PE&RS SPECIAL ISSUE

A BRIEF SYNOPSIS ON MAPPING THE EVERGLADES

FOREWORD

This issue of *Photogrammetric Engineering & Remote Sensing* is focused on mapping the Everglades – a vast area of subtropical wetlands in South Florida. Three organizations, the South Florida Natural Resources Center, Everglades National Park; the Center for Remote Sensing and Mapping Science, The University of Georgia; and the South Florida Water Management District, have established an up-to-date geographic information system (GIS) database and associated maps that provide baseline information on vegetation patterns throughout Everglades National Park, Big Cypress National Preserve, Biscayne National Park, Florida Panther National Wildlife Refuge, and the South Florida Water Management District Water Conservation Areas. In the case of the federal lands, the Center for Remote Sensing and Mapping Science at The University of Georgia has been responsible for mapping efforts, working in conjunction with the South Florida Natural Resources Center, Everglades National Park. Correspondingly, the South Florida Water Management District has undertaken to map Water Conservation Area 3 which lies adjacent to the Big Cypress National Preserve.

The catalyst for these projects was the observation of noticeable changes in Everglades vegetation patterns during the past several decades and a decrease in wildlife populations—thought by many to be attributable to expanding agricultural land use along the northern and eastern margins of the Everglades, increased nutrient supply associated with agricultural production, modification of water flow through the construction of canals and levees by the U.S. Army Corps of Engineers, and competition for water supplies due to urban development and agricultural land use in lands bordering the Everglades. However, it was the damage caused by Hurricane Andrew in 1992 and the subsequent availability of federal funds that permitted the vegetation mapping project to become a reality. Recently, the planned Everglades restoration efforts provided further momentum to the project.

The six articles that follow document the efforts to establish baseline information on vegetation patterns throughout the Everglades and the magnitude of off-road vehicle (ORV) trail use in Big Cypress National Preserve. In the first of these articles, Doren *et al.*, document the recent history of Everglades vegetation mapping projects and clearly note the absence of any comprehensive, detailed vegetation map coverage prior to 1994. They also define the requirements for current, up-to-date information in support of restoration efforts – pointing out the ecological need to quantify perceived landscape changes and provide accurate spatial information in support of on-going modeling efforts. A strong case is made for collecting and analyzing spatial information on vegetation patterns through the integrated use of Global Positioning System (GPS) surveys, remotely sensed images, and GIS analysis techniques — data and methodologies that will be of considerable importance for the conservation of natural resources in the 21st Century. In this context, technical and economic arguments are made for monitoring selected "high-resolution" sites distributed throughout the Everglades, rather than attempting to frequently conduct wall-to-wall mapping operations. Concern is expressed, however, that adequate resources may not be allocated to maintain and up-date vegetation databases as changes are noted throughout the region, or to integrate these data with field level analyses.

Welch *et al.*, document the feasibility of integrating GPS surveys, satellite remote sensing, air photointerpretation and GIS technology to create vegetation and ORV databases and associated map products. A differential GPS survey along roads extending northward through the center of the study area was undertaken to establish ground control points (GCPs), which, in conjunction with well-defined features taken from 1:24,000-scale U.S. Geological Survey topographic line maps available at that time for the land areas bordering the Everglades, provided the GCP framework necessary to rectify eight SPOT satellite panchromatic images of 10-m resolution. The geocoded satellite images were then employed as a source of GCPs for the 1:40,000-scale color infrared (CIR) aerial photographs from which the vegetation and ORV databases and 1:15,000-scale maps were constructed. Field verification of interpretation was accomplished using GPS-assisted accuracy checks. This involved taking a laptop computer on-board a helicopter, linking the computer to a GPS antenna and displaying in real-time the track of the helicopter superimposed on a SPOT satellite image of the terrain. This technology proved invaluable in facilitating field reconnaissance and was easily integrated into the photointerpretation process. The resulting vegetation database is housed at the South Florida Natural Resources Center, Everglades National Park, and the South Florida Water Management District, whereas the ORV trail database is retained by Big Cypress National Preserve. The latter database reveals a large volume of ORV use over the last several years, with more than 40,000 km of trails crisscrossing the Preserve.

Madden *et al.*, more fully discuss the photointerpretation process and the Everglades Vegetation Classification System developed for this project, and the subsequent creation of a digital photointerpretation key that incorporates oblique color pictures recorded from a helicopter with a hand-held camera and vertical CIR photographs obtained from an aircraft with a standard photogrammetric camera. Photographs of some 89 plant communities and species contained in the hierarchical Everglades Vegetation Classification System have been scanned, organized, and matched with text descriptions of the plants so as to provide both photointerpreters and scientists with details on the various vegetation communities – all readily accessible via a desktop personal computer.

Exotics are a specific category of vegetation causing considerable problems in Everglades National Park. Specifically, Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* spp.), and *Melaleuca* (*Melaleuca quinquenervia*) are displacing native vegetation, and several hundred thousand dollars are spent annually to control the spread of exotics. McCormick describes the use of large-scale CIR photographs to map *Melaleuca* in a "high resolution" site

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in East Everglades, achieving an accuracy of better than 90 percent. She clearly demonstrates that a detailed knowledge of the vegetation species in combination with the integrated use of GPS, remote sensing, and GIS techniques permits the monitoring of exotic plant growth and distribution from large-scale CIR aerial photographs.

In addition to the influx of exotics, National Park Service and South Florida Water Management District managers are concerned about the spread of cattails as a result of increased nutrient input and alterations of hydroperiods. Rutchey and Vilchek describe the use of 1:24,000-scale CIR aerial photographs from 1991 and 1995 to create a digital database of cattail coverage in the South Florida Water Management District's Water Conservation Area 2. Results from this study reveal that the area covered by monotypic cattail quadrupled over a four year period. The authors also clearly define the advantages of photointerpretation techniques for deriving detailed information on wetland vegetation.

The value of the Everglades vegetation databases for monitoring and modeling vegetation patterns and their response to variations in hydroperiod, nutrient influx, and pollution is documented in the above mentioned articles. In addition, however, remote sensing data, ground photographs, and vegetation databases can be linked to text descriptions and to digital video and audio clips to provide an interactive multimedia approach that incorporates GIS technology. Hu describes such an approach undertaken by the Center for Remote Sensing and Mapping Science to demonstrate the feasibility of using a personal computer to provide representations of geographic features and interrelationships between flora, fauna, and human activities in Everglades National Park.

Overall, the construction of the Everglades vegetation database has required the integration of a variety of remote sensing, mapping, and GIS techniques to provide the first detailed border-to-border spatial information for the wetland areas of South Florida managed by federal and state agencies. It is hoped that the availability of these databases will motivate the respective agencies to provide the resources to maintain and utilize them to their full potential.

GUEST EDITORS

Roy Welch and Marguerite Madden
Center for Remote Sensing and Mapping Science
Department of Geography
The University of Georgia
Athens, Georgia 30602

Robert F. Doren
Southeast Regional Office
National Park Service
Southeast Environmental Research Program
Florida International University
University Park Campus
Miami, Florida 33199

Ken Rutchey
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406