Mapping Plant Alliances of the Pine Barrens Management Opportunity Area

Prepared by:
Joshua G. Cohen, Helen D. Enander, and Michael A. Kost

Michigan Natural Features Inventory
P.O. Box 30444
Lansing, MI 48909-7944

Michigan DNR

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Cover photograph: Intermittent wetland (Alliance IV.A.1.N.f) with pine barrens (Alliance V.A.6.N.F) in the foreground and dry northern forest (Alliance I.A.8.N.B) in the background (Photo by Michael Kost).

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF PHOTOGRAPHS

INTRODUCTION

Efforts to conserve biological diversity and manage natural resources have often focused on protecting and managing natural communities. Natural communities constitute the habitat in which species interact and provide the critical ecosystem functions (e.g., nutrient cycling) on which all life depends. In the past, protection and management of natural communities at the regional and national level has been complicated by the lack of consistent definitions for many natural community types. The U.S. National Vegetation Classification (USNVC) provides a standardized classification system of natural communities for the U.S that allows vegetation types to be consistently classified and mapped across administrative and political boundaries (Anderson et al. 1998, Grossman et al. 1998, Faber-Langendoen 2001, Rapp et al. 2005). Because the classification is hierarchical, it allows vegetation to be classified and mapped at multiple scales, thus facilitating comparisons among sites at the local, regional, and national levels. Most applications of the classification require mapping to the alliance level, which involves characterizing the dominant or diagnostic species in the uppermost vegetation strata of the community.

The benefits of using a consistent hierarchically-based vegetation classification system such as the USNVC are numerous. For example, it enables comparisons of the ecological community richness and variability across regions and administrative boundaries, provides information on the geographic distributions of community types, and helps elucidate relationships between natural communities and ecological processes and disturbance regimes (Grossman et al. 1998). A detailed map of plant alliances at Camp Grayling will facilitate a more thorough understanding of the area's ecological integrity and its importance to regional biodiversity. In addition, a detailed map of plant alliances will provide land managers with a useful tool for monitoring changes in the vegetation and help facilitate communication with other governmental and conservation agencies.

In 2005 MNFI prepared a digital map of plant alliances in the Pine Barrens Management Opportunity Area at Camp Grayling. This work involved a combination of GIS modeling, aerial photography interpretation, ground truthing, and map production. Limiting the scope of the project to a portion of Camp Grayling such as the Pine Barrens Management Opportunity Area allowed modeling, mapping, and classification methods to be tested and refined, which will facilitate their extension to the remainder of Camp Grayling and other areas of the northern Lower Peninsula.

STUDY AREA

The Pine Barrens Management Opportunity Area is located in north central Crawford County, on the Camp Grayling Military reservation, within the Grayling Forest Management Unit which is administered by Michigan's Department of Natural Resources' Forest, Fire, and Mineral Management Division. The total acreage of the Pine Barrens Management Opportunity Area is approximately 5,007 acres (2,026 ha). The legal description for this area is T27N, R2W sections 7, 8, 9, 10, 15, 16, 17, and 18 (Figure 1).

Ecoregional Context

The management area is located within the Grayling Outwash Plain Sub-subsection of the regional landscape ecosystems described by Albert (1995) (Figure 2). This area is a high outwash plain and contains several large moraines of ice-contact material (Albert 1990). The management area occurs in an outwash channel and borders an area of ice-contact to the west. Topography of the management area is nearly level in the central and eastern portions and becomes rolling in the west, where ice-block depressions are common. The soils are primarily excessively well-drained Graycalm-Grayling sands and Graycalm sands. The Grayling Outwash Plain Sub-subsection experiences some of the most extreme climatic conditions in the Lower Peninsula, with below freezing temperatures occurring throughout the growing season, especially within ice-block depressions (Palmgren 1999).

Historical Conditions

The earliest records of vegetation in the Camp Grayling Management Area are from the General Land Office (GLO) surveys conducted in the mid-1800s. Surveyors generally described the area as "gently rolling burnt land" with vegetation along section lines
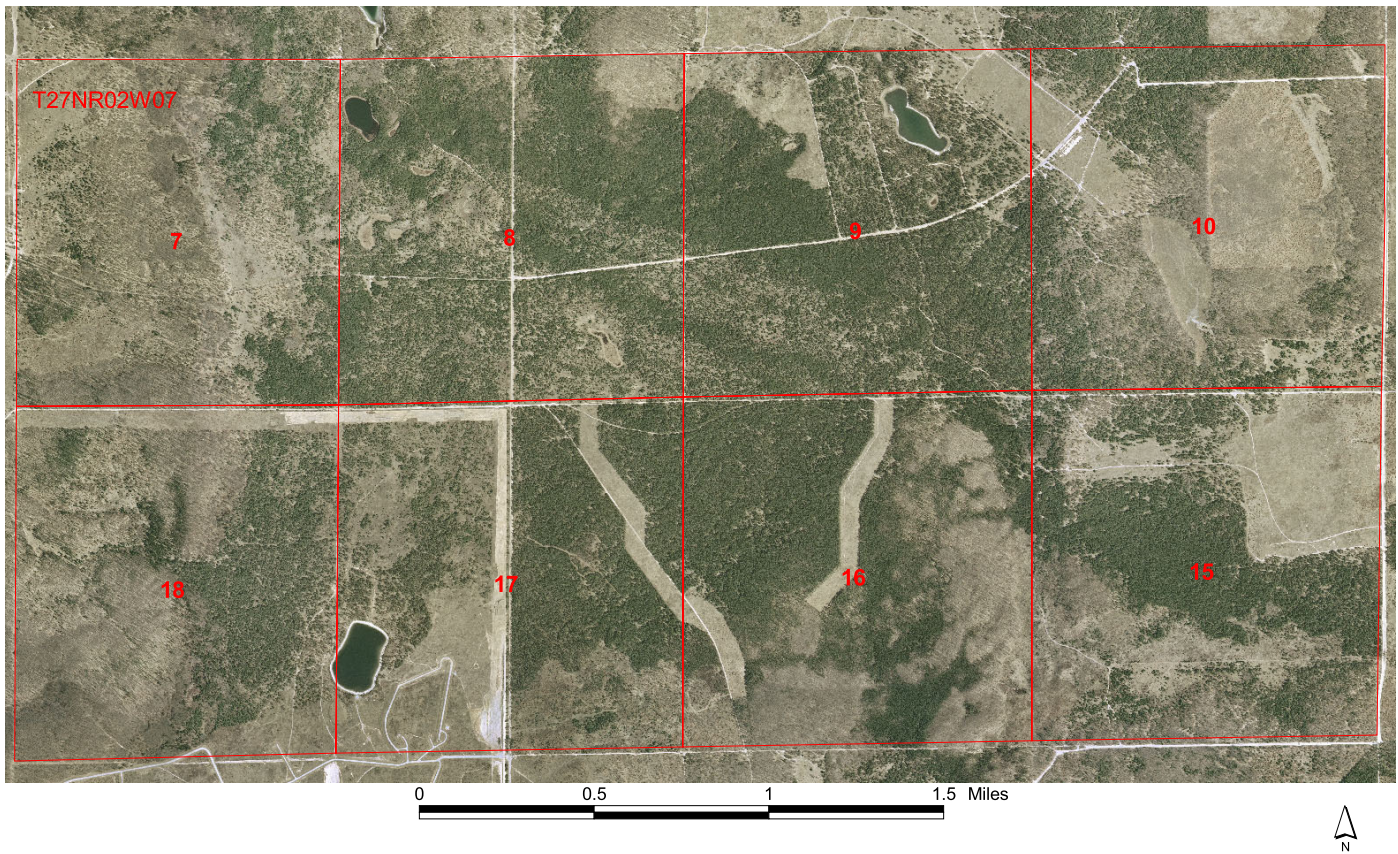
Figure 1: 2000 aerial photograph of Pine Barrens Management Opportunity Area at Camp Grayling, courtesy of Camp Grayling.
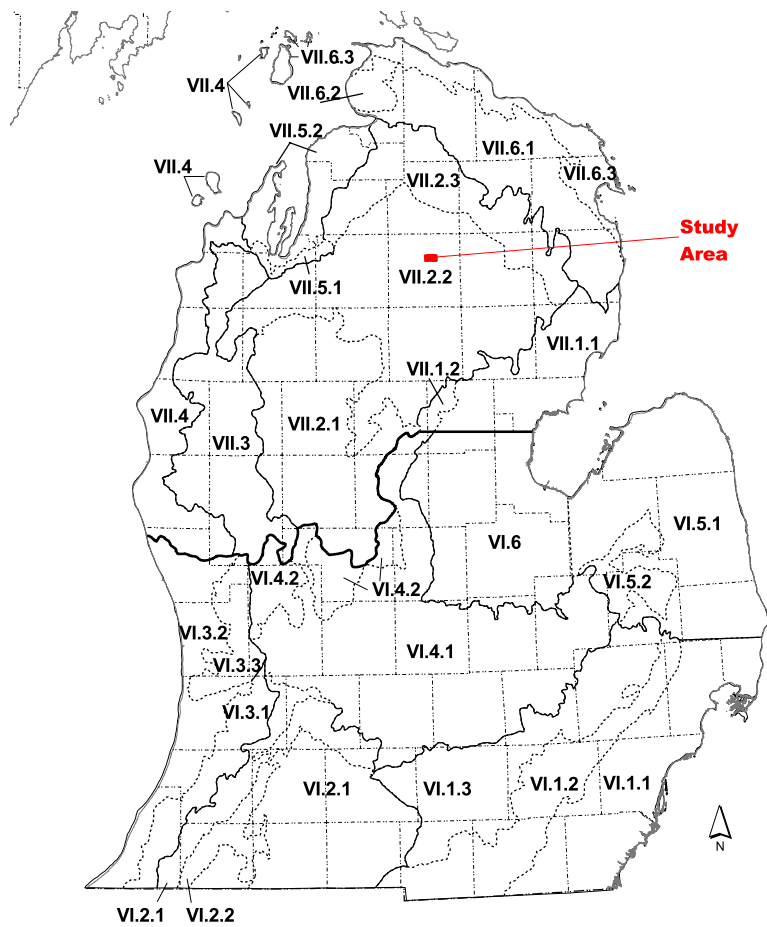

Figure 2: Study area within the Ecoregions of Michigan's Lower Peninsula (Albert 1995).
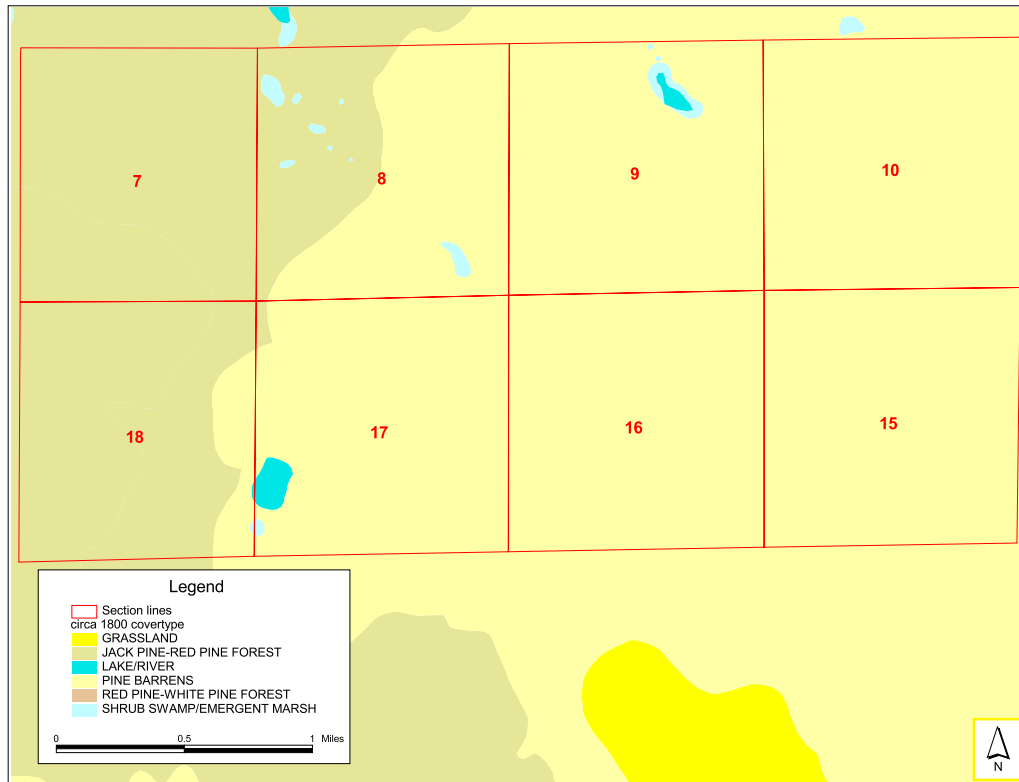
Figure 3: Vegetation circa 1800 of the Pine Barrens Management Opportunity Area at Camp Grayling (Comer et al. 1995).

noted as "large and small pines" and "thickets of jack pine with scattered red pine". Comments by the early GLO surveyors such as, "pine poles killed by fire", "jack pine nearly all killed by fire", and "timber burnt, dead", make it clear that fire played a major role in shaping this landscape. These descriptions illustrate an open ecosystem of fire-adapted species, containing widely-scattered, uneven-aged jack pine and red pine, dense thickets of jack pine, and many dead standing trees or snags. From information provided by the GLO surveyors, it appears that the North Camp Grayling Management Area was once part of a patchy mosaic of open pine barrens and jack pine-red pine forest that encompassed more than 160,000 acres in the mid-1800s (Comer et al. 1995) (Figure 3). Remnants of this extensive pine barrens continue to exist there today (Kost et al. 2000).

METHODS

Aerial Photograph Interpretation

MNFI staff conducted aerial photography interpretation of color infrared 1978 (1:24,000, Michigan DNR), and black and white infrared 1998 aerial imagery (1:15,840, Michigan DNR). A stereoscope was used to delineate each distinct polygon of natural community type and its associated alliance. A total of eight alliances were identified within this area (Table 1). We also created a lake class and a disturbed class for large areas that have been modified by extensive anthropogenic disturbance (i.e., wide tanks trails and ammunition ranges). Topographic maps, 1938 black and white panchromatic aerial photographs (1:20,000, Michigan State University Aerial Imagery Archive), and state forest operations inventory stand maps for the Grayling Forest Management Unit were used to help identify polygons that were difficult to classify and to refine polygon boundaries.

GIS Analysis and Modeling

A separate GIS analysis, modeling, and mapping effort occurred concurrently with the aerial photograph interpretation. A map of the area was generated using available GIS layers, which included circa 2000 satellite-interpreted land cover, Digital Elevation Models (DEMs), and MNFI natural community polygons from the Biotics database (Michigan DNR 2003, NOAA 2003, USGS 2003, MNFI 2004). Maps of the GIS analysis and aerial photograph interpretation were produced and brought into the field for ground truthing.

Ground truthing

MNFI staff ground truthed the aerial photograph interpretation and the GIS analysis using the following methodology. Four, four-mile, east-west transects were established a half mile apart. Along each transect we stopped every tenth of a mile or at every change in cover type to note the dominant vegetation of the overstory, understory, and ground cover. In addition, information was noted on the soils and the spacing and diameter of canopy trees. For each unique alliance we also tested soil pH and examined the soil profile using a soil auger. This information was used to classify each point into a plant alliance and then check the accuracy of the aerial photograph interpretation and the GIS analysis. In addition to points established along the transects, we ground truthed polygons that were difficult to identify using aerial photograph interpretation and GIS analysis. MNFI staff established 425 ground truth points.

RESULTS

A total of eight plant alliances were identified during aerial photograph interpretation and GIS modeling and confirmed by ground truthing (Table 1, Figure 4). The most common plant alliances of the Pine Barrens Management Opportunity Area were the Jack Pine Forest Alliance (Photograph 1), the Jack Pine – (Northern Pin Oak, Black Oak) Forest Alliance, and the Jack Pine – (Red Pine) Wooded Herbaceous Alliance (Photograph 2), which constituted 36%, 28%, and 22% of the study area respectively. An additional 5% of the area was mapped as Little Bluestem – (Sand Dropseed) Herbaceous Alliance and Black Oak – (Northern Pin Oak) Wooded Herbaceous Alliance. The Quaking Aspen – Paper Birch Forest Alliance (covering 3.4% of the area) was uncommon. The most prevalent wetland type was the Leatherleaf – (Sheep Laurel) Seasonally Flooded Dwarf-Shrubland Alliance (.44% of the area) (Photographs 1 and 3). Minor portions of the area were covered by Lake (.50%) and the Pondweed species – Coontail species – Waterweed species Permanently Flooded Herbaceous Alliance (.08%). A significant acreage was classified as anthropogenically disturbed (close to 5%) (Table 1).

The aerial photograph interpretation was a far more accurate means of mapping the alliances compared to the GIS analysis. As a result, ground truthing was used to refine the polygons created during the aerial photograph interpretation and produce the final map of the alliances of the Pine Barrens Management Opportunity Area (Figure 4). In general, forested alliances were mapped accurately by both systems with finer precision exhibited by the aerial photograph interpretation. The pine barrens alliance was not accurately mapped by the GIS analysis; the aerial photographic interpretation of the pine barrens alliance was far more accurate. Ground truthing was required in several instances to differentiate pine barrens from recently harvested jack pine forest. Small-scale wetlands could not be mapped confidently to the alliance level by either method, although small-scale wetlands could be mapped generally using aerial photograph interpretation. GIS analysis missed many of the small wetlands because of the coarseness of the resolution of the data layers employed. Field classification was required of the small wetlands, many of which can only be differentiated by on the ground assessment of ground flora, hydrology, soils, and/or pH.

DISCUSSION

Alliance mapping provides resource managers with a standardized and hierarchical methodology for assessing ecological community richness, distribution, and extent at multiple spatial and temporal scales. A national effort to map alliances provides the capacity to gauge the ecological significance of the Camp Grayling alliances at the local, regional, and national scale. Such an effort is of critical importance for conservation of globally and locally rare communities, such as pine barrens, to provide more accurate assessments of extent and distribution, to assess the success of restoration efforts, and set and refine conservation priorities. At the local scale, alliance maps can serve as a monitoring tool. For example, within the Pine Barrens Management Opportunity Area, following implementation of the pine barrens management plan (Kost et al. 2000), success of landscape-level restoration of pine barrens can be determined by periodically mapping the alliances and thereby monitoring coarse changes in vegetation over time.

Table 1: Acreage of plant alliances of the Pine Barrens Management Opportunity Area.

Alliance Name	Alliance Code	MNFI Natural Community	Acreage	Percent Area
Little Bluestem - (Sand Dropseed) Herbaceous Alliance	V.A.5.N.c	dry sand prairie	211	4.22%
Jack Pine - (Red Pine) Wooded Herbaceous Alliance	V.A.6.N.F	pine barrens	1108	22.14%
Black Oak - (Northern Pin Oak) Wooded Herbaceous Alliance	V.A.6.N.c	oak barrens	58	1.16%
Jack Pine - (Northern Pin Oak, Black Oak) Forest Alliance	I.C.3.N.A	dry northern forest	1380	27.56%
Jack Pine Forest Alliance	I.A.8.N.B	dry northern forest	1791	35.76%
Quaking Aspen - Paper Birch Forest Alliance	I.B.2.N.b	dry-mesic northern forest	170	3.40%
Leatherleaf - (Sheep Laurel) Seasonally Flooded Dwarf-Shrubland Alliance	IV.A.1.N.f	intermittent wetland	22	0.44%
Pondweed species - Coontail species - Waterweed species Permanently Flooded Herbaceous Alliance	V.C.2.N.a	submergent marsh	4	0.08%
Lake	NA	NA	25	0.50%
Anthropogenically Disturbed	NA	NA	238	4.75%
Total			**5007**	**100%**

Photograph 1: Intermittent wetland (Alliance IV.A.1.N.f) surrounded by dry northern forest (Alliance I.A.8.N.B) (Photo by Joshua Cohen).
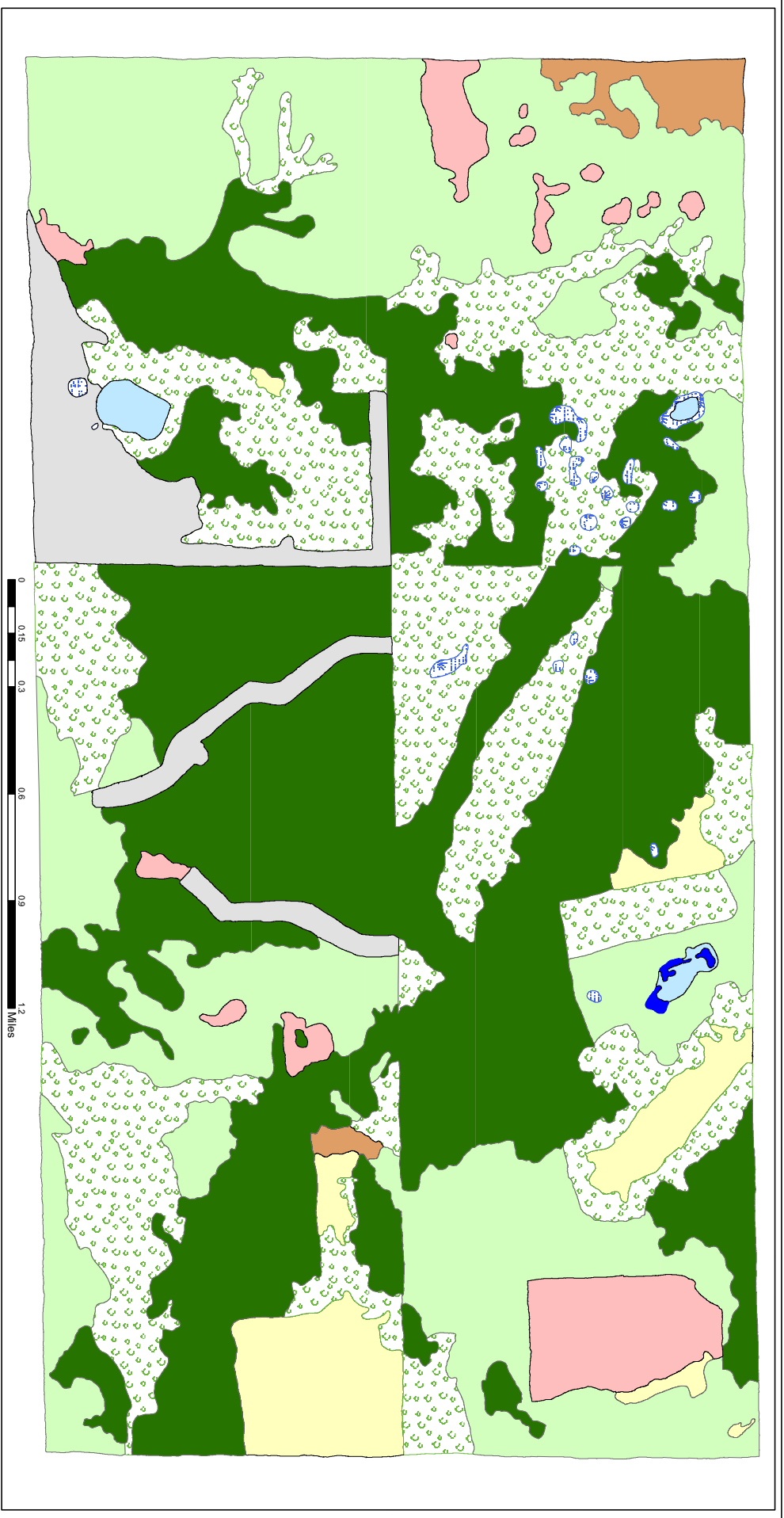
Legend

- Little Bluestem - (Sand Dropseed) Herbaceous Alliance
- Jack Pine - (Red Pine) Wooded Herbaceous Alliance
- Black Oak - (Northern Pin Oak) Wooded Herbaceous Alliance
- Jack Pine - (Northern Pin Oak, Black Oak) Wooded Herbaceous Alliance
- Jack Pine Forest Alliance

- Quaking Aspen - Paper Birch Forest Alliance
- Leatherleaf - (Sheep Laurel) Seasonally Flooded Dwarf-Shrubland Alliance
- Pondweed species - Coontail species - Waterweed species Permanently Flooded Herbaceous Alliance
- Lake
- Anthropogenically Disturbed

Figure 4: Map of the plant alliances of the Pine Barrens Management Opportunity Area at Camp Grayling.

0   0.15   0.3   0.6   0.9   1.2
Miles

N

Photograph 2: Pine barrens (Alliance V.A.6.N.F) (Photo by Michael Kost).

Photograph 3: Intermittent wetland (Alliance IV.A.1.N.f) with pine barrens (Alliance V.A.6.N.F) in the foreground and dry northern forest (Alliance I.A.8.N.B) in the background (Photo by Michael Kost).

CONCLUSION

As a result of this mapping project, we recommend aerial photograph interpretation in conjunction with ground truthing as the best method for accurately mapping the alliances of the Camp Grayling area. GIS analysis could be employed to generate coarse maps of the forested alliances of the Camp Grayling area; however, GIS analysis alone does not adequately map small-scale wetlands and barrens systems.

ACKNOWLEDGEMENTS

REFERENCES

Albert, D.A. 1990. A regional landscape ecosystem classification of Michigan stressing physiographic, geologic, and soil factors. Ph.D. dissertation. U. of Mich., Ann Arbor, MI. 384 pp.

Albert, D.A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: A working map and classification. Gen. Tech. Rep. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/1998/rlandscp/rlandscp.htm (Version 03JUN98).

Anderson, M., P. Bourgeroln, M.T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D.H. Grossman, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A.S. Weakley. 1998. International classification of ecological communities: Terrestrial vegetation of the United States. Volume II. The National Vegetation Classification Systems: List of types. The Nature Conservancy, Arlington, Virginia, USA.

Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Corner, and D.W. Schuen (map interpretation). T.R. Leibfreid, M.B Austin, C.J. Delain, L. Prange-Gregory, L.J. Scrimger, and J.G. Spitzley (digital map production). 1995. Michigan's presettlement vegetation as interpreted from the General Land Office surveys, 1816-1856. Michigan Natural Features Inventory, Lansing, MI.

Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association of Biodiversity Information, Arlington, VA. 61pp + appendix (705 pp.).

Grossman D.H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: Terrestrial vegetation of the United States. Volume I, The National Vegetation Classification System: Development, status, and applications. The Nature Conservancy, Arlington, VA.

Kost, M.A., P.J. Higman, D.L. Cuthrell, and J.L. Cooper. 2000. North Camp Grayling Pine Barrens Management Plan. Report prepared for Michigan Department of Military and Veterans Affairs. 28 pp. + Appendices (39 pp).

Michigan Department of Natural Resources, Forest, Mineral, and Fire Management Division. 2003. Integrated Forest Monitoring Assessment and Prescription (IFMAP) / GAP Lower Peninsula Land Cover. Remote sensing image. Time period of content 1997-2001.

Michigan Natural Features Inventory. 2004. Statewide Biotics 4 Database. Lansing, MI.

National Oceanic and Atmospheric Administration Coastal Services Center. 2003. C-CAP Late-Date Classification of the Lower Peninsula of Michigan. Remote sensing image. Time period of content 1997-2001.

Palmgren, G.R. 1999. Growth of jack pine and northern pin oak in landscape ecosystems of northern Lower Michigan and occupancy by the Kirtland's warbler. M.S. thesis, U. of Mich., Ann Arbor, MI. 148 pp.

Rapp, J., D. Wang, D. Capen, E. Thompson, and T. Lautzenheiser. 2005. Evaluating error in using the National Vegetation Classification System for ecological community mapping in northern New England, USA. Natural Areas Journal 25(1): 46-54.

United States Geological Survey. 2003. Digital Elevation Model (DEM) for Michigan. Raster digital dataset. 1:24,000 scale.