

Illinois Gap Analysis Project

Compiled from Final Project Report

Introduction

Illinois is known as the “Prairie State,” a part of the vast grassland in central North America that once stretched from Indiana west to Nebraska, south to Texas and north to the Canadian Provinces of Saskatchewan and Alberta with outlying areas in Ohio and Arkansas. The landscape in Illinois once consisted of approximately 21.6 million acres of prairie and 13.8 million acres of forest (Iverson et al. 1989). Today, Illinois is dominated by agriculture.

Our objectives were to: (1) map vegetation types; (2) map predicted distribution of terrestrial vertebrates; (3) document occurrence of inadequately represented vegetation types in special management areas; (4) document occurrence of inadequately represented terrestrial vertebrate species in special management areas; and (5) make all information available to resource managers and land stewards in a readily accessible format.

Land Cover

The land cover classification developed for the Illinois Gap Analysis Project represents the third statewide land cover classification derived from Landsat satellite imagery. The first classification was developed by the Department of Geography at the University of Illinois at Urbana-Champaign from 1978–1981. The second and third classifications were developed by the Illinois Department of Natural Resources (IDNR), Illinois Natural History Survey (INHS), and Illinois State Geological Survey (ISGS) from 1991–1995 and 1999–2000, respectively.

The Land Cover of Illinois 1999–2000 (LCOI 99–00) was developed as part of the Illinois Interagency Landscape Classification Project (IILCP), a cooperative, interagency initiative that began in late 1999 between the U. S. Department of Agriculture National Agricultural Statistics Service (USDA–NASS), the Illinois Department of Agriculture (IDA),

and the Illinois Department of Natural Resources (IDNR) aimed at providing statewide land cover information on a recurring basis. The LCOI 99–00 was the primary product of the IILCP initiative and was the result of integrating the directed supervised classification of agricultural lands from the USDA–NASS Cropland Data Layer (CDL) Program (USDA–NASS 2000) and the unsupervised training and maximum likelihood classification of non-agricultural lands. The primary source information for the computer classification was Landsat 5 TM and Landsat 7 ETM+ satellite imagery acquired for three dates (triplicates) during the spring, summer, and fall seasons of 1999 and 2000. Twenty-three classes were delineated. The IILCP established a website in 2003 to provide information pertaining to interactive land cover statistical information on a state, county, and watershed basis, and also provide free download access to several data products developed during the project (IDA 2003). In addition, Illinois Land Cover, a 1:500,000 scale map, was published in June 2005 and has been made available by the Illinois State Geological Survey (ISGS) at <<http://www.isgs.illinois.edu/nsdihome/webdocs/landcover/index.html>>, and by the Illinois Natural History Survey (INHS) at <http://www.inhs.uiuc.edu/chf/pub/educational_mat.php>.

The IILCP initiative also produced the Illinois GAP land cover classification. The Illinois GAP land cover classification was developed to meet the requirements of Gap Analysis and fulfill the need for a detailed classification of land cover at the vegetation alliance level. A detailed Gap Analysis classification of the vegetated areas of the state was completed using similar methodology to the IILCP, with the notable exception of methodological differences in forested and urbanized areas as required for GAP. The final GAP classification can be aggregated to the IILCP classification, as well as a modified Anderson Level I classification (Anderson et al. 1972). Assessment of the classification accuracy was conducted using independent ground verification samples and standard accuracy assessment analysis and reporting procedures.

Results

The IL-GAP land cover classification distinguishes 29 land cover types; including 7 agriculture cover types, 5 forest cover types, 5 urban or built-up land cover types, 8 wetland types and 4 other categories (Table 1).

Agricultural land represents 11,158,349.61 hectares (ha) or 76.5 percent of the Illinois landscape. The most extensive cover types are comprised of monoculture row crops, principally corn and soybeans, which are typically rotated annually. Together, these two crop types account for 8,876,246.4 ha or 60.8 percent of Illinois' surface area. Because Illinois is dominated by agricultural lands, it was important to separate the agriculture cover categories by specific land use type.

Rural grassland ranks second in surface area with 1,697,106.64 ha, comprising 11.6 percent of Illinois' surface area. This category includes permanent pastureland, roadsides and fence lines, railroad right-of-ways, waterways, prairies, and other grassland cover situated in rural areas.

Five upland forest categories total 11.4 percent of the total surface area. Dry-mesic upland forest is the most common forest type in Illinois, representing 981,992.2 ha or 6.7 percent of the total surface area.

Urban or built-up land makes up the next largest category, occupying a total of 944,843.10 ha or 6.5 percent of the total surface area. Chicago is the largest urbanized area in Illinois and accounts for more than one-half of the total urban land cover.

Eight wetland categories total 555,245.89 ha or 3.8 percent of the land area, including woody and herbaceous types. Surface water makes up 1.7 percent of the total area for a total of 266,631.11 ha. The remaining three categories, barren and exposed land, clouds, and cloud shadows, comprise 0.1 percent of the total land cover classification.

Accuracy Assessment

Accuracy results for the Illinois GAP land cover classification are summarized in three tables in this section. The appropriate accuracy statistic to use depends on the intended use of the classification. Using the modified Anderson Level I of generalization, overall accuracy is 91 percent with FIA data and 96 percent without FIA data. The IILCP LCOI 99-00 Level accuracy is 81 percent and 84 percent, respectively. Finally, the Natural Community Level

Table 1. Illinois Gap Analysis Project land cover codes and cover types.

Land cover code	Land cover type
Agricultural	
11	Corn
12	Soybeans
13	Winter wheat
14	Other small grains and hay
15	Winter wheat/soybeans (double-cropped)
16	Other agriculture
17	Rural grassland
Forested	
22	Dry upland forest
23	Dry-mesic upland forest
24	Mesic upland forest
25	Partial canopy/savanna upland forest
26	Coniferous forest
Urban and built-up	
31	High density urban
32	Low/medium density urban
33	Medium density urban (TM scene 2331 only)
34	Low density urban (TM scene 2331 only)
35	Urban open space
Wetland	
41	Shallow marsh/wet meadow
42	Deep marsh
43	Seasonally/temporarily flooded wetland
45	Mesic floodplain forest
46	Wet-mesic floodplain forest
47	Wet floodplain forest
48	Swamp
49	Shallow water wetland
Other	
51	Surface water
52	Barren and exposed land
53	Clouds
54	Cloud shadows

accuracy is 75 percent or 82 percent, respectively. All but one of the overall accuracy statistics meet the GAP standard of at least 80 percent accurate, and a number of the key individual categories demonstrated much higher accuracy values.

Limitations and Discussion

In the IL-GAP land cover classification, grasslands offered particular challenges because in most cases they are actively managed. Common grassland management practices in Illinois include prairie restoration, the periodic use of fire, grazing, haying, the Conservation Reserve Program (CRP), and the Conservation Reserve Enhancement Program (CREP). The challenge for remote sensing analysts is that the results of the management practices are visible on the landscape and affect the spectral responses viewed by remote sensing devices. The end result is that in many cases management practices may have more effect on the spectral response of a grassland tract than does the species composition. It is difficult, for example, to spectrally distinguish tracts of tall grass prairie and CRP if both have similar management practices. During the time period the land cover was being created, no statewide digital layer representing areas of prairies, CRP, and CREP existed to help separate the grasslands into finer categories. Thus, the final Illinois Gap land cover classification contains one category for grasslands called rural grassland. Future updates of the land cover classification shall incorporate more detailed grassland categories such as CRP, warm season grass, and cool season grass using ancillary data that is now available statewide.

The GAP land cover classification represents the best and most comprehensive land cover layer available to date in order to support wildlife habitat relationship modeling for vertebrates in the State. Generally, the GAP land cover classification is most appropriate for use in regional resource planning at the watershed or county level. In terms of scale, the classification should be used for analysis at a map scale of 1:100,000 or smaller. Often, it will be more appropriate to work in terms of probabilities of occurrence rather than precise occurrence or non-occurrence of a given land cover type. Inappropriate uses would include using the GAP classification to define precise boundaries between mapped features for regulatory purposes or for acquisition; generating specific area measurements for small aerial features; or using GAP data to establish the accuracy of other data.

Due to its level of detail, it is anticipated that the Illinois GAP land cover classification will be used in a wide range of analyses for a diverse group of end users. For example,

the GAP land cover classification is being used by CTAP professional scientists to help select yearly monitoring sites in key habitats types (i.e. forests, grasslands, and wetlands) throughout the state. It is also being used by IDNR scientists in support of the Illinois Wildlife Action Plan (formerly the Illinois Comprehensive Wildlife Conservation Plan) to identify and characterize the remaining key wildlife habitats and identify and prioritize areas for conservation and restoration in the state. The GAP land cover classification also is being used by numerous graduate students in Fish and Wildlife Ecology at the University of Illinois at Urbana-Champaign as the major source data layer for identifying and analyzing key habitat areas for their thesis research.

Given the open and public availability of the Illinois GAP land cover classification, its widest dissemination and use is encouraged. All data products, metadata, and accuracy assessment files relating to Illinois GAP land cover classification are available for public download from the Illinois Gap Analysis Project website at the Illinois Natural History Survey <<http://www.inhs.uiuc.edu/cwpe/gap/>>, as well as the Illinois Department of Agriculture website <<http://www.agr.state.il.us/gis/index.html>>.

Terrestrial Vertebrate Distributions

The Illinois Gap Analysis Project (IL-GAP) mapped predicted species distributions in accordance with the standards of the National GAP Handbook as of February 16, 2000. The spatial resolution of the models is 30 meters, as provided by the IL-GAP land cover classification. To reduce files sizes and for distribution purposes, all vertebrate models were resampled to a 90 meter spatial resolution. The output of the predicted vertebrate species distributions depended on the input of spatial data; therefore, all ancillary data were formatted to match the IL-GAP land cover classification. GAP products are intended for applications at the landscape scale (Csuti and Crist 2000), thus all predicted species distributions were produced at 1:100,000 scale.

Distributions were predicted for 485 terrestrial vertebrate species. Final predicted species distributions were not created for species with historical or questionable hexagon ranges. A total of 736 predicted distributions were created for 60 mammals, 266 migratory birds, 48 permanent resident birds, 152 summer resident or breeding birds, 111 winter resident birds, 41 amphibians, and 58 reptiles. The total number of models did not equal the total number of species because multiple ranges were created for some bird species.

Mammals

Most mammals have been well studied in Illinois and the distributions were straightforward. Because the distribution of mammals relied on locations from museum collections, research scientist studies, and information gathered from district wildlife biologist mail surveys, the distribution maps likely had higher richness areas where the sampling was conducted (i.e. major universities such as the University of Illinois at Urbana–Champaign). Bats were the most difficult order to model because the habitats they use as roosting sites, such as caves and old buildings, are not represented in the land cover. Thus, only the foraging habitat was modeled for bats. Distributions for fossorial species tend to be overestimated due to the inability to map the understory vegetation in the land cover or to use soil types in the final distribution.

Birds

Museum collections along with observations by amateur and professional ornithologists provided a detailed record of occurrences of bird species across Illinois through 2000. By using such a large number of data sources in the creation of the hexagon range distributions as well as creating multiple distribution ranges (migratory, summer resident or breeding, permanent resident, and winter resident) for each species, the distributions for all birds species have been very well documented. These sources of information probably make the bird distributions models the most complete and up-to-date of all the vertebrate taxonomic groups. The use of model modifiers, especially lakes and habitat edges, greatly improved the distributions for many bird species.

Amphibians and Reptiles

Habitat modeling for amphibians and reptiles was difficult because many species depend on microhabitat features that are not present in the land cover, such as downed logs or suitable hibernacula. Also, many landscape features required by herpetofauna could not be modeled due to unavailable statewide data layers (i.e. water depth, temperature, or vernal pool locations).

The Illinois GAP Project did not conduct an accuracy assessment for the vertebrate habitat modeling process.

Land Stewardship

Public lands (federal, state, non-governmental organization [NGO], and local) comprise approximately 4,477 km² (3.1 percent) of Illinois, whereas private lands make up 141,465 km² (96.9 percent) of the State. The area of Illinois land in status 1 and 2 is 334 km² (0.2 percent) and 1,429 km² (1.0 percent), respectively. Protection status 3 lands cover 2,678 km² (1.8 percent) of Illinois, and 141,501 km² (97.0 percent) are in status 4. Although we have attempted to assess the land stewardship to the best of our ability, the IL-GAP stewardship layer is best considered as a snapshot view of available information.

Gap Analysis—Land Cover

Ten vegetation types have less than 1 percent of their distribution on GAP Status 1 and 2 lands. As expected, these include all agriculture and urban categories (except some urban areas in the Chicago region). Clouds and clouds shadows, which were unable to be removed from the classification, also fall into this category. Seventeen vegetation types have between 1 and 10 percent of their distribution on GAP Status 1 and 2 lands. These include grasslands, upland and floodplain forests, medium and low density urban areas in the Chicago region, barren and exposed lands such as quarries, and most of the herbaceous wetlands. The seasonally/ temporarily flooded wetland is the only land cover type with between 10 and 20 percent of its representation on GAP Status 1 and 2 lands. The majority of this cover type occurs along the Illinois and Mississippi Rivers, which have numerous lands owned and/or managed by either federal or state agencies (i.e. U.S. Army Corps of Engineers, Illinois Department of Natural Resources). Swamp is the only land cover type with between 20 and 50 percent of its distribution on GAP Status 1 and 2 lands. The swamp land cover type is located only in southern Illinois and the largest area is in the Cache River area. Much of the Cache River area is owned and/or managed by either federal or state agencies (i.e. U.S. Fish and Wildlife Service or the Illinois Department of Natural Resources). There is no land cover in Illinois that has at least 50 percent of its distribution on protected lands.

Gap Analysis—Vertebrates

Of the 359 vertebrate species assessed by IL-GAP, 88.0 percent had less than 10 percent of their predicted distributions on status 1 or 2 lands. This includes 55 mammals (91.6 percent), 47 permanent resident birds (98.0 percent), 122 summer resident birds (80.3 percent), 36 amphibians (87.8 percent), and 56 reptiles (96.5 percent). The species with less than 1 percent of their predicted distribution in status 1 and 2 lands include 8 mammals, 15 permanent resident birds, 18 summer resident birds, 3 amphibians, and 6 reptiles for a total of 50 species (13.9 percent). Of these 50 species, nine (18.0 percent) are listed as either state threatened (ST) or state endangered (SE) (ST = 3, SE = 6). Three species (two amphibians and one summer resident bird) had predicted distributions that totaled less than 50,000 ha, including the Jefferson salamander (*Ambystoma jeffersonianum*ST), hellbender (*Cryptobranchus alleganiensis*), and Snowy Egret (*Egretta thula*SE). Not only did these species have less than 1 percent of their predicted distribution in status 1 and 2 lands, but their overall distributions were restricted. Three out of the four species with a total predicted distribution less than 50,000 ha are listed as threatened or endangered species in Illinois. These species require special attention if habitats are to be maintained.

Conclusions

In Illinois, wildlife must be conserved on private lands, which will require some new approaches, as well as continuing with some of current approaches already in place at the state level. The Farm Bill, with its incentive programs to conserve erodible lands, and the Wetland Reserve Program, is one already in place in Illinois. In some cases, where particularly valuable wildlife habitat occurs, it is possible for government agencies or non-government organizations to purchase conservation easements on private lands. Other possibilities are cooperative agreements between public and private interests, tax incentives, and education.

References Cited

- Anderson, J.R., E.E. Hardy, and J.T. Roach, 1972. A land-use classification system for use with remote sensor data. U.S. Geological Survey Circular 671, 16 p.
- Csuti, B., and P. Crist. 2000. Methods for developing terrestrial vertebrate distribution maps for gap analysis. A handbook for conducting gap analysis. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, Idaho.
- (IDA) Illinois Department of Agriculture. 2003. Geographic Information System. Available from <<http://www.agr.state.il.us/gis/index.html>>
- Iverson, L.R., R. Oliver, D. Tucker, P.G. Risser, C.D. Burnett, and R. Rayburn. 1989. Forest resources of Illinois: An atlas and analysis of spatial and temporal trends. Illinois Natural History Survey, Special Publication 11.
- (USDA–NASS) U. S. Department of Agriculture–National Agricultural Statistics Service. 2000. Cropland data layer program. Available from <<http://dnr.state.il.us/orc/Wildliferesources/theplan/>>
- (IDNR) Illinois Department of Natural Resources. 2008. Illinois wildlife action plan. Available from <<http://dnr.state.il.us/orc/Wildliferesources/theplan/>>