NORTH CAROLINA DIVISION OF WATER QUALITY

ENVIRONMENTAL SCIENCES SECTION

http://h2o.enr.state.nc.us/esb/index.html

This past spring saw the retirement of two long time SWPBA supporters here in the NC Division of Water Quality, past SWPBA Presidents Jimmie Overton (ESS Section Chief) and Patricia (Trish) MacPherson (Biological Assessment Unit Supervisor). Due to budget constraints at the State level, both positions are currently frozen. Jay Sauber (Ecosystems Unit Supervisor) is acting ESS Chief while Eric Fleek and Bryn Tracy are sharing supervisory duties for the Biological Assessment Unit. Both Jimmie and Trish are missed here around the building; however they do drop by from time to time to check on things. Below are summaries submitted by the various Units in ESS as well as from the Wetlands Group.

AQUATIC TOXICOLOGY UNIT

North Carolina's Aquatic Toxicology Unit (ATU) consists of three main areas:

- Compliance and enforcement of toxicity requirements in NPDES permits
- Biological laboratory certification
- Compliance and watershed testing in ATU's toxicity testing lab.

A summary of each ATU area and their recent activities are described below. ATU staff welcomes input from other SWPBA members about toxicity work in their areas, so please contact us with questions, comments, etc. Staff contacts and additional ATU information can be found on our webpage at: http://www.esb.enr.state.nc.us/ATU.html

ATU Compliance and Enforcement
All permitted dischargers of complex wastewater in the state are required to perform self-monitoring of aquatic toxicity of their wastewater. Currently this totals over **558** industrial and municipal facilities. The ATU reviews all toxicity data reported by these facilities to verify data quality, track compliance with established permit limits, and make enforcement recommendations for non-compliant situations.

In 2008, ATU Compliance reviewed and documented over **2251** self-monitoring aquatic toxicity tests. ATU reviewed over **133** permits, verifying all information was correct for bioassay monitoring requirements.

ATU Enforcement sent out **89** Notices of Violation (NOVs) for noncompliance of the Whole Effluent Testing (WET) NPDES requirements. Included in these were **65 NOVs** for limit non-compliance, of which **20** were for NPDES permits that included the copper and zinc action level policy notices. There were **4 NOVs** for non-reporting or late reporting. ATU issued **1** Notices of Deficiency **(NODs)** in lieu of NOVs. NODs rather than NOVs are issued for deficiencies such as reporting WET data on the monthly DMR but then not sending the toxicity test report ATU. There are various other reasons that ATU assesses severity in issuing NODs versus NOVs. There were no warning letters sent for minor monitoring infractions.

ATU Enforcement had **11** civil penalty assessments over the course of 2008 for either late/non-reporting or for limit violations. ATU reviewed over **26** other documents for TRE/TIE progress reports, consent orders, copper and zinc final reports, biocide 101 forms for NPDES permit renewal, and various other toxicity reviews.

Overall facility compliance with self-monitoring limitations established by a facility's NPDES permit averaged **98%.**

ATU Lab Certification:
All toxicity analyses reported by dischargers must, by water quality regulations, be performed by a biological laboratory certified by the State for these tests. The ATU operates this certification program, which includes laboratory inspections, data tracking, and performance evaluation testing (PE testing). PE testing is an annual " blind round robin" testing procedure in which our lab (ATU) prepares an unknown chemical mixture and submits it to all North Carolina certified WET labs. The data is statistically interpreted in order to determine if all certified labs are able to meet the performance parameters.

For the year 2008, ATU certified/recertified **16 labs** for WET testing and Aquatic Population Survey Analysis. One lab was decertified during the year but regained certification after a month. ATU performed **12 laboratory inspections** and reviewed all Standard Operation Procedures for these labs. ATU investigated **1 disagreeing split tests** that are defined as one facility effluent sample that is analyzed from two separate labs.

ATU Lab Section:
The lab section conducts toxicity testing to support the Whole Effluent Toxicity (WET) monitoring program as well as a variety of special studies. Primarily, ATU uses modified EPA methods for measuring acute and chronic toxicity of wastewater and surface waters to freshwater and marine organisms. The principle testing organisms are *Ceriodaphnia dubia* (water fleas), *Pimephales promelas* (fathead minnows), and *Mysidopsis bahia* (mysid shrimp). Additionally, ATU has used a variety of micro-biotests and *Daphnia* feeding inhibition tests to support special studies, such as Total Maximum Daily Load (TMDL) development or watershed toxicity assessments. The micro-biotests are small scale biological tests that provide a variety of sublethal endpoints over a range of ecological functional groups, such as algae, yeast, bacteria, and crustaceans.

Toxicity testing performed in support of the Whole Effluent Toxicity (WET) monitoring program is coordinated with the 7 DWQ Regional Offices. The goal is to monitor 20% of the major permit holders each year. The toxicity testing conducted at the ATU lab is performed in addition to the regular self-monitoring toxicity testing performed by the NPDES permit holders. The ATU testing serves as a quality assurance check for the facilities and the regular contract laboratories.

ATU is currently working with the NCDOT and the USGS on a bridge stormwater runoff project. ATU is providing consultation in the development of a time-variable toxicity testing method for stormwater runoff from bridges.

BIOLOGICAL ASSESSMENT UNIT

http://h2o.enr.state.nc.us/esb/BAU.html

Fieldwork for 2009 began in February with macroinvertebrate swamp stream sampling in the Coastal Plain ecoregion of the State. Afterwards, numerous fish and benthic studies required sampling in the following watersheds: Hiawassee, Little Tennessee, Savannah, Roanoke and Cape Fear. In addition to annual basinwide sampling, other studies that are ongoing include: HQW/ORW stream reclassifications; Trout Reclassifications; RAMS (see Ecosystems Unit below), drought monitoring, Mills River Pesticide study, FERC relicensing studies and Regional Offices requests. All together, the Biological Assessment Unit will collect nearly 300 benthic samples, approximately 100 fish community samples and between 20 and 30 fish tissue sampling locations in 2009.

Benthos

After several years of data collection and analyses, the benthic sampling protocols used in North Carolina are now adapted to assign bioclassifications to small streams in the Mountain and Piedmont regions. Previously, with some exceptions, streams with watershed sizes less than three square miles were not able to be rated with one of the five standard bioclassifications (Excellent, Good, Good-Fair, Fair and Poor). For the new method, please see: http://h2o.enr.state.nc.us/esb/documents/SmallStreamsFinal.pdf

Fish Tissue

The NCDWQ Fish Tissue Contaminant Program monitors approximately 20 to 30 stations across NC and processes roughly 300 fish samples every year. A collaborative state-wide effort is currently underway with North Carolina's wildlife biologists and health officials to fill data gaps in the state mercury database among the most frequently harvested inland fish. DWQ is also assisting with an evaluation of the impact of reduced mercury emissions from the state's major coal-fired power plants on the levels of mercury observed in fish tissue. As emission reductions take place at power plants, annual monitoring of 13 sate-wide water bodies is scheduled to continue over a 10 year period for mercury trend analysis. Results from heavy metals and organic contaminant analysis are routinely forwarded to the NC Department of Health and Human Services for fish consumption risk assessments and support for fish advisories.

Fish Community Assessment

The Oriental Weatherfish in North Carolina

Bryn H. Tracy, NCDWQ and Peter Schneider, City of Greensboro

Another non-indigenous species is reported for the first time from North Carolina. The Oriental Weatherfish, *Misgurnus anguillicaudatus* (Cantor 1842) (Figure 1), was collected at three sites in the upper Haw River system. Two specimens were collected by Jeff Deberardinis and Michelle Simonson, while Victor Holland and Bryn were chasing Crescent Shiners and Spottail Shiners on the other side of the streams, with the North Carolina Division of Water Quality. Another

specimen was collected by staff from the City of Greensboro's Water Resources Department (Peter Schneider, Rebecca Wells, Debbie Shoffner, and Roy Graham) with valuable assistance from Chuck Smith, Guilford College. The specimens were from:

1. Varnals Creek, SR 2116, Alamance County, 124 mm total length (TL), collected April 13, 2009;
2. Haw Creek, SR 2158, Alamance County, 148 mm TL, collected April 13, 2009; and
3. South Buffalo Creek Thurston Avenue, Guilford County, 145 mm TL, collected June 22, 2009 (Figure 2).

Figure 1. The Oriental Weatherfish, *Misgurnus anguillicaudatus* (Cantor 1842). Photo courtesy of Noel M. Burkhead, USGS, Gainesville, FL.

The specimens were found in slackwater pools and along the stream margins associated with silts, sands, and small woody debris. The Varnals and Haw creek sites are within 2.6 miles of one another, but the site on South Buffalo Creek is approximately 50-60 stream miles upstream (Figure 2). Separating the lower two sites from the upper site are four dams (three across the Haw River with two at Swepsonville and one at Altamahaw and a dam across Reddy Fork at Ossipee). It is thus likely that the three specimens represent two, widely separated introductions. However, it is not known if the species is established at any of the sites or is found at other sites within the Haw River system. Future surveying would be necessary to determine if the species is established at these locales and is dispersing into new streams throughout the upper Haw River system. Seven other non-indigenous species were collected from these three sites: Rosefin Shiner, Crescent Shiner, Fathead Minnow, Red Shiner, White Sucker, Green Sunfish, and Redear Sunfish. The specimens will be vouchered at the North Carolina State Museum of Natural Sciences (http://www.naturalsciences.org/research-collections/research-specialties/fishes).

The Oriental Weatherfish, also known as the Dojo, Weather Loach, Japanese Weatherfish, and Amur Weatherfish, is native to eastern Asia. In the Untied States it has been reported across the country from Washington to Florida, from New York to California, and from Illinois to Louisiana. Sources of the illegal introductions range form the aquarium trade, bait fish and aquarium releases, Asian food markets, to biological supply companies supplying specimens for developmental biology and embryology courses. Specimens may grow up to 250 mm TL and feed on benthic invertebrates and detritus. The coldwater species is tolerant of low dissolved oxygen concentrations and can aestivate by burrowing into the mud to withstand droughts.

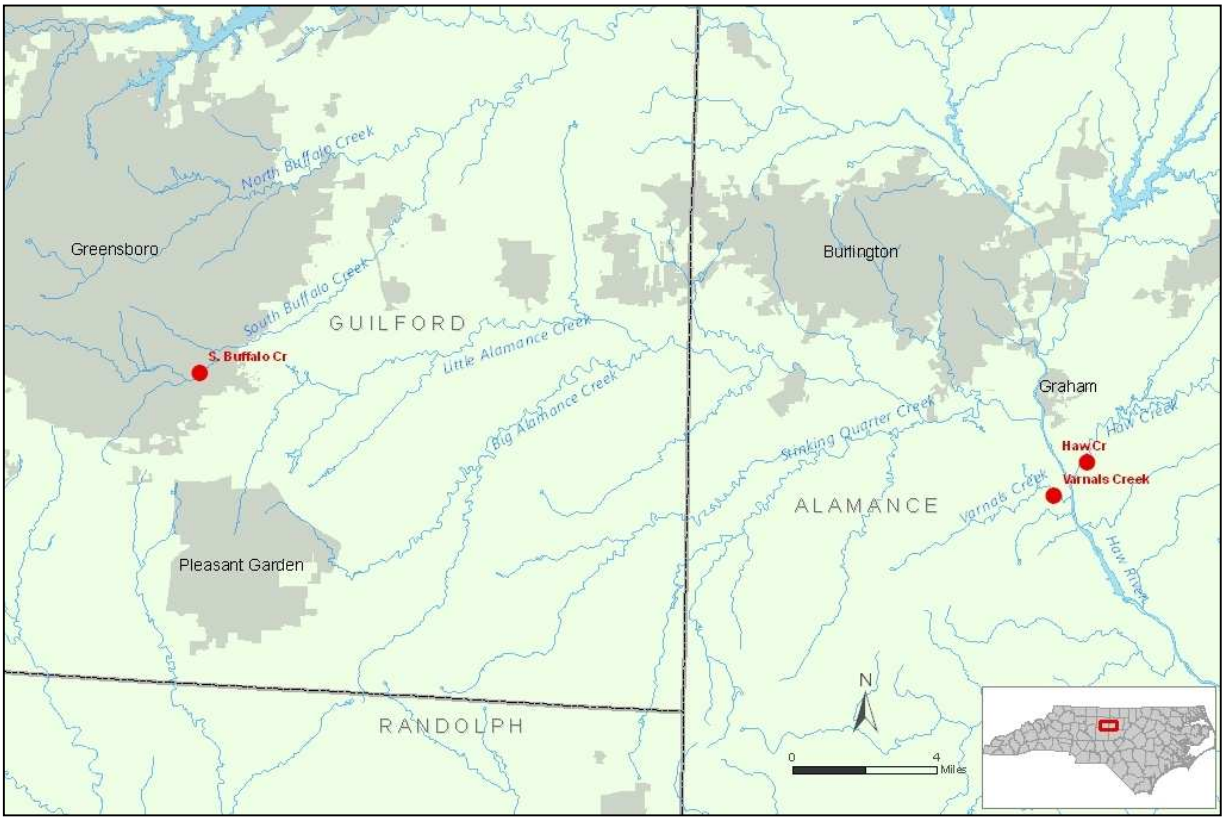


Figure 2. Distribution of the Oriental Weatherfish in the upper Haw River system, North Carolina. Map courtesy of Mark Hale, DWQ.

For additional information and citations on this species, please consult: Nico, L. and P. Fuller. 2009. *Misgurnus anguillicaudatus*. USGS nonindigenous aquatic species database. Gainesville FL. <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=498> Revision Date: 8/6/2009.

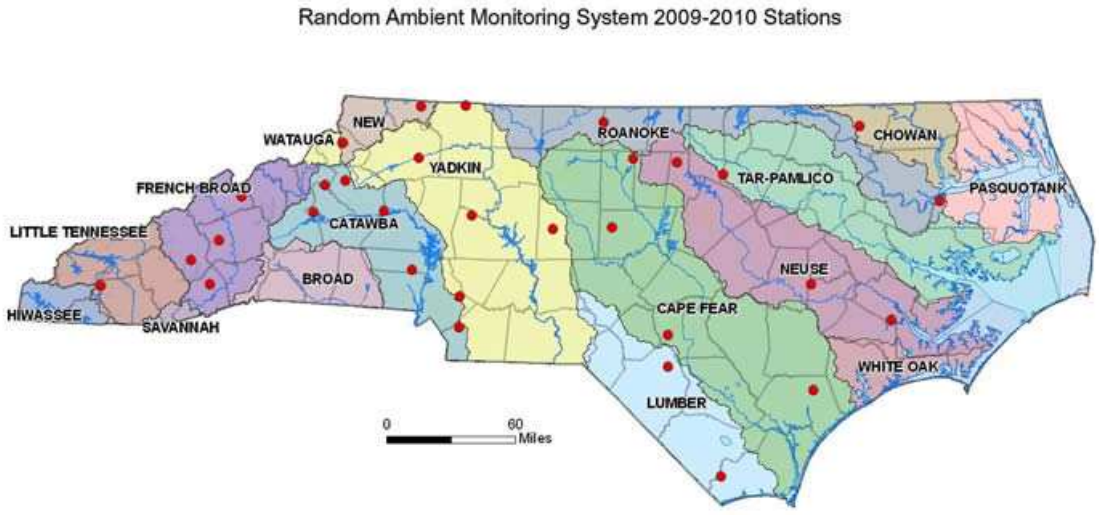
ECOSYSTEMS UNIT

The Random Ambient Monitoring System, started in January 2007, is a new component of DWQ's Ambient Monitoring Network. RAMS is a probabilistic monitoring initiative where sampling locations are randomly located on freshwater streams throughout the state.

Initially, twenty-nine sampling sites were chosen for the program. Those sites were sampled once per month for two years, then were retired. At that time, new sites were be chosen and they will be sampled for two years. This cycle will continue for the life of the program. The current cycles is comprised of 31 sites.

The following parameters are collected once per month for a total of 24 times in two years: field meter parameters such as dissolved oxygen, specific conductance, temperature and pH; alkalinity, chloride, fluoride, sulfate, dissolved organic carbon, turbidity, total metals, dissolved metals, mercury (by method 1631), and volatile organics. The following parameters are collected once every other month for a total of 12 times in two years: cyanide, sulfide, semi-volatile organics, pesticides, and PCBs.

RAMS has several valuable features. Because most streams in North Carolina are small streams, the majority of RAMS sites are also on small streams. DWQ's traditional ambient monitoring network does not have much data on smaller streams, because it has historically focused on large rivers and areas with known water quality problems. In addition, RAMS will allow us to answer broad questions about the water quality of North Carolina streams with a statistical rigor that had not been possible before. RAMS will also allow DWQ to collect data on water quality parameters that are rarely examined. Finally, it will also aid in the development of alternative methods of measuring metals, such as dissolved concentrations and toxicity via biotic ligand models.



NC Wetland Monitoring Program Activities 2003-present

Development of a Wetland Monitoring Program for Headwater Wetlands in North Carolina (EPA Grant CD 974260-01) –
The following provides the Executive Summary of the aforementioned grant which was completed from 2003-2008 – See, http://h2o.enr.state.nc.us/ncwetlands/pdu.htm, for full report.

North Carolina wetlands have been affected negatively by watershed development. Urbanization, agriculture and silviculture have altered the quality of stormwater runoff that flows into wetlands and impacts surrounding upland buffers and wildlife corridors. Wetlands can act as a natural filtering system for water quality by removing, reducing, or transforming pollutants. This natural filtering is especially important with headwater wetland systems since they are the primary water source for first order streams. These wetlands also reduce downstream erosion by retaining stormwater runoff and releasing it more slowly after a heavy rain. Headwater wetlands provide important habitat for macroinvertebrates and amphibians, both of which are sensitive to stressors in their environment such as impacts to water quality and wetland habitat, and deforestation of the surrounding upland buffer. Maintaining the ecological integrity of these headwater wetland systems is necessary not only to protect wildlife habitat but also to protect the water quality of the entire downstream watershed.

The original objective of this EPA Wetland Program Development Grant (CD 974260-01) was to "elucidate the differences and similarities among amphibians, macroinvertebrates and vegetation along a gradient of human disturbance within specific wetland types". To meet this objective, a NC wetland monitoring program was begun with a focus on the monitoring of physical, chemical, and biological parameters of one type of wetland- headwater wetlands. Headwater wetlands were chosen as the initial wetland type to monitor because these systems are a very important natural resource found in the highest reaches of watersheds across the entire state. The North Carolina Division of Water Quality (NC DWQ) conducted a monitoring effort on 11 Coastal Plain and 12 Piedmont headwater wetlands located along a disturbance gradient during a two year period. Two physiographic regions were chosen to examine any variation of headwater wetlands across these regions. Monitoring strategies were developed for wetland water quality, hydrology, soils, amphibians, macroinvertebrates, and plants. Disturbance measurements of each wetland were determined with the Ohio Rapid Assessment Method (ORAM is a wetland rapid assessment) and a Land Development Index in order to analyze the abiotic and biotic data.

This study showed that headwater wetlands located in the Piedmont tended to be small bowl-shaped wetlands that graded into narrow intermittent or perennial channels while headwater wetlands in the Coastal Plain were flatter wider systems. Headwater wetlands are often impacted by road crossings and ditches (especially in the Coastal Plain) that have the capacity to alter the hydrology, water quality, and habitat structure. Impacts to

the watershed and headwater wetlands can be especially damaging since headwater wetlands affect downstream aquatic resources. Regional differences as well as the quality of the wetland can cause variability between the soils, topography, and vegetation, which can affect the water quality. In this study, water quality in the Coastal Plain was more acidic and had higher levels of calcium and magnesium most likely due to regional soil differences. Headwater wetlands that have maintained a natural condition are forested with mature trees, primarily hardwoods with red maple (*Acer rubrum*), sweet gum (*Liquadambar styraciflua*), and tulip poplar (*Liriodendron tulipifera*) dominating in both the Coastal Plain and Piedmont regions. Coastal Plain headwater wetlands tend to have a more dense coverage of shrubs and understory trees while Piedmont headwater wetlands have a more diverse and denser coverage of herbaceous plant species. A diverse array of amphibian and macroinvertebrate species is found in headwater wetlands. Many amphibian species require the fish-free conditions that undisturbed headwater wetlands provide. This study, found 26 species of amphibians (17 in the Coastal Plain and 19 species in the Piedmont), 5 of which require fish-free conditions, and 246 macroinvertebrate taxon (160 in the Coastal Plain and 175 in the Piedmont).

The water quality analysis showed that headwater wetlands effectively reduce pollutants in downstream waters, have a significant correlation between water quality and the condition of the wetland water quality and the condition of the watershed, and that headwater wetlands of lower quality actually have a better capacity for reducing pollutants than wetlands of higher quality. This last finding indicates that headwater wetlands still maintain the ability to filter pollutants even when impacted by human disturbance. The hydrological analysis showed that headwater wetlands located in more urban watersheds tended to have flashier hydroperiods than wetlands located in more natural watersheds. During the growing season, the water table remained within a foot of the ground level at least 46% of the time. The water table was within a foot of the surface 75% and 72% of the growing season for the Coastal Plain and Piedmont sites respectively. The water table for urban headwater wetlands sites was within a foot of the surface during the growing season 62% of the time whereas natural sites had a longer period of 84%. The soils analysis showed that magnesium, copper, and zinc soil content increased as the quality of the wetland and surrounding buffer decreased. Draft Indices of Biotic Integrity (IBIs), composed of five to ten metrics, were developed from the amphibian, macroinvertebrate, and plant monitoring survey results to measure how disturbance affects these biotic communities. Candidate metrics were identified through the examination of the monitoring results and a literature review of comparable studies. The amphibian and macroinvertebrate metrics responded more to the specific water quality and soil chemistry disturbance rather than ORAM and LDI, indicating these taxa are influenced more by water quality and soil chemistry than by wetland condition (ORAM) and surrounding land cover (LDI). The plant metrics, however, did have a strong correlation with LDI and ORAM. The biotic results of this study show there are significant differences between amphibian, macroinvertebrate, and plant communities located in headwater wetlands of variable quality.

Field Verification of Wetland Functional Assessment Methods within Local Watershed Planning Areas (CD 96422105-0) – Fieldwork 2006-2008, Final Report being prepared in 2009

The purpose of this grant project is to further verify and validate the NC Wetland Assessment Method (NC WAM) by doing a quantitative and extensive assessment of the physical, chemical, and biological characteristics of three types of NCWAM identified wetlands. Monitoring methodologies were developed and used on three general wetland types (as defined by the NCWAM wetland key): Small Basin Wetland, Riverine Swamp, and Bottomland Hardwood. The results of this assessment will be compared to NCWAM evaluation scores that have been determined for these wetland sites (NCFAT 2008). The results of this study will also be used to characterize the physical, chemical, and biological attributes of these three types of wetlands. This work will continue the establishment of a NC wetlands monitoring program which was completed for headwater wetlands (grant CD 974260-01, see above). Additionally NCDWQ has been working with the NC Ecosystem Enhancement Program (NC EEP) to locate wetland study sites in watersheds to assist with the preparation of NC EEP management plans. Physical, chemical, and biological monitoring information of the wetland study sites and a landscape analysis will provide valuable information for the NC EEP watershed management plans. Wetlands were chosen in watersheds that the NC EEP identified as needing watershed plans due to planned growth and development activities. In the Fishing Creek Watershed, located primarily in Granville County in the piedmont, six small basin wetlands and six bottomland hardwood wetlands of variably quality were chosen for monitoring and evaluation. In the Lockwood Folly Watershed, located in Brunswick County in the coastal plain, six small basin wetlands and six riverine swamp forest wetlands were chosen for monitoring and evaluation. The wetlands chosen are of variable quality.

Level I (remote ArcGIS spatial analysis), Level II (rapid assessments), and Level III (intensive assessments) have been competed for the wetland sites. The level I analysis involved a spatial land cover analysis of the watershed and 100 m buffer of each site. Level II has involved completing rapid assessments; NCWAM and Ohio Rapid Assessment Method on each site (NCFAT 2008, Mack 2001). Level III has involved intensive wetland monitoring surveys and samples for amphibians, aquatic macroinvertebrates, vegetation, water quality, hydrology, and soils. These monitoring results will also be used to develop Indices of Biotic Integrity for the amphibian, macroinvertebrate, and vegetation communities of small basin, riverine swamp forest, and bottomland hardwood forest wetlands. The field data is currently being analyzed for the completion of the final report in October 2009.

Geographically Isolated Wetlands in Eastern Carolina: Southeast Isolated Wetland Assessment – Fieldwork 2008 – 2010, Final Report 2010 or 2011

The purpose of the *Southeast Isolated Wetlands Assessment* (SEIWA) project is to (1) estimate the number and spatial extent of isolated wetlands in an eight county area (Brunswick, Bladen, Robeson, Columbus, Florence, Dillon, Horry, and Marion counties) in the NC and SC coastal plain using geographic information system (GIS) mapping tools and probability based estimators (2) provide, using similar GIS and statistic techniques and historical data, an estimate of the number and spatial extent of isolated wetland loss; (3) estimate the assimilative capacity of isolated wetlands for selected, key pollutants; (4) use these collective results to estimate the cumulative effect of isolated wetlands from a total pollutant assimilative capacity perspective (5) assess the hydrologic connectivity of clusters of isolated wetlands in the landscape; and (6) characterize the biotic communities (amphibians, aquatic macroinvertebrates, and plants) of one or two types of isolated wetlands.

Methodologically, the project employs a three-level assessment strategy. For Level I assessments, existing geospatial and remote sensing imagery was evaluated and used to develop a population frame (GIS mapping tool) of polygons that are likely to contain, are contained or intersect isolated wetlands in the North Carolina/South Carolina study area. This population frame was used to develop a probability sampling design that was used to select a random set of locations (polygons) in the study area. The GIS mapping tool was ground-truthed for accuracy at 170 sites in the study area during the Level II assessment. Additionally, each wetland was identified with the NCWAM key and NCWAM and ORAM rapid assessments were completed on each site to gather information on the condition and function of each site (NCFAT 2008, Mack 2001). Lastly the depth and size was determined for all sites and the volume was determined for half the sites to obtain information on the extent, depth, and holding capacity of the isolated wetlands in the study area. The Level II field work resulted in 79 of 170 sites being deemed to be wetlands while 42 of the 170 sites contained isolated wetland(s). For the Level III intensive survey work, a sub-sample of the clusters of isolated wetlands that were located with the GIS mapping tool will surveyed for pollutant absorption capacity and hydrologic connectivity. Level 3 sampling will focus on measuring their hydrologic and water quality responses at the landscape scale and measuring the diversity of biotic communities (amphibians, aquatic macroinvertebrates, plants) to better characterize them. Level III sites have been chosen in Marion and Brunswick counties. Monitoring wells are in the process of being installed, soil samples have been taken, and vegetation communities assessed.

Hydrologic Connectivity, Water Quality Function, and Biocriteria of Coastal Plain Geographically Isolated Wetlands (CD 95415809), Fieldwork 2009 – 2011, Final Report 2012

The goal of this IWC project proposal is to expand work underway on isolated wetlands in eight NC and SC Coastal Plain counties that has already been funded and started for the SEIWA REMAP grant. This grant project proposes: **(1.)** To develop biocriteria for "at-risk" isolated Coastal Plain wetlands. This will be accomplished by completing a Level III intensive survey of the water quality, soils, vegetation, amphibians, and macrobenthos for 10-12 isolated wetland sites and combining those results with comparable survey results obtained from the two clusters of isolated wetlands that will be intensively surveyed for the SEIWA REMAP grant project results. Sites that were identified as small basin wetlands and identified for the Level II work SEIWA REMAP grant will be used for the biocriteria development. Other potential data to be used in the development of the biocriteria for isolated wetlands are the intensive survey results from isolated basin wetlands located in Brunswick County that were collected for the "Field Verification of Wetlands Functional Assessment Methods" grant (CD-96422105-0). **(2.)** To determine the pollution absorption capacity of 10 to12 isolated Coastal Plain wetlands in order to gain a better understanding of the water quality function of these systems. Water quality will be assessed in the isolated wetland and downstream. **(3.)** To identify and characterize the hydrological connectivity of 10-12 isolated Coastal Plain wetlands in order to improve the understanding of how these systems interact with and are connected to downstream water bodies. **(4.)** To determine the acreage of isolated wetlands that have been impacted and mitigated in North Carolina since 2002 and find out if there has been a net loss or increase of these systems. This information is needed to work toward a net-increase rather than a net-decrease of this critically important and vulnerable natural resource. The NC DWQ Basinwide Information Management System (BIMS) database will be used to determine this information. **(5.)** To further verify and validated the NCWAM by statistically comparing and correlating the intensive survey biocriteria results to the NCWAM score results for the major type of isolated wetlands – small basin wetlands. This analysis will be based on a stratified random sample of isolated wetlands visited for SEIWA REMAP grant. Therefore these results can be extrapolated to the population of isolated wetlands in our eight county study area.

Wetland study sites are currently being located with the Level I SEIWA grant mapping tool in NC and SC to meet goals 2 and 3. Level II data from the SEIWA grant will be used to randomly locate sites for goal 1 and 5 later in 2009 and early 2010.

Implementation Grant – Wetland Functional Assessment: Expansion and enhancement of the North Carolina Wetland Assessment Method (NC WAM) (WL 9643505-1), Fieldwork 2009, Final Report in third quarter, 2010.

North Carolina Wetland Assessment Method (NCWAM)is a rapid, reference-based wetland quality assessment method developed by the NC Wetland Functional Assessment

Team. The goal of the team was to develop an accurate, consistent, rapid, observational, and scientifically-based field method to determine the level of function of a wetland relative to reference condition (where appropriate) for each of 16 major North Carolina general wetland types. NCWAM gives an overall score of high, medium, or low for the general wetland functional assessment. The score is based on the evaluation of three functions; hydrology, water quality, and habitat. Scores are also generated for each of these three functions and also for the subfunctions that make up the three functions.

The appropriate state and federal agencies plan to adopt NC WAM as the standard wetland evaluation method in North Carolina. This adoption would not preclude use of other wetland evaluation methods in NC where appropriate on a case-by-case basis. The agencies believe that this method will be useful for project planning, alternatives analysis, compliance/enforcement, mitigation planning and tracking functional replacement in the state. The implementation details of how NC WAM will be used will be developed by the regulatory agencies and will receive separate public notice and comment before adoption at a later date.

The method has been beta tested and will be useful for various wetland permitting issues throughout the state. However to fully develop and implement NC WAM, there are several issues which need to be explored. If (as anticipated) these issues are successfully addressed by NC WAM, then the utility of the method will be expanded dramatically. These issues are to be addressed in this grant. The issues are to:

1. compare NC WAM results to other rapid assessment methods,
2. test the usefulness of NC WAM for mitigation sites,
3. develop and implement the NC WAM "Tool Box" which is an internet-based compilation of reference sites,
4. to test NC WAM for isolated and "Rapanos" wetlands, and
5. assist with training of public agency staff.
6. calibrate/validate NCWAM with level three wetland monitoring data, with primary emphasis on Headwater Wetlands; subsequent analysis will be performed with other wetland types (Riverine Swamp Forest, Bottomland Hardwood Forest, and Basin Wetlands).

NCWAM is being compared the Ohio Rapid Assessment method (ORAM), using Headwater Wetlands, Isolated Wetlands, Riverine Swamp Forest, Bottomland Hardwood Forest, and Basin Wetlands. When the national rapid assessment (USA-RAM) becomes available, NCWAM will be correlated with it in future wetland monitoring projects.

A preliminary report (a student's master's project) has been written on the usefulness of NCWAM for mitigation sites. The initial conclusion was that NCWAM may prove useful in tracking the success of mitigation sites, but more detailed study comparing NCWAM's rating with mitigation data it needed.

Most of the NCWAM tools are accessible form the web, the actual NCWAM tool box is still in development and may evolve into a database before the internet accessibility is complete.

Data is being collected by the Isolated Wetland Grants and will be used as a preliminary evaluation of NCWAM's usefulness/accuracy. The level three data that is being collected will be used to help calibrate/validate NCWAM with isolated wetlands.

The majority of the field work is complete and most of the data has been collected from 34 headwater wetlands. The level three data collected includes water chemistry/quality, soil analysis/composition, hydrology, and biological surveys of the vegetation, amphibians, and macroinvertebrates. This data will be used to evaluate/correlate the ratings produced by NCWAM for these wetlands. Modifications to the NCWAM may be necessary if some of the subfunctions are not correlating with the level three data.

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