Level 1, Level 2, and Level 3 Isolated Wetland Assessment in NC and SC Coastal Plain

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Isolated Wetland in North and South Carolina

Isolated wetlands (IWs) provide hydrological, water quality, carbon sequestration, and ecosystem benefits that are important for preserving biodiversity and ecosystem stability. These wetlands are more vulnerable than other wetlands because their size is generally small and they lack a surface water connection to downstream navigable waters. Changes in federal jurisdiction (SWANCC vs. ACOE et. al., 2001 and Rapanos and Carabell vs. ACOE, 2006) have made the protection of isolated wetlands the responsibility of the states. In NC, impacts to these wetlands have been subject to permitting requirements since 2001. However, SC recently gained authority to regulate isolated wetlands in the coastal region and is currently trying to move forward in the protection of IWs statewide.

Two different EPA funded studies were conducted on in an eight county study area in NC and SC in order to better understand the distribution and condition of IWs in this region. The first study, "The Southeast Isolated Wetland Assessment" (SEIWA), was a collaborative effort between RTI International, NC Department Environment and Natural Resources , the University of South Carolina , SC Department of Health and Environmental Control, and Oregon State University from 2007-2010. The SEIWA study took a three leveled approach to assessing IWs in this 8-county region; Level 1 – Geographic Information Systems (GIS) was used to identify IWs in the study area, Level 2 – A rapid on the ground assessment of a random sample of Level 1 sites was completed, and Level 3- an intensive assessment of the hydrologic, water quality, and biocriteria of selected IW sites. The second study, "Hydrologic Connectivity, Water Quality Function, and Biocriteria of Coastal Plain Geographically Isolated Wetlands", referred to as the Isolated Wetland Connectivity study (IWC), is a program development grant that the NC Division of Water Quality and University of SC have partnered on. This second grant, commenced in 2009 and projected to be completed later this year, is a follow-up study to the SEIWA study for the expansion of the Level 3 work started in the SEIWA study.

Southeast Isolated Wetland Assessment (SEIWA)

SEIWA Level 1

SEIWA Level 1 Method– A GIS Isolated Predictive Mapping tool was developed with these steps-

1. A layer of polygon sinks was generated from raster elevation data (LiDAR for five counties, USGS hypsography elevation data for three counties).
2. Wetland likelihood determined by overlaying GIS layers from wetland soils data, National Wetland Inventory data, and "black spots" that are dark spots visible in CIR imagery which are often associated with wetland features. Likelihood of ditching connectivity determined using road layers and agricultural land cover.
3. A masking procedure was used to remove polygon sinks that had a low probability of being IWs (IWs touching water bodies, in floodplains, or in developed land cover).
4. The GIS data used to generate each candidate IW polygon was used to assign a ranking score of 1 (not likely to be an IW) to 10 (highly likely to be an IW) for each criteria to each candidate IW polygon.

SEIWA Level 1 Results- Results highly varied based on whether LiDAR or USGS hypsography data was used to develop the GIS Isolated Predictive Mapping Tool.

1. LiDAR derived mapping tool produced 322 to > 1,500 sinks / square mile
2. Hypsography derived mapping tool produced 22 to 27 sinks / square mile.

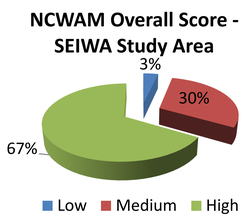
SEIWA Level 2

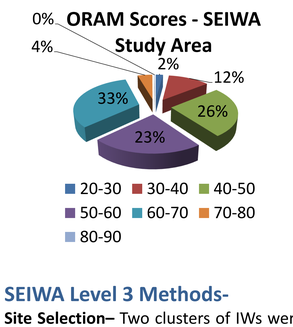
SEIWA Level 2 Method– A probability-based sampling design was used to randomly select 170 sites for the Level 2 analysis from the Level 1 results. Sites were chosen based on the stratification of the sample area by county and clustering by the 14-digit hydrologic unit (HUC). The following procedures were completed during the Level 2 field survey:

1. The site was determined to be a wetland or an upland.
2. Sites that were wetlands were surveyed for a hydric connection to downstream waters.
3. If the site had no downstream hydric connection and was an IW then the following procedures were completed:
   - The site was delineated using the using 1987 Corps of Engineers methods (ACOE 1987).
   - Wetland type was defined with the NC Wetland Assessment Method [NCWAM (NC FAT, 2008)], *NC Third Approximation* (Schafale and Weakley, 1990) and *The Natural Communities of SC* (Nelson 1986).
   - Two rapid assessment methods were conducted - the NCWAM (NC FAT, 2008) and Ohio Rapid Assessment Method (Mack 2001).
   - Soil samples were assessed in the field and collected for analysis.
   - Deepest depth was surveyed at all the IWs and volume was surveyed at half the IWs.

SEIWA Level 2 Results –

1. 22% of candidate IWs for the entire region were identified to be IWs, 35% for NC and 13% for SC.
2. NCWAM and ORAM scores – see Figures below.
3. Average depth ranged from 0.03-2 ft deep (mean = 1.3 ft), Max depth ranged from 0.4 to 7 ft deep (mean = 2 ft), Water storage ranged from 0.003-3.4 acre-ft (mean= 0.20 acre-ft).
4. Wetland Type – NCWAM- 96% Basins and 4% Pocosins , see Table below for other wetland classifications.
5. Overall – 1.9% of wetlands are estimated to be IWs in the 8-county region, IW mean size is 0.68 ac, most are forested.





SEIWA Isolated Wetland Types and Proportions (numbers) In the Study Area

Third Approximation (NC)	Natural Communities SC	Percent of IWs	SE Percent of IWs
Small Depression Pond	Pond Cypress Pond	29	23
Wet Pine Flatwoods	Pine Flatwoods	24	19
Nonriverine Wet Hardwood Forest	Non Alluvial Swamp Forest	19	14
Small Depression Pocosin	Pocosin	14	8.0
Nonriverine Swamp Forest	Non Alluvial Swamp Forest	6.7	6.7
Vernal Pool	Swamp Tupelo Pond	3.4	1.7
Small Depression Pocosin	Swale Pocosin	1.4	1.5
Small Depression Pond	Limestone Sink	0.94	0.97
Cypress Savannah	Pond Cypress Savannah	0.67	0.57
Pond Pine Woodland	Pond Pine Woodland	0.33	0.29

SE = Standard Error

SEIWA Level 3

SEIWA Level 3 Methods-

Site Selection– Two clusters of IWs were selected for an intensive survey. Each cluster was composed of two IWs, one cluster in NC and one in SC. High quality sites as indicated by the rapid assessment results, were chosen to best analyze the relationship between the IWs and landscape benefits.

Biocriteria Surveys– Amphibians, aquatic macroinvertebrates, and vegetation were surveyed to assess the biological quality of each site.

Physical and Chemical Surveys- Hydrology – connectivity of the IWs within a cluster and to downstream waters was assessed with shallow wells. Water Quality – Surface and ground water samples were collected to establish baseline water quality conditions for IWs. Soils – Surrounding upland and wetland soils samples were collected and analyzed for phosphorous adsorption capacity via P-adsorption Index (PSI).

Level 3 Results –

Sites- One cluster of wetlands was composed of two limesink cypress ponds located in the Greenswamp Nature Conservancy preserve in Brunswick County, NC and the other cluster of wetlands was composed of one pocosin IW and one cypress savannah IW located in the Woodbury Wildlife Management Area in Marion County, SC.

Amphibians– The amphibian species composition of the sites was affected by the presence of standing water, which was year round at the Brunswick sites but seasonal at the Marion sites and the low pH level which limits the use of amphibian species. Diversity ranged from 4 to 9 species, percent tolerant species ranged from 67 to 84%, and percent sensitive ranged from 4 to 18.2%.

Macroinvertebrates- Similar to amphibian results the ecological differences between the sites affected the results. Higher DO levels in the water resulted in 10x higher abundance at the Marion sites however the percent tolerant species was higher at the Marion sites (90.8 % and 97.1 %) then the Brunswick sites (42.9 % and 65.5 %) due to the large number of mosquito larvae.

Plants- Plant species composition was associated with the wetland community type each IW was defined as - cypress ponds, pocosin, or cypress savannah. The Floristic Quality Assessment Index (FQAI) scores indicated all sites were high quality (scores ranged from 16 to 32).

Hydrology- The hydrology survey indicated that surface and groundwater were linked and that both rainwater and groundwater affected the IW hydrology.

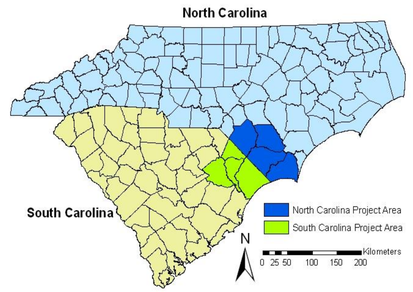
Water Quality- IWs in the study had high acidity levels and low nutrient levels in comparison to connected wetlands. There tended to be an upward trend in phosphorous and nitrite/nitrate moving away for the wetland. This may have been caused by the turbid upland well water quality samples that were high in sediments.

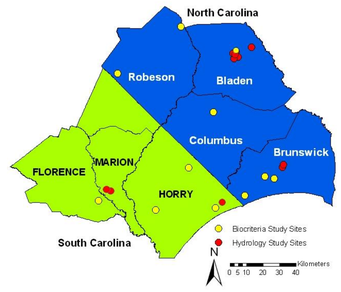
Soils- The PSI was much higher in the wetland soils (median value of 16.0) then surrounding upland (median value of 5.5) indicating that IWs have a significant ability to adsorb phosphorus.

Hydrologic Connectivity, Water Quality Function, and Biocriteria of Coastal Plain Geographically Isolated Wetlands (Isolated Wetland Connectivity IWC)

The IWC project has five goals to further expand the Level 3 findings of the SEIWA study. Field sampling has been completed and results are currently being analyzed.

1. To develop biocriteria for the IW amphibians, macroinvertebrates, and vegetation.
2. Further validate and verify the NCWAM through comparison with the intensive survey results.
3. To determine the pollution absorption capacity through the collection of upland and wetland water and soil samples.
4. To characterize the hydologic connectivity of IWs with downstream connected water bodies (defined as either streams or connected wetlands).
5. To determine the acreage of IWs that have been impacted and mitigated in NC since state regulatory laws required protection in 2001.





IWC Methods

Site Selection- Two sets of sites were used for the study, biocriteria and hydrology. Eleven biocriteria sites (four in SC and seven in NC) were selected from the SEIWA Level 2 sites with a stratified random procedure that chose High, Medium, and Low value NCWAM sites. This random selection procedure allows for the extrapolation of the NCWAM study results that correlate with the intensive study results to the entire study region. Eleven hydrology sites (eight in NC and three in SC) were selected non-randomly as these sites needed to be accessible and secure for well installation and located within the vicinity of a downstream connected water body. See Map Figures above.

Biocriteria Sites –

Amphibians- Surveyed for amphibians twice with timed surveys, cover boards, and funnel traps in Feb-Mar and May 2012.

Aquatic macroinvertebrates – One semi-quantitative survey with sweep nets in Feb-Mar 2012.

Vegetation – Surveyed plant species cover, presence, and woody species DBH with the Carolina Vegetative Survey (Peet et al. 1997) methods in July and August 2010.

Hydrology and Water Quality Sites-

Hydrology- A shallow subsurface stratigraphy was determined for each site to ensure permeability. Surveyed monitoring wells that ranged in depth from 5 ft to 40 ft and outfitted with transducers (seventy-six in NC and eleven in SC) were installed along a transect from the IW to the connected water body to characterize hydrologic connectivity. Aquifer pump tests were also performed at three NC sites.

Water Quality – Water quality samples were collected in the IW, downstream connected water body, and from the wells. Surface water and ground water samples were analyzed for TOC, DOC, Metals, and Nutrients, groundwater samples were also analyzed for Nitrite+Nitrate.

Soil – Soil samples in the IW and surrounding upland were assessed in the field for color and texture and analyzed for percent humic matter, CEC, Base Saturation %, pH, Exchanged Acidity, metals, phosphorous PSI and %LOI.

IW Impacts in NC– The NC DWQ Basinwide Information Management System and Mitigation Database are being reviewed to determine impacts and mitigation associated with IWs in NC.

IWC Results

Results are currently being analyzed. Preliminary results for the biocriteria are shown in Project Posters "The Biocriteria of Isolated Wetlands in the North and South Carolina Coastal Plain", Number 232, and "Isolated Wetlands the Groundwater Connection – 1. Water Table Monitoring", Number 245 and "Isolated Wetlands the Groundwater Connection – 2. Hydrogeology", Number 246.