

Alabama Gap Analysis Project

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The Gap Analysis Program (GAP) is a nationally sponsored program administered through the United States Geological Survey- Biological Resources Division (USGS-BRD) and facilitated at the state or regional level. The mission of GAP is to develop baseline data sets needed to assess biological diversity at statewide, regional and national scales. GAP employs Geographic Information Systems (GIS) to perform a gap analysis and identify the degree to which native animal species and plant communities are currently protected in the existing network of conservation lands. Gap analysis is an analytical process that assesses the conservation of species and their habitats collectively by mapping the distribution of native species and plant communities for comparison against patterns of land use and land management. Animal species or plant communities that are not adequately protected or unprotected in lands currently managed for conservation are considered a conservation “gap.”

The Alabama Gap Analysis Project (AL-GAP), instituted in 2001 through the Alabama Cooperative Fish and Wildlife Research Unit (ALCFWRU) at Auburn University, is one of the state level projects affiliated with the National GAP program. The objectives for AL-GAP include: 1) promoting cooperative approaches toward development and use of GAP data, 2) mapping existing land cover of Alabama, 3) producing maps of predicted distributions of vertebrate species occupying habitat in the state, 4) mapping ownership of public and private conservation lands within the state, 5) categorizing all stewardship lands according to management status, 6) producing a database of the total surface area and relative representation for each class of land cover and animal species relative to land stewardship categories, 7) producing a written report of mapping, assessment, analysis methods, results, accuracy and limitations and 8) developing a plan for maintenance and updating of the information.

The primary objective of National GAP, the funding source for AL-GAP, is to produce national-scale data sets and maps for biological diversity analyses, by combining the results of individual state projects. However, GAP methodology varied among state projects, which resulted in difficulties with “edge matching” data sets at state boundaries. To resolve these disparities, second generation regional GAP projects have been established, involving multiple research laboratories working in collaboration to produce data sets at a regional extent rather than an individual state extent. To avoid past issues of edge matching across political boundaries, regional GAP projects divide mapping ef-

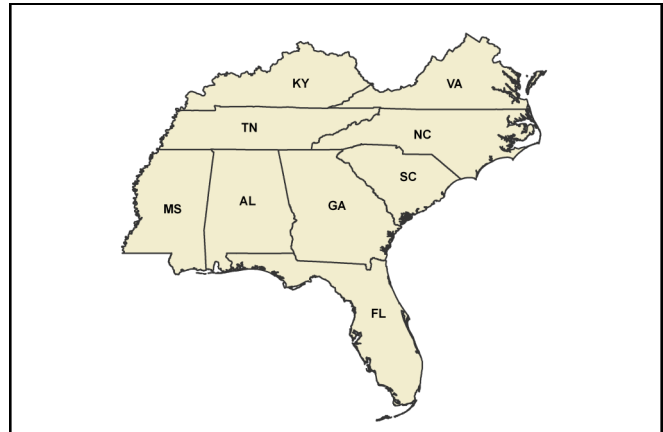


Figure 1. Biodiversity and stewardship were mapped for a 9-state area in the Southeast Gap Analysis Project

forts along ecologically distinct boundaries, and re-map land cover, vertebrate predicted distributions and stewardship data using standardized methods, mapping units and source data (e.g. hydrology, topography, etc).

In the southeastern United States, a regional project encompassing a nine state area (Figure 1) was initiated in February 2003 (Southeast Regional GAP, SE-GAP). At the onset of SE-GAP, AL-GAP was still developing approaches to state level mapping. This situation afforded AL-GAP the unique opportunity to work within the framework of SE-GAP and combine mapping efforts with the regional project. Teaming with the regional project allowed AL-GAP to become an integral partner in SE-GAP, and ensure the development of state level datasets that were regionally consistent. In essence, the collaboration allowed for “seamless” data to be created with states bordering Alabama, virtually avoiding past issues associated with edge matching data across state boundaries.

Mapping work and data for SE-GAP were developed as part of a cooperative effort among three labs; Alabama Cooperative Fish & Wildlife Research Unit, AL-GAP Project, Auburn University, AL; Biological and Spatial Information Center (BaSIC), North Carolina State University, NC; and the Natural Resources Spatial Analysis Laboratory (NARSAL), Institute of Ecology, University of Georgia, GA. As a result of the SE-GAP collaboration, state-level objectives for AL-GAP remained unchanged. Therefore, the state-specific analysis for Alabama was based on land cover, vertebrate distribution and stewardship data parsed directly from the SE-GAP data.

Land Cover

A map of current (circa 2000) land cover was created using Landsat Enhanced Thematic Mapper (ETM) imagery that has a spatial resolution of 30 meters. For the portion of the region including Alabama, land cover was generated by first stratifying the area into three relatively homogeneous mapping areas: the coastal plain, piedmont and uplands. Land cover in each of these physiographic areas was mapped separately using spring, summer and winter satellite scenes. Ancillary data layers (landform, soils, etc.) were employed to improve image classification. The classification scheme used to generate the map was a modified Anderson level II (Anderson et al. 1976) classification for non-natural classes and NatureServe's Ecological Systems (Comer et al. 2003) for natural and semi-natural vegetation. The classification was generated using a variety of techniques and training data from aerial imagery and field surveys.

In the resulting land cover map, the most common general land cover classes include upland forest (53% of the state area, 6799073 hectares), row crop-pasture (19%, 2603287 ha), shrub-scrub (9%, 1140974 ha) and wetland forest (7%, 1401372 ha) (Appendix 1.0). The resulting land cover map has 71 classes. At the time of this writing, an accuracy assessment has not been completed for the piedmont or the upland mapping regions. However, an accuracy assessment has been completed for the coastal plain. In the coastal plain individual class accuracies are highly variable and range from 8 to 100 percent. The area adjusted average accuracy of the map is 56%. The Kappa coefficient for the coastal plain accuracy assessment is 0.56.

Terrestrial Vertebrate Distributions

Potential habitat was identified within the state for 368 species, including: 155 breeding and two non-breeding birds, 56 breeding and one non-breeding mammal, 65 amphibians and 89 reptiles. Potential habitat distributions were based on known geographic range limits, habitat affinities, and environmental variables. Geographic range limits were delineated using a combination of occurrence records (e.g. field surveys, harvest data), expert opinion and previously published range maps. A Wildlife Habitat Relationship Database (WHRD) derived from current literature was created to identify species' affinities toward various landcover types and other biotic elements (e.g. hydrology, soil or elevation). A spatial query was then constructed within a Geographic Information System (GIS) to associate parameters from the WHRD with the land cover map, geographic range limit and ancillary data to yield a habitat distribution map for each species within the state. The resultant habitat map for each species was a binary raster grid produced at a 30-meter grid cell resolution with 1s representing predicted presence of habitat and 0s denoting absence.

A panel of 22 expert reviewers from state and federal conservation agencies and academic institutions as-

essed the reliability of the habitat models used to predict each species' habitat distribution. An analysis of the expert reviews suggested that 113 of the 368 models could be improved using existing information. For these species, suggestions provided by the panel were incorporated in the model and the predicted habitat distribution was mapped again.

Species Richness

Species richness maps were generated by combining predicted habitat distribution maps for all 368 vertebrate species. The resultant richness maps identify where the same number of elements co-occur in the same geographic locations. Species richness, or vertebrate biodiversity, in general was evenly distributed across the state (Table 1). The highest mean biodiversity of all terrestrial vertebrate species is concentrated in the Southeastern Plains and Southern Coastal Plain Ecoregion. These regions together comprise nearly 61% of the land area of the State and, as a result, would be expected to have the highest impact on the overall species richness values. By contrast, patterns of predicted species richness were variable among the different vertebrate taxonomic groups (Table 2). Breeding birds represented the taxonomic group with the highest mean richness in the state, but also encompass 42% of the total breeding species found in Alabama. Mean richness for mammals, reptiles, and amphibians was 19, 15, and 8 species respectively.

Land Stewardship

A land stewardship map was produced to provide an assessment of the protection status for vertebrate species and land cover communities. Land parcel boundaries were obtained from various state and federal agencies and voluntarily provided by private landowners and conservation land institutes. Each land parcel was attributed with ownership, management description (i.e. management activity) and managing agency. All stewardship parcels were also categorized according to GAP Management Status, four levels of commitment to maintenance (i.e. protection or management) of biodiversity or habitat conservation. Stewardship lands with a Status of 1 or 2 are permanently protected from non-natural land cover conversion. Status 3 lands are administered according to a documented management plan, but some consumptive or degradation activities are allowed. Status 4 lands have no management plan in place to protect them from conversion to non-natural land cover. Based on this classification, only 4.08 % or 553,999 hectares of Alabama currently have some degree of commitment towards the management or protection of biodiversity (Status 1, 2, or 3) (Table 3). Of these lands, only 164,844 hectares (29%) could be considered permanently protected (State 1 or 2).

Table 1. Percent cover of each Ecoregion (Griffith et al. 2001) and mean species richness* of each taxonomic group and across all groups.

Ecoregions	% Land Area of the State	Amphibians	Reptiles	Mammals	Breeding Birds	All Taxa*
Southeastern Plains	59.61	9	17	20	40	87
Southern Coastal Plain	1.41	8	15	17	40	80
Piedmont	9.33	6	12	18	39	75
Interior Plateau	6.38	6	11	17	40	75
Ridge and Valley	8.66	6	13	18	39	75
Southwestern Appalachians	14.61	6	12	18	38	74

*Includes only breeding species.

Table 2 Mean species richness of each taxonomic group statewide

Taxa	Mean	Maximum	Minimum	% of Total Breeding Species
Breeding Birds*	39	78	0	42%
Mammals*	19	34	0	16%
Reptiles	15	43	0	24%
Amphibians	8	38	0	18%
All Groups*	81	169	0	100%

* Minus wintering species

Table 3 Area and percentages of protected lands (Status 1, 2, or 3) summarized by ownership. (Excludes Status 4 lands which have no legally mandated conservation management plans).

Ownership	Status 1		Status 2		Status 3		State-	
	ha	%	ha	%	ha	%	ha	%
Federal	17,500	3.1	50,055	9.0	356,681	64.4	424,237	76.6
State	13,142	2.4	73,065	13.2	23,461	4.2	109,668	19.8
Local Government	-	-	504	0.1	-	-	504	0.1
Non-Governmental Organization	-	-	4,378	0.8	60	<0.1	4,437	0.8
Private	-	-	6,200	1.1	8,954	1.6	15,154	2.7
Total	30,643	5.5	134,201	24.2	389,155	70.2	553,999	

Table 4 Number and percentages of vertebrate species percent distribution within management status 1 and 2 summarized by taxonomic group.

Taxonomic Group	Percent Distribution in Status 1 and 2 Lands										Total
	< 1%		1-10%		10-20%		20-50%		>50%		
	#	%	#	%	#	%	#	%	#	%	
Amphibians	18	15.1	47	22.0	0	0.0	0	0.0	0	0.0	65
Reptiles	30	25.2	54	25.2	2	13.3	3	16.7	0	0.0	89
Mammals	19	16.0	36	16.8	2	13.3	0	0.0	0	0.0	57
Birds	52	43.7	77	36.0	11	73.3	15	83.3	1	100.0	156
All Species	119	32.4	214	58.3	15	4.1	18	4.9	1	0.3	367*

*Excludes non-breeding mammals

Gap Analysis

The general protection status of each biotic element (i.e., land cover type or vertebrate species) was determined by intersecting the land cover and each species' predicted distribution with the stewardship map. These results indicated the relative protection afforded to each biotic element within the state. More than half of all land cover classes (37 of 71) within Alabama have less than 1% of their distribution on Status 1 and 2 lands. Of these 37 classes, 16 are non-natural classes, that do not generally require protection, and 21 are natural Ecological Systems. Some of these systems include the East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland, East Gulf Coastal Plain Upland Longleaf Pine Woodland, Southern Coastal Plain Non-riverine Cypress Dome and Southern Mesic Slope Forest. Further analysis finds that less than 1% of the predicted distribution of 32.4 % (119 of 367) of the native vertebrates is protected in Status 1, 2 or 3 lands (Table 4). By contrast, greater than 10% of the predicted habitat for only 9.26% (34 of 367) of native vertebrates is protected by similar conservation efforts.

Data Availability

AL-GAP project data can be downloaded from the Alabama Cooperative Fish & Wildlife Research Units, AL-GAP website < www.auburn.edu/gap >, or the National Gap Analysis Program website < www.gapanalysis.nbi.gov >.

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Appendix 1.0 Area (in hectares and acres) and percent area by class in the GAP land cover map for the state of Alabama.

Value	Map unit name	Hectares	Acres	Percent
1	Open Water (Fresh)	278,415	686,758	2.1
2	Open Water (Brackish/Salt)	11,459	28,265	0.1
3	Open Water (Aquaculture)	8,705	21,473	0.1
4	Developed Open Space	626403	1,545,128	4.7
5	Low Intensity Developed	194,095	478,767	1.4
6	Medium Intensity Developed	54,826	135,238	0.4
7	High Intensity Developed	19,364	47,764	0.1
12	Florida Panhandle Beach Vegetation	379	935	< 0.1
17	Bare Soil	19,126	47177	0.1
18	Quarry/Strip Mine/Gravel Pit	3,393	8369	< 0.1
28	Southern Interior Acid Cliff	210	517	< 0.1
29	Southern Interior Calcareous Cliff	93	229	< 0.1
30	Southern Piedmont Cliff	475	1171	< 0.1
32	East Gulf Coastal Plain Dry Chalk Bluff	96	237	< 0.1
33	Southern Piedmont Granite Flatrock	56	139	< 0.1
35	Unconsolidated Shore (Lake/River/Pond)	329	812	< 0.1
36	Unconsolidated Shore (Beach/Dune)	1,066	2629	< 0.1
38	Allegheny-Cumberland Dry Oak Forest and Woodland-Hardwood	254,133	626861	1.9
44	East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest - Hardwood Modifier	212,863	525061	1.6
45	East Gulf Coastal Plain Limestone Forest	12,271	30269	0.1
46	East Gulf Coastal Plain Northern Dry Upland Hardwood Forest	67,480	166450	0.5
49	East Gulf Coastal Plain Northern Mesic Hardwood Forest	143,645	354323	1.1
51	East Gulf Coastal Plain Southern Mesic Slope Forest	288,461	711538	2.2
53	South-Central Interior Highlands Dry Oak Forest	166,264	410117	1.2
54	South-Central Interior Mesophytic Forest	285,509	704256	2.1
60	Southern Ridge and Valley Dry Calcareous Forest	678,227	1672961	5.1

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68	Southern Piedmont Mesic Forest	136,469	336623	1.0
69	East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland - Woodland Modifier	5,153	12712	< 0.1
71	Evergreen Plantations	832,293	2052989	6.2
79	East Gulf Coastal Plain Maritime Forest	9,124	22507	0.1
85	Southern Appalachian Low Mountain Pine Forest	290,214	715862	2.2
86	Southern Piedmont Dry Oak-(Pine) Forest - Loblolly Pine Modifier	72,521	178886	0.5
94	East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Loblolly Modifier	1,807,882	4459442	13.5
95	East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Open Understory Modifier	108,079	266596	0.8
100	Southern Piedmont Longleaf Pine Woodland	24,321	59992	0.2
101	East Gulf Coastal Plain Northern Dry Upland Hardwood Forest - Offsite Pine Modifier	7,573	18679	0.1
102	Allegheny-Cumberland Dry Oak Forest and Woodland - Pine Modifier	50,936	125641	0.4
103	Southern Ridge and Valley Dry Calcareous Forest	56,536	139,455	0.4
106	East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest - Mixed Modifier	221,741	546,960	1.7
107	Northeastern Interior Dry Oak Forest - Mixed Modifier	23,866	58,869	0.2
118	Ridge and Valley Calcareous Valley Bottom Glade and Woodland	11	27	< 0.1
125	Successional Shrub/Scrub (Clear Cut)	702,929	1,733,892	5.2
126	Successional Shrub/Scrub (Utility Swath)	36,128	89,115	0.3
127	Successional Shrub/Scrub (Other)	401,917	991,395	3.0
132	East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland - Herbaceous Modifier	3,676	9,067	< 0.1
143	East Gulf Coastal Plain Dune and Coastal Grassland	1,002	2,472	< 0.1
145	Clear cut - Grassland/Herbaceous	51,014	125,835	0.4
146	Other - Herbaceous	152,464	376,077	1.1

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Value	Map unit name	Hectares	Acres	Percent
149	Row Crop	841,474	2,075,635	6.3
157	East Gulf Coastal Plain Large River Floodplain Forest - Forest Modifier	423,993	1,045,848	3.2
158	East Gulf Coastal Plain Small Stream and River Floodplain Forest	646,177	1,593,904	4.8
161	South-Central Interior Large Floodplain - Forest Modifier	7,270	17,932	0.1
162	South-Central Interior Small Stream and Riparian	69,185	170,656	0.5
163	Southern Coastal Plain Blackwater River Floodplain Forest	205,950	508,009	1.5
164	Southern Piedmont Large Floodplain Forest - Forest Modifier	152	375	< 0.1
165	Southern Piedmont Small Floodplain and Riparian Forest	26,707	65,878	0.2
179	Southern Coastal Plain Nonriverine Basin Swamp	5,247	12,942	< 0.1
186	East Gulf Coastal Plain Near-Coast Pine Flatwoods - Offsite Hardwood Modifier	847	2,089	< 0.1
187	East Gulf Coastal Plain Near-Coast Pine Flatwoods - Open Understory Modifier	24,576	60,621	0.2
189	East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods	19,250	47,484	0.1
192	South-Central Interior/Upper Coastal Plain Wet Flatwoods	4,385	10,817	< 0.1
195	Southern Coastal Plain Nonriverine Cypress Dome	1,349	3,327	< 0.1
199	Cumberland Riverscour	4,183	10,318	< 0.1
206	East Gulf Coastal Plain Tidal Wooded Swamp	4,101	10,117	< 0.1
233	East Gulf Coastal Plain Treeless Savanna and Wet Prairie	2,673	6,593	< 0.1
238	East Gulf Coastal Plain Large River Floodplain Forest - Herbaceous Modifier	21,062	51,952	0.2
250	Mississippi Sound Salt and Brackish Tidal Marsh	12,292	30,321	0.1