Ground-Truthing the UNDERC Property using GIS; Filling the Gaps in the Ottawa National Forest Surveys of Surrounding Forests

BIOS 569: Practicum in Field Biology

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Abstract

Habitat classification of any area is important if any study is going to take place. In the case of UNDERC no habitat classification has been done on the property, making studies harder than they need to be. Creation of a map in ARCview and the ground-truthing of the UNDERC property would greatly benefit the future UNDERC classes. Classification of the Property was done by the UNDERC class of 2005 making this project not only a personal project but a collaboration of efforts. UNDERC comprises of 6150 acres of forested and grassy lands and 1350 acres of water lands (creeks, lakes, marshes). With the completed map the whole property can be viewed from a classified color coded view. Now researches no longer have to drive and hike to find different forest habitats and marshes but only have to look at a map and find the GPS coordinates of the area and go directly to the site.

Introduction

Geographical Information Systems (GIS) have become the leading tool for mapping and data assembling for many professional and private organizations and researchers that include but are not limited to the United States Forest Service (USFS), logging companies, biological researchers, population molders, invasive species monitors, archaeologists just to name a few. The base set of programs of GIS started to take shape in 1968; GIS has evolved from a clumsy set of programs that only a select few trained technicians could manipulate into a user friendly set of programs. The "GIS package" is comprised of three separate but linked programs, ArcView, ArcMap, and ArcCatalogue.

When using GIS in the research fields a researcher is using multiple technologies and strategies for collecting data. Usually the researcher will be using the Arc programs in the lab, maps are almost always used, aerial photography and satellite imagery may also help with the visualization of what is on the ground, you can also use the imagery to geo-reference the data that will be inputted into the programs.

Ground-truthing is a major component of almost all GIS work ever done, ground-truthing calls for a researcher or researchers to go out into the field that needs to be identified and to physically go to each different area (the area can easily be defined on the aerial or satellite imagery that has been obtained) and classify it by the dominant vegetation or the type of area it is (i.e. Quacking aspen, open grassland). After all the data collection the collected data can be put into the programs, the data is usually assembled as 'layers', with the layers completed they can be 'switched' on and off to show or not show the selected layers.

Foresters, ecologists, and resources managers have used GIS technology for a wide range of uses that include: habitat restoration (Cadwell et al. 1996), modeling vegetation dynamics and transitions through time (White and Mladenoff 1994), invasive species studies (Bushing et al. 1997, Myers 1994) and many others. The extensive use of GIS in the world has become wide spread, with use of the ARC software package being used world wide.

The leading developer in GIS technology advancement is Environmental Systems Research Institute (ERSI), the ERSI corporation started in 1969 as a privately owned consulting firm that specialized in land use analysis projects. As ERSI continued its leaping technological advancements in the GIS fields they decided in 1982 to release

their first commercially available GIS software called ArcInfo. This program took simple geographical features (polygons, shapes, names of area, and lines) and linked them to a readily available data base that assigned each of these features a certain spatial measurement (length, distance, distance between two points, area of feature, etc). After this giant leap in technology ERSI released yet another major advancement in the GIS field ARCview in 1991, now not only could they assign features spatial measurements they could link all the data and view the data in a simple windows based program (http://www.ersi.com/about_ersi.html, McCoy and Johnston 2002).

The Ottawa National Forest (ONF) has been using GIS (ArcView and its sister programs), along with extensive satellite imagery and aerial photography to create an extensive, an massive habitat classification map of the ONF area in the Upper Peninsula of Michigan and Wisconsin (UP). The ONF has created 35 different habitat types or classifications for the forests in the UP, these classifications can range any were from a open grass field to a old growth hemlock stand. Habitat 'codes' area assigned to a certain area by way of habitat classification (classification is done by the dominant vegetation present or feature such as: marshes, open land, rocks, streams, lakes, bogs, etc). The researcher will denote different types of classification on a aerial photo or satellite image by the different colors that different features reflect (trees will reflect a color anywhere from a white to a deep green color while open grass reflects a cream to a brilliant white area, water shows up deep blue but more commonly black) and then visit each of these differences in color on foot to identify and assign a habitat classification 'code'. The process of going into the field after the shapes and different color denotation is done to assign a habitat classification 'code' is commonly called "Ground-Truthing". The

UNDERC property has yet to be 'ground-truthed', even though the ONF borders the UNDERC property on three of its sides.

The project I have completed has filled in this 'gap' in the ONF survey. With the completion of the project the UNDERC property has taken its own leap forward in the use of GIS and is now classified in such away that coincides with the ONF surveys that have taken place. The project followed all classification codes that the ONF has created, although the creation of some extra codes have been created to help with the classification of the UNDERC property (the original 35 that the ONF created were too broad for the UNDERC habitats). Ground-truthing techniques and imagery, and the same ArcSoftware were used as the ONF. The completion of the project now fills in the 'hole' in the ONF classification maps, that 'hole' is the UNDERC property.

Methods and Materials

The UNDERC property encompasses approximately 7500 acres (somewhere around 6150 acres of land, and a combined water area of 1350) on both sides of the sate line between Wisconsin (Vilas Co.) and Michigan (Gogebic Co). The project that has been completed has taken all of these acres of land and put them into a classification code.

The project had two very distinct functions or ideals that needed to be done: The complete habitat classification of the UNDERC property (done by ground-truthing), putting the data into the GIS programs and analyzing them to analyze how much each type of forest or different habitat feature is on the UNDERC property.

Satellite imagery was obtained through by UNDERC through the ONF via the United State Geological Survey (USGS), these photos have been taken in infrared so that

different features show up a different color. The photos them selves look like a quilt of different shades of reds, whites, blacks, and some blue, with each of the different colors representing something different. The edges of these features may sometime be very easy to distinguish from one another (water from trees) but other times it may not be able to distinguish (differing in tree some tree stands). Distinguishing the different habitat areas is the first step in the ground-truthing process, the UNDERC class each had satellite photos and had to visually see the difference in color or habitat. After the visual recognition of the differing areas or colors the stands were outlined to create a 'polygon' that was later imputed into the GIS software. With the outlining of the different stands or areas each has a unique shape, roads will be a simple line, tree stands can range anywhere from a circle to a very strange shape with many sides, ponds and lakes may be round or ovate in shape. With the outlines of the different features complete the researchers (UNDERC class and myself) had to go out and visit each of the shapes drawn to 'ground-truth' the area outlined.

Ground-truthing consisted of each of the researchers going out into each location that they distinguished as different from one another and assigning it one of the 35 ONF codes of classification (however 3-4 codes were made). With the ground truthing complete the polygoning of the stands could begin, in a sense polygoning is much like tracing a picture, with the satellite photos of the property I outlined each of the different stands with the create polygon tool, after the polygon was created it had to be assigned a classification number. With the classification number comes a color so that each stand is readily distinguished from its neighboring stands. With the 'ground-truthing' of the UNDERC property complete I was able to do simple statistics on how much of each

forest stand in of the property. Also I was able to give the largest stand of each of the types and which stand is more common then the others.

With the creation of the map that was made the future students of UNDERC can add on to and make new layers of information ranging form animal signs to the abiotic factors of ponds.

Results

The completed map shows what types of forest habitat is were. With the completion of the GIS project the hole that was in the ONF classification maps is now filled.

Percentages of forest cover widely differ between the stands from 0.5 percent to 16 percent of total coverage. Red pine coverage is .5% or 30.75 acres, white pine and hemlock coverage is around 0.5% or 30.75 acres, balsam fir-spruce-aspen coverage is around 10% or 615 acres, wetland black spruce coverage is around 0.5% or 30.75 acres, wetland cedar coverage is around 0.5% or 30.75acres, tamarack coverage is around 0.5% or 30.75 acres, white spruce coverage is around 0.25% or 15.375 acres, mixed lowland hardwood coverage is around 0.5% or 30.75 acres, yellow birch coverage is around 0.25% or 15.375 acres, red maple coverage is around 0.5% or 30.75 acres, sugar maple coverage is around 16% or 984 acres, hardwoods-hemlock coverage is around 2% or 123 acres, mixed hardwoods coverage is around 16% or 984 acres, quaking aspen coverage is around 7 percent or 430.5 acres, paper birch coverage is around 0.5% or 30.75 acres, aspen-birch-spruce coverage is around 3.5% or 215.25 acres, non-forested lowland (brush covered) coverage is around 2% or 123 acres, non-forested upland (brush covered) coverage is around 1% or 61.5 acres, non-forested open coverage is around 2.5% or 153

acres, mixed coniferous and deciduous forest coverage is around 15% or 922.5 acres, mixed wetland hardwoods coverage is around 2% or 123 acres, mixed wetland forest coniferous and deciduous coverage is around 2.5% or 153 acres, total water coverage encompasses around 1350.75 acres.

About 46% of the UNDERC property is covered by deciduous tress, 5% is open land including brush land, 19% is coniferous, and the remaining 30% is mixed forest.

Completed map is figure 1.0.

Forest habitat percentages figure 2.0

Forest acres taken up figure 2.1

Discussion

With the completion of the GIS project the UNDERC program now has a idea and general reference to what types of forest habitats are on the property. Habitat classification of the property will make future studies progress fast because the researchers will not have to go out looking for certain types of forest stands, they will just have to open the map and look for what they are looking for. In the future more researchers will be able to add onto the already created layers in ARCview and be able to expand on the information stored and that will be readily available. Given more time in the future a more complex study of the forests could take place including things like, fire history, stand age, stand density, stand value (for sales), soil characteristics, and other biotic and abiotic factors.

With the constant advancement in GIS and the related technologies also along with the constant change in the forest habitat, the total re-truthing of the property would be good to have done every 10 years or so. The project would have gone at a faster rate

with more recent satellite imagery (10 years old is sufficient but not recommended), training of all individuals involved in the project in GPS and basic use of the ARC programs, and further training of all individuals in basic tree and habitat identification.

Researchers will no longer have to spend valuable time driving and hiking to find certain areas of habitat. They will be able to look on a the completed map and find a habitat type they need for the study, get the GPS coordinates and go directly to the site.

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Figures

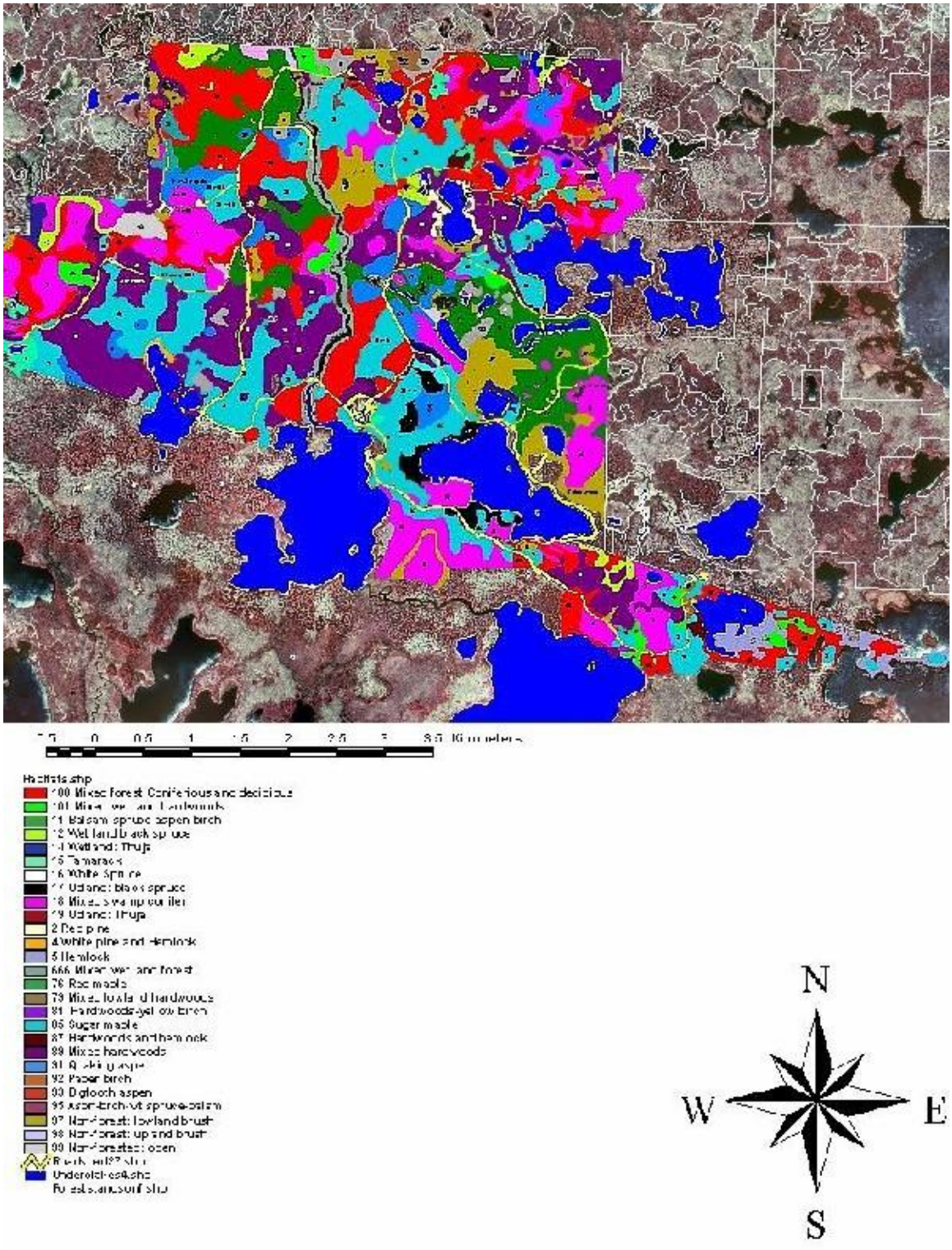

Figure 1.0: completed map of habitat classification for the UNDERC property.

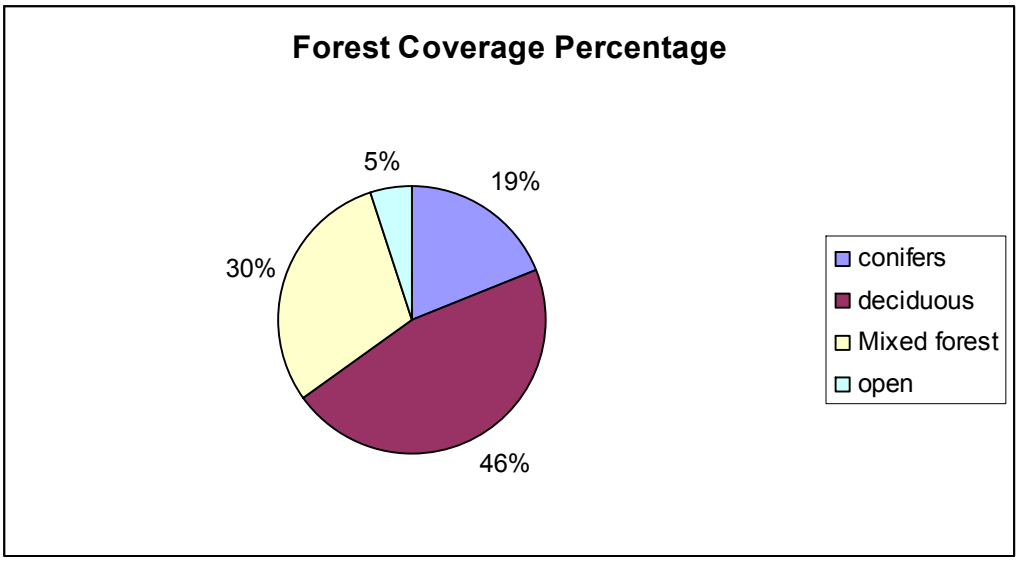

Figure 2.0 Pie chart showing percent of each type of forest stand divided up into four categories.

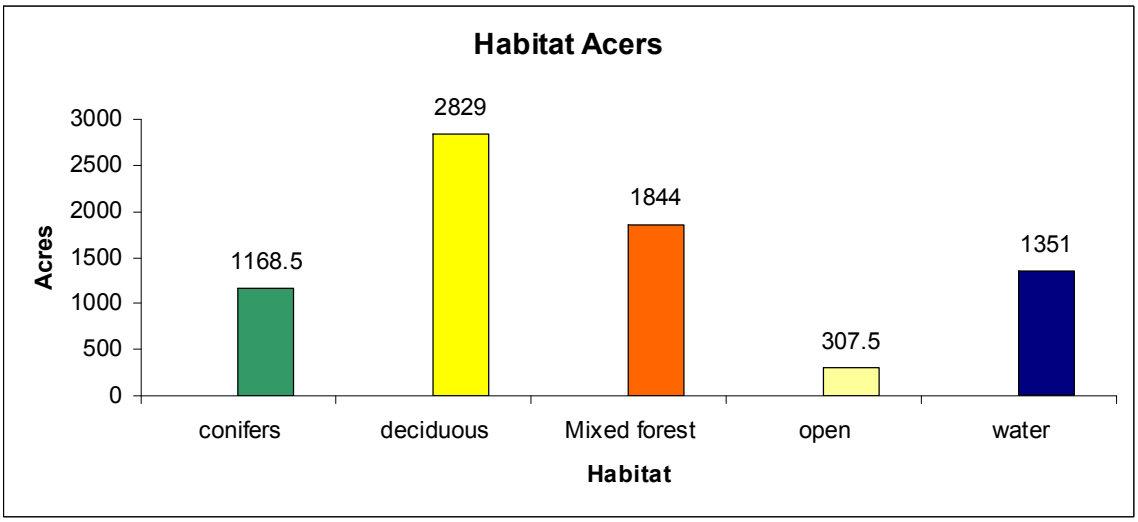

Figure 2.1 Bar chart showing acres of land taken up by the major habitat types.