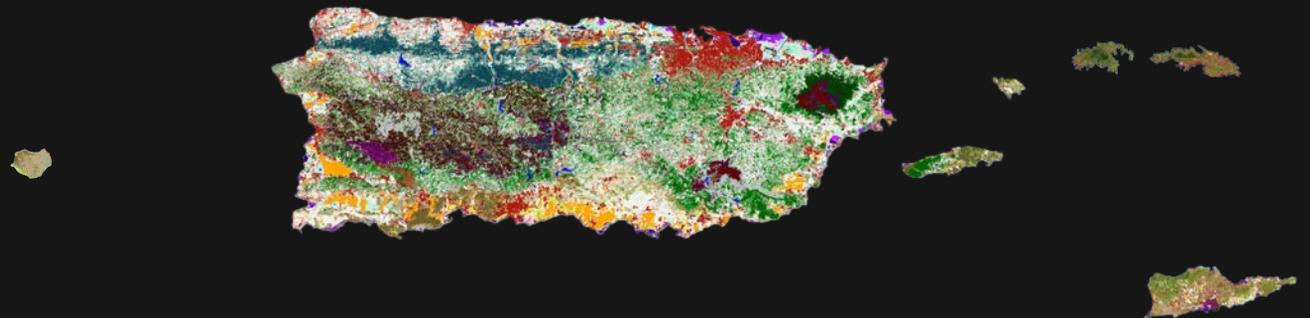


Caribbean Landscape Conservation Cooperative

Providing science and technology for conservation planning and action



Helping conserve, sustain and restore natural and cultural resources in Caribbean land and seascapes

The Caribbean Landscape Conservation Cooperative was started in 2010 by founding members from Federal, Commonwealth, and Territorial agencies in Puerto Rico and the US Virgin Islands. They were concerned with the conservation of natural and cultural resources and looking for ways to work across traditional boundaries.

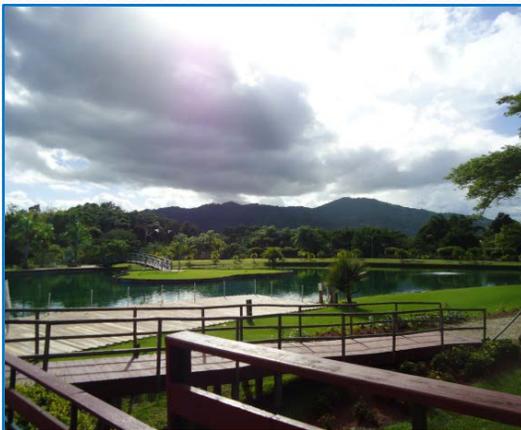
The CLCC is a framework for conducting conservation science and action that many partners can participate in. This is our first annual report of activities covering January to December 2012.

The CLCC is led by the US Forest Service International Institute of Tropical Forestry in Río Piedras, Puerto Rico.



Our 2012 Annual Report Includes:

- Messages from the CLCC Interim Steering Committee and Coordinators
- Introduction
- Our Mission and Vision
- Executive Summary



Botanical Garden, Caguas, Puerto Rico

- Summary of Activities
- Capacity: Staff and Facilities
- Staff Bios
- Interim Steering Committee



Camuy Cave Park, Camuy Puerto Rico

- Outreach
- Annual Meeting Summary
- Research Projects
- Contact Information



Greetings CLCC partners!

Message from the CLCC Coordinator
William Gould- USDA/FS/IITF



It has been a real honor to help launch the Caribbean Landscape Conservation Cooperative. From the very beginning there has been an outpouring of enthusiasm, support, and great ideas to help build a strong foundation for the Cooperative. There has also been a high level of trust and support from various agencies and individuals willing to take a leap outside their traditional roles and work towards shared conservation priorities. This Cooperative has been and will be what the partners make it. As long as we set our sights high we can accomplish great things with the combined spirit and capacities of many people and organizations that share a vision of a sustainable future that values our land, seas, freshwater, wildlife, and cultural resources.



William Gould
Research Ecologist
and CLCC Coordinator
U.S. Forest Service
International Institute
of Tropical Forestry



Message from the CLCC Chair
Leopoldo Miranda-FWS



I first would like to express my sincere gratitude for your ongoing support of our newly created Caribbean Landscape Conservation Cooperative. Our cooperative represents a strong partnership among natural resources management agencies, conservation organizations and individuals who are interested in achieving a sustainable future for the Caribbean Islands' natural and cultural resources. No matter how challenging these conservation issues may be, our cooperative strives to become a catalyst, facilitator and a forum where the Caribbean communities can exchange scientific information to inform decision makers, at all levels of government and society, of what a sustainable landscape and seascapes looks like. I am very pleased with what we have accomplished so far in our first year and I am looking forward to a very exciting future of our Cooperative.



Leopoldo "Leo" Miranda
U.S. Fish and Wildlife Service
Assistant Regional Director
Ecological Services
Southeast U.S., Puerto Rico
and U.S. Virgin Islands

Message from CLCC Partnership and Outreach Coordinator Kasey R. Jacobs-IITF/NOAA/DNER

The last year was quite the year for conservation in the U.S. Caribbean in terms of new challenges, new initiatives and new projects. Over the last year we have seen the listing of the *coquí llanero* as an endangered species and the designation of critical habitat by the U.S. Fish & Wildlife Service, we have collectively learned from new landscape approaches to restore Puerto Rico's coffee regions in the mountains to protect coral reefs by the Natural Resources Conservation Service along with many partners, the beginnings of the El Yunque Forest Plan Revision Process by the U.S. Forest Service, the convening of the first Protected Areas Congress by DNER and The Nature Conservancy, and the topic of sustainability progressing by EPA's PR and VI Recycling Partnerships. And personally, the last year has been very rewarding as the 140+ members of the Puerto Rico Climate Change Council completed Puerto Rico's first islands-wide vulnerability assessment to climate change under the guidance of DNER and the Puerto Rico Coastal Zone Management Program. I feel so grateful that my work on this project as a NOAA Coastal Management Fellow lead me to being hired as Partnership & Outreach Coordinator for the CLCC.

For me, it has been very exciting to witness the culture changes that each agency is going through. Agencies are recognizing the need to work across jurisdictions, connect landscapes and seascapes, work across disciplines and with inclusion of the social sciences, integrate the human, economic, cultural and built environment aspects into the field of conservation, and, most importantly and arguably most challenging, improving cooperation and collaboration with other agencies, non-governmental organizations, universities, community groups and the private sector.

Since my start with the CLCC in October 2012 I've had the privilege to work with so many inspirational partners while we create, refine and facilitate the CLCC framework for conservation science and action. I look forward to working with the Caribbean conservation community over the next year to develop more research groups, conservation action teams, and advisory groups.

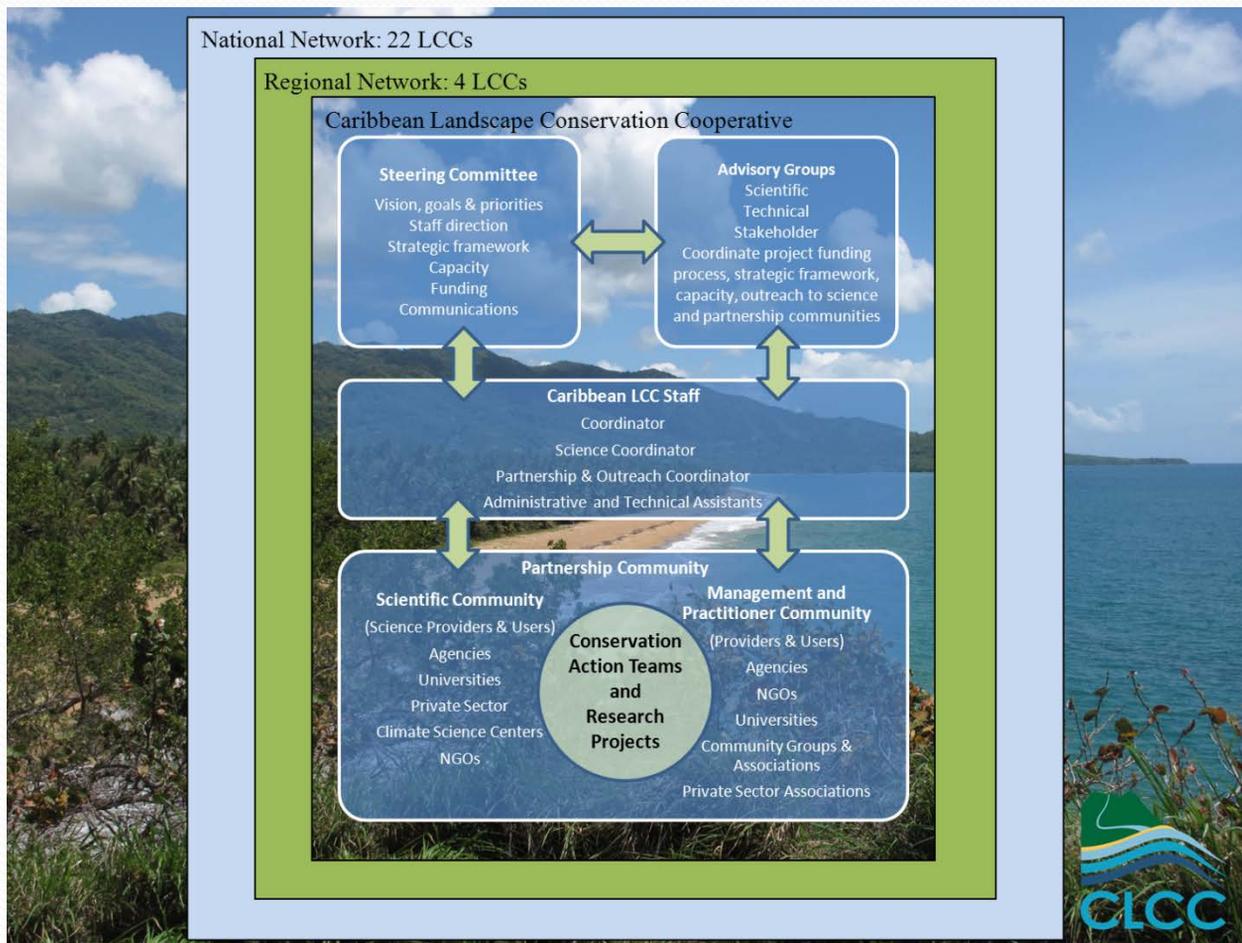


Introduction

There are great conservation challenges in the Caribbean, including competing demands for open space, climate change, sea level rise, vulnerable marine and coastal habitats, degraded lands in needs of restoration, and many native and endemic threatened and endangered species in need of monitoring and protection.

The Caribbean Landscape Conservation Cooperative is part of a network of 22 cooperatives nationally, 4 cooperatives regionally, and is structured to enable partners to identify shared conservation priorities, address shared science and information needs, and develop conservation actions that accomplish shared goals.

Collaborating in conservation is a proven and successful way to work. Developing a long term framework for multi-partner conservation science and action is a new and exciting idea.





THE CLCC: NEWEST ADDITION TO THE LCC NETWORK

Purpose. The CLCC provides a collaborative framework to conduct conservation planning and management at several scales, from decisions on site management to understanding the implications of management actions regionally, nationally and globally. It is a platform for partners working to integrate information, perform regional assessments of conservation status, assess future scenarios, and collaborate in applied conservation science.



What We Do. The CLCC develops and provides science-based information to support diverse conservation initiatives and a platform for partners to exchange information and support accomplishing shared conservation goals.

www.caribbeanlcc.org

“Our domain includes the terrestrial and marine components of Puerto Rico and the U.S. Virgin Islands. We recognize the connectivity with the greater Caribbean and the continental regions through shared species, habitats, and conservation opportunities and goals.”



Mission

To develop and provide the best available conservation science and strategies to agencies, decision makers, organizations, researchers, and the general public in order to conserve, restore and sustain natural and cultural resources in the Caribbean.



Hacienda Buena Vista, Ponce, P.R.,
Conservation Trust of P.R.

Vision

To be a catalyst for collaboration and a primary source for science-based information to sustain natural and cultural resources in Caribbean land and seascapes.

Key components to our vision are that landscape and seascape conservation:

- Is based on a comprehensive understanding of the natural wealth of the land and sea;
- Applies to a wide range of spatial and temporal scales;
- Is a complex enterprise that addresses issues of life quality, sustainability and economic systems and the health of the land;
- Encourages best management practice for all situations;
- Does not tell people what to do, but what options are available;
- Requires open dialogue among all sectors of society;
- Requires continuous information sharing among all sectors of society;
- Is rooted in the past and projects to the future;
- Is flexible, nimble, and adaptive to changing socio-ecological conditions;
- Leverages the talents, knowledge, and contributions of all people.



Executive Summary



The CLCC Interim Steering Committee is composed of members from Federal, Commonwealth, and Territorial agencies from Puerto Rico and the US Virgin Islands, including the U.S. Fish & Wildlife Service, National Oceanic and Atmospheric Administration, U.S. Forest Service, Puerto Rico Department of Natural and Environmental Resources, the Virgin Islands Department of Planning and Natural Resources, U.S. Geological Survey, the National Park Service, and the Environmental Protection Agency. The Staff of the CLCC has been also growing this year and includes a Coordinator, a Partnership and Outreach Coordinator, and an Administrative Assistant. The staff has been working side by side with the Interim Steering Committee to develop a foundation for what we hope will be a long-lived organization that can achieve the goals of the CLCC in the years to come.

During 2012 the Interim Steering Committee (ISC) met several times in person and established monthly conference calls. These meetings have served as a platform for discussing our mission and vision, our organizational structure, research and conservation actions, desired outcomes, and governance strategies to be used within the CLCC.

Interim Steering Committee Meetings

April 26th

The first formal meeting of the Interim Steering Committee (ISC) with 15 participants. The themes discussed in this meeting were:

- Organizational Structure
- Steering Committee
- Composition
- CLCC Charter
- Staffing
- Activities for FY 12-13

April 26, 2012
SC meeting, San Juan



October 31st –
November 1st

The members of the ISC met in San Juan, PR to discuss shared goals for moving forward. A decision making process was established, the ISC was selected to act for the following six months with the task of developing a charter and full Steering Committee.

A Tiger Team was tasked with developing recommendations for a formal Steering Committee.

More about the Tiger Team on the next page...

Tiger Team

A Tiger Team comprised of Susan Silander, Kasey Jacobs, Pedro Ríos, Ernesto Díaz, and William Gould was tasked with developing recommendations on long-term Steering Committee size and membership to present to the Interim Steering Committee for consideration.

The Interim Steering Committee with the help of the Tiger Team is also focusing on the following over the next few months:

Key perspectives needed for a Caribbean conservation discussions

Processes & criteria for inviting new Steering Committee new

Role of NGOs on the Steering Committee

Becoming an International, Caribbean-wide LCC

as opposed to a US Caribbean LCC

Identifying a vision for a Caribbean conservation landscape of the future

How partners can work collaboratively to do conservation better



Ventana Cave, Arecibo & Utuado
Karst Region, Puerto Rico

Summary of Activities for 2012

January - June 2012

- The CLCC website was initiated with the goal of creating an important information center for Conservation in the Caribbean.
- We translated our factsheets to Spanish and made them available in a series of Open Houses that the CLCC hosted.
- The CLCC Coordinator attended the Southeast Climate Science Center meeting at the St. Petersburg Coastal and Marine Science Center, February 14-17.
- The CLCC Coordinator, Bill Gould and SC member, Dave Brown, participated in the National LCC workshop in Denver, CO, March 27-29.
- A logo for the CLCC was created.
- On April 26 SC members met in an all-day meeting to discuss several points such as the structure of the organization, decision making process, charter document, and staffing positions.
- CLCC opened a  account.
- Karen Sola was contracted to work on a Compendium of Coalitions of Conservation on PR and USVI.
- CLCC presented in the NOAA in the Caribbean meeting on May 15-16 at the USVI, St. Thomas.
- The CLCC Science Coordinator position was announced by the FWS.
- A post doc was selected to begin working with a vegetation dynamics model for PR and the USVI.
- CLCC Coordinator hosted a series of Open Houses around the island: IITF-FS headquarters, Protected Areas meeting hosted by TNC, and State of the Climate meeting sponsored by DNER.



Summary of Activities for 2012

July - December 2012

- Dr. Azad Henareh began working at the IITF modeling vegetation dynamics for the CLCC.
- CLCC Partnership and Outreach Coordinator, Kasey Jacobs, joined the CLCC Staff.
- CLCC Coordinator presented a poster at the LTER 2012 All Scientists Meeting in Denver, CO.
- CLCC hosted several Open Houses in the DPNR USVI, at the UPR Humacao Campus, and co-sponsored a workshop on Ecosystem-based Adaptation with the Puerto Rico Climate Change Council and The Nature Conservancy in Guánica, P.R.
- CLCC extended an invitation to the Conservation Trust of Puerto Rico for possible future collaboration.
- Interviews for Science Coordinator positions were conducted by a committee.
- CLCC co-hosted a surrogate species workshop with the USFWS on October 30-31.



- On Nov 1 CLCC hosted our first Annual Meeting in San Juan, Puerto Rico. Over 100 people from different agencies and organizations attended.
- Oct 31- Nov 1 the ISC members had the chance to meet in person again and develop recommendations for a formal Steering Committee. They selected a Tiger Team to provide recommendation to the rest of the team in different aspects of the decision making process.



- Our first CLCC Quarterly Connections Newsletter was released with a meeting report of the Nov 1st event.
- In mid November the CLCC Coordinator and Partnership Coordinator participated at a National LCC meeting in Lafayette, Louisiana.
- On December 3rd CLCC Coordinator presented a talk to the IGERT program students at the UPR Rio Piedras.

Capacity: Staff and the Interim Steering Committee

A. Staff

- William Gould, CLCC Coordinator, USFS Research Ecologist, IITF/USDA-FS
- Kasey Jacobs, Partnership and Outreach Coordinator, NOAA/DNER/FS S&PF
- Marixa Maldonado, Administrative Assistant, IITF/FS
- Azad Henareh, Postdoctoral Scientist, IITF/NCSU
- Brent Murry, Science Coordinator, USFWS/IITF (as of May 2013)

B. Interim Steering Committee

- Leopoldo Miranda, CLCC Interim Steering Committee Chair and Assistant Regional Director, US-FWS
- Ernesto Díaz, CLCC Interim Steering Committee Co-Chair and Director, DNER Coastal Zone Management
- Jean-Pierre Oriol, CLCC Interim Steering Committee Co-Chair and Director, USVI DPNR Coastal Zone Mgmt.
- Pedro Ríos, US Forest Service, El Yunque National Forest
- Constance Carpenter, Program Manager, USFS IITF State and Private Forest
- José Cruz, USFWS Caribbean Field Office
- Lisamarie Carrubba, NOAA Field Office
- Susan Silander, Project Leader, USFWS Caribbean Islands Complex
- Dave Brown, Director, NOAA Southern Region Climate Services
- Pedro L. Díaz, Director, Caribbean Water Science Center, USGS (Retired December 2012),
- Evelyn Huertas, US Environmental Protection Agency Region 2- Caribbean
- Rafael W. Rodríguez, Director, USGS Florida Water Science Center and Interim Director, USGS Caribbean Water Science Center
- Edwin Almodóvar, State Director, NRCS Caribbean Area Office

C. Advisory Committee

- Bill Uihlein, Regional Director, US FWS
- Jaime Collazo, Professor, NC State University
- Adam Terando, USGS SE CSC
- Nicholas Drayton, VI-EPSCoR



El Morro Fort, San Juan, Puerto Rico

Staff Bios

William Gould, PhD

CLCC Coordinator
USDA/FS/IITF
wgould@fs.fed.us

Is a research ecologist with the USDA Forest Service at the International Institute of Tropical Forestry in Río Piedras, Puerto Rico. His research involves integrating field and remote sensing data to analyze landscape patterns and processes in a wide range of ecosystems including tropical, temperate, boreal and arctic biomes. He is active in studies of conservation science, biodiversity, ecology, land cover mapping, modeling future scenarios for conservation planning, and field education and outreach. He is the team leader of the Puerto Rico Gap Analysis Project and associated studies, the Coordinator of the Caribbean Landscape Conservation Cooperative, and leads the GIS and Remote Sensing Laboratory at the International Institute of Tropical Forestry.

Kasey R. Jacobs

Partnership and Outreach Coordinator
FS S&PF/NOAA/DNER
kaseyrjacobs@caribbeanlcc.org

Before joining the CLCC as the Partnership & Outreach Coordinator, she served in the Puerto Rico Coastal Zone Management Program in the Department of Natural and Environmental Resources as a NOAA Coastal Management Fellow. During the two year fellowship, Kasey worked with her Fellowship Mentor, Director Ernesto L. Diaz, to coordinate the Puerto Rico Coastal Adaptation Project. The project convened over 140 scientists, researchers, planners, architects, and practitioners into The Puerto Rico Climate Change Council (PRCCC). The PRCCC conducted Puerto Rico's first climate change vulnerability assessment and recommended adaptation strategies. Originally from Long Island, New York and South Florida, Kasey completed her Bachelor of Science in Marine Environmental Science from Southampton College. After university, Kasey served as Long Island and Connecticut Program Coordinator for Citizens Campaign for the Environment. Kasey graduated with a master's degree (MESC) from the Yale School of Forestry and Environmental Studies. Her graduate work included serving as a Climate Change Advisor for the Permanent Mission of Belize to the United Nations as well as Head of Delegation for Yale University to the United Nations Framework Convention on Climate Change's (UNFCCC) Council of the Parties 15 in Copenhagen, Denmark. For her master's thesis Kasey conducted field research on climate change adaptation and disaster risk reduction in West Sumatra, Indonesia and interned for Mercy Corps Indonesia. Her graduate research also included assisting Professor Gaboury Benoit with the project "Investigation of Sediment Transport and Accumulation in St. Thomas, US Virgin Islands Watersheds". Her research interests have continued after grad school as currently Kasey is studying social-ecological resilience of small-scale fisheries using system dynamics modeling.

Staff Bios

Azad Henareh, PhD

CLCC Staff

North Carolina State University/IITF

ahenareh@mtu.edu

Azad Henerah is a new postdoctoral researcher supported by North Carolina State University. He is working as a visiting scientist with the USDA Forest Service at the International Institute of Tropical Forestry in Río Piedras, Puerto Rico. Azad is working in the GIS lab modeling future scenarios of land cover based on climate projections. He will be coordinating with other future scenario modeling (stream flows, urban growth) as part of the Caribbean Landscape Conservation Cooperative. Azad just graduated from the School of Forest Resources and Environmental Science, Michigan Technological University in Houghton, Michigan with a Ph.D. His research interests include global effects of climate change, large scale vegetation and ecosystem change, disturbances and their interactions on landscape structure and ecosystem functions at large scales, and changes in their dynamics through time. See his publications (<http://www.linkedin.com/pub/azad-henareh/35/388/703>).

Marixa Maldonado

CLCC Administrative Assistant

Graduate Student/USDA-FS/IITF

mmaldonadoroman@fs.fed.us

Mrs. Maldonado is a graduate student in environmental sciences at the Universidad Metropolitana, San Juan. She has a BS in Biology from the UPR-Rio Piedras. Marixa is a HACU Alumni (Hispanic Association of Colleges and Universities) since 2010. She was a HACU intern in 2010 with the DOI-BLM in Wenatchee, WA where she did field work as part of a summer team, monitoring vegetation for sage grouse habitats. In summer of 2011 she was an intern with the USFS in Blairsville, GA where she worked doing field work in the Chattahoochee National Forest. Her thesis project is related to the study of the presence of heavy metals in sediments from mangrove ecosystems in Peninsula La Esperanza, which is part of the Natural Reserve of Las Cucharillas Marsh, Cataño, P.R.



Steering Committee Information

LEOPOLDO MIRANDA

Chairman, Steering Committee
Assistant Regional Director
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Co-Chairman, Steering Committee
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JEAN PIERRE ORIOL

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Steering Committee Information

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JOEL TUTAIN

Superintendent
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You can find the complete bios of
the ISC members on our
[Quarterly Connections](#)
[Newsletter](#)

In the following link:

[http://caribbeanlcc.org/files/2012/12/C
LCC_QuarterlyConnections_DEC2012_
English2.pdf](http://caribbeanlcc.org/files/2012/12/C
LCC_QuarterlyConnections_DEC2012_
English2.pdf)

CLCC Website and Newsletter

We are developing a website to share information, data, documents, and build a virtual community among the CLCC partners. The website has an area for news and events where we will post CLCC and related partner activities.

In the website you will find :



CaribbeanLCC.org

- CLCC Information, Documents, Themes, and Issues
- Geospatial and Monitoring Data plus Interactive Mapping
- Social Networking Tools and Forums for Conservation Practitioners
- News and Events
- Multimedia Section for Podcast, Photo and Video Sharing
- Blog to Promote Ongoing Conversations about Conservation

Our **Newsletter** is a place where different partners and interested individuals can share their stories and their information on conservation issues and news. Our first volume includes details from the November 1st CLCC meeting , Steering Committee full biographies and future action items.



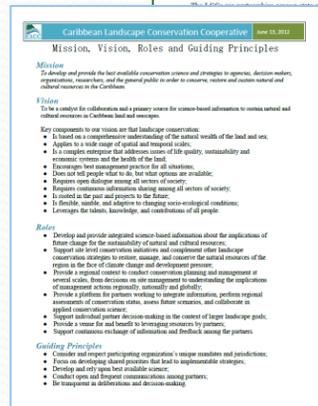
Available in English
and Spanish

In the first Issue you will find :

- Summary report of the first annual CLCC meeting in San Juan
- Projects for 2012-2013
- Call for guest articles
- Biographies of the ISC
- Caribbean Action Snapshot -*What Conservation Looks Like.*

OUTREACH : TWITTER PAGE

@Caribbean_LCC is a bilingual page that was launched during the fall last year and in the present has over 300 followers! During our Annual Meeting on November 1st we posted tweets about what was happening on the meeting and it was a success. Here you can find not only CLCC news but conservation related events and news taking place in Puerto Rico, the Virgin Islands and the rest of the Caribbean basin.



dedicated agencies, regional organizations, tribes, as a geographic area. They support resource flows at a broader scale than any individual member's landscape-scale initiatives including special, sensitive species, and water availability and habitats and provide a vision for sustainable

Our domain includes the terrestrial and marine components of Puerto Rico and the U.S. Virgin Islands. We recognize the connectivity with the greater high shared species, habitats, and conservation

CLCC Factsheets



Account summary for Nov 1st meeting in San Juan

Annual Meeting Highlights

November 1, 2012 we hosted the first annual meeting of the CLCC in San Juan, Puerto Rico which focused on *Conservation Science and Collaborative Landscapes*. The program included cooperative conservation science and action talks from the San Juan Bay Estuary Program, Casa Pueblo & the Center for Landscape Conservation, The Conservation Trust of Puerto Rico, and North Carolina State University. A luncheon was a special treat provided by The Conservation Trust of Puerto Rico that included a keynote talk from Dr. Ariel Lugo, Director of the International Institute of Tropical Forestry. Dr. Lugo spoke on *Conservation in the Anthropocene: How Puerto Rico is Leading the World*.

Many participants called the meeting a success in terms of gaining a better understanding of the CLCC and creating a shared excitement for future collaborations. We accomplished a lot of CLCC business as well. The Steering Committee made advances on defining their organizational structure, composition and governance, while the CLCC staff generated a more specific list of interested participants and a preliminary list of the ways organizations and individuals would like to participate and benefit from the CLCC.

Distribution of participants on the annual meeting :

30% Local government
29% Academia
19% Federal government
14% Non-profit
5% Private Sector
3% Other

We started a list of potential Conservation Action Teams with draft goals and actions (see next page). The meeting helped generate ideas for future activities of the CLCC as well as feedback on our planned actions. Additional outcomes of the meeting include plans for more engagement and future meetings in the U.S. Virgin Islands as well as more use of interactive online tools such as Webex for active participation by remote users.

Annual Meeting at a Glance

SELECT BRAINSTORMED RESULTS BY CHOSEN THEMES FROM PARTICIPANT WORKSHOP COMPONENT OF 2012 ANNUAL CLCC MEETING*



Human Dimensions/Ecosystem Services/Built Environment

- Incorporate social sciences
- Publish success stories
- Expand existing programs like blue flag, reuse programs and brown field redevelopment programs

Working Lands and Sea/Agriculture/Fishing

- Help overcome communications and human resources challenges
- Carry message of connections between land and sea
- Develop research questions that responds to the interests of the fishers and farmers

Decision Making & Policy

- Promote long-term management plans
- Help implement conservation laws
- Identify priority conservation areas by region
- Provide portal to information of alternatives to selling land for development (e.g., transfer of development rights; easements; tax breaks; mitigation banks)

Citizen Science

- Develop a plan or guide to achieve recruitment of citizen scientists with CLCC support
- Develop teams that can analyze the citizen science data collected

Monitoring & Research Integration

- Create common database or repository/standardizing protocol and data management (data exists but access does not)
- Determine additional need for data and at what scales (ask stakeholders) – state of knowledge and objectives of existing projects

Education

- Identify organizations that already work well with communities. Conservation Action Team could expand current efforts.
- Create a webpage with database, newsletter, and listserv – a.k.a. sharing platforms – to assist with creating a network
- Work on curriculum development, research, and programs to reeducate the community

Invasive Species

- Support existing IAS projects that educate citizens about horticulture & pet trade and do citizen science
- Partner with universities to monitor IAS distribution, assess potential threats or monitor in the field
- Inspire and support undergraduates to study Integrated Pest Management programs that already exist
- Support the development of a national invasive species strategy for Puerto Rico and USVI
- Help integrate PR & USVI partners into the different Caribbean networks that already exist but have poor U.S. representation

*Contact us if you would like a copy of the detailed notes from the 2012 CLCC Annual Meeting

Research Projects

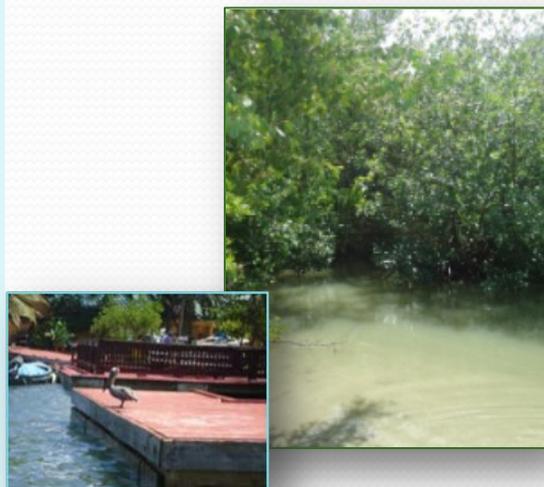
Assessing climate-sensitive ecosystems in the US Southeast

Jaime Collazo and Jennifer Costanza

As climate changes, a better understanding of how ecosystems in the Southeast and Caribbean will be affected is vital for identifying strategies to protect these ecosystems. While information on climate change affects exists for some ecosystems and some places, a synthesis of this information for key ecosystems across the region will enable decision-makers, including the LCCs, to prioritize current efforts and plan future research and monitoring. In this project funded by the Department of Interior's Southeast Climate Science Center, we are synthesizing existing information on ecosystem vulnerability to climate change. For this analysis, we are collaborating with the Caribbean LCC, NatureServe, and the USGS Tennessee Water Science Center.

We are organizing our synthesis based on the three components of climate change vulnerability: Exposure, sensitivity, and adaptive capacity. Thus far, we have worked with all LCCs in the Southeast to identify a set of focal ecosystems for analysis. For each of the focal ecosystems, we are currently conducting a first round of vulnerability assessment by using GIS to analyze each ecosystem's physical geography and ecology, climate conditions, and conservation status. Next, we will choose a subset of these focal ecosystems to conduct a more detailed vulnerability analysis using NatureServe's Habitat Climate Change Vulnerability Index tool. The result of our research will be a list of key conservation strategies that will help ecosystems adapt to climate change.

Las Cucharillas Marsh,
Cataño



Research Projects

Implementing Precipitation Runoff Modeling System (PRMS) with Dynamic Land Cover in Puerto Rico

Ashley van Beusekom, Lauren Hay and Jaime Collazo

We have implemented a daily time step watershed model (PRMS – Precipitation Runoff Modeling System) for Puerto Rico for 1983-2008. PRMS is a deterministic, distributed-parameter, physical process based modeling system developed to evaluate the response of various combinations of climate and land use on streamflow. We are now exploring the model's sensitivity to land-cover change.

Optimizing for a best-fit geographical distribution of the PRISM climate data (<http://www.prism.oregonstate.edu/>) divides the whole of the island into four basins that are modeled separately (see Figure 1). In Figure 2, we show the monthly and yearly simulated and observed streamflow for a stream gage in basin 3 (the Luquillo Mountains area, pink in Figure 1). The output is plotted for 1982-2008. The PRMS calibration period is highlighted in blue, 1991-2000.

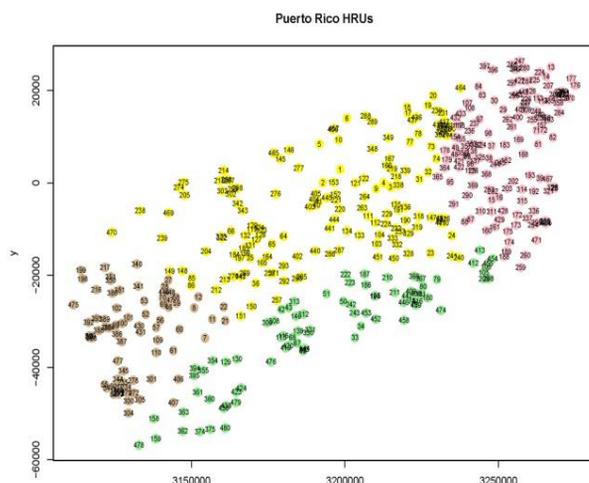


Figure 1: Puerto Rico's divided into hydrologic response modeling units and then divided into 4 basins. Pink is basin 3.

The black lines are the observed flows and the colored lines are the simulated flows. The simulated volume of the flows matches the observed volume very well during the calibration period. However, in the years before the calibration period, 1983-1990, the model over-predicts the flow. In the years after the calibration period, 2001-2008, the model under-predicts the flow.

(continued on next page)

Research Projects

Implementing Precipitation Runoff Modeling System (PRMS) with Dynamic Land Cover in Puerto Rico

Ashley van Beusekom, Lauren Hay and Jaime Collazo

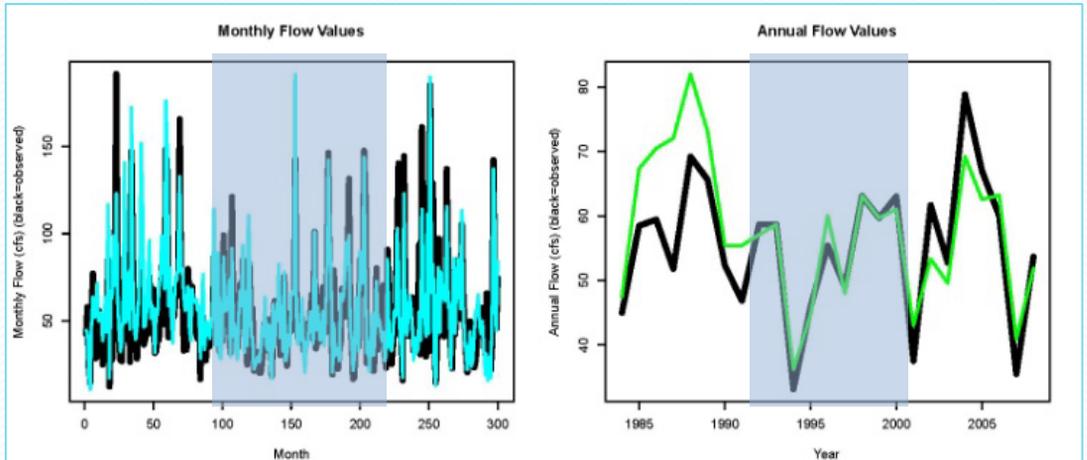


Figure 2: Simulated and observed flows in basin 3.

We observe this same trend in the other basins.

We hypothesize that our model error is due to not accounting for land-cover change. We are now inputting the historical land-cover change in terms of impervious surface percentage, canopy density, and cover-type: bare, grass, shrub, or tree. By using these several dynamic parameters, we have a large number of degrees of freedom with which to implement land-cover change. We use Puerto Rico land-cover studies from the International Institute of Tropical Forestry (IITF) laboratory in 1951, 1977, 1991, 2000, and 2010. The exploration of the historic land-cover change and its effect on runoff will greatly help inform PRMS for future conditions once downscaled climate model output becomes available.

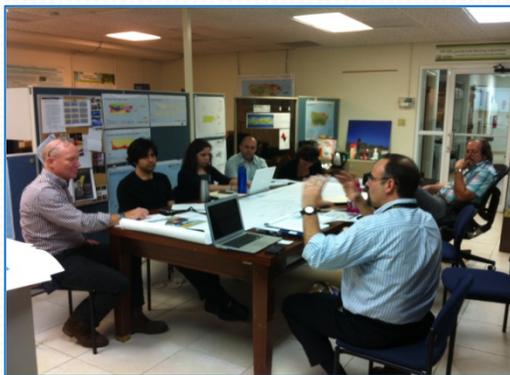
Research Projects

PR and USVI

Ecosystem Governance Knowledge Base

Glenn Page, Audrey Swanenberg and Jeselyn Calderón-Ayala

A team from SustainaMetrix, led in Puerto Rico by Jeselyn Calderon-Ayala and in Maryland by Glenn Page and Audrey Swanenberg, will be assisting the CLCC and partners in the development of an inventory of conservation based actions, collaborative structures and sources of governance at multiple scales to serve as a basis for an ecosystem governance knowledge base.



February 2013 Meeting in S.J., P.R.

There are four main components to this work:

First, the team will engage with principal participating organizations of the CLCC and conduct interviews with steering committee members regarding their organization's structure, priority areas of focus, priority issues they are addressing, goals and objectives, core capacity, range of conservation activities on Puerto Rico and USVI, as well as their involvement in other forms of conservation-based collaborative structures.

Second, the team will define specific attributes of the intended collaboration within the CLCC so that its existence, development, quantity, quality and effects can be measured, observed and documented. The team will be using the Collaboration Evaluation and Improvement Framework (CEIF).

(continued on next page)



Research Projects

PR and USVI

Ecosystem Governance Knowledge Base

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Third, the team will examine examples of ecosystem-based governance at three scales (watershed, jurisdictional and international) to model a process to inventory and map collaborative structures in place, their goals and objectives, current activities, and other potential sources of governance at these scales.



Landscape of Puerto Rico's mountains

The team will be using *The Analysis of Governance Response to Ecosystem Change* developed by Olsen, Page and Ochoa 2009.

Fourth, the team will make a series of recommendations to the CLCC for the development of an

expanded ecosystem governance knowledge base, use of the knowledge base to define and refine goals, to sequence and prioritize actions, and to evaluate progress of the CLCC along the way.

The goal of the project is to build adaptive capacity, increase learning by doing, and increase the overall quality of the collaborative process of the CLCC.

1 Woodland, Rebecca H. and Michael S. Hutton. 2012. *Evaluating Organizational Collaborations: Suggested Entry Points and Strategies*. *American Journal of Evaluation*, Sage Publishing, 33(3) 366-383.

2 Olsen S.B.; Page, G.G.; & Ochoa E. (2009) *The Analysis of Governance Response to Ecosystem Change : A Handbook for Assembling a Baseline*. LOICZ Reports and Studies No. 34. GKSS Research Center, Geesthacht, 87 Pages.

Research Projects

Vegetation dynamics related to climate and land use in Puerto Rico and the US Virgin Islands

Azad Henareh, William Gould and Jaime Collazo

This project is supported by the US Geological Survey, North Carolina State University (NCSU) and the US Forest Service International Institute of Tropical Forestry (IITF). The research is housed in the IITF GIS and Remote Sensing Laboratory. Postdoctoral researcher Azad Henareh (NCSU/IITF) works with IITF Research Ecologist William Gould and NCSU professor Jaime Collazo to conduct two studies as the main components of the project:

1. **Spatial factors of land cover transition in Puerto Rico**

The transition between land cover types is dependent upon landscape spatial arrangement. Land cover maps for 1951, 1977-78, 1991-2, and 2000 are available from the previous studies (Figure 1) (Brockman, 1952; Gould et al., 2007; Helmr et al., 2002; Ramos and Lugo, 1994). We are developing a land cover from 2010 aerial photography.

For each transition type at each time step we calculate all topographic, climatic, hydrologic, management, and other spatially referenced themes. We are using binomial logistic regression to calculate the probability of each transition based on the main underlying factors, and we check whether the spatial factors with significant effects change through time. The transition probabilities based on spatial arrangement will be a new source of information for all spatially explicit landscape modeling of the area.

2. **State and transition simulation modeling of vegetation dynamics**

We will use the calculated transition probabilities from our first step as inputs for simulations in a state and transition model. The model will be created in Path tool which uses state-and-transition models to simulate the future vegetation conditions on a landscape. The model in Path environment will be connected to TELSA tool which is used to process the GIS data and do the simulations in a spatially explicit environment.

(continued on next page)

Research Projects

Vegetation dynamics related to climate and land use in Puerto Rico and the US Virgin Islands

Azad Henareh, William Gould and Jaime Collazo

We will validate the model projections for accuracy. Our simulations will be used along with results from climate change, hydrology, and urban modeling being done by the NCSU team to help in assessing future scenarios, spatial planning, and resource management in light of climate change.

Literature cited:

Brockman, V. M. (1952). *The Rural Land Classification Program of Puerto Rico*, Evanston, IL: Northwestern University, Studies in Geography.

Gould, W. A., Alarcón, C., Fevold, B., Jiménez, M. E., Martinuzzi, S., Potts, G., Solorsano, M., & Ventosa, E. (2007). *Puerto Rico gap analysis project—final report*. USGS, Moscow, ID and the USDA Forest Service International Institute of Tropical Forestry, Río Piedras, PR.

Ramos, O. M., & Lugo, A. E. (1994). Mapa de la vegetación de Puerto Rico. *Acta Cient*, 8, 63-66.

Helmer, E. H., Ramos, O., del M Lopez, T., Quiñónez, M., & Diaz, W. (2002). Mapping the forest type and land cover of Puerto Rico, a component of the Caribbean biodiversity hotspot. *Caribbean Journal of Science*, 38(3/4), 165-183.

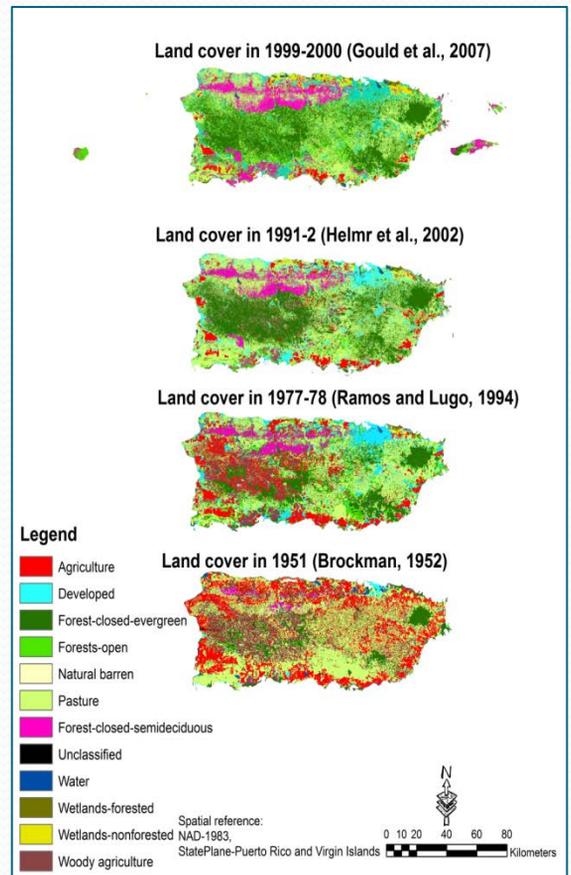


Figure 1: Land covers of Puerto Rico.



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