Paper L 16

THE USE OF ERTS-1 DATA FOR THE INVENTORY OF CRITICAL LAND RESOURCES FOR REGIONAL LAND USE PLANNING

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ABSTRACT

Computer-generated spatial and statistical comparisons of critical land resource data derived from conventional sources, RB-57 photographs, and ERTS images, for an eastern Wisconsin test site, suggest that certain critical land resource data can be mapped from ERTS images on a statewide basis. This paper presents one of the biotic resources, "wetlands", as an example of the use of ERTS imagery to inventory land resources.

1. INTRODUCTION

The ERTS-1 project members at the University of Wisconsin-Madison are investigating the application and use of ERTS imagery as a data source for regional and state resource planning. A variety of resources are being evaluated and examined to determine the potential for the detection and monitoring of these resources from satellite and high altitude platforms. Resources being evaluated for detection include major biotic communities, landform configurations, land and resource areas altered by man-induced activities (e.g., farming, extraction, urbanization, and power plant construction) and the monitoring of land activity changes. This paper presents one of the biotic resources, "wetlands", as an example of the use of ERTS imagery to inventory land resources. The inventory of wetlands is especially important because the Governor's Wisconsin Land Resources Committee has concluded that "wetlands" are a critical resource, and yet, as of this date, state and regional planners do not know, in a quantitative sense, the location or extent of the State's wetland resources.

2. WETLANDS INVENTORY

To determine the effectiveness of the ERTS sensors for resource

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detection and inventory, a sample site in eastern Wisconsin is being utilized. This 10 x 30 kilometer "Sheboygan Test Site", shown in Figure 1, is part of a larger (10,000 square kilometer) test site generally located between Green Bay and Milwaukee, Wisconsin. The variable "open swamp" in the 10,000 cell, computer-based REMAP I (Regional Environmental Mapping and Analysis Process) data bank can be used as a measure of "wetlands" distribution in the study area. The REMAP I data bank was developed to assist the Wisconsin Department of Transportation locate a corridor for Interstate 57 and is serving as a comparison basis for the ERTS-1 investigation. "Open Swamp" can be defined as areas of wetlands occupied by such biotic communities as those dominated by grasses, sedges, emergent aquatics, dogwoods, shrub-willows, and alders. Such communities are variously called bogs, wet meadows, marshes, or swamps.

Figure 6 is a computer-processed spatial comparison which presents quantitative information about the occurrence of "open swamp" in the Sheboygan Test Site, as derived from 3 different sources: (A) ERTS-1 multispectral imagery; (B) RB-57 high altitude color infrared photography; and (C) the REMAP I data bank. Each cell shown in this sample site is one square kilometer in size, referenced according to the UTM system. The density of the symbol printed in each cell shows the percentage of that cell occupied by "open swamp" (blank = 0%; "." = 1-9%; "," = 10-19%; etc.). Beneath each 300 square kilometer area shown on Figure 6 is given the total acres of the variable "open swamp" as determined from each of the three data sources. Numbers of occurrence and numbers of acres for each of the three types of data source (A, B and C) are presented for each level of occurrence.

The information derived from ERTS imagery was interpreted from two different dates examined concurrently - 14 September 1972 and 13 December 1972. Figure 3 shows an ERTS image (9 August 1972) of most of the REMAP I data bank area with the 10 x 30 kilometer Sheboygan Test Site outlined. Figures 4 and 5 show examples of ERTS imagery from 9 August 1972 and 13 December 1972 for this test site. In examining the four MSS bands, the images produced by Band 5 were found to present the most information for this particular variable for the dates data were available.

Information from the RB-57 photographs was interpreted from color infrared positive transparencies taken in September 1971 (September has been found to be a superior time for photo interpretation of many vegetational communities in this region). An example of RB-57 photography for the test site is shown as Figure 2.

"Open swamp" as it exists in the REMAP I data bank was obtained from two sources: (1) Borgner land cover survey maps, and (2) interpretation of small-scale panchromatic aerial photographs. The Borgner studies represent the most complete inventory of vegetational resources for the entire state of Wisconsin. They were ground studies done during the 1930's in which species types and communities identification were made.

While some areas of the state have been studied more recently (e.g., Menominee County), no other data source exists for the state as a whole. The Borgner studies were supplemented with interpretations from black and white aerial photographs in an attempt to update the Borgner maps.

Figure 6 illustrates certain differences in the spatial distribution of the variable "open swamp" as derived from the three data sources. The most conspicuous difference is in the total numbers of acres of open swamp accounted for as interpreted from each data source: 2673 acres from ERTS 1; 2248 acres from RB-57; and 5002 acres in REMAP I data bank. From preliminary investigations (ground studies and re-check of interpretations), it is our conclusion that the ERTS and RB-57 derived data are a closer approximation of the location and extent of the wetland resource in the test site than the data now stored in the REMAP I data bank. The REMAP I data represent the best existing data as derived from conventional data sources. These REMAP I data are less valid than ERTS and RB-57 data for two reasons: (1) many areas that were wetland communities in the 1930's when the Borgner maps were compiled have disappeared, and (2) the data sources used were conducive to generating errors. These errors exist in both the original Borgner studies (now generally recognized by Wisconsin ecologists as being of limited value) and in extraction and classification errors when using small-scale panchromatic photographs as a data source for interpretation. Many lowland forest areas were incorrectly coded as wetlands and account for the larger total number of acres of "wetlands" stored in the REMAP I data bank. Such classification errors were <u>not</u> made during interpretations from ERTS-1 or RB-57 data because: (1) the data were of recent vintage (1971-72), and (2) the interpreters were able to differentiate well between lowland forest and open swamp. In the case of interpretations from RB-57 color infrared photographs (September 1971), community distinctions were possible because many plants were entering dormancy. In the case of interpretations from ERTS images, these distinctions were possible by means of an examination of two dates of imagery (September and December).

In comparing the ERTS-derived data with the RB-57-derived data, both the spatial results and the numerical quantities are as expected. It appears that certain small wetland areas (e.g., less than 10% of a cell) can be recognized on RB-57 photographs but cannot be identified on the ERTS images due to resolution limitations. Resolution and edge definition characteristics appear to influence an interpreter into perceiving higher percentile levels (percents of cell classified as open swamp) on ERTS images than on RB-57 photographs.

It is important to note that the delineating of wetlands, their extent and degree of occurrence, is only the first step in a resource inventory. Eventually, questions of wetland diversity, wetland quality, amount of biotic habitat, and similar concerns must be quantified. Many of these questions can be approached with RB-57 photographic data. ERTS data offer the advantage of sequentiality and can also exist in a number of formats.

As previously mentioned, we are investigating a variety of resources to determine the potential for the detection and monitoring of these resources from satellite and high altitude platforms. Initially, 15 resource types have been mapped for the Sheboygan Test Site and another 300 square kilometer test site near Green Bay. Computer calculations and spatial printouts, such as shown in Figure 6, have been prepared for these 15 resource types. The results obtained for "Forest" and "Agriculture" have been especially promising. They show (for the Sheboygan Test Site):

	Total Acres (A) ERTS	Total Acres (B) RB-57	Total Acres (C) REMAP I
Forest	11,992	14,507	12,599
Agriculture	45,352	44,830	48,894

3. SUMMARY

Effective regional and state land resource planning are dependent upon relevant information which presently may not exist, except in inaccurate or archaic forms. Also critical, for use by state and regional planners, is resource information at varying scales, including land resource information for citizen educational purposes, large area planning (e.g., power plant sites), public facility planning (e.g., controlled access highways), and information for legislation and control of land resources. As presented in this paper, the detection, inventory and monitoring of wetland resources appears feasible for the scales of planning just described, except for legal control (which requires accurate property description). Importantly, it was shown in this paper that ERTS-interpreted information in the case of wetland resources was more descriptive and accurate than the current statewide information sources. For the detection of the wetland resources as overall patterns, the ERTS images appear comparable to RB-57 photographs as a data source.

With the coming advent of statewide planning systems, such as New York's LUNR and Minnesota's MLIS, plus the need to inventory specific resources, the extent of applicability and usefulness of satellite sensors will be tested. Definitions and data resolution levels of resource information are being established by planning and governmental agencies. In the State of Wisconsin, for example, the State is implementing a Critical Resource Information Program (CRIP) aimed at establishing definitions, units of measurement, inventory, and monitoring of critical land resources for planning and legislative purposes. The desire and need to inventory and monitor land resources during the coming decade is obvious and the extent of applicability of ERTS satellite sensors will be of utmost interest to members responsible for and interested in the land resource planning and decision processes.

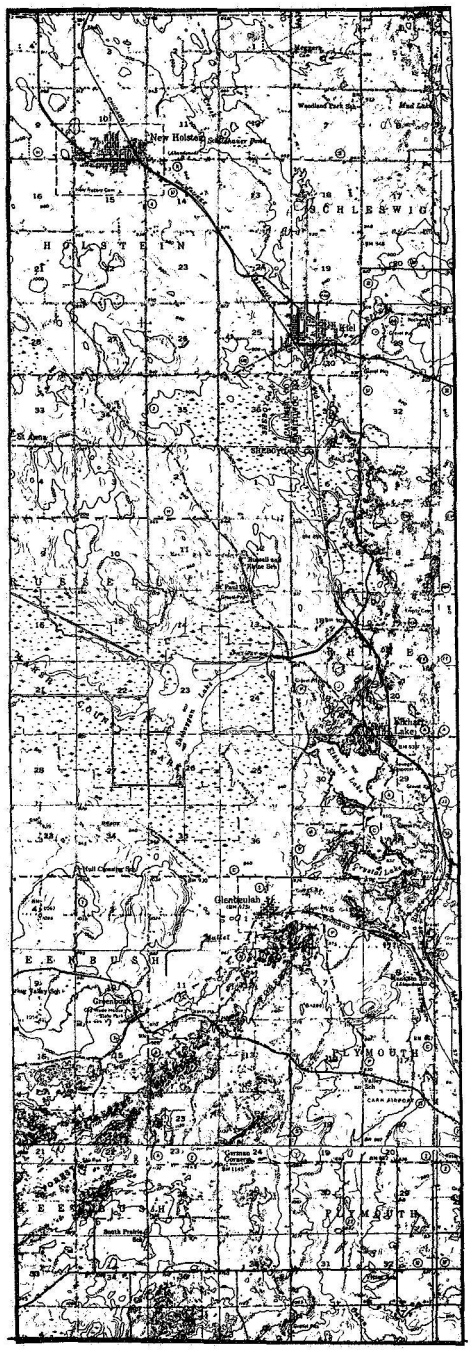

FIGURE 1

U.S.G.S. TOPOGRAPHIC MAP
10x30 km SHEBOYGAN TEST SITE

FIGURE 2

RB-57 PHOTO, 4 June 1972
Hasselblad, b/w red band

!W089-00 W088-30! W088-00! N043-00!
09AUG72 C N43-54/W087-54 N N43-54/W087-52 MSS 5 D SUN EL53 AZ132 192-0236-G-1-N-D-2L NASA E

FIGURE 3 - ERTS BAND 5 (MSS-red), August 9, 1972
GREEN BAY-MILWAUKEE REGION

FIGURE 4

ERTS BAND 5 (MSS-red)
9 August 1972

FIGURE 5

ERTS BAND 5 (MSS-red)
13 December 1972

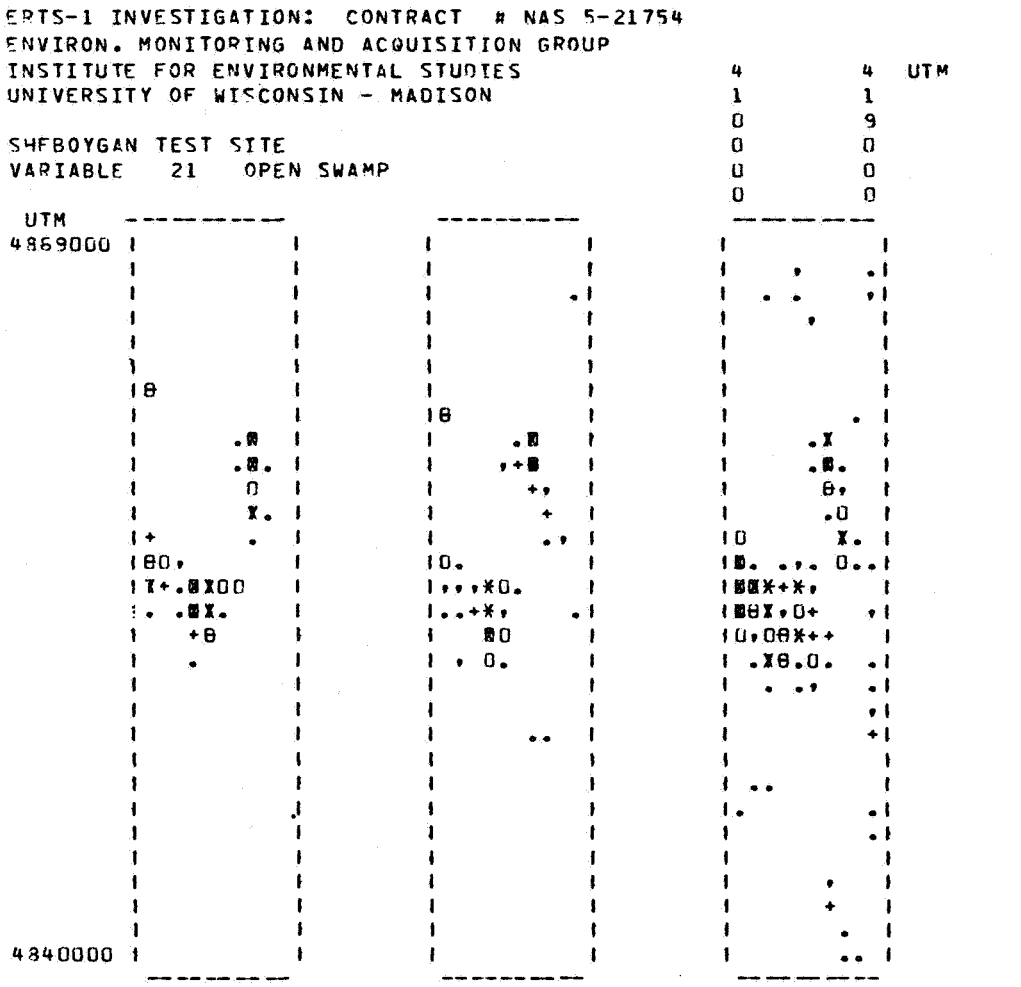

FIG. 6 WETLANDS (REMAP I VARIABLE "OPEN SWAMP")
ERTS and RB-57 INTERPRETATIONS vs REMAP I DATA BANK

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