

RELATIVE ACCURACY OF FOREST COVER CLASSIFICATION OF LAND USE AND LAND COVER MAPS FOR INDIANA

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INTRODUCTION

The Land Use and Land Cover (LUDA) digital map products are prepared by the U.S. Geological Survey (USGS) using data obtained from remote sensors on aircraft and satellites that are classified using rigid, standardized criteria (Anderson, *et al.*, 1976). LUDA digital data tapes provide a possible land use and land cover data source for developing Geographic Information Systems (GIS). LUDA maps (1:250,000-scale) are thematic quadrangles, depicting classifications of land use and land cover in a polygon format. The area covered by LUDA maps corresponds to that of USGS 1° to 2° topographic quadrangles of the same scale. A minimum mapping unit of 16 ha (40 a) is used for forest cover (Forest Land and Forested Wetlands); land with a timber-crown aerial density (closure) $\geq 10\%$ not developed for other land uses or classified otherwise. Since many forest tracts in Indiana are ≤ 16 ha, the concern was that LUDA maps might underestimate the amount or proportion of forest acreage. Our objective was to verify the relative accuracy of the forest cover classifications for areas with less than 40% forest cover in Indiana.

STUDY AREAS

Two study areas with less than 40% forest cover were chosen from another study (Backs, 1987) to verify the accuracy of the forest cover classifications on LUDA maps. Each study area included 1 to 3 subsample units, which encompassed sites where the restoration of eastern wild turkey (*Meleagris gallopavo silvestris*) had been initiated. The subsample units allowed comparisons between the two map types over smaller areas with variations in the amount of forest cover and distribution. The study area in northwest Indiana (Northwest) included portions of Starke, Laporte, and Marshall counties. Three subunits encompassed wild turkey release sites at Jasper-Pulaski State Fish and Wildlife Area (Jasper-Pulaski); Winamac State Fish and Wildlife Area and Tippecanoe State Park (Winamac-Tippecanoe); and the Menominee State Wetlands Area (Menominee). The proportion of forest cover across the study area is low ($\leq 15\%$) and often exists as small discontinuous blocks or tracts (≤ 16 ha). The small forest blocks were of particular interest to LUDA map verification, since they were smaller than the minimum mapping unit.

The southwest Indiana study area (Southwest) included portions of Warrick, Spencer, Pike, Dubois, and Gibson counties. The study area also included portions of the Patoka State Fish and Wildlife Area and Lincoln State Park. One subsample unit encompassed a wild turkey release site along the Little Pigeon Creek drainage (Pigeon Creek). The proportion of forest cover across the study area was generally 20-40%, existed in > 16 ha blocks, and was relatively more continuous than found

TABLE 1. Forest cover amounts obtained from USGS LUDA maps and USFWS wetlands maps¹.

Study Areas	Area Size (km ²)	Percent Tract Size (ha) Cover	Forest ($\bar{x}$; n)
NORTHWEST INDIANA			
Menominee			
Wetlands Maps	199	10	6; 36
LUDA Map	211	23	149; 33
Winamac-Tippecanoe			
Wetlands Maps	82	14	19; 60
LUDA Map	87	24	109; 19
Jasper-Pulaski			
Wetlands Maps	93	15	28; 49
LUDA Map	105	35	242; 15
NORTHWEST TOTAL			
Wetlands Maps	1,062	5	11;435
LUDA Map	1,217	16	83;238
SOUTHWEST INDIANA			
Pigeon Creek			
Wetlands Maps	98	38	270;120
LUDA Map	109	33	257; 14
SOUTHWEST TOTAL			
Wetlands Maps	646	33	36;585
LUDA Map	713	33	428; 55

¹ U.S. Geological Survey's Land Use and Land Cover (LUDA) Maps (1:250,000); Chicago (1975-78); Vincennes (1977, 1980-81). U.S. Fish and Wildlife Service's Wetlands Inventory Maps (1:24,000); San Pierre, North Judson, Denham, Bass Lake, Culver, Rutland, Knox East, Knox West, Donaldson, Plymouth, Chrisney, De Gonnia, Bonnville, Lynnville, and Folsomville. All 1984.

in the Northwest. Descriptive maps of the study areas and subsample units are presented in Backs (1987).

METHODS

LUDA maps for Indiana were obtained from the National Cartographic Information Center, USGS. Forest cover (Forest Land and Forested Wetland classifications) polygons were manually highlighted with colored ink pens. Wetland maps (1:24,000) were aerial photo composites reproduced according to specifications of the U.S. Fish and Wildlife Service (1987). The area covered by each wetland map corresponds to that of each respective standard USGS topographic maps (1:24,000-scale). Forest cover < 2 ha is discernible and a minimum mapping unit for forest tracts on the wetlands maps was ≥ 5 ha with $\geq 40\%$ timber-crown closure. Forest tract boundaries were delineated in pencil to make them more visibly defined. Other land uses ≥ 2 ha contained within larger forest tracts were deleted from forest cover acreages. The amount of forest cover determined from the wetlands maps was considered the actual amount present for verifying the accuracy of the LUDA forest cover classifications.

Forest cover was manually measured on both types of maps using an electronic planimeter (Numonics, Model No. 1260). Data were compiled by study area and subsample units for respective comparisons.

RESULTS AND DISCUSSION

The proportion of forest cover and mean tract size were generally greater on the LUDA maps, especially when forest cover was $<15\%$ on the wetlands map (Table 1). The magnitude of these differences was also related to average forest tract size with more pronounced differences occurring where forest tracts existed as small, discontinuous blocks. This is quite evident in comparisons between the Pigeon Creek subunit of the Southwest to the subunits of the Northwest. Forest cover along the Pigeon Creek drainage exists as continuous strands or tracts as opposed to the small, isolated blocks often found on the Northwest subunits.

The broader criteria for classifying forest cover on the LUDA maps (i.e., $\geq 10\%$ versus $\geq 40\%$ timber-crown closure for the wetlands maps) would initially appear to contribute to an upward bias in the amount of forest cover on the LUDA maps. This discrepancy was considered a minor factor in classification differences, because most forest tracts on the wetlands maps had crown closures $\geq 40\%$. Some small differences in the amount of forest cover depicted on the two maps probably resulted from the disappearance of timber during the time period when the two map types were completed. The LUDA maps were generally 5-6 years older than the wetlands maps. The slight discrepancies in the study area sizes were attributed to manual measuring errors and differences in map scales.

Overall, the accuracy of the LUDA maps improves as forest cover exceeds 30% and exists in larger, more continuous tracts. While not examined, LUDA maps may tend to overestimate the amount of forest cover (underestimate Agriculture land classifications) as the proportion of forest cover exceeds 70%. The biases of the LUDA forest cover classification are relatively minor and LUDA maps presently represent the most complete planimetric, digitized, data base for forest cover and other land uses in Indiana. LUDA maps and digital tapes are inexpensive, readily available, and could serve as useful data bases for regional forest land use applications to developing GIS technologies. Further verification and refinements in LUDA data bases will be possible as GIS technologies are employed by land use agencies in Indiana.

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