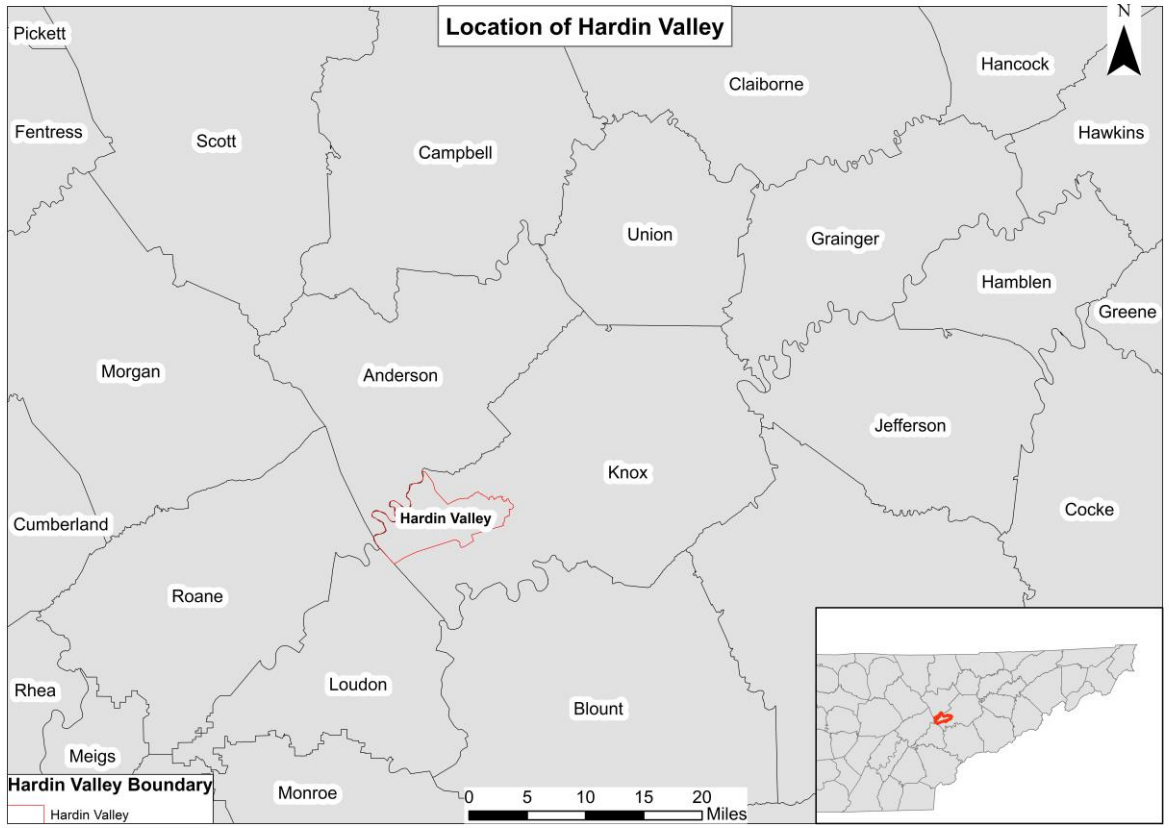
LANDSAT ANALYSIS:

The Study of a Once Rural Community

Introduction

HARDIN VALLEY

- Located in Knox County, TN.
- Once a predominantly rural community.
- Utilize capabilities of Landsat imagery and GIS to determine the distribution and magnitude of urban growth.



Literature Review

- Remote sensing is the acquisition of information about the Earth's surface using satellite or aircraft for detecting changes in land cover for environmental, land resource management, and urban planning purposes
- The size and location of urban growth studies varies. As long as the data is available, the smallest municipality to the largest can be analyzed
- Determining urban growth through the use of remote sensing and GIS can be accomplished by using several different methods, change detection is a common method

Research Objective

- How has the spatial distribution of land use/land cover changed due to urban growth over the last fifteen years?
- Is there a spatial pattern to the urban growth in Hardin Valley?

Importance of Research

- The use of remote sensing and GIS allows urban planners and local governments to monitor the size and scope of urban growth so resources and infrastructure can be allocated to the areas of greatest need
- If left unchecked, growth can expand into fragile lands and habitats, the use of remote sensing and GIS allows growth to monitored as needed
- Local utilities and planners are struggling to keep up with the current growth

Data

- Classifying the data available in the imagery required supervised classification of the imagery
- Classifications used:
  1. Urban
  2. Forest
  3. Grassland
  4. Bare land
  5. Water
- Training sites produce a pixel count for each classification based on the spatial resolution of the imagery
- The resulting pixel count for each classification was then turned into the area (km^2 and acres) used in the analysis

Summary of Landsat Images

Year	Sensor	Date	Path/Row	Spatial Resolution (m)
2003	Landsat 7 ETM	4/14/2003	19/35	30
2007	Landsat 5 TM	5/13/2007	19/35	30
2013	Landsat 8 OLI/TIRS	10/26/2013	19/35	30
2018	Landsat 8 OLI/TIRS	10/24/2018	19/35	30

Methods

- The supervised maximum likelihood method is considered “one of the significant supervised classification methods”, with each cell is assigned the classification to which it has the highest probability of being a member
- Change detection determines the change between the classifications from two or more time periods
- Determining classifications:
  1. Urban - roads, buildings, parking lots, airports, and other impervious surfaces
  2. Forest - any area covered by trees
  3. Grassland - areas covered by grass, to include lands used as grazing for livestock or other agricultural purposes
  4. Bare land - any land stripped of grass or forest
  5. Water - lakes, creeks, and ponds; detention ponds in developed areas will be considered ponds

Results

- The area of Hardin Valley is 117 km^2 or 28,817 acres, with results showing that the amount of urban area increased over the course of the study
- Urban land use growth from 2003-2007 was 6.8%, 12.3% from 2007-2013, and 3.57% from 2013-2018.
- Bare land in the Hardin Valley area is a sign that urban development is imminent.

Accuracy Assessment Results

Year	Overall Accuracy (%)	Kappa Coefficient
2018	81	0.737
2013	80	0.730
2007	79	0.701
2003	84	0.734

Year/Area (Acres)

	Land Use	2003	2007	2013	2018
1	Urban	4,688	5,009	5,627	5,828
2	Forest	8,083	6,021	10,714	7,701
3	Grassland	13,912	15,088	10,637	12,791
4	Bare land	711	1,282	443	1,076
5	Water	1,423	1,418	1,397	1,422

Table 1

% Growth (Acres)

Land Use		2003-2007	2007-2013	2013-2018
1	Urban	6.84	12.33	3.57
2	Forest	-25.51	77.94	-28.12
3	Grassland	8.45	-29.50	20.25
4	Bare land	80.31	-65.44	142.89
5	Water	Water changes were not monitored due to little change.		

Table 2

Land Use Change (Acres)

2013-2018		Percent (%) Change
Forest to Urban	62	30.85
Grassland to Urban	117	58.21
Bare land to Urban	18	8.96
2007-2013		
Forest to Urban	29	4.69
Grassland to Urban	433	70.06
Bare land to Urban	156	25.24
2003-2007		
Forest to Urban	68	21.18
Grassland to Urban	212	66.04
Bare land to Urban	41	12.7

Table 3

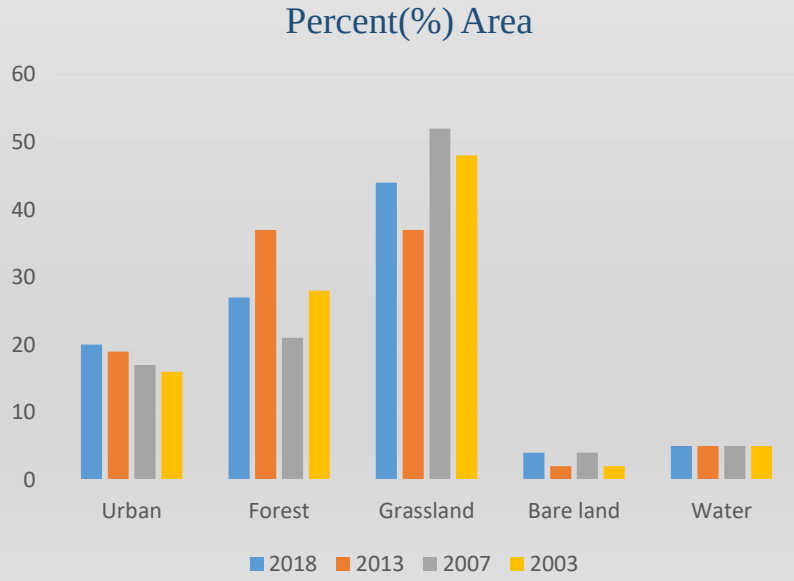
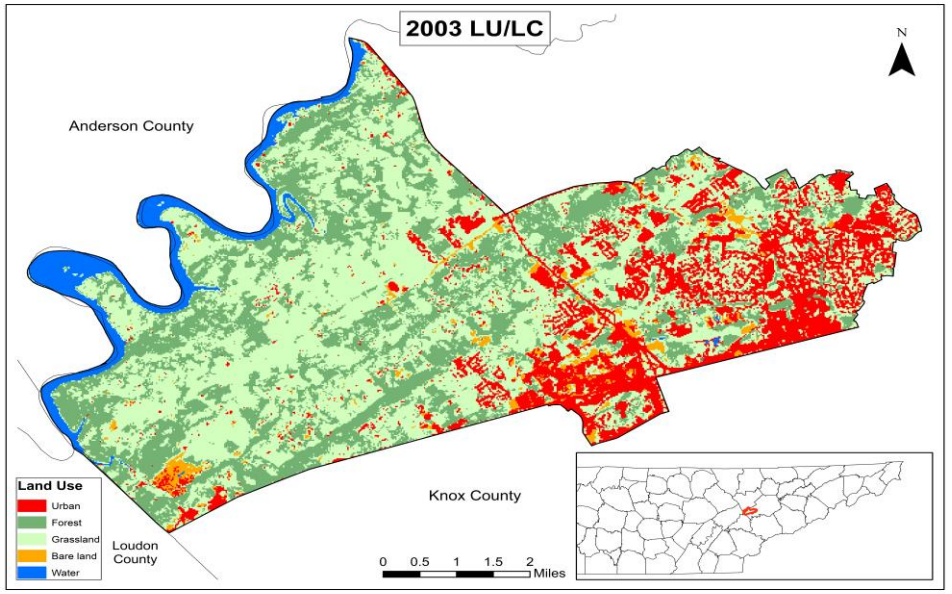
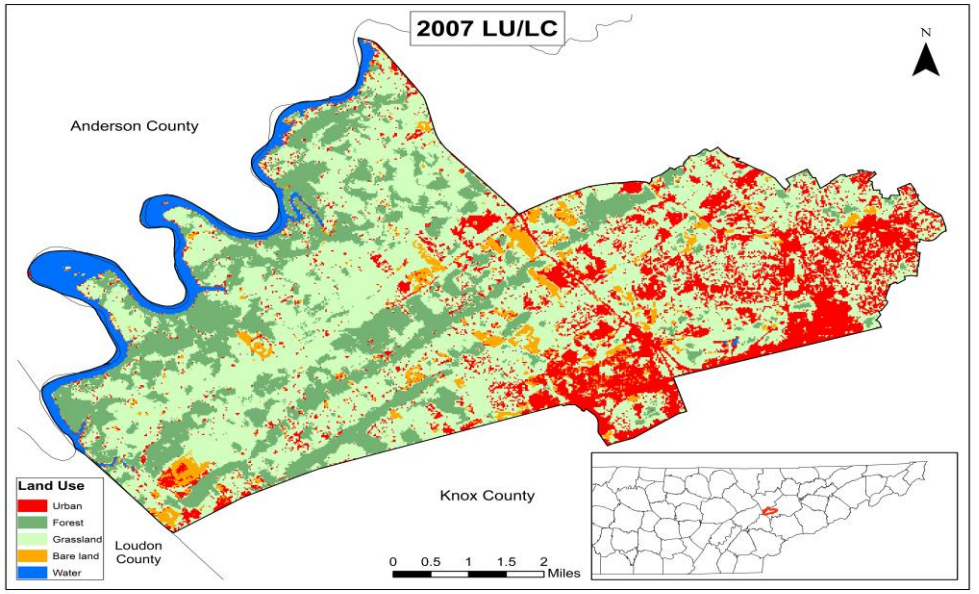


Figure 1


2003 LU/LC
N
Anderson County
Knox County
Loudon County
Land Use
Urban
Forest
Grassland
Bare land
Water
0 0.5 1 1.5 2
Miles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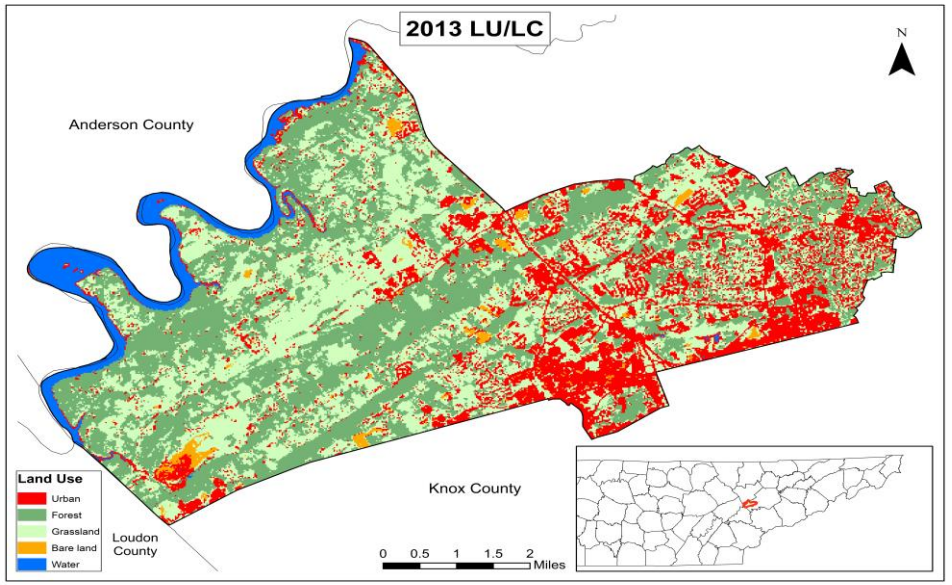
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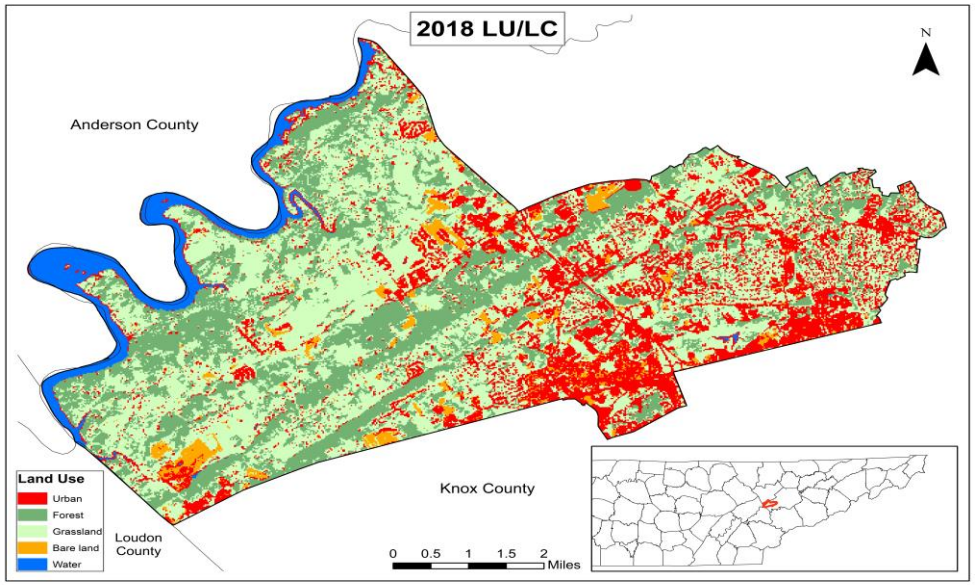
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Summary of Results

- Growth of urban area is primarily at the expense of grasslands. Forests lost the next highest amount of area during the study period, followed by bare land
- There is a westward trend of urban growth from the core in the southern/central region of Hardin Valley
- Complete neighborhoods were constructed during 5-year study periods

Conclusions

- Overall, Hardin Valley's growth rate was lower than all studies, but a majority are studies of the developing world
- The study revealed that grasslands lost the most area to urban growth, but was also the most commonly misclassified land use in all periods of the study
- Large amounts of bare land in one period led to higher growth in the next period

Discussion

- It would be more useful for the results of this study to be compared with communities of similar size, if available
- It would beneficial to have study areas in the United States to compare the results with as it is more likely the same factors would influence urban growth within the U.S
- Due to the lack of research available for urban areas in the U.S., perhaps it is best to combine Land use/Land cover change studies with traffic studies and approved building permits in order to have a more complete picture of urban growth.

Thank you for your time during this presentation and a special thanks to Dr. Jonathan Kozar for his patience and guidance during this research.