Appendix N. Ecosystems and Habitat Mapping Technical Team Report

Prepared by Jason Lee, Team Leader

Wildlife conservation measures such as land acquisition on a statewide level are challenging due primarily to the scale and complexity of issues regarding prioritization, especially for a state as biologically diverse as Georgia. With a limited budget, how does a state assess wildlife value on one property versus another? A good decision process is one that accounts for the complexity of the issues while producing an easy to understand result, typically a map. The SWAP Habitat Mapping process attempts to compile current biological knowledge, current land conditions, predicted future impacts, and biological opinions in a transparent and objective way to better define areas of biological importance.

This report details the cumulative efforts of DNR to initiate and plan for this process, and is intended to be both an internal blueprint for SWAP Habitat Modeling and also a public resource. It our hope that federal, state, local government and private partners can utilize this prioritization process to promote and conserve wildlife in Georgia.

Technical Team Members

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Approach

On December 12, 2013, Team members assembled at Ocmulgee State Park in McRae, Georgia to discuss goals and plans for SWAP habitat mapping and modeling. Nongame DNR presented a general outline of preferred approaches based on SWAP needs, singular and overall goals, and processes to achieve them. This overall goal can best be described as a comprehensive modeling and mapping approach, and was approved by the team. The team then discussed the status of individual components such as land cover products or species models in terms of availability, potential importance, and accuracy. After review of available datasets and budgetary limitations it was obvious to the group that only portions of that overall objective could be achieved by the 2015 SWAP deadline.

In spite of this and after subsequent internal Nongame DNR deliberation and research and approval by the Habitat Team, it has been determined that steps toward the overall goal of an exhaustive modeling approach will be appropriate. Although not all individual datasets will be incorporated due to lack of availability, those will be developed and included in the near future. We consider this a dynamic modeling process that will be useful by 2016, but continue to build on current available data and eventually produce the desired comprehensive model.
In the following draft report, the process proposed and deliberated for SWAP Habitat modeling is presented, as well as future goals and opportunities, and merits of individual components that will contribute to the overall goal.

Identified Overall Needs

- To update the original SWAP Conservation Opportunity Areas map with a thorough prioritization process that is based primarily on the habitat needs of rare species and land cover maps, answering the question of 'What areas do we need in conservation to sustain Georgia's biodiversity'?
- To create a dynamic process that allows for improving the map over time as new information becomes available.
- A public website to display the prioritization and engage public and partners.

Identified Products

Final products that will need to be developed for the SWAP to achieve identified needs are the specific goals. The final opportunity map will be a single integrated composite index based on ranked component input data (the individual components will also be made public). Some of

these data are not available currently, so an essential part of this process is to identify data needs (which will then be listed as goals). Occasionally a placeholder may be used until an improved dataset can be developed. Products identified as goals are (Goals 2-5 will form the composite Conservation Opportunity Map):

1. Land cover maps & status and trends over past decade
2. Land cover derivatives (urban projections, Landscape Suitability, Habitat Richness, etc.)
3. Wildlife Corridor Opportunities (Greenways)
4. Priority Watersheds
5. Conservation Lands, status and trends
6. Species Habitat Models

With each of these products, a list of goals and data needs for improving the Opportunity map components will also be produced if necessary.

The following Sections discuss these individual products in more detail.

1. Land Cover Mapping

The basis of all habitat prioritization modeling is land cover. Most importantly it is used as the building block for all species models, and for land cover status/trends. For some types of analysis, general land cover is adequate. Analysis related to urban projections, agriculture land changes, or acres of silviculture for example are best done at a coarse scale.

Status and Trends for General Land cover:
Below are spatial and tabular representations of general land cover trends per Ecoregion from 2006 to 2011 (the most recent NLCD land cover map). Although this only covers half of the time period since the 2005 SWAP, it covers the time period from 2006-2008, a very intense period for development in the State. The trends are presented in percentage increase per land cover class (so, for instance Agriculture in the Southeastern Plains decreased by 2.7%, from 6,603 total square miles to 6,423 total square miles).

Overall, the 2006-2011 period appears to be relatively stable from a general land cover perspective. The most notable overall trends for these 6 years are a substantial increase in 'Early Successional', a significant increase in 'Developed', mostly stable 'Wetland" trends and significant 'Forest' and 'Agriculture' loss.

The forested loss, spread evenly across Deciduous, Evergreen and Mixed Forests types (see table below), is primarily into Herbaceous and Scrub/Shrub (shown in figures below as Early Successional) and Development. Herbaceous and Scrub/Shrub can represent conversion to another land use or can represent the early reforestation phase. Some of this loss from forest could also be explained from timber revenues declining after 2007, and silviculture becoming substantially less lucrative relative to other land uses, but most likely represents substantial clearcuts from 2006-2008 when timber prices were significantly higher, and cut areas are in the early, more open phase of silviculture reforestation. Presumably neither of these are an overall forest loss as those areas will return to forest. Hay/Pasture and Cultivated Crops appeared to be

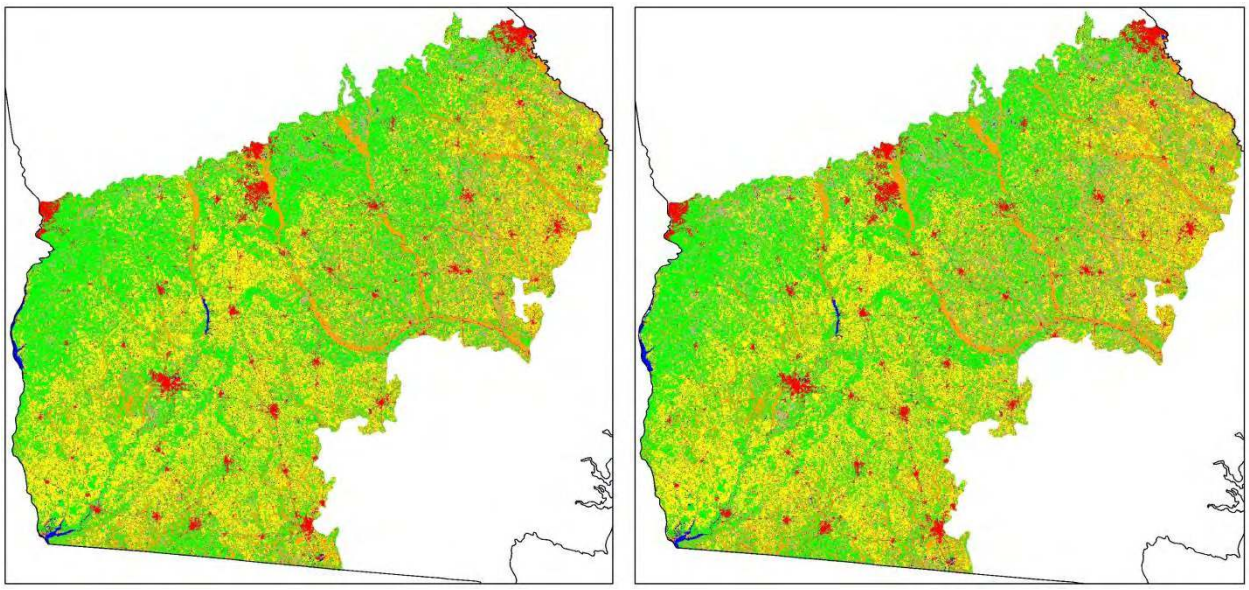
stable overall in the State. The increase in Development is likely to have been due to larger forested and agriculture properties being subdivided, sold and converted to suburban type developments during the growth period (2006-2008). This loss of forest and agriculture to development is significant and concerning.

Importantly, virtually no wetland loss may signal good news statewide as the trend of wetland loss seems to have abated for now. Coastal and Southeastern Plain wetlands, which have been drained and heavily converted to pine plantation over the past few decades appear to be stable from 2006-2011. Perhaps this is due to more marginal, easily converted, wetlands being exhausted and decreased timber revenues not justifying further hydrologic modifications.

NLCD Classes	**Square Miles 2006**		**Square Miles 2011**	
Open Water	856		872	
Developed, Open Space	3524		3588	
Developed, Low Intensity	1580		1564	
Developed, Medium Intensity	453		522	
Developed, High Intensity	211		230	
Total Developed	5767		5904	
Deciduous Forest	10788		10350	
Evergreen Forest	12933		12326	
Mixed Forest	2079		1914	
Total Forest	25801		24590	
Hay/Pasture	4740		4634	
Cultivated Crops	5766		5631	
Total Ag	10506		10265	
Woody Wetlands	8162		8018	
Emergent Herbaceous Wetlands	1111		1270	
Total Wetland	9273		9288	
Barren Land	180		199	
Shrub/Scrub	2705		3835	
Herbaceous	3562		3711	
Early Successional	6446		7746	

Table of overall land cover status and trends for Georgia per the National Land Cover Dataset. Figures below are generalized further and described in maps (figures generated by Chris Canalos)

Changes in Land Cover
Ecoregion: Southeastern Plains



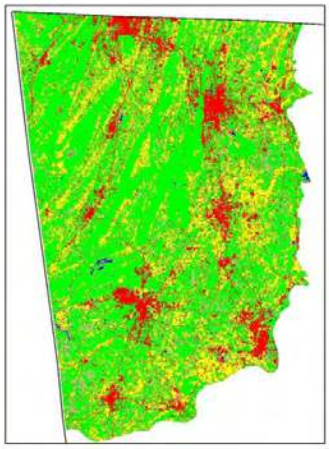
2006* 2011*

Land Cover Type	Percent change (%)	Change
Open Water	2.4	increase
Developed	1.2	increase
Forest	5.0	decrease
Agricultural	2.7	decrease
Wetlands	<0.1	increase
Early Successional	21.2	increase

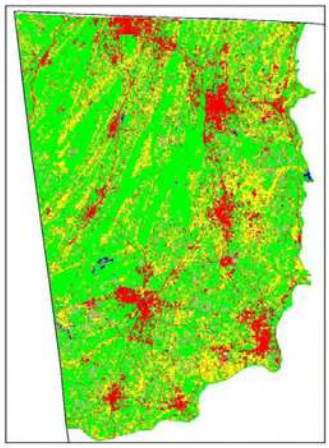
National Land Cover Database (NLCD) Class Collapse Scheme:
Developed: Open Space, Low Intensity, Medium Intensity and High Intensity
Forest: Deciduous, Evergreen and Mixed Forest
Agricultural: Hay/Pasture and Cultivated Crops
Wetlands: Woody and Emergent Herbaceous Wetlands
Early Successional: Barren, Herbaceous and Scrub/Shrub

*US Geological Survey National Land Cover Database (NLCD)

Changes in Land Cover
Ecoregions: Southwestern Appalachians and Ridge and Valley



2006*



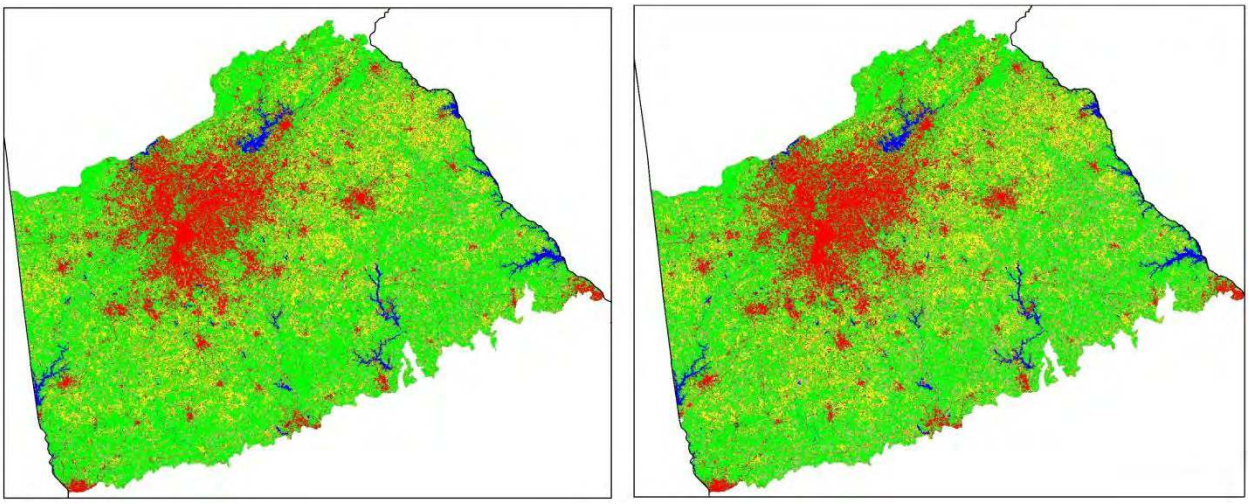
2011*

Land Cover Type	Percent change (%)	Change
Open Water	0	no change
Developed	2.4	increase
Forest	1.5	decrease
Agricultural	1.1	decrease
Wetlands	0	no change
Early Successional	11.2	increase

National Land Cover Database (NLCD) Class Collapse Scheme:
Developed: Open Space (Low, Medium, and High Intensity)
Forest: Deciduous, Evergreen and Mixed Forest
Agricultural: Hay/Pasture and Cultivated Crops
Wetlands: Woody and Emergent Herbaceous Wetlands
Early Successional: Barren, Herbaceous, Scrub/Shrub

*US Geological Survey National Land Cover Database (NLCD)

Changes in Land Cover
Ecoregion: Piedmont



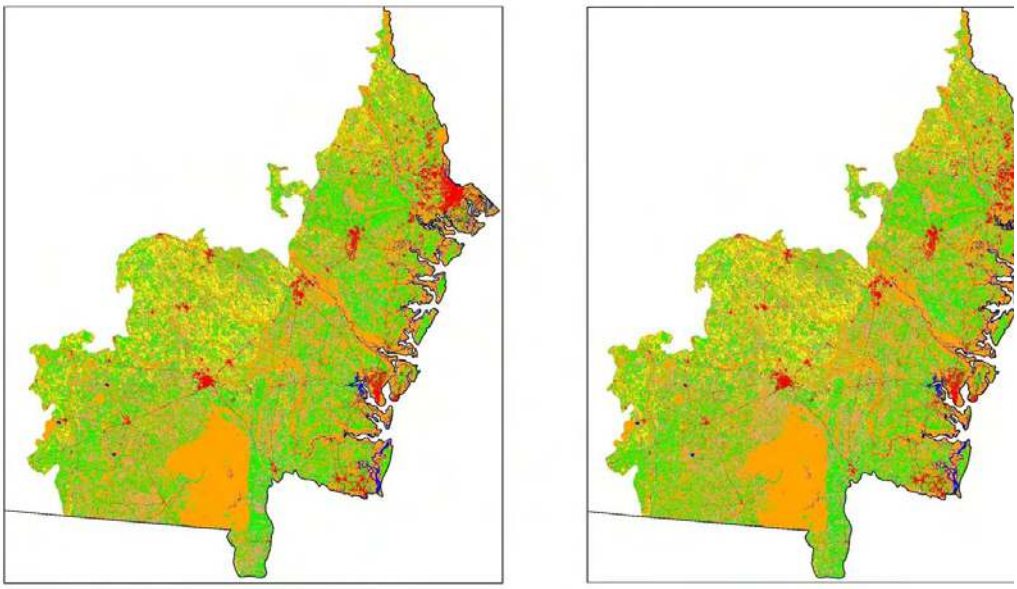
2006* 2011*

Land Cover Type	Percent change (%)	Change
Open Water	0	no change
Developed	3.2	increase
Forest	5.4	decrease
Agricultural	1.1	decrease
Wetlands	2.0	increase
Early Successional	27.1	increase

National Land Cover Database (NLCD) Class Collapse Scheme:
Developed: Open Space, Low Intensity, Medium Intensity and High Intensity
Forest: Deciduous, Evergreen and Mixed Forest
Agricultural: Hay/Pasture and Cultivated Crops
Wetlands: Woody and Emergent Herbaceous Wetlands
Early Successional: Barren, Herbaceous and Scrub/Shrub

*US Geological Survey National Land Cover Database (NLCD)

Changes in Land Cover
Ecoregion: Southern Coastal Plain



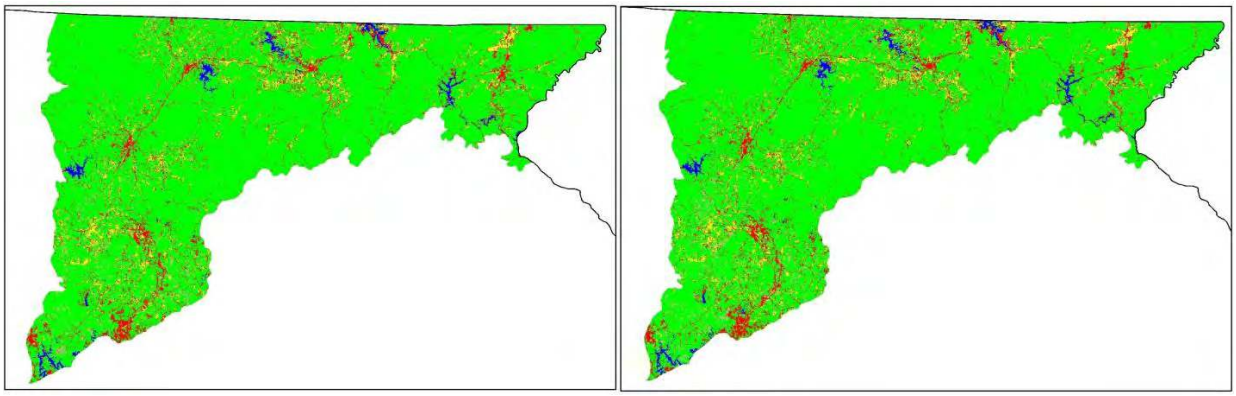
2006* 2011*

Land Cover Type	Percent change (%)	Change
Open Water	6.1	increase
Developed	2.1	increase
Forest	6.0	decrease
Agricultural	3.0	decrease
Wetlands	<0.1	increase
Early Successional	12.1	increase

National Land Cover Database (NLCD) Class Collapse Scheme:
Developed: Open Space, Low Intensity, Medium Intensity and High Intensity
Forest: Deciduous, Evergreen and Mixed Forest
Agricultural: Hay/Pasture and Cultivated Crops
Wetlands: Woody and Emergent Herbaceous Wetlands
Early Successional: Barren, Herbaceous and Scrub/Shrub

*US Geological Survey National Land Cover Database (NLCD)

Changes in Land Cover
Ecoregion: Blue Ridge



2006* 2011*

Land Cover Type	Percent change (%)	Change
Open Water	2.9	increase
Developed	1.6	increase
Forest	0.8	decrease
Agricultural	1.8	decrease
Wetlands	0	no change
Early Successional	15.3	increase

National Land Cover Database (NLCD) Class Collapse Scheme:
Developed: Open Space, Low Intensity, Medium Intensity and High Intensity
Forest: Deciduous, Evergreen and Mixed Forest
Agricultural: Hay/Pasture and Cultivated Crops
Wetlands: Woody and Emergent Herbaceous Wetlands
Early Successional: Barren, Herbaceous and Scrub/Shrub

*US Geological Survey National Land Cover Database (NLCD)

Maps are generated from NLCD; for percentages, Developed classes are merged, Forest classes are merged, Hay/Pasture and Cultivated Crops are merged into Ag, Wetland Classes are merged, Barren Land, Shrub/Scrub and Herbaceous are merged into Early Successional and Open Water stays Open Water.

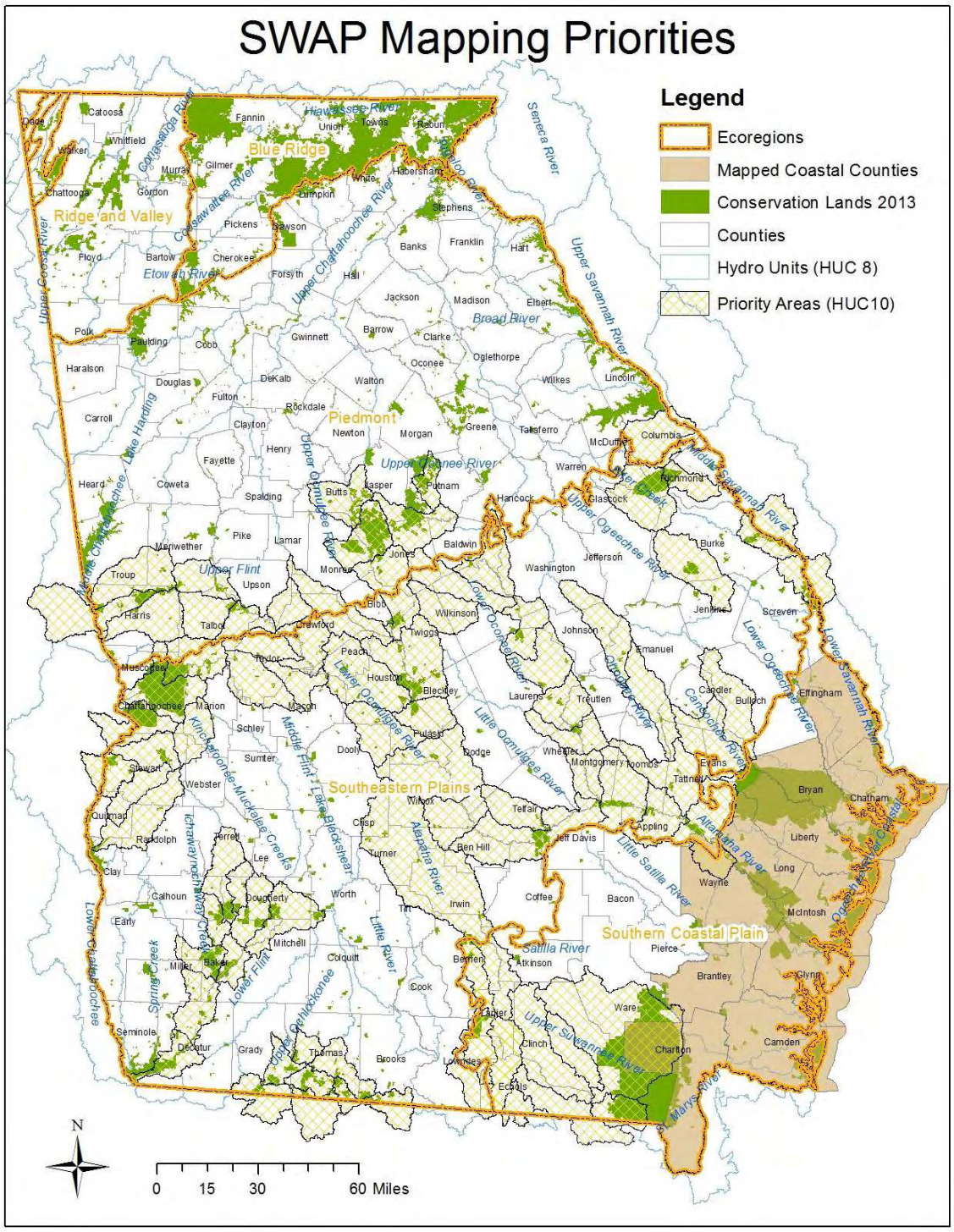
However, there is much diversity of habitats within the more natural land cover types that are important for individual species use. For example, upland longleaf pine and pine flatwoods may both be called natural pine in a general land cover, but usually consist of very different flora species(and attract different fauna).

Due to this, it is crucial that land cover maps be as accurate and details as possible. From 2007 to 2010, Nongame staff mapped vegetation for much of the Southern Coastal Plain of Georgia to

a precise level based on the National Vegetation Classification System developed by NatureServe. This field-based inventory and fine-scale mapping approach has yielded great benefits for coastal conservation, specifically in the ability to analyze habitat priorities. With the coastal habitat map, we are able to clearly ascertain the relative abundance plant communities and refine our priorities accordingly. This ability has led DNR to the conclusion that precise inventory mapping is worth the investment statewide, as it allows us to remove considerable uncertainty and refine our priorities.

To that effect, and considering budgetary limitations, we have drafted a prioritization for the State for future fine-scale mapping efforts (see map below). Natural systems, (not overly affected anthropogenic ones such as agricultural and urban classes) will be the primary targets for mapping, decreasing the mapping extent considerably. The target classification system will be determined later, but the Natural Communities of Georgia is our current goal, with Natureserve Ecological Systems/Associations also possibilities depending on budget factors and needs for specific areas.

The Habitat Team agreed that the Southeastern Plains stands out as the biggest land cover gap. The Team also agreed that for many needs, the Piedmont, Appalachians, Ridge and Valley and Cumberland Plateau Ecoregions can be currently served by 2002 Southeast GAP Land cover data. Although 10 years old, some change detection from current GLUT/NLCD maps can accurately incorporate major changes and so can still be useful until further fine scale mapping is completed.

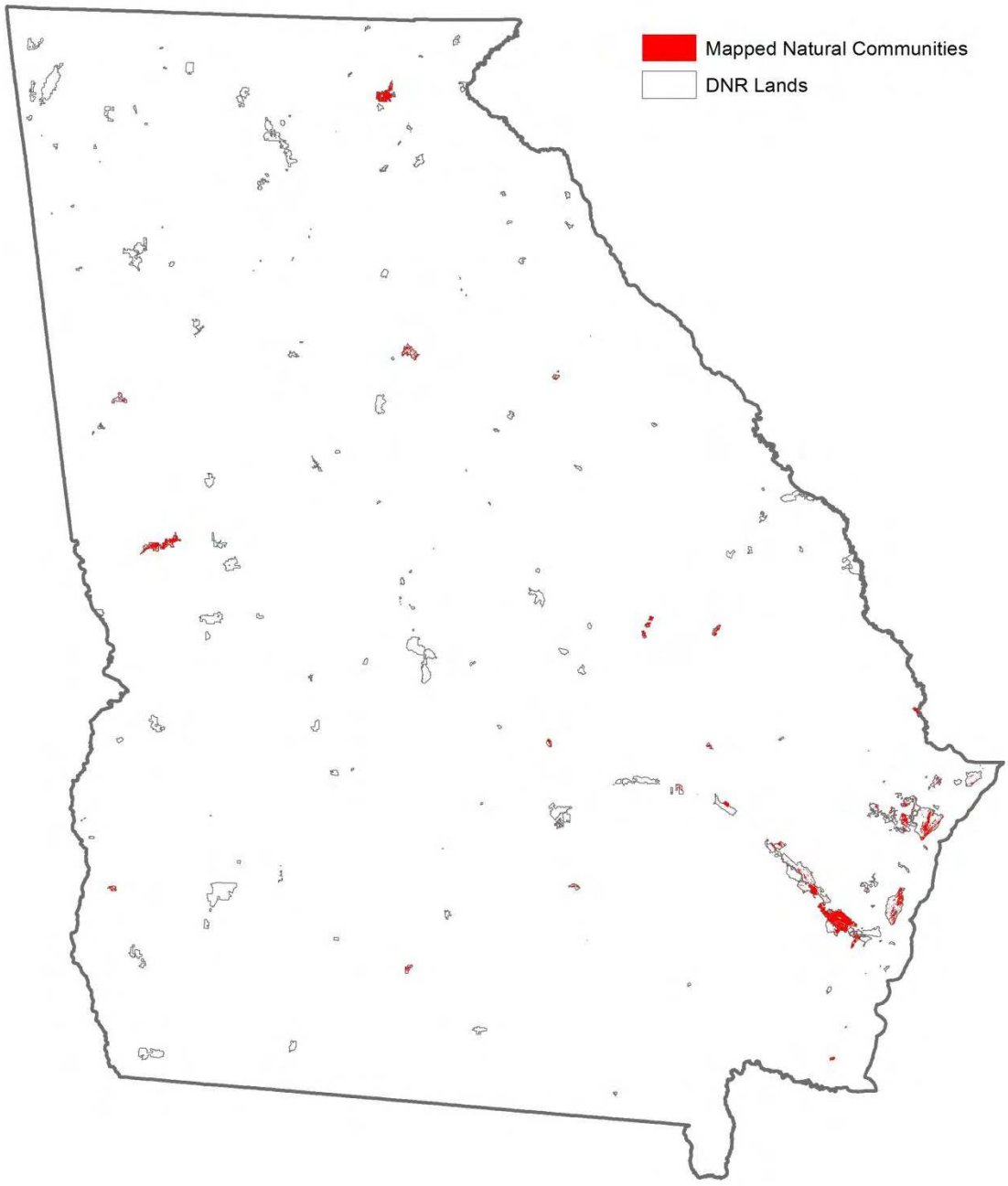


The Southern Plains is our largest land cover gap as it does not have a reliable land cover map (of finer scale than general land cover) since 1998. The draft Priority Areas above show areas of conservation interest and without recent land cover, and the coastal areas (in brown) previously mapped.

In addition to the above spatial prioritization, DNR has identified some Southeastern Plain priority habitats that need to be inventoried and mapped. These include high quality longleaf pine- savannas and woodlands, wet pine flatwoods, pitcherplant bogs, cypress savannas (limesinks), mesic slopes, calcareous bluffs, Altamaha grit outcrops and associated wetlands, remnant black belt prairies, canebrakes, calcareous flatwoods, river shoals, granite outcrops, ultramafic glades, and Florida scrub. Two more important habitats to map at finer resolutions are saltmarsh and brackish marsh and associated components such as high marsh, low marsh, levees and oyster beds. Although we have the extent of each well mapped, there is much biodiversity within each that should be better studied, classified and mapped accordingly.

DNR has completed fine scale mapping for Sandhills, Carolina Bays, sagponds, Doughtery Plain isolated wetlands, and wet oak flats. Having these and the above areas mapped to the Natural Communities level will help answer the question: 'What natural habitats are present in Georgia, and what is their extent and abundance?'

DNR has also completed fine scale land cover maps for most State Parks, Natural Areas and a few Wildlife Management Areas. These are currently being compiled and crosswalked (status below) to a standardized, single map, to begin to answer the question: 'What natural habitats, and how many and how much of, do we have protected?' To completely answer that question, fine scale mapping for ALL conservation lands including federal and private conservation lands, so this is a SWAP high priority.



Lands in red denote fine scale mapping, all others are DNR lands that are priority mapping areas. Most DNR and other protected lands are not mapped to a fine scale. Map and data below generated by Jacob Thompson and Jason Lee, NCS.

From the initial crosswalk, acreages of Natural communities currently protected are:

Natural Communities	**Acres**
Acidic glades, barrens, and rocky woodlands	13
Bottomland hardwoods	4635
Coastal wet oak flats	51
Cove forests	109
Cypress-gum ponds	1911
Cypress-tupelo river swamps	3037
Depression marshes and cypress savannas	2
Dry deciduous hardwood forests	1192
Dry evergreen oak woodlands	3236
Dry upland longleaf pine woodlands	469
Floodplains, bottomlands, and riparian zones	1389
Freshwater and oligohaline tidal marshes	2789
Granite outcrops	19
Interdunal wetlands	1225
Intertidal beaches, sand bars, and mud flats	669
Low- to mid-elevation oak forests	2135
Maritime dunes	456
Maritime forests	12729
Mesic forests	1265
Mesic slope forests	830
Montane longleaf woodlands and forests	1326
Mountain bogs	1
Oak-pine-hickory forests	7568
Pine flatwoods	5552
Pine-oak woodlands and forests	3563
Riverbanks and levees	240
Sandhills and river dunes	2973
Seepage slope swamps and shrub bogs	1544
Seepage wetlands	16
Small stream floodplain forests	60
Tidal swamps	13906
Total	74910

The total acreage mapped to the classification level we need is 74,910 acres. Georgia DNR owns over 475,000 acres, so more mapping needs to be accomplished to complete all state lands to a fine-scale level (although many of these lands are mapped accurately to a coarser level such as Ecological Systems) that is often necessary for decision making. Again, a comprehensive, fine scale inventory of all habitats in protection will be very useful in analyzing conservation needs.

Although we have not developed a schedule for fine scale mapping these and other priority habitats, we will seek funding for this work and set timelines and goals in 2015. The SWAP Monitoring team will have overlapping and complimentary efforts, and will be consulted with.

Land Cover Updates

A crucial component of land cover mapping is regular updates that reflect changes in extent, type or quality of habitat. This is an approach that may not be cost effective if the original method is re-employed for fine-scale mapping (which is considerably expensive). Therefore, change-detection methods are the preferred solution for updates. This consists of an automated process that identifies areas of substantial change, and the remapping process is then a more manageable and less costly process.

In addition to change detection methods, advances in automated land cover classification are showing promise for fine-resolution vegetation mapping. Of particular note are methods successfully pioneered by the Missouri Resource Assessment Partnership (MoRAP) for Missouri and Texas land cover mapping utilizing high quality point data to inform customized classification models. This option needs to be properly vetted for usefulness and application to the Georgia landscape, and may have applications in areas where fine-scale mapping is not possible. The option of mapping the entire Southeastern Plains with a MoRAP-type methodology will also be considered. Urban, silviculture and agricultural and areas can be updated with coarser scale land cover datasets such as GLUT or NLCD.

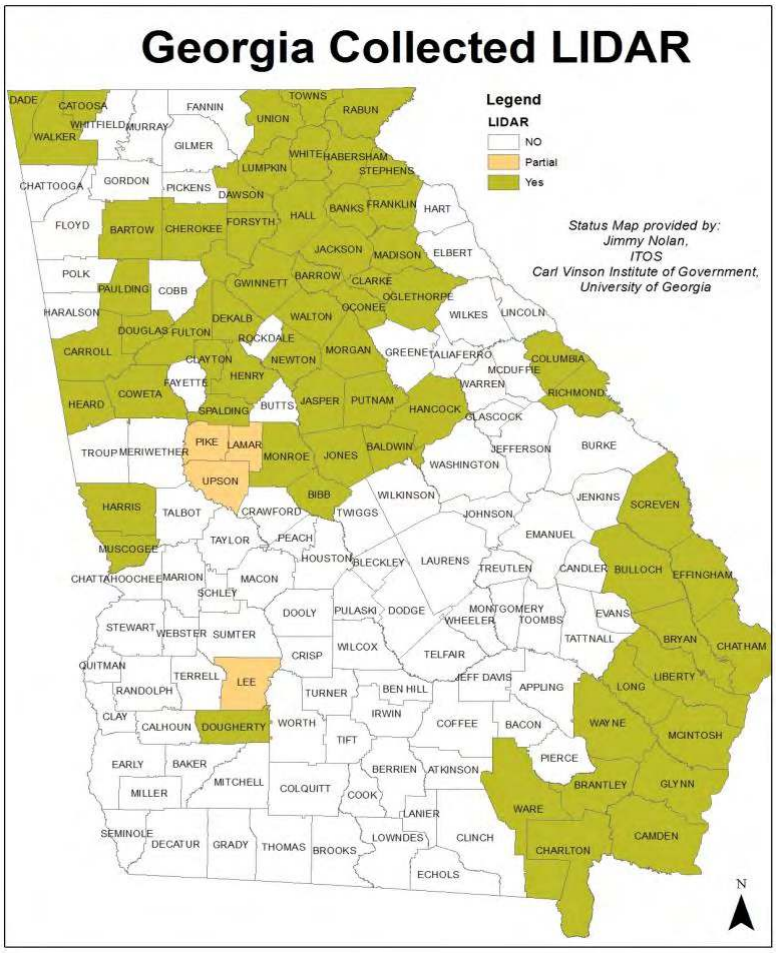
Restoration of ecosystems, especially of longleaf pine systems, needs to be accounted for in future mapping efforts. The reintroduction of prescribed fire is improving habitat across the state, and monitoring fire frequency is an important goal. The Landfire program is actively pursuing monitoring and mapping fire history in Georgia, and collaboration in this effort would be beneficial. Hydrologic restoration will be important to account for as well. The SWAP monitoring Team will be engaged for collaboration to achieve this goal.

Soils Maps

NRCS SSURGO (soils) digital maps have been completed for the entire State. This is an extremely beneficial dataset that will offer us a chance to increase land cover mapping accuracy and detail significantly. Vegetation responds closely to soil types, and some fauna such as the keystone species gopher tortoise inhabit only certain soil types.

Identified data needed to facilitate land cover mapping

One of the most significant needs to support land cover mapping is higher resolution digital elevation data produced by Lidar. Accurate elevation models derived from Lidar data are capable of refining the vegetation mapping process greatly, producing more accurate and more detailed land cover datasets. The Lidar status map below shows current availability of Lidar for Georgia. (Note that not all data are publicly available; some are the property of individual counties.)



Counties that have acquired Lidar in Georgia as of December 2014.

Also important to land cover mapping is timely, high resolution imagery. There are multiple ways to acquire high resolution imagery, and cost is usually the determining factor in how that acquisition takes place. Working with federal partners and local governments is commonly the most productive way forward. Another alternative that has the added benefit of repeatability is DNR aerial mapping capabilities such as onboard helicopter sensors.

When prioritizing land for conservation, it is often advantageous to include ecosystem services (or function of habitat) for land cover types. Future mapping efforts should consider modifiers to help with this task. Attention should be paid to species present or other important components.

2. Land Cover Derivatives and Landscape Condition Models

Data layers that qualify and quantify lands for habitat purposes can help prioritize land for conservation. These layers are mostly derived from general land covers using metrics that describe land cover attributes such as patch size (how large a homogenous land cover area such as a forest is) or contiguity. Other complementary layers (such as number of inventoried species per area) are often added to increase functionality. *The overall goal for our landscape*

conservation initiatives is to target biologically and topographically diverse, well connected, large areas. Given that, our identified layers needed are:

- Species Richness for Vertebrates Landscape Suitability (Patch/parcel size & Natural land cover)
- Wetlands, Floodplains & Recharge areas
- SLEUTH model of projected urban development
- Landscape Resilience concept: landform/connectivity/fragmentation. For the Coast and the Southeastern Plain, these datasets need reworking with higher quality elevation data.

Of these, the SLEUTH and Floodplains/Recharge Areas datasets are currently available.

3. Wildlife Corridors

Habitat connectivity provides benefits for most species, including plants, insects and mobile vertebrates. To foster connectivity between existing and future conservation lands, and to further provide corridors for species movement, a Greenway/corridors layer has been drafted for input into our prioritization process. *Please note that this is only one input of the final Conservation Opportunity Map*. Due to the complex issues that determine the feasibility of establishing and maintaining wildlife corridors, the actual drafting is mostly a manual process that utilizes multiple datasets. *Many of the corridors shown below exist and function currently as wildlife corridors, and so the primary goal is to retain that current land use, and to promote a matrix of restored and working lands, (not necessarily publicly owned).*

The following are important themes and priorities we considered when developing the draft map of potential wildlife corridors:

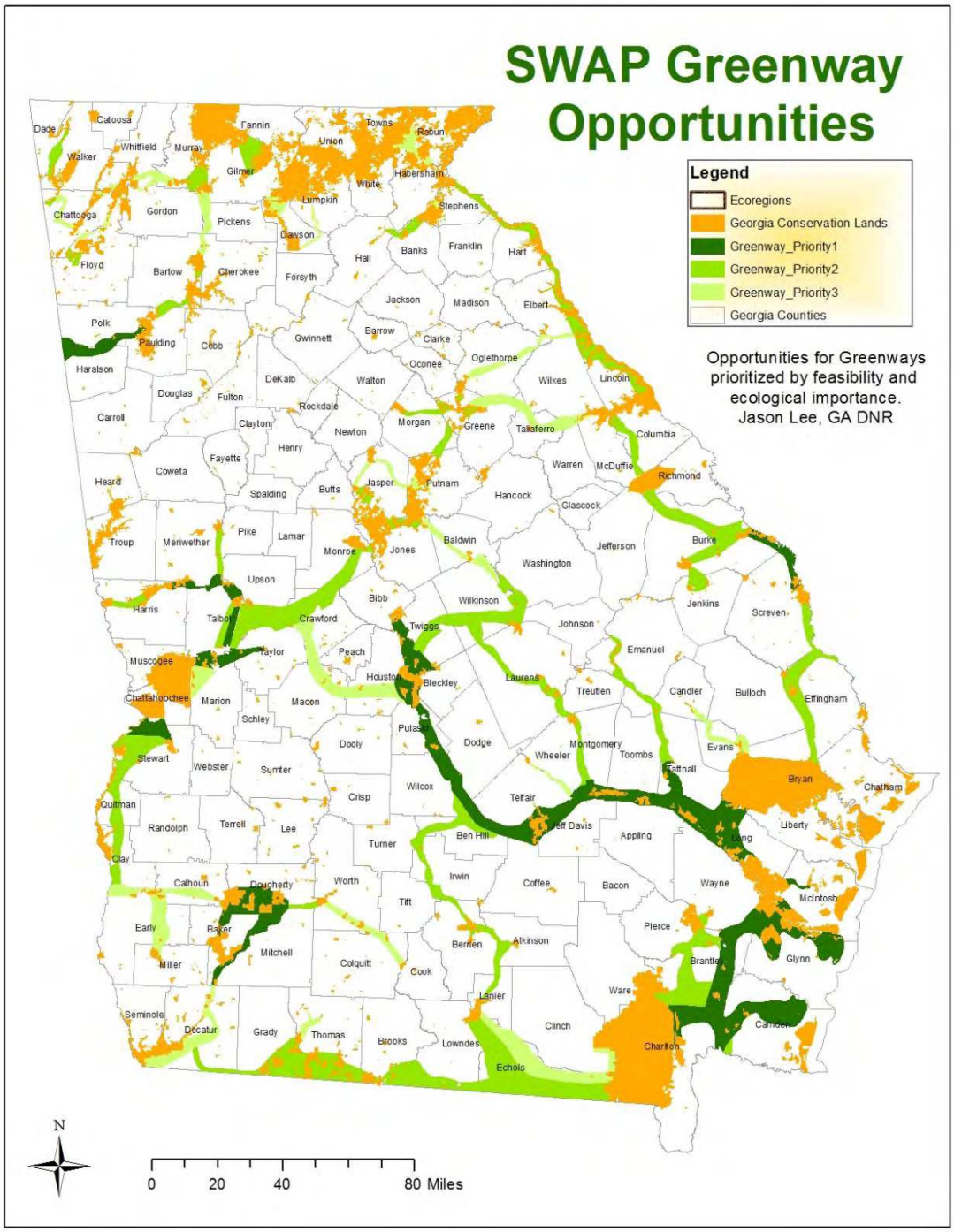
- Different species require different corridor types and sizes. Therefore, the best corridors will be large with diverse topography and land cover. Practically, this often means having significant adjacent uplands with riverine based corridors.
- Wetlands have layers of protection, both natural and regulatory (that must be accounted for in allocating limited conservation dollars.* Although wetlands are being converted to uplands (primarily ditched and drained, permissible under CWA), overall they do have more protection than upland sites.
- High Connectivity values per modeled land cover metrics (Local Connectedness model from TNC, SALCC Circuitscape Black Bear and Pine Snake models.)
- Connectivity between areas with priority species that require large habitat patches (e.g., RCW, gopher tortoise, eastern indigo snake). This usually indicates that the areas are currently functioning as corridors.
- Areas of high biodiversity are a priority for connections.
- Existing land uses (agriculture/forestry) provide some connectivity. A designated corridor within a matrix of more compatible land uses is superior to one that is not.
- High priority streams and watershed delineated by the Fishes and Freshwater Invertebrates Team

- Coastal areas that provide migration routes for species and habitats affected by sea level rise
- Coastal and Southeastern Plain areas with diverse topography (landforms).
- Adjacent states' conservation lands and plans are important to further enhance connectivity at a regional scale.

**A significantly impactful piece of wetland protection, the Biggert-Waters Act of 2012, rolls back federal flood insurance subsidies for new development in flood prone areas. This lack of subsidy will substantially increase costs for flood insurance, and will undoubtedly have a dampening effect on construction in wetlands. This Act, combined with Clean Water Act regulations and the No Net Loss federal policy, could be a powerful deterrent to development in wetlands.*

It is worth noting that, in Georgia, habitat connectivity is highest in the Blue Ridge Ecoregion. New corridors are needed primarily in other parts of the state, with the Fall Line region, Southeastern Plain and Coast as optimum targets due to ample affordable and available opportunities, priority species requirements and projected impacts from sea level rise. Ideally, all major conservation areas within the State should be connected eventually.

There are multiple ways to achieve a biologically effective corridor, depending on the target species, land use, land condition, land prices, and other factors. At minimum, development should be avoided in these areas via easements, at maximum the land should be acquired by the state and restored to a natural condition. The range of options for between these two extremes should be considered carefully for any potential property. The Draft Greenway Opportunities map below reflects all of these considerations. Please contact jason.lee@gadnr.org with any questions.

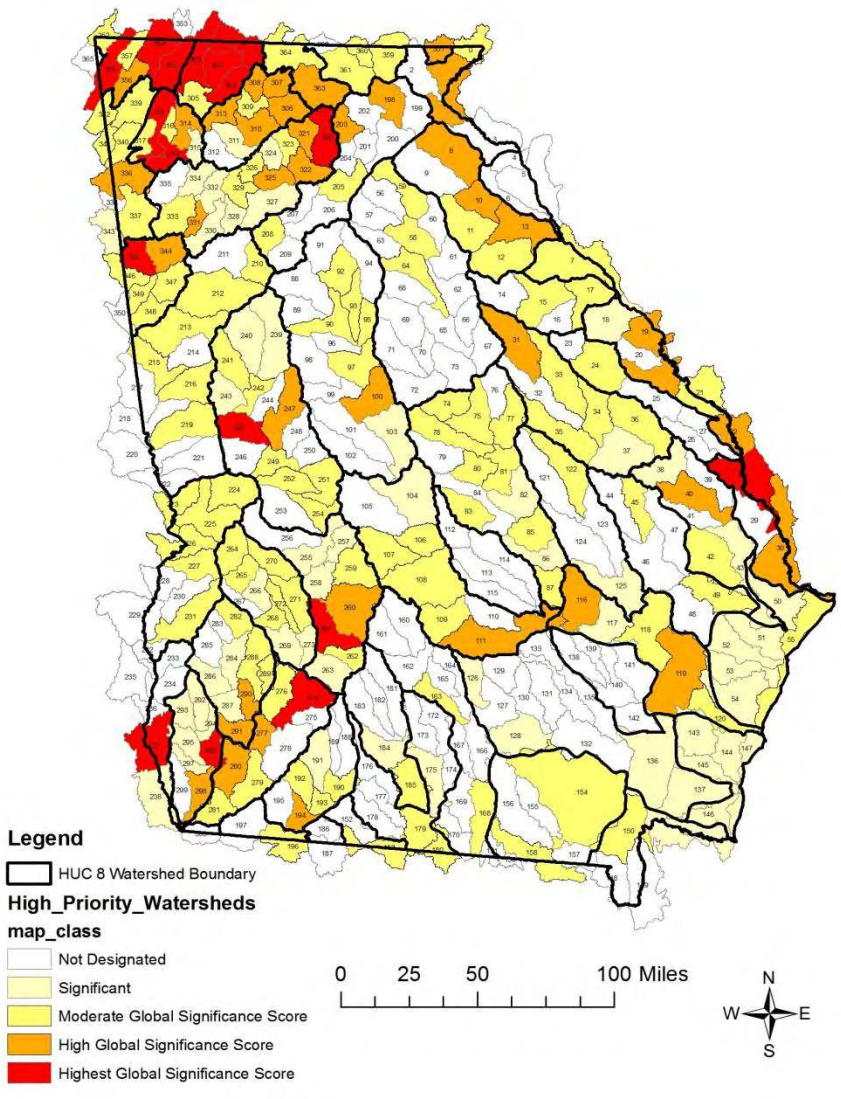


*Note that these do **not need to all be acquired and restored**; fully functioning natural landscapes, but could be a matrix of natural and working lands (forest) including some agriculture. Many of these exist and function currently as wildlife corridors, and so a primary goal is to retain that current land use. The Priority 1 area totals approximately 1 million acres. Thanks to Wade Harrison, Brett Albanese, Jon Ambrose, Matt Elliott and Brent Womack for edits and guidance.*

4. Priority Watersheds

The SWAP Fishes and Freshwater Invertebrates Technical Team and the SWAP Aquatic Habitat Technical Team have developed and implemented a prioritization method for watersheds at the Hydrologic Unit Code 10 watershed scale based upon the number of important populations of high priority aquatic species they support, as well as the global rarity of each species. Important populations of high priority species were designated in watersheds based upon the date of species occurrences, existing protection (e.g., conservation lands), existing condition (e.g., land use) and future threats (e.g., projected urbanization).

The Habitat Modeling Team has assessed the results and intends to incorporate this valuable information into the overall conservation priority process. Please refer to the SWAP Aquatic Habitat Team report for more details or contact Brett Albanese at Brett.Albanese@dnr.state.ga.us



High priority watersheds identified during the 2015 revision of Georgia's State Wildlife Action Plan.

5. Conservation Lands

In order to efficiently strategize for conservation, a comprehensive inventory of current protected areas is essential. In addition to current locations and acreages of conservation lands, it is also necessary to know the level of protection (how permanently protected) and the type of protection (is it managed primarily for wildlife, for silviculture, or other uses?).

Currently, there are substantial gaps in obtaining all of these parameters in a timely fashion. Below is a description of the level of reporting by land acquisition partners:

State of Georgia (Georgia DNR, GA Forestry Commission)

- Per the Georgia Land Conservation Act, GA DNR is required to maintain the State Land Conservation GIS
- Maintains an accurate, up to date GIS inventory of State of Georgia acquisitions and conservation easements acquired by the State or facilitated through the Georgia Conservation Tax Credit Program.
- Determines and records level of protection
- Partially successful in defining and recording the type of protection (often this is variable and dependent on uncontrollable variables)

Federal (Fish and Wildlife Service, Department of Defense, Forest Service, National Park Service)

- Maintains accessible, accurate, up to date GIS inventory of acquisitions.
- Determines and records level of protection
- Partially successful in defining and reporting the type of protection.

Land Trusts

- Some maintain accessible, accurate, up to date GIS inventory of acquisitions. Some updates are provided to GA DNR.
- Determines and records level of protection
- Partially successful in defining and reporting the type of protection.

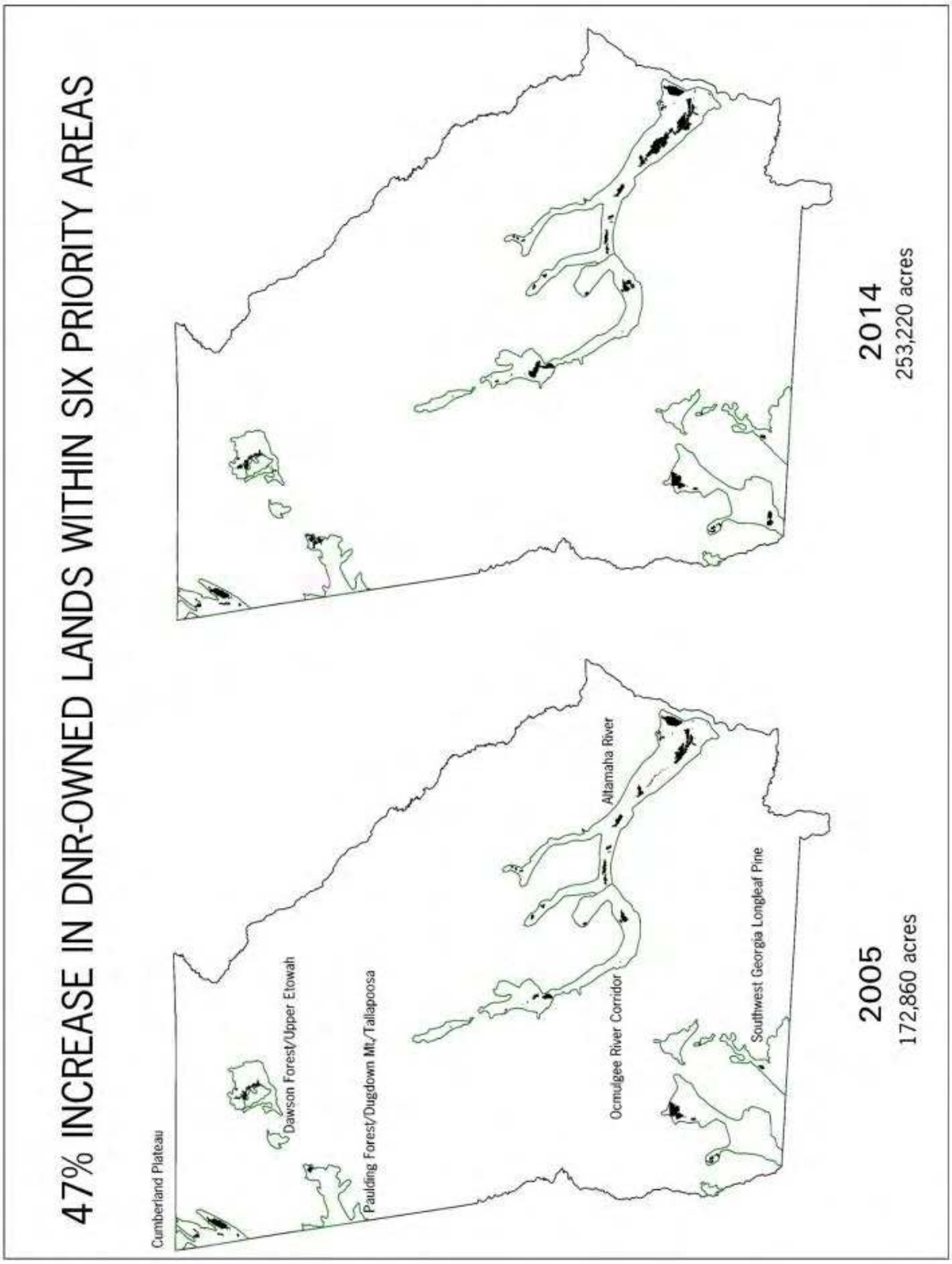
Local Governments

- Some maintain accessible, accurate, up to date GIS inventory of acquisitions, but none regularly provide updates to a statewide layer
- Do not generally determine and record level of protection
- Not generally successful in defining and reporting the type of protection.

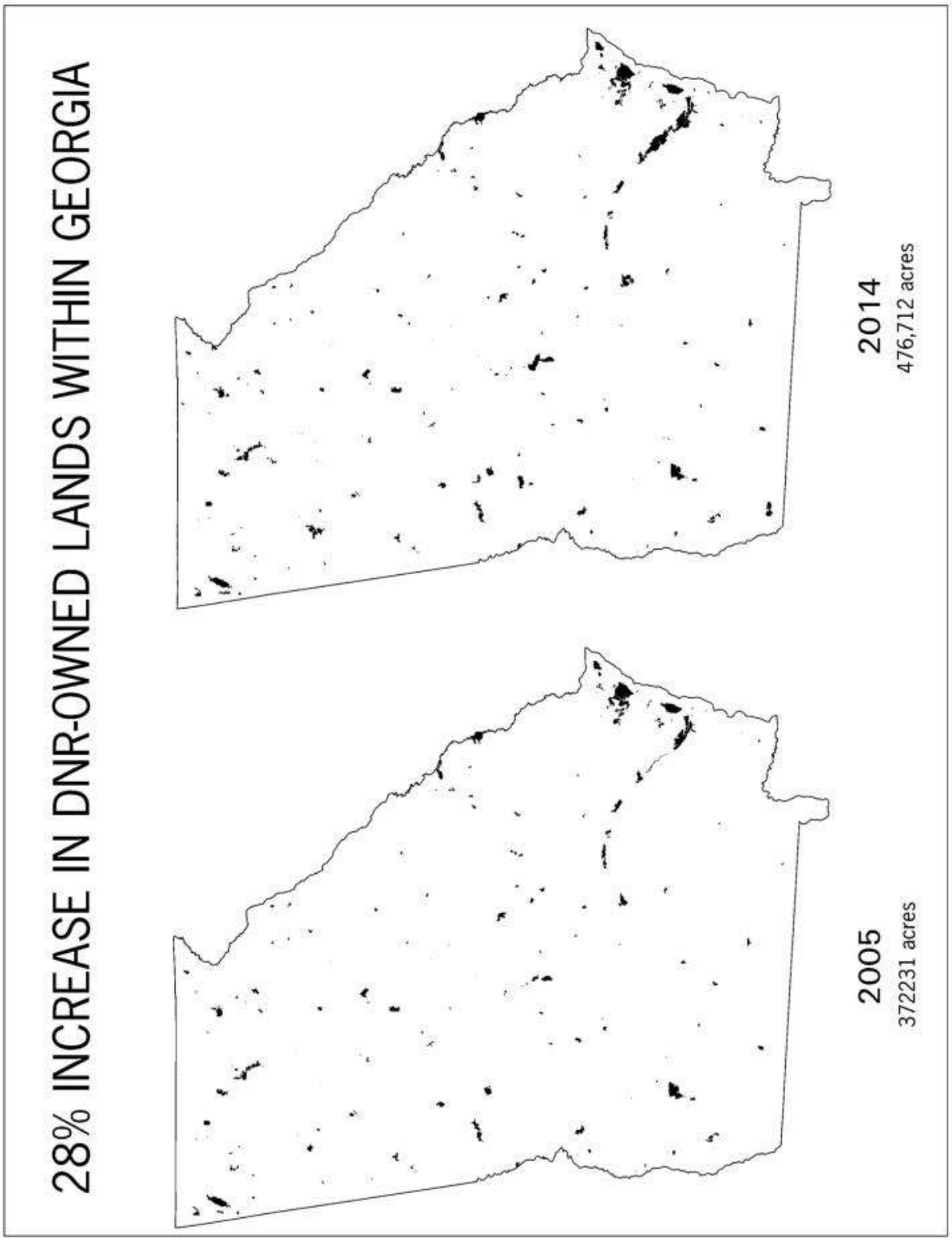
As evidenced by the above, it would be beneficial to have statewide coordination for conservation acquisition inventorying. It is also important to understand the impact of more

marginal conservation lands such as wetlands and areas zoned for non-urban uses (local land use zoning may be an important attribute for conservation lands, and currently, this is not accounted for in a statewide conservation lands database.) To that effect, spatial representations of both protected wetlands and zoning would also be helpful.

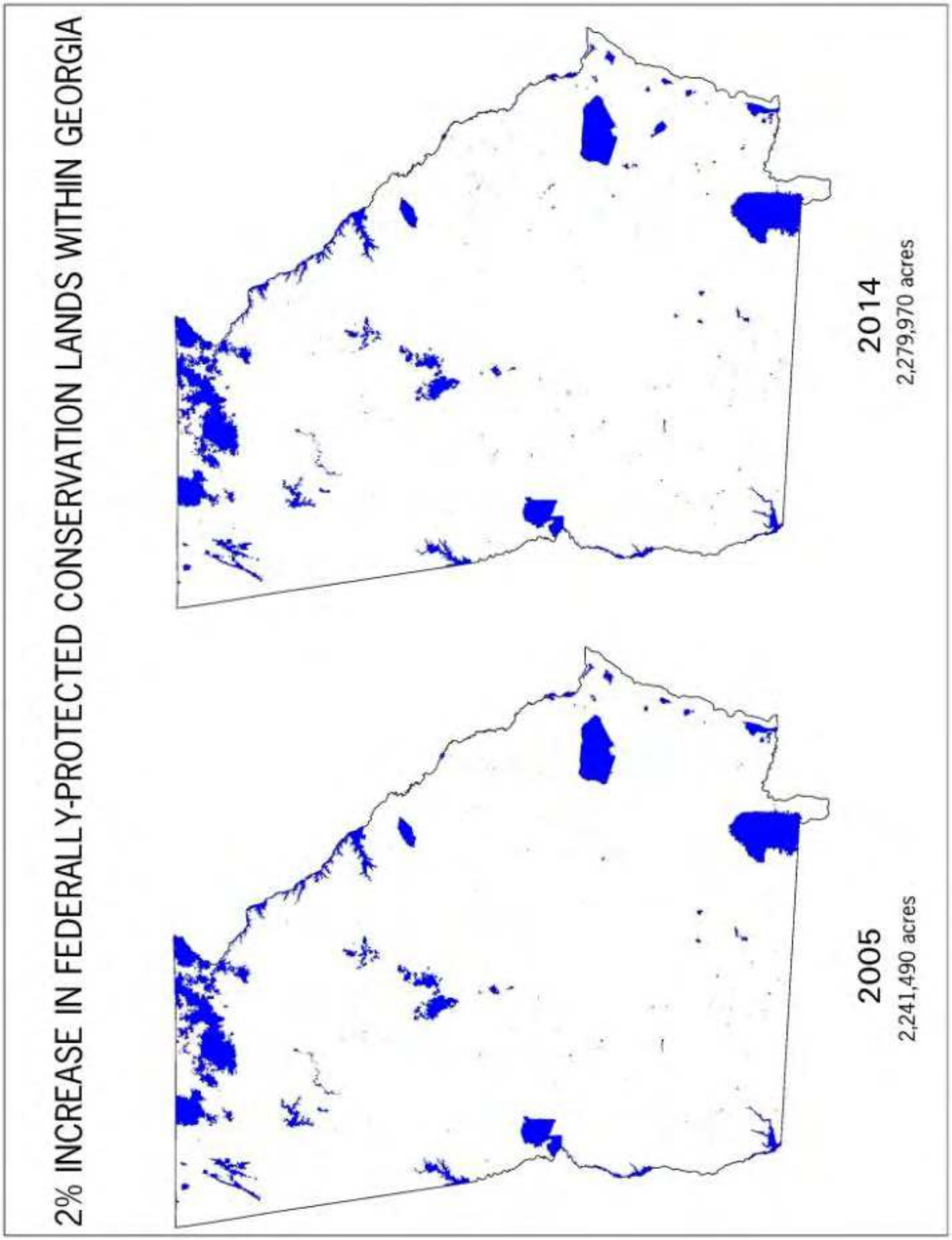
Progress of conservation acquisitions can be measured with several metrics. Below are maps showing accomplishments in Georgia land conservation over the past decade, encompassing 9 of the 10 years since the 2005 SWAP (all but the current year). Note that the Six Priority Areas shown in the following maps will be built upon, amended and ultimately supplanted by the overall results of the SWAP Habitat prioritization process.



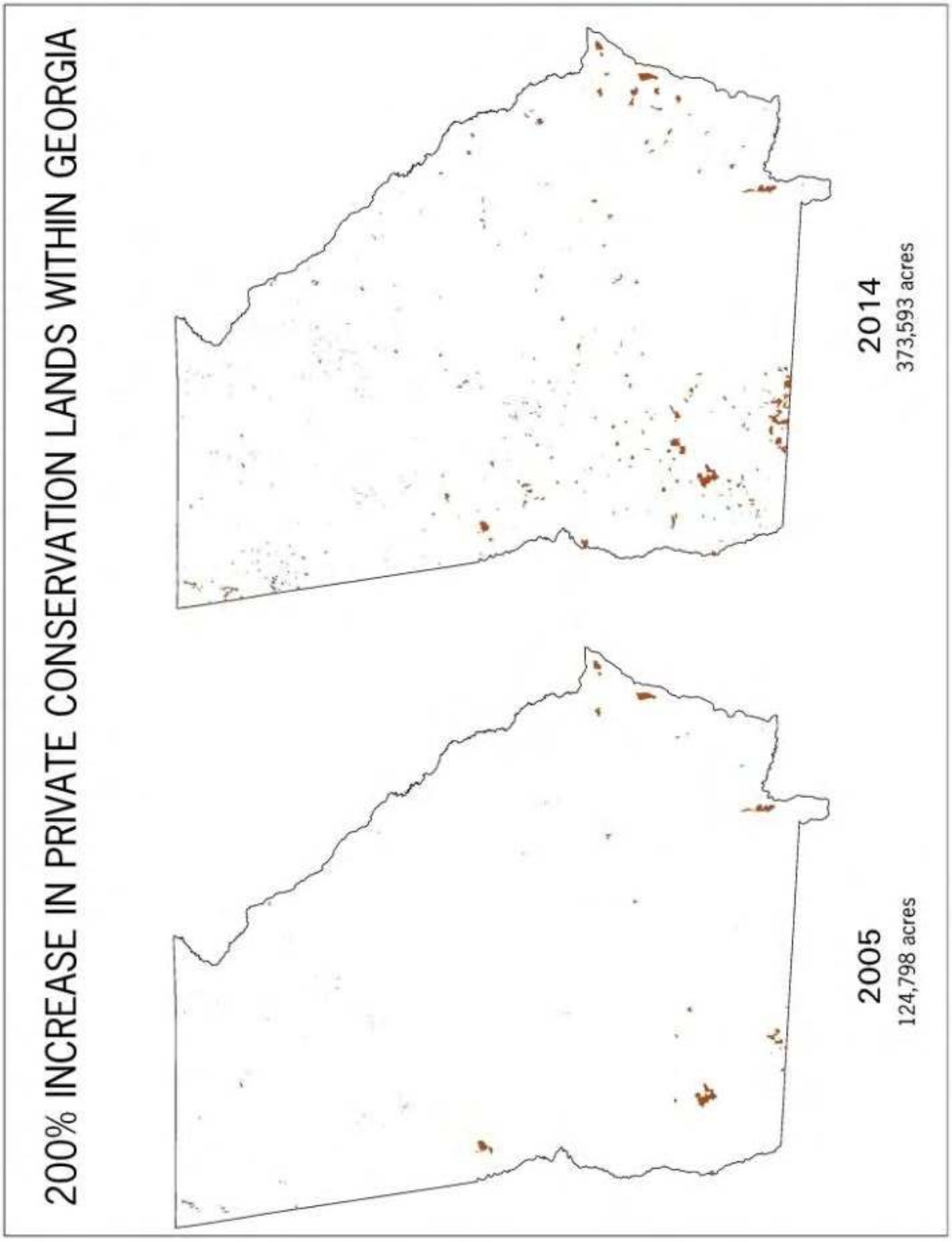
2005 Priority areas were defined using the 2005 SWAP Opportunity Map as a guide. These do not include easements. Figures generated by Chris Canalos, NCS DNR.



Statewide acquisitions since 2005 SWAP. 6% of our acquisitions were in non-priority areas.



Federal land protected in Georgia over past decade.



Private land protected in Georgia over past decade.

In the past 5 years alone, there have been 245,000 total acres (federal, state, land trust, local) protected. That totals 0.7% of the 37 million acres in Georgia.

As noted in the land cover section of this report, it is important to map which habitats are protected in the state, so that we can understand better where to focus our conservation efforts.

6. Species Habitat Modeling

To manage for individual high priority species, habitat requirements must be well understood. The function of the habitat modeling process is to translate those requirements into a spatial representation (a map) that accounts for current and potential habitat to identify areas for conservation targeting.

These models should be accurate and updatable and account for all Georgia species of concern. Our proposal in regards to this is three-fold:

First, we want to encourage a dynamic modeling process wherein researchers maintain models through time. As modeling assumptions shift, as land cover and climate changes, or as conservation lands are added, these changes should be incorporated into the model and new results produced. Although not always feasible, we intend to support this approach in a variety of ways to ensure that the habitat models stay current.

Secondly, these models should incorporate climate change and sea level rise projections where applicable. This would create a future habitat component to habitat models that will be beneficial for long term planning.

Thirdly, we are operating with limited budgets, and in order to produce more immediate, valuable results we have and will initially pursue species habitat models focused on "umbrella" or indicator species. These umbrella species have been chosen as representative of suites of species that associate with priority habitats, and are conducive to the modeling process (we have species occurrence data, we understand habitat requirements, and the species responds predictably to land cover data we have access too).

Our current umbrella list includes (*models/maps we currently have or are in development by researchers):

- Mammals
  - Yellow Bat
  - Summer Range of the Indiana Bat
  - *Black Bear *(SALCC)*
- Plants
  - Georgia aster
  - Relict trillium
  - Sandhills rosemary
  - Fringed campion

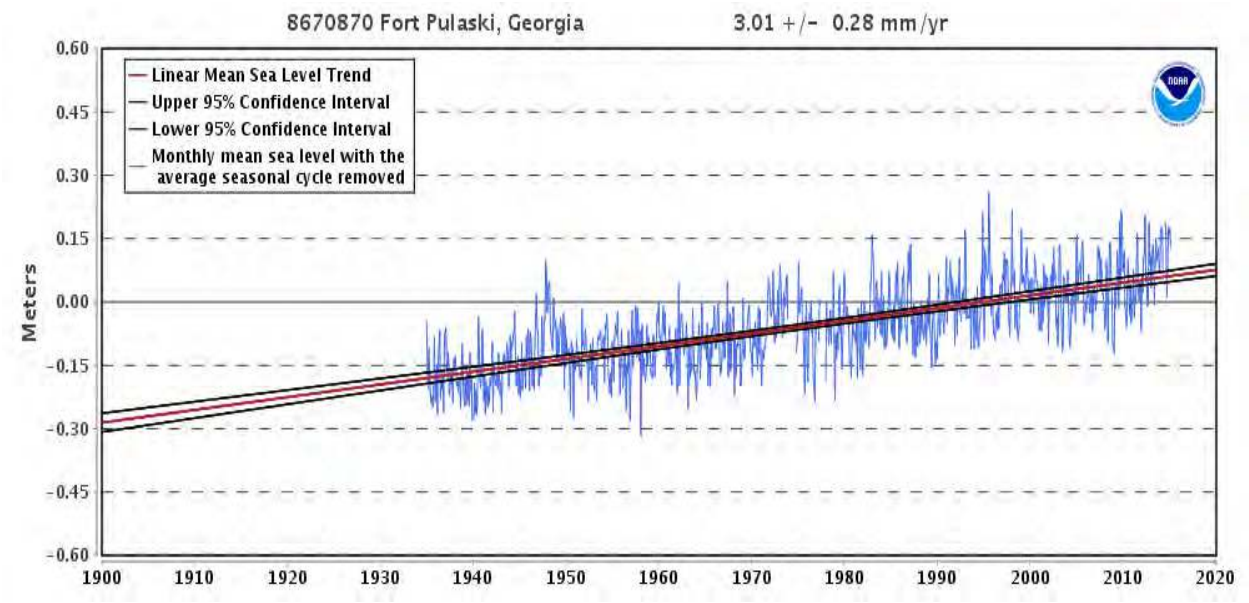
  - Georgia plume
- Reptiles/Amphibians
  - Green Salamander
  - *Bog Turtle
  - *Gopher tortoise *(Clint Moore)*
  - *Pine Snake *(Jeff Hepinstall-Cymerman)*
  - *Indigo Snake
  - *Striped Newt
  - *Flatwoods Salamander
  - *Southern hognose Snake *(Jeff Hepinstall-Cymerman)*
- Birds
  - *Swallowtailed Kite *(Ken Myer)*
  - Henslow's Sparrow
  - Red Headed Woodpecker
  - *American Kestrel
  - American Wood Stork
  - *Birds of Pine Savannas/Woodlands (Northern Bobwhite, Red Cockaded Woodpecker, Bachman's Sparrow; *SALCC*)

As stated, over time we will add important species to the above list and begin to fill in species that may not be covered under any of these categories.

Sea Level Rise & Climate Change

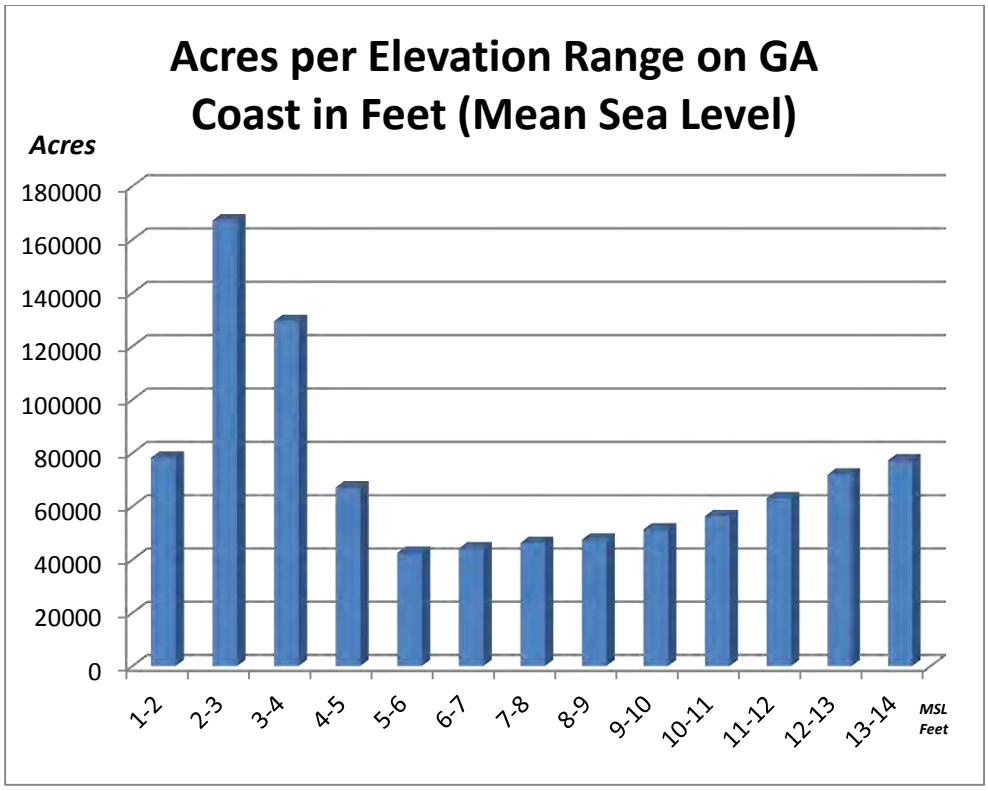
Climate change and sea level rise (SLR) are difficult to incorporate into the planning process. In addition to the uncertainty associated with understanding projections that reach far into the future, there is also considerable uncertainty inherent to the models themselves. However, it is important that the SWAP process begin to account for changes that may occur so that we are prepared.

Recent Sea Level Rise on the Georgia Coast:



The past 80 years has seen 10 inches of recorded rise per the NOAA Fort Pulaski tidal gauge near Savannah. Most sea level rise models predict this to accelerate sharply over the next decade.

From a planning perspective, we have the Sea Level Rise Affecting Marshes Model (SLAMM) based on high accuracy, Lidar derived elevations. This dataset projects various scenarios of SLR over the coming 100 years, and should be utilized whenever considering coastal habitats response to SLR. Of note is that much of the coast of Georgia is well situated for the next 30 years due to the predominance of high elevations. However, the vast expanses of saltmarsh will begin fragmenting substantially over that period, and will be followed by marsh drowning on a large scale.



Distributions of elevations on the Coast of Georgia, per Lidar.

Other useful coastal datasets for understanding potential SLR impacts are Historical Shoreline Change (Chester Jackson, Georgia Southern), Hardened Shoreline dataset (Clark Alexander, SKIO) and the Coastal Habitat Map (GA DNR).

Based on our current understanding of projected trends, the four most significant habitat concerns for the Georgia coast are:

- Marsh drowning creating significant habitat degradation
- Volatile extreme tides through rising sea level (frequent flooding of marginal upland habitats and associated species)
- Long-term coastal habitat migration (ample conservation lands and time for habitats to shift upland to new optimal areas)
- New and expanding populations of invasive species

As mentioned previously, an optimal way to approach land conservation on the coast that accounts for sea level rise is to target diverse topographical areas on the near coast. This approach should also be biased towards land with substantial areas above 13 Foot Mean Sea Level, which is the initial zone of elevation in which we have the least protection. For areas below 13'MSL, there is adequate protection in various ways (considerable wetlands, floodplains and near coast areas that are somewhat undevelopable or are already in conservation). 13' MSL is the first missing link in the chain of habitat migration that is necessary for coastal habitats to respond to SLR.

One possible exception to the protection level of areas below 13' MSL is highlighted by the lack of mitigation options for areas that will become marsh in the future. Mitigation is an important conservation tool that is legally designed to account for current impacts to wetlands primarily by restoring other impacted wetlands. Unfortunately, in order to satisfy requirements that mitigation credits be scored between the time of impact and the time of restoration (i.e., lost years of wetland function), mitigating for current impacts with future marsh areas is not easy to quantify. When will that upland area become marsh, and what type of marsh will it become are central questions. Nevertheless, there are significant ecological gains to be realized if future marsh areas can be used in the mitigation process.

It is also important that climate predictions be incorporated into species models as future scenarios. The SWAP Climate Change committee will provide guidance for these purposes, including other areas of the State that may be affected.

Data Needs

Identified data needs in addition to land cover:

- Lidar (statewide)
- Statewide tax parcel database
- Invasive species locations and projections
- Ecosystem services spatial layer

Summary

In summary, Georgia DNR's plan for implementation of SWAP Habitat Modeling goals is to build a comprehensive, dynamic modeling process that will result in a weighted priority index to be utilized for land acquisition by DNR, federal, state, local and private partners for wildlife conservation. Final prioritization inputs will be:

- Priority Vegetation Communities
- Habitat Richness Vertebrates
- Landscape Suitability (Patch/parcel size & Natural land cover)
- Floodplains & Wetlands & Recharge areas
- SLEUTH (future development)
- SLR and climate change impacts
- Focal Species Habitat Suitability models
- Priority Watersheds
- Connectivity Corridor potential

Immediate action items to reach the goals are:

- Compile and crosswalk existing high resolution mapping for the State
- Initiate mapping Priority Areas and Communities
- Create and/or commission Landscape Suitability derivations

- Build Species Habitat Models for selected species
- Develop and implement a plan for expansion and improvement of the Conservation Lands database
- Compile existing datasets into priority index (map)
- Construct mapping web portal to show primary inputs and results