Scanning, Georeferencing, and Interpreting the 1927 Photography Set for Voyageurs National Park

A Final Report to the Great Lakes Inventory and Monitoring Network

by

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INTRODUCTION

The International Joint Commission commissioned for a set of 1500 B&W photos to be taken of the Voyageurs National Park (VNP) area in May of 1927 as part of an international border survey, of which ~800 are from within VNP boundaries. These photos contain valuable information that can be most efficiently utilized in an electronic format. Therefore, this project proposed to have the photos scanned, georefenced, and mosaiced for use as a GIS layer in a myriad of natural and cultural resource issues. This project also proposed to have the images photo-interpreted to document cover classes and extract other information about disturbance events such as fires and logging. These photos are the oldest set of photos taken for VNP and will likely contribute greatly to VOYA management and visitor education as well as several I&M Vital Signs, including land-use/land-change.

METHODS

Image Organization and Purchasing

A total of 845 photos were selected from the entire photo set (Figure 1) that encompassed all of Voyageurs National Park (Appendix 1). Of these, 134 needed to be purchased from the Canadian Air Photo Library to complete the set (Appendix 1).

All scanning, rectification, and photo interpretation were done through a CESU cooperative agreement with the Minnesota Department of Natural Resources' Resource Assessment Program in Grand Rapids, MN.

Scanning and Rectification
Photographs used in creating the mosaic were monochrome prints at a nominal 1:10,000 scale, taken in 18 near-parallel flight lines running east-west. Print image areas measured between 7 and 7 ¼ inches along the line of flight, and between 9 and 9 ¼ inches in the north-south dimension. Prevalence of sun glint in water areas is evidence that the season was summer. Photographs were taken to provide stereoscopic coverage, with approximately 60 percent endlap along flight lines and widely varying sidelap between lines.

The photos were scanned at 600 dpi using to produce 8-bit TIFF files. These TIFFs have nominal pixel size of about 1.5 feet on the ground. The digital photos were then rectified against 1991 USGS DOQQs and 2003 NAIP orthophotos using ERDAS Imagine 8.7 software. Individual rectified photos were provided as ERDAS Imagine (.img) files.

In addition to the individual photos, the MN DNR also provided a mosaic. This was produced in ERDAS Imagine software using approximately every second frame (462 photos). The mosaic was then resampled to 1-meter GSD, exported as a Geo-TIFF, and compressed to a MrSID file. Both the individual .img files and the MrSID mosaic were provided to the park with the final product.

Cover Class Interpretation
In addition to the digital photos, the MN DNR created a general cover class polygon shapefile. This was produced by interpreting the prints stereoscopically to a 20-acre minimum mapping unit using a scanning stereoscope. Cover type polygons were ocularly transferred from delineated photographs to an orthophoto mosaic made from scanned prints rectified to match 1991 USGS Digital Orthophoto Quarter-Quadrangles and 2003 USDA NAIP orthophotos (http://www.apfo.usda.gov/NAIP.html).

Water, nonforest and unstocked classes were delineated first. The residual forested area was subdivided into conifer and deciduous classes, and these were further subdivided by size and density. Classification of forested areas was necessarily subjective on account of the relatively poor resolution and highly variable illumination of the 1927 photographs, which in some areas made even the land/water distinction problematic. Use of modern aerial photography made it possible to make fairly clear distinctions between nonforest, unstocked and forest lands in many cases where the 1927 photos by themselves provided little evidence.

The final polygon shapefile is an 11-class, 655-polygon interpretation of surface cover to a nominal 20-acre minimum unit, interpreted from about 800 aerial photos taken in 1927 over most of the present Voyageurs National Park. The following classes were distinguished in interpretation:

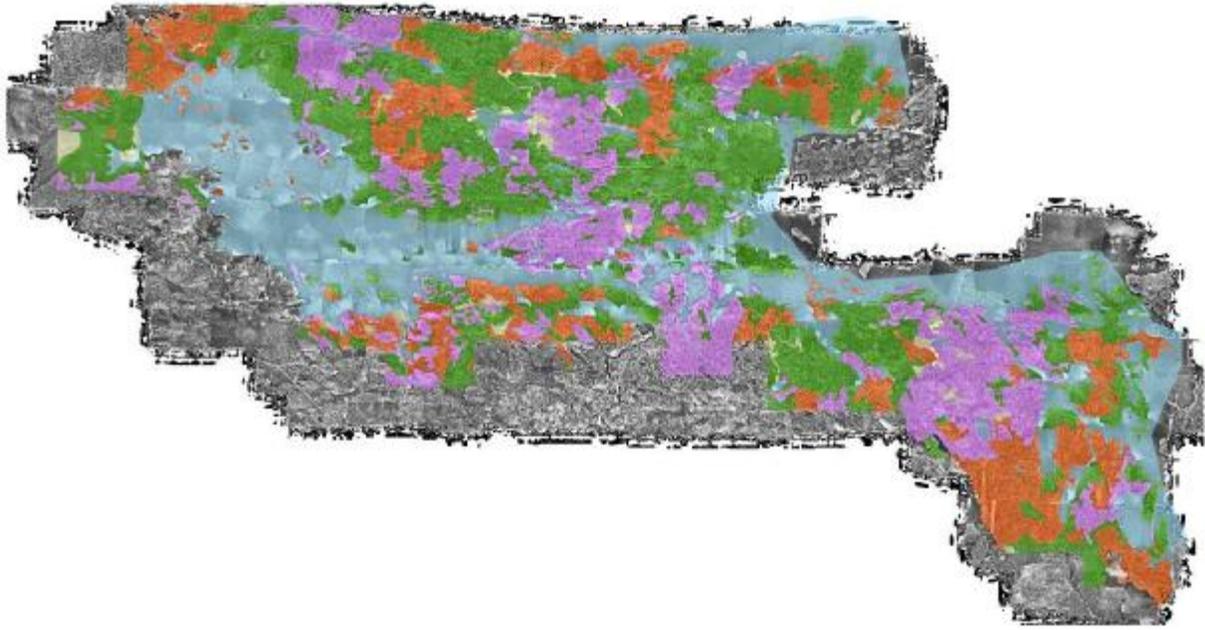| Cover Classes	Subclasses	Definitions	Examples
Water	N/A	Permanent open water	Lakes, ponds, streams, large flowages
Nonforest land	N/A	Land area not able to support forest growth	Bogs, bare rock, permanent shrub or grassland
Unstocked forest land	N/A	Land area capable of supporting forest, but having less than 10% tree crown cover in 1927	Logged or burned-over forest areas
Conifer forest	Subclass labels required --	Forest land with more than 10% crown cover, more than 50% of which is coniferous	Jack pine, red/white pine, spruce, fir, tamarack, white-cedar
	Size: Tall	Pole/sawtimber, > 20 ft.	
	Size: Short	Seedling/sapling, < 20 ft.	
	Density: High	> 50% crown cover	
	Density: Low	< 50% crown cover	
Deciduous forest	Subclass labels required --	Forest land with more than 10% crown cover, more than 50% of which is deciduous	Aspen, birch, northern hardwoods, black ash, willow
	Size: Tall	Pole/sawtimber, > 20 ft.	
	Size: Short	Seedling/sapling, < 20 ft.	
	Density: High	> 50% crown cover	
	Density: Low	< 50% crown cover	

Figure 1. 1927 photo interpretation for Voyageurs National Park. Blue polygons are open water, purple are unstocked, orange are deciduous, and green are conifers.
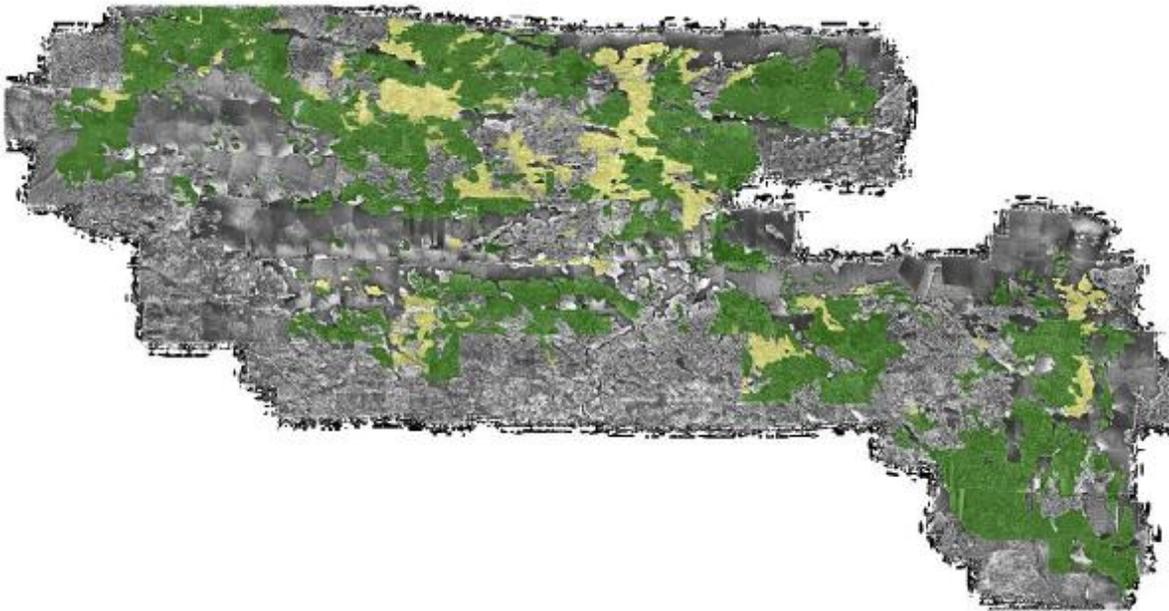

Figure 2. 1927 photo interpretation for Voyageurs National Park highlighting stocking density. Green polygons are areas of high density and yellow polygons are areas of low density. Image is overlaid on the 1927 photomosaic.
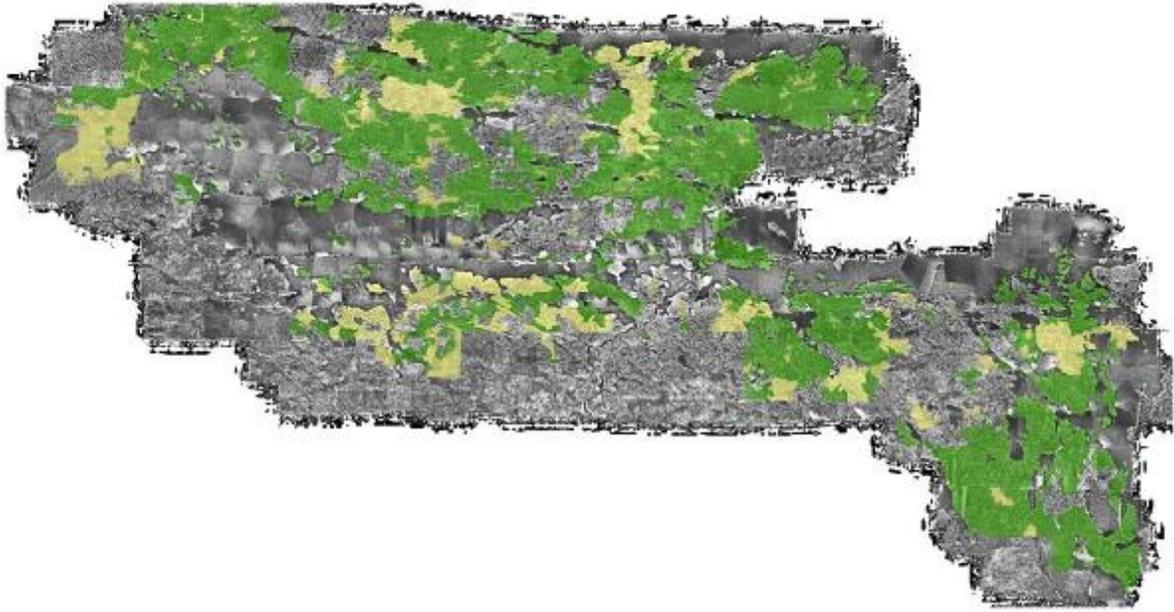
Figure 3. 1927 photo interpretation for Voyageurs National Park highlighting height classes. Green polygons are tall and yellow polygons are short. Image is overlaid on the 1927 photomosaic.

Uses
These photos and interpretations will be valuable for a variety of projects. The cover class interpretation will help vegetation and fire management by providing stand age and disturbance information. The photos will also help to map past land use in the park. Cultural Resources will benefit by being able to map historic logging camps, roads, and railways.

APPENDIX 1. List of 845 photos sent to MNDNR Resource Assessment lab for inclusion in photomosaic and interpretation for Voyageurs National Park. The photo #s of the 134 prints purchased by GLKN for this project are also shown.

Flight Line	Photo #'s	Photo #'s Purchased
FA 432	#16-66	
FA 433	#23-78	#30
FA 434	#22-75	#22-75
FA 435	#19-78	
FA 436	#28-107	#107
FA 437	#1-40	#31-40
FA 438	#1-5	
FA 438	#29-111	#101-111
FA 439	#1-29	
FA 439	#49-56	
FA 439	#95-111	#111
FA 440	#1-108	
FA 441	#1-33	
FA 441	#66-108	#66-108
FA 442	#1-94	#79-80
FA 443	#22-57	
FA 443	#103-113	#103-113
FA 444	#1-14	
FA 444	#59-80	