES and stigmastanol or effluent. Compared to DES alone, none of these treatments caused a significant reduction in the media concentrations of VTG.
5. The detection limit for this assay was typically 15-25 ng VTG/mL medium. Both the results of the screening and the experimental limit-of-detection were in agreement with data published by other researchers for work with other species.

This WRRI-funded work has developed an effective, *in vitro* xenoestrogen screen that utilizes primary hepatocyte cultures from the channel catfish (*Ictalurus punctatus*), an environmentally and commercially important species in North Carolina and the southeastern United States. In addition to its utility for screening individual chemicals, the experimental

design developed here allows for examination of a wide variety of aquatic pollutants, including complex mixtures of chemicals such as those often associated with industrial and municipal waste treatment processes.

CALL FOR PAPERS IN WATER RESOURCES FOR:

1. 1999 Annual North Carolina Water Resources Research Conference—March 25, 1999—N.C. State University McKimmon Center, Raleigh, NC

This conference will highlight all water resources research that is being conducted in North Carolina and provide an opportunity for researchers to meet and discuss their work with others interested in water research. University and other researchers, representatives from local, state and federal agencies, and industrial and agricultural representatives should attend this conference to gain current information on research that is addressing water resource issues. The Plenary session will address the topic "Meeting NC Water Supply Needs" with two invited speakers. Papers addressing current research and North Carolina applications on the following general topics are invited as well as other related subjects: ■ Water Supply Issues ■ Novel Measurement Techniques ■ Environmental Risk Assessment ■ Flood Plain Issues ■ Nutrient Management ■ Environmental Effects of Structural Controls Aquatic Habitat Restoration. **Abstracts are due January 8, 1999.** Space will also be provided for posters. For information on how to submit abstracts for papers or posters, contact Robert Holman at (919) 515-2815.

2. Mountain Water Resources: Understanding and Management—April 27, 1999, Asheville Radisson, Asheville, NC

This conference will highlight water resources research being conducted in the mountain region of North Carolina and provide an opportunity for mountain researchers to meet and discuss issues and their work with others interested in water research. University researchers, government agencies, industrial and agricultural representatives in the mountain region of North Carolina should attend this conference to gain current information on research that is addressing mountain water resource issues. This conference will be different from the March 25, 1999, WRRI Annual Conference and only address mountain issues and research. The Plenary session will specifically focus on water resource issues in the mountain region of North Carolina. There will be several sessions such as: ■ Flow Management ■ Wetlands ■ Aquatic Habitat ■ Water Quality ■ Human Health Issues ■ Riparian Areas ■ Water and Wastewater ■ Groundwater ■ Economic Issues ■ Atmospheric Issues ■ Erosion and Sediment Control ■ Storm Water.

Abstracts for this conference are due Dec 4, 1998. Space will also be provided for a poster session. If you are interested in presenting a paper or poster, contact Robert Holman at (919) 515-2815 for details on requirements for submission of abstracts.

Publications continued

The N.C. Division of Pollution Prevention and Environmental Assistance, the N.C. Division of Water Resources, and the Land-of-Sky Regional Council have published *Water Efficiency Manual for Commercial, Industrial, and Institutional Facilities*. According to the manual, some areas of North Carolina that have experienced growth rates of 20 to 30 percent are facing water supply challenges. Since nonresidential use accounts for about 43 percent of the average daily demand for public water supply systems in the state (as opposed to 38 percent for residential uses), meeting water supply challenges in high-growth areas will require more efficient use by industry, business, and institutions —such as government and universities. This manual is designed to help nonresidential water users to adopt improved technologies and practices that will allow them to deliver equal or better service with less water. The publication is available from the Pollution Prevention Clearinghouse at (800)763-2036.

The latest issue of N.C. Sea Grant's *WaterWise* newsletter describes various urban stormwater structural best management practices, how they work, and how effective they are. *WaterWise* is a free newsletter. Request it by calling (919) 515-2454.

The *National Pollutant Removal Performance Database for Stormwater BMPs—1997* contains summaries of 123 urban BMP pollutant removal monitoring studies. The 190-page report includes a statistical and graphical comparison of removal rates for seven groups of stormwater BMPs: ponds, wetlands, water quality swales, grass channels, filters, infiltration and on-site devices. The report is available for \$25.00 from the Center for Watershed Protection. Call 410-461-8324 or visit the center's website and print an order form: <http://www.pipeline.com/~runoff/>

The N.C. Division of Water Quality has published the final *Broad River Basinwide Water Quality Management Plan* and the final *Yadkin-Pee Dee River Basinwide Water*

Quality Management Plan. Both publications are available upon request. Call Hope Thompson at (919) 733-5083, Ext 360.

The U.S. Geological Survey has recently published *Low-flow characteristics and discharge profiles for selected streams in the Neuse River Basin, North Carolina* (USGS WRI Report 98-4135) and *Lake Hickory, North Carolina: Analysis of ambient conditions and simulation of hydrodynamics, constituent transport, and water-quality characteristics, 1993-94*

(USGS WRI Report 98-4149). For information on obtaining the reports call the USGS N.C. District Office at (919) 571-4000.

The N.C. Division of Water Resources has recently published *Hydrogeologic Framework and Ground Water Resources of the North Albemarle Region, North Carolina*. Report author Jeff Lautier constructed an up-to-date hydrogeologic framework of the area including Camden, Chowan, Currituck, Gates, Pasquotank, Perquimans, eastern Bertie and Hertford counties in North

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North Carolina Precipitation/Water Resources

	September	October
Rainfall (+/- average)		
Asheville	1.62" (-2.25")	1.79" (-1.80")
Charlotte	3.79" (+0.29")	1.38" (-1.98")
Greensboro	2.34" (-1.18")	0.62" (-2.88")
Raleigh	3.55" (+0.36")	2.78" (-0.08")
Wilmington	5.38" (+0.34")	1.36" (-1.33")

Streamflow

Index Station (County, Basin)	September mean flow (CFS) (% of long-term median)	October mean flow (CFS) (% of long-term median)
Valley River at Tomotla (Cherokee, Hiwassee)	42 (49%)	44 (54%)
Oconaluftee River at Birdtown (Swain, Tenn)	123 (52%)	126 (52%)
French Broad River at Asheville (Buncombe, FB)	487 (45%)	768 (54%)
South Fork New near Jefferson (Ashe, New)	153 (61%)	160 (45%)
Elk Creek at Elkville (Wilkes, Yadkin/Pee-Dee)	23 (50%)	27 (44%)
Fisher River near Copeland (Surry, Yadkin/Pee-Dee)	55.3 (54%)	97.5 (80%)
South Yadkin River near Mocksville (Rowan, Yadkin/PD)	82.8 (47%)	96.3 (53%)
Rocky River near Norwood (Stanly, Yadkin/Pee-Dee)	1,543 (533%)	366 (168%)
Deep River near Moncure (Lee, Cape Fear)	271 (72%)	198 (81%)
Black River near Tomahawk (Sampson, Cape Fear)	556 (159%)	83.2 (36%)
Trent River near Trenton (Jones, Neuse)	237 (568%)	14.1 (35%)
Lumber River near Boardman (Robeson, Lumber)	888 (132%)	444 (89%)
Little Fishing Creek near White Oak (Halifax, Pamlico)	23 (62%)	11.5 (35%)
Potocasi Creek near Union (Hertford, Chowan)	26.3 (171%)	25.7 (169%)

Groundwater

Index well (Province)	September depth below surface (ft) (departure from average for month)	October depth below surface (ft) (departure from average for month)
Blantyre (Blue Ridge)	31.89 (-0.19)	33.61 (-0.24)
Mocksville (Piedmont)	16.94 (+0.67)	17.54 (+0.21)
Simpson (Coastal Plain)	4.68 (+1.02)	5.32 (+0.25)

Source: U.S. Geological Survey's *Water Resources Conditions in North Carolina*

**The North Carolina Lake Management Society's
5th Annual Fall Workshop
"Water Quality and Watershed Issues at Lake Rogers"**



**Vance-Granville Community College South Campus
On NC 56, East of I-85, Creedmoor, NC
8:30 am – 3:00 pm, Friday, December 11, 1998 (new date)**

Lake Rogers, in the upper Neuse River Basin, is a fine jewel in the landscape of southern Granville County. The reservoir serves as the drinking water supply for the citizens of nearby Creedmoor. Lake Rogers and nearby Lake Holt are the only water supply reservoirs for this area. Land-use issues and long-term water quality problems have drawn citizens, local environmental organizations, and resource agencies together to learn more about the lake and its watershed. Lake Rogers is threatened in its capacity to store water by sedimentation and in its ability to supply clean water by excess nutrients. Agriculture, development, failing septic systems, and urban runoff threaten water quantity and quality within the region. You are invited to participate in this informational and educational workshop. Upon conclusion of this workshop, your knowledge can serve as a basis for future lake management efforts at Lake Rogers.

Workshop registration fee postmarked on or before December 4, 1998, is \$20. Fee includes registration and lunch. Preregistration is strongly encouraged to ensure a sufficient number of lunches, mid-morning break refreshments, and programs are ordered. After December 4 and on-site, a \$5.00 late fee will be assessed.

Name _____

Address _____

City, State, Zip Code + 4 _____

Daytime Telephone (including area code) _____

E-mail address (if applicable) _____

Please cut along the dotted line and mail this form along with your check (made payable to NCLMS) to: NCLMS, P.O. Box 28348, Raleigh, NC 27611-8348.

For more program information, contact Bryn Tracy at (919) 733-6946 (work) or (919) 779-7575 (home) or bryn_tracy@h2o.enr.state.nc.us or visit website: <http://www2.ncsu.edu/ncsu/CIL/WRRI/nclms.html>

Carolina and some southern counties in Virginia. He concludes that the best option for water-concerned counties in the eastern North Albemarle region is to further develop potable water supply in the Yorktown aquifer. For information on obtaining the report, contact Lautier at (919) 733-4064.

The N.C. Division of Water Resources has published *Hydrogeologic Assessment of the Proposed Deepening of the Wilmington Harbor Shipping Channel, New Hanover and Brunswick Counties, North Carolina*. Results of model simulations described in the study indicate that dredging of the Wilmington Harbor shipping channel will not cause any short-term changes in water levels of the Peedee and Castle Hayne Aquifers. Contact Jeff Lautier at (919) 733-4064 for information on obtaining the report.

Conferences and workshops

The Georgetown University Center for Food & Nutrition Policy will present *Pfiesteria & the Environment: Convergence of Science & Policy* Dec 10-11, 1998, at the Georgetown University Conference Center. For information call (202) 965-6400 or check website <http://www.ceresnet.org/newpage1.htm>. JoAnn Burkholder of NCSU, is keynote speaker.

The Environmental Law Institute will present *Environmental Impact Assessment: National Environmental Policy Act and Related Requirements* Dec 10-11, 1998, at the Madison Hotel in Washington, DC. For information call (215) 243-1630 or check website <http://www.ali-aba.org/aliaba/CD25.HTM>.

The American Association for the Advancement of Science will hold its 1999 Annual Meeting, *Challenges for a New Century*, Jan 21-26, 1999, in Anaheim, CA. For information call (202) 326-6431 or check website <http://www.aaas.org/meetings/scope/>. Presenters from N.C. universities include JoAnn Burkholder, NCSU; Larry Crowder and Orrin Pilkey, Duke University; and Emily DeVoto, UNC-Chapel Hill.

Websites

Volvo Cars of North America has created a website, "**Cars and Their Environmental Impact**," to provide junior high and high school educators information they can use to enhance environmental science lesson plans. Material includes how cars work, how cars impact the environment, how impacts have been reduced by government and car companies, what car owners can do to reduce impacts, and what the future holds. According to the site, 12 million cars were junked in 1996, representing more than 12 million tons of recoverable iron and steel. The URL is <http://www.environment.volvocars.com/>.

The Environmental Defense Fund has developed a website that lets users view data from the **U.S. EPA toxic release inventory (TRI) at the state, regional, county, or city level**. Users can enter a zip code and see a map of their area showing manufacturers and industries that reported TRI data. URL is <http://www.scorecard.org>.

The Neuse River has a homepage.



<http://www2.ncsu.edu/ncsu/CIL/WRRI/neuse.html>

WRRI has initiated a comprehensive web site for information on the Neuse River. Currently the site includes: ■ links to all known Internet sites related to the Neuse, ■ links to research documents (or summaries) related to the Neuse, and ■ links to or information about agencies and groups concerned with Neuse River management.

North Carolina Water Resources Association

NCWRA

North Carolina Section of the American Water Resources Association

Luncheon and Forum Schedule

Feb 22, 1999	New Developments in Erosion and Sediment Control
April 12, 1999	Wetlands Restoration and Related Programs
Sept 13, 1999	Stormwater: NPDES Phase II and Neuse River Rules
Dec 6, 1999	Cape Fear Basin Water Quality Issues

All luncheon/forums take place at 11:30 am at the Jane S. McKimmon Center on the N.C. State University campus. For additional information call Robert Holman at WRRI (919/515-2815).

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