Forest Formation and Land Cover Map Series: Puerto Rico, Vieques and Culebra

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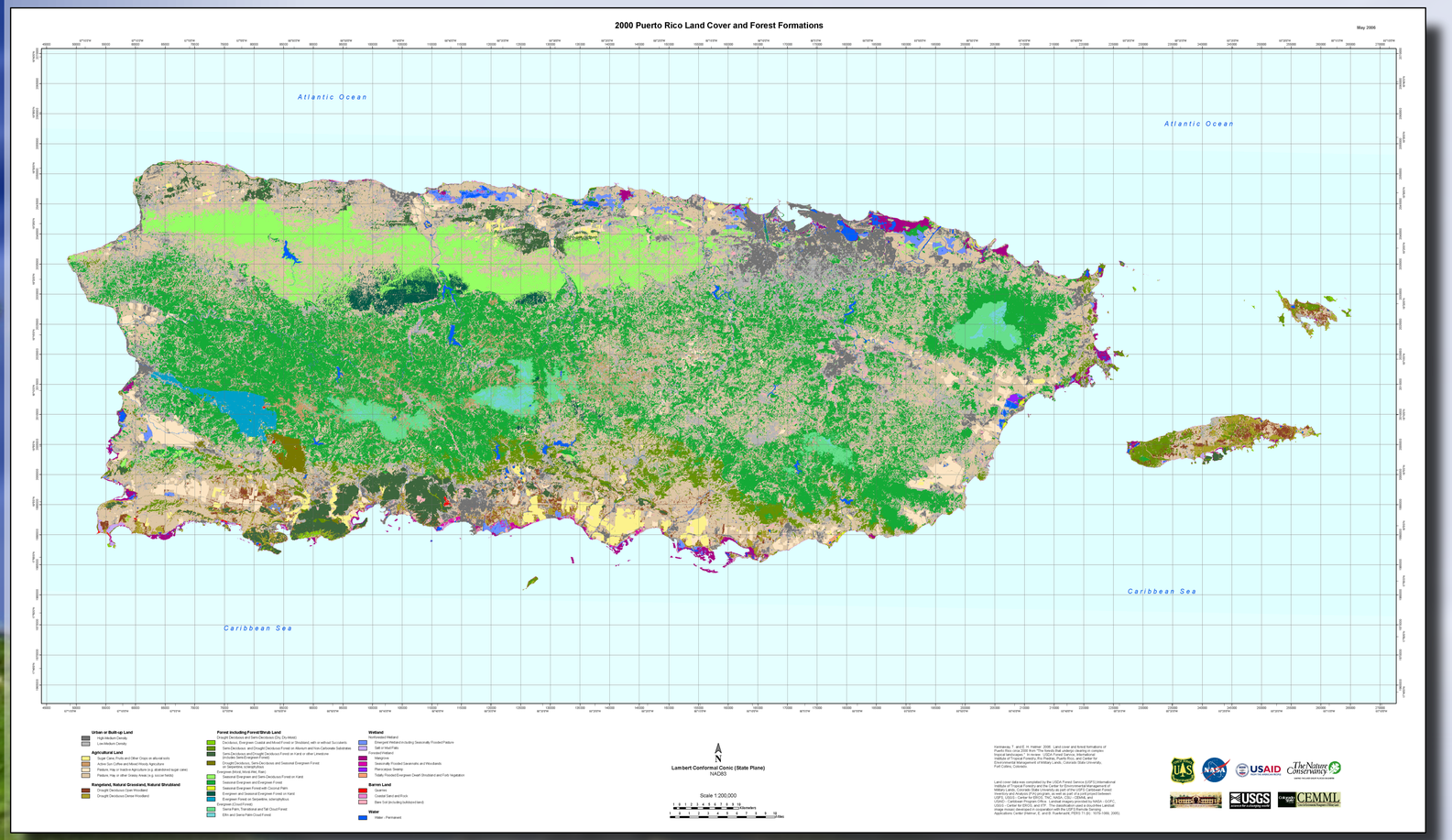
ABSTRACT

From Kennaway, T., and Helmer, E., 2007, The forest types and ages cleared for urban development in Puerto Rico: in review, International Institute of Tropical Forestry, Río Piedras, Puerto Rico.

We developed forest formation and land cover maps for Puerto Rico, Vieques, and Culebra for 1991 and 2000 from Landsat satellite imagery. The image mosaics (Helmer and Ruefenacht, 2005) were classified with decision tree software used on a combination of ancillary raster data, including topographic variables, and spectral bands. The image mosaics were developed with regression tree normalization to replace cloudy areas with data from other Landsat scenes. Classification accuracy was assessed with aerial photos. The forest classification scheme relates closely to that described by Areces-Malea (1999), with modifications similar to those in Helmer (2002). We also digitized a land cover map from 1951 (Brockman, 1952), and we joined digital land cover maps from 1978 (U.S. Geological Survey (USGS) and Puerto Rico Department of Natural Resources and Environment) into one island-wide coverage.

Cultivated land area in Puerto Rico decreased over the second half of the 20th century, while forests were re-established on lands that were formerly grazed or cultivated, and developed land area increased. These trends in Puerto Rico are no longer unique. Economic shifts are leading to similar land cover changes on other Caribbean islands (Helmer and others, submitted) and in many tropical regions (Kauppi and others, 2006). To understand how urban change affects forests, we estimated the age distributions of the forest types that were cleared from 1991-2000. Most of the forest that was urbanized was young. These young forests are at lower elevations with gentler slopes, which is where agriculture has lasted longer and urban development is easier. Lowland forests, including semi-deciduous and drought-deciduous forests and woodlands, and seasonal evergreen forests, are the most vulnerable to urban development, and are among the least-protected forest types. In addition, we found that forests located on karst topography are some of the oldest forests on the island, and make up a large proportion of the old forests that are cleared for land development. Old forests on rugged karst lands with little agricultural value, which were reforested long ago, are now vulnerable to urban development if they are close to urban centers and unprotected.



Land Cover Maps produced by USDA Forest Service and The Nature Conservancy

CONTRIBUTORS

The U.S. Agency for International Development and the U.S. Department of Agriculture (USDA) Forest Service provided funding for this work. Cooperating institutions included the U.S. Geological Survey (USGS) Center for Earth Resources Observation and Science, The Nature Conservancy, the Center for Environmental Management of Military Lands of Colorado State University, and the USDA Forest Service Rocky Mountain Research Station. The National Aeronautics and Space Administration (NASA) Global Observation of Forest Cover program funded much of the Landsat imagery. Pete Weaver, Ariel Lugo, Danilo Chinea, Bonnie Ruefenacht, Tom Ruzycki, Calvin Bagley, Brent Read, Ray Czaplewski, Rudy King, Thomas Brandeis, Larry Tieszen, and Tom Albright provided invaluable assistance.

DATA AVAILABILITY

These land cover data and cartographic products will be available in June 2007 for download at the following Web sites: USGS Center for Earth Resources Observation and Science - International Programs (http://edcintl.cr.usgs.gov) and USDA Forest Service International Institute of Tropical Forestry (http://tropicalforestry.net/).

REFERENCES

Areces-Mallea, A., Weakley, A.S., Li, X., Sayre, R.G., Parrish, J.D., Tipton, C.V., and Boucher, T., 1999, A guide to Caribbean vegetation types: classification systems and descriptions: Arlington, Va., The Nature Conservancy.

Brockman, V.M., 1952, The rural land classification program of Puerto Rico: studies in geography: Evanston, Ill, Northwestern University.

Kauppi, Pekka E., Ausubel, J. H., Fang, J., Mather, A. S., Sedjo, R. A., and Waggoner P. E., 2006, Returning forests analyzed with the forest identity: Proceedings of the National Academy of Sciences of the United States of America v. 103, p. 17574-17579.

Kennaway, T., and Helmer, E.H., submitted, Quantifying the forest types and ages cleared for urban development in Puerto Rico: Río Piedras, P.R., International Institute of Tropical Forestry.

Helmer, E.H., Kennaway, T., Pedreros, D., Tieszen, L., Marcano, H., Schill, S., Ruzycki, T., Carrington, S., and Clark, M., submitted, Forest formations and land cover of St. Kitts, Nevis, St. Eustatius, Grenada and Barbados with effective tools to map complex tropical landscapes with satellite imagery: Río Piedras, P.R., International Institute of Tropical Forestry.

Helmer, E.H., Ramos, O., Lopez, T.d.M., Quiñones, M., and Diaz, W., 2002: Mapping forest types and land cover of Puerto Rico, a component of the Caribbean biodiversity hotspot: Caribbean J. Sci., v. 38, p. 165-183.

Helmer, E.H., and Ruefenacht, B., 2005, Cloud-free satellite image mosaics with regression trees and histogram matching: Photogrammetric Engineering and Remote Sensing, v. 71, p. 1079-1089.

* Work performed under USGS contract 03CRCN0001