# MONITORING THE MESOAMERICAN BIOLOGICAL CORRIDOR: A NASA/CCAD COOPERATIVE RESEARCH PROJECT

(NAG5-8712 University of Maine)

**Final Report Submitted to NASA-ESE by**


**Steven A. Sader**
**Department of Forest Management**
**University of Maine (NAG5-8712)**
**Orono, Maine 04469-5755**
Sader@umenfa.maine.edu
**http://www.ume.maine.edu/~MIAL**

**Thomas Sever and Daniel Irwin**
**NASA-Global Hydrology Climate Center**
**MSFC, Huntsville, Alabama 35805**
Tom.sever@msfc.nasa.gov
Daniel.Irwin@msfc.nasa.gov
**http://ghrc.msfc.nasa.gov**

**Sassan Saatchi**
**NASA-Jet Propulsion Laboratory**
**Pasadena, California 91109**
Saatchi@congo.jpl.nasa.gov


**July 31, 2004**

**Abstract**

To foster scientific cooperation under a Memorandum of Understanding between NASA and the Central American countries, the research project developed regional databases to monitor forest condition and environmental change throughout the region. Of particular interest is the Mesoamerican Biological Corridor (MBC), a chain of protected areas and proposed conservation areas that will link segments of natural habitats in Central America from the borders of northern Columbia to southern Mexico. The first and second year of the project focused on the development of regional satellite databases (JERS-1C, MODIS, and Landsat-TM), training of Central American cooperators and forest cover and change analysis. The three regional satellite mosaics were developed and distributed on CD-ROM to cooperators and regional outlets. Four regional remote sensing training courses were conducted in 3 countries including participants from all 7 Central American countries and Mexico. In year 3, regional forest change assessment in reference to Mesoamerican Biological Corridor was completed and land cover maps (from Landsat TM) were developed for 7 Landsat scenes and accuracy assessed. These maps are being used to support validation of MODIS forest/non forest maps and to examine forest fragmentation and forest cover change in selected study sites. A no-cost time extension (2003-2004) allowed the completion of an M.S. thesis by a Costa Rican student and preparation of manuscripts for future submission to peer-reviewed outlets. Proposals initiated at the end of the project have generated external funding from the U.S. Forest Service (to U. Maine), NASA-ESSF (Oregon State U.) and from USAID and EPA (to NASA-MSFC-GHCC) to test MODIS capabilities to detect forest change; conduct literature review on biomass estimation and carbon stocks and develop a regional remote sensing monitoring center in Central America. The success of the project has led to continued cooperation between NASA, other federal agencies, and scientists from all seven Central American Countries (see SERVIR web site for this ongoing work – servir.nsstc.nasa.gov).

Keywords:

Research Fields- deforestation, land cover classification, habitat fragmentation

Geographic Area/Biome- Central America, humid tropical forest

Remote Sensing- Landsat, SAR, MODIS

Methods/Scales- data fusion, integrated assessments, regional scale

Scientific Question Addressed: What are the changes in land cover/land use?
(forest monitoring and mapping)

Proportion of Social Science: 0

GOFC Forest Themes: Map/monitor-50%, change-25%, other (training)-25%

Goals: Develop regional satellite databases for Central America to map and monitor

forest cover , forest fragmentation and change along the Mesoamerican Biological Corridor. Develop research partnerships with Central American scientists and cooperators.

Accomplishments:

- Four training/workshops conducted in Central America
- JERS, MODIS, and Landsat-TM regional mosaics available for the first time for Central America
- Preliminary analysis of forest cover and change indicate that forest cover was higher, forest change is lower inside the corridor units than outside. Forest clearing rates appear to be lower (based on 26% sample) than 1980 rates reported by FAO.
- Regional land cover and accuracy assessed database (7 Landsat scenes)
- Publications and other research products (see attached list)

New Findings – nothing to report this period

New Potential - nothing to report this period

Products

1. JERS-1C mosaic (late 1996) at 100m rectified to 3 arc-second DEM for Central American region.
2. MODIS mosaic (2001) at 250m for Central American region.
3. Landsat-TM mosaic (late1980's to early 1990's). Note that this comes from the NASA Scientific Purchase Databuy (EarthSat) database but we produced the mosaic (TM 3,4,5) at 250m rectified to the DEM.
4. A CD-ROM containing the three mosaics and other research products delivered by the NASA Delegation to Central America in June, 2001.

**List of Publications and Presentations**

*Book Chapter -In Press:*

Sader S.A., R.R. Chowdury, L. Schneider, and B.L. Turner. Forest change and human driving forces in Central America. Chapter 4 in: G.Guttman, A. Janetos and D. Skole (Eds.), Land Change Science: Observing, Monitoring and Understanding Trajectories of Change on the Earth's Surface. Kluwer Academic Publishers, The Netherlands. (In Press)

*Published Article-Refereed*

Hayes, D.J. and S.A. Sader. 2002.Analyzing a forest conversion history database to explore the spatial and temporal characteristics of forest change. Landscape Ecology 17(14):299-314.

*Conference Papers and Abstracts – Published*

Sader, S.A., T. Sever and D. Irwin. 2002. Monitoring the Mesoamerican Biological Corridor using multi-scale and multi-temporal Remote Sensing. American Society for Photogrammetry and Remote Sensing Annual Meeting, November, 10-15, 2002, Adams Mark Hotel, Denver CO. ASPRS (Abstract on CD-ROM).

Sader, S.A., D.J. Hayes, D.E. Irwin and S.S. Saatchi. 2001. Preliminary forest cover estimates for Central America (1990's) with reference to the proposed Mesoamerican Biological Corridor. American Society for Photogrammetry and Remote Sensing, (ASPRS), 2001 Annual Meeting, St. Louis, Missouri, April 23-26. ASPRS, Bethesda, Maryland (on CD-ROM).

*Technical Reports*

Sader, S.A., T. Sever and S.S. Saatchi. 2001. Monitoring the Mesoamerican Biological Corridor: a NASA/CCAD cooperative research project. Year 2 progress report (NAG5-8712), submitted to NASA-ESE, 19pp.

Sader, S.A., T. Sever, D. Irwin and S. Saatchi. 2000. Monitoring the Mesoamerican biological corridor: A NASA/CCAD Cooperative Research Project, year 1 progress report submitted to NASA-ESE (NAG5-8712), 12 pp.

*Presentations*

Sader, S.A., D. Hayes, D. Irwin and S. Cordero-Sancho. Forest change and fragmentation comparisons using TERRA MODIS and Landsat ETM+ imagery. Eastern CANUSA Forest Science Conference -3rd No. American Forest Ecology Conference, Oct. 19-20, 2002, University of Maine. (Poster).

Sader, S.A. Land use/cover change in Central America. International Human Dimension Program, International Geosphere and Biosphere Program. Focus 1 workshop on Synthesis of Land Change Processes in Latin America. Arizona State University, November 16-18, 2002. Invited Presentation.

Sader, S.A. Forest cover and forest change in Central American protected areas and proposed corridors. Oregon State University, Corvallis OR. May 30, 2002. Invited Presentation.

Sader, S.A. Monitoring forest cover and change in Central America with special reference to the Mesoamerican Biological Corridor. NASA Land Cover/Land Use Change Science Team Annual Meeting, Nov. 12, 2002, University of Maryland- College Park. Invited Poster Presentation.

Sader, S.A., D. Irwin, T. Sever, S. Saatchi. The NASA/CCAD Mesoamerican Biological Corridor project. Central American Commission on Development and the Environment

(CCAD) Workshop and NASA delegation to Central America. San Salvador Marriott, June 12, 2001. Invited Presentation.

Sader, S.A., D. Irwin, T. Sever and S. Saatchi. The NASA/CCAD Mesoamerican Biological Corridor project and deforestation research in northern Guatemala. Central American Commission on Development and the Environment Workshop and NASA Delegation to Central America. Guatemala City Marriott, June 14, 2001. Invited Presentation.

Sader, S.A. Annual progress report on the NASA/CCAD Mesoamerican Biological Corridor Project. NASA-Land Cover/Land Use Change Science Team Meeting. Univ. of Maryland, Nov. 19, 2001. Invited Presentation.

Irwin, D., S.A. Sader, and D. Hayes. Forest change and carbon accounting methods using multi-scale satellite data for the Central American region. International Forum on Mitigation of Global Climate Change. USAID Regional Meeting, January 21-23, 2003, Panama City, Panama. Invited Presentation.

Sader, S.A. The NASA/CCAD Mesoamerican Biological Corridor Project. Wildlife Ecology Seminar, Univ. of Maine, Orono, ME. Nov. 26, 2001.

Sader, S.A. Remote sensing technology for monitoring deforestation in Central America. U.S. Agency for International Development PROARCA Regional Meeting, Sheridan Antigua, Guatemala Feb. 27, 2002.Invited Presentation.

*Thesis*

Cordero Sancho, S. 2004. Landsat spectral analysis, waveband selection and classification accuracy assessment of coffee plantations in Central America. Unpublished M.S. Thesis, University of Maine, Orono, ME

*Manuscripts in Preparation:*

Cordero-Sancho, S. and S.A. Sader._Spectral analysis and accuracy assessment of coffee crops in Costa Rica.

Cordero-Sancho, S. and S.A. Sader. Coffee crop environmental characterization and socio-economic relationships to the Mesoamerican Biological Corridor in Costa Rica.