Latin American Chair for Ecology in Tropical Forest and Biodiversity Management

The Latin American Chair for Ecology in Tropical Forest and Biodiversity Management was created in 1996 from a donation made by the Swiss Development Cooperation (COSUDE) to the Foundation for Education and Research in the Development and Conservation of Natural Resources in the American Tropics (FUNDATROPICOS), which is the administrator of the funds that finance the chair.

This chair coordinates and executes research, leads graduate education processes and participates in a wide range of outreach activities, collaborating extensively with partners within and outside of CATIE.

Areas of work

The extensive work of this chair falls under three areas of action: research, education and outreach.

Research area

The Chair for Ecology conducts applied research on natural forests and territories to support the use and conservation of biodiversity at multiple scales and to improve the provision of ecosystem services to both rural and urban communities.

Among the lines developed in this area is the determination of the impacts of these drivers of change regarding the status of the communities and populations of plants and animals in natural forests and the ecosystem services they provide; it emphasizes the degree of interaction between these drivers, for instance, between forest management interventions and climate variation:

- Climate change
- Landscape fragmentation
- Forest management for sustainable wood production

Ecosystem services evaluations are performed by applying functional diversity approaches (see the description of the Diversus project). Research is also done on the effectiveness of secondary succession for restoring ecosystem services (see the description of the
Neoselvas project) and the potential impacts of climate change on mountain forests (see the description of the CLIMIFORAD program).

The research approach and specific sublines are:

- Long-term applied ecological research

Many questions about the conservation and sustainable use of forests in human-dominated landscapes can only be answered through long-term research. In Costa Rica during the 1987-2012 period, CATIE established a set of ten long-term studies on forest dynamics in permanent sample plots (PSP), within the context of anthropogenic impacts. These studies that include formal experimental studies, are conducted in 150 plots that combined cover about 147 hectares for which we have data from thousands of trees, palms and lianas, in some cases for as long as 25 years.

This unique line of work that the Chair executes, now supported by new institutional consortiums and funding sources (e.g. see the project description for Successional pathways and rates of change in tropical forests of Brazil, Costa Rica, and Mexico (Neoselvas) and the CLIMIFORAD Program), has provided reliable quantitative data on topics such as:

- Productivity of forest management and its impacts on ecosystem processes and services
- Carbon sequestration and biodiversity restoration in abandoned agricultural lands
- Potential for corridors in fragmented landscapes to conserve plant communities and tree species
- Relationship between environmental and altitudinal variability, forest types and ecosystem services
- Impacts of climate change on the distribution of forests, species and their functionality

The information gathered over more than two decades of monitoring has influenced forest management and territories in the region directly and indirectly through its use in graduate education. Long-term ecological research on permanent plots supports conservation efforts involving ecological monitoring programs, such as forest certification, conservation in private reserves and national monitoring for compliance with the objectives of the Convention on Biological Diversity (CBD).
Funding: Swiss Development Cooperation (COSUDE), Leverhulme Trust (London), Department for International Development (DFID, UK), Neoselvas projects, CLIMIFORAD Program, Darwin Initiative (UK), USAID, National Science Foundation (United States).

- **Successional routes and change rates in tropical forests of Brazil, Costa Rica and Mexico (Neoselvas)**

The chair is one of the research groups in this project coordinated by Dr. Robin Chazdon of the University of Connecticut (USA). The project focuses on studying the processes of secondary forest regeneration taking place on abandoned agricultural lands. Project studies conducted in the central Amazon (Manaus, Brazil), northeastern Costa Rica and Chiapas, Mexico, reveal that the observed changes in forest vegetation often vary from predictions based on studies that consider a single period of time in forests of different ages since the time of abandonment.

This project combines four existing projects in the tropical forests of Latin America. Coordinated annual plant censuses in long-term studies of permanent plots are conducted to test specific chronosequence predictions for a range of dependent variables, including stem density, size distributions, basal area, biomass, species richness, species composition and composition of different life forms. Rates of change observed in dependent variables can be compared with estimated rates from chronosequence studies within each region, based on the best statistical models.

By understanding how dynamics at the stand level deviate from the general chronosequence patterns within each of these regions, researchers can identify factors, and key ecological processes and mechanisms that influence successional pathways. The long-term data obtained can provide essential information to guide forest restoration, carbon sequestration, and biodiversity conservation in the Neotropics. Finally, results from the study could allow the development of better predictive models with wider application about successional vegetation dynamics in complex tropical landscapes today.

In its current phase, the project is involving new participants working in the dry forests of Nizanda, State of Oaxaca, Mexico.

**Funding:** National Science Foundation (USA).

- Assessment of the resilience of ecological and social systems in changing landscapes: doctoral research or education program in Idaho and Costa Rica (IGERT 2)

Called IGERT 2, this is the second project of the NSF funding program IGERT (Integrative Graduate Education and Research Traineeship) awarded to the University of Idaho/CATIE team. The chair, with Bryan Finegan at the helm, is part of the IGERT 2 research team. Finegan is also a member of the project's Steering Committee, coordinated by Dr. Nilsa Bosque-Pérez of the University of Idaho.

The project aims to train 24 CATIE/Idaho doctoral program students and generate interdisciplinary knowledge about the socio-ecological resilience of various landscapes in Costa Rica and the state of Idaho, USA.

Finegan, in collaboration with other professors from the two institutions, leads a team of five students working in the San Juan La Selva Biological Corridor area in Costa Rica. These are the students and the subjects they are addressing:

- **Adina Chain-Guadarrama:** *Functional biodiversity patterns in old-growth forests of a disturbed Neotropical landscape, and their implications for ecosystem service provision.*

- **Kate Cleary:** *Ecology and conservation genetics of seed-dispersing and pollinating bats in the human-dominated landscape of the San Juan-La Selva Biological Corridor.*

- **André Sanfiorenzo:** *Forest fragmentation influences on the genetic diversity and reproductive ecology of bat-pollinated and/or bat-dispersed mid-canopy tree species in the Caribbean lowlands of Costa Rica.*

- **Ricardo Santiago-García:** *Neotropical forest succession: structural, functional and phylogenetic composition of regenerating forest communities and its implication for conservation and restoration of the San Juan-La Selva Biological Corridor, Costa Rica.*

- **Irene Shaver:** *The Effects of Land Use Change and Human Migration on Costa Rica’s Biodiversity Conservation Initiatives.*
Funding: National Science Foundation (U.S.), CONACyT (Mexico, Chain-Guadarrama)

http://www.cals.uidaho.edu/igert2

- Diversus (Functional biodiversity effects on ecosystem processes and services and sustainability in America).

Change in land use is considered by many to be the driver of global change with the greatest potential to affect biodiversity and ecosystem processes and services in the coming decades. One of the main ways that changes in land use can alter the functioning of ecosystems is through a change in functional diversity (FD) of plants. These changes alter the ecosystem services obtained by different stakeholder groups.

The research is directed toward the design and implementation of a new interdisciplinary approach for analyzing and comparing information from field studies about changing land use in America, from the tropics to the tundra. A conceptual linkage is constructed between the trajectories of the main changes in land use, FD, ecosystem processes and services, and the vulnerability and sustainability of the production systems that rely on them. It provides empirical content for such an approach through the integration of new studies of FD and ecosystem processes, linking ecological and socioeconomic conceptual models and empirical information on ecosystem services obtained in the field. Traditional research methods for obtaining empirical data in the field can be combined with participatory methodologies to promote the involvement of different stakeholders from the initial stages of the processes.

The following has already been achieved for developing the interdisciplinary conceptual framework:

- Building a network of scientists that relates land use as a driver of global change, with changes in the FD and ecosystem processes and services in America.
- Developing the first comparison of the effects of land use on FD and establishing how these have the potential to alter ecosystem processes in systems under different degrees of climate control.
- Establishing relationships between FD, ecosystem functioning and the major ecosystem services received by different local and non-local stakeholders.
- Developing a conceptual framework and a set of empirical tools and recommendations available to a wide community of scientists, para-scientists and
land managers, to be used as a basis for management decision making aimed at evaluating and optimizing the values of the ecosystem services of the land considering the interests of different groups.

The project has the potential to advance the interdisciplinary field of ecology and sustainability in the region. It can improve the scientific understanding of the relationship between FD and ecosystem processes, and it can carry out the first large-scale attempt to assess FD in megadiverse Neotropical forests. A standard set of protocols that can be widely used in the study and management of FD in the region can be developed in the process and made available to a wider community. Supported by empirical data and validated by the participation of different stakeholders, the project can provide the first conceptual framework for the relationship between FD and ecosystem services obtained or lost due to different common land use practices in the region. It will contribute to capacity building in interdisciplinary ecosystem assessments in America, with an emphasis on Latin America at different levels, from scientists to rural organizations.

**Funding:** Inter-American Institute for Global Change Research (IAI) IAI-CRN 2015 (supported by the National Science Foundation, Grant GEO-0452325).


- **Regional Program:** Potential Impacts of Climate Change on Forest Ecosystems on Iberoamerican Mountains and Tools for the Adaptation of Management (CLIMIFORAD-Climate change, Iberoamerican Mountain Forests and Adaptation)

The regional program *Potential Impacts of Climate Change on Forest Ecosystems on Iberoamerican Mountains and Tools for the Adaptation of Management (CLIMIFORAD)* is an initiative coordinated by the Ecology Chair of CATIE and it is currently funded by the Inter-American Development Bank (IDB) and the Korea Forest Research Institute. CLIMIFORAD aims to contribute to regional adaptation to climate change through greater awareness of its impacts on high mountain forest ecosystems and through the development of tools for better forest management.

The program aims to consolidate an international network of research centers interested in the issues of climate change, adaptation, mitigation and adaptive forest management. This network functions as a platform for strengthening knowledge exchange and generating new information to strengthen the capacities of participating research institutions.
CLIMIFORAD prioritizes work in the Latin American territories, determining the potential impacts of climate change on ecosystem services provided by natural forests in the life zones: premontane wet forest (bmh-P), premontane rainforest (bp-P), lower montane rainforest (bp-MB), montane rainforest (bp-M) and subalpine rain paramo (pp-SA) (Holdridge 1978).

Activities are now being implemented in these territories:

- Reventazón Model Forest (BMR) - Costa Rica
- Department Risaralda - Otún River Basin Model Forest - Colombia
- Cerro Azul Meámbar National Park (PANACAM), Honduras
- Panguipulli Commune, Los Ríos Region Model Forest - Chile
- Izta – Popo National Park - Mexico

The construction of regional climate change scenarios in key territories for the program; modeling of impacts on ecosystems, species and ecosystem services; the consolidation of an international network for forest monitoring through permanent plots located along altitudinal gradients; and the generation of publications on adaptive forest management are among the main outputs of the project.

Participating institutions (in alphabetical order):

- CATIE: Tropical Agricultural Research and Higher Education Center (Costa Rica) - executes the project and uses resources from the IDB contribution. Coordinator: Diego Delgado (ddelgado@catie.ac.cr), Principal Investigator: Bryan Finegan (bfinegan@catie.ac.cr)
- CIFOR – INIA: Forest Research Centre - National Research Institute for Agriculture and Food Technology (Spain). Principal investigators: Isabel Cañellas (canellas@inia.es), Guillermo Gea Izquierdo (gea.guillermo@inia.es)
- CONIF: National Corporation for Forestry Research and Development (Colombia). Principal investigator: Victor Nieto (victornieto@conif.org.co)
- ESNACIFOR: National School of Forestry (Honduras). Principal investigator: Zoila Ávila (z.avila@esnacifor.edu.hn, nedad2@yahoo.com)
- FIC: Foundation for Research on Climate (Spain). Principal investigator: Jaime Ribalaygua (fic@ficlima.org)
- INFOR: Forest Institute (Chile). Principal Investigator: Marjorie Martin (mmartin@infor.cl)
- INIFAP: National Institute for Forestry, Agriculture and Livestock (Mexico). Principal Investigator: Miguel Acosta Mireles (acostamm@colpos.mx)
- UPM: Polytechnic University of Madrid (Spain). Principal Investigator: Ignacio García-Amorena (ignacio.garciaamorena@upm.es)
**Funding:** Inter-American Development Bank (IDB)


Within the CLIMIFORAD Program, the project for *Climate Change and tropical mountain forests, ecological processes, ecosystem services and socio-ecological adaptation* is also being developed.

This project is implemented under the framework of a collaborative agreement for research between the Korea Forest Research Institute (KFRI) and CATIE. The people responsible for the project are:

- Dr. Sung Joo Han, Director, Division of Forest Ecology and project leader on behalf of the KFRI.
- Dr. Park, Byung-Bae, Investigator, Forest Ecology Division, serves as the technical representative for KFRI.
- Dr. Bryan Finegan, Director of the Production and Conservation in Forests Program and project leader for CATIE.
- M.Sc. Luis Diego Delgado, Investigator, Ecology Chair in Tropical Forest Management, serves as a technical assistant coach for CATIE.

The agreement runs until December 31, 2017 and has the following activities:

- Determining the effects of climate, soil and vegetation on ecosystem processes in forests along the Caribbean-Villa Mills altitudinal gradient in Costa Rica.
- Gathering traditional knowledge about the forest, including aspects of biodiversity in the Reventazón Model Forest territory in Costa Rica.
- Providing useful knowledge for decision-makers on the following topics: a) impacts of climate change on forest ecosystems in the Reventazón Model Forest territory in Costa Rica, b) threats and strategies for socio-ecological adaptation.

The idea is to develop two studies with KFRI that will provide a baseline of knowledge to support the work program in the Reventazón Model Forest (one of the CLIMIFORAD territories):
Study 1. Ecological processes and ecosystem services

1.1. Effects of climate, soil and vegetation on the litter and its decomposition along an altitudinal gradient extending from 400 to 3000 masl.

1.2. Climate controls on the growth of trees, lianas and the stand, and their relationship to litter decomposition rates along an altitudinal gradient extending from 400 to 3000 masl.

1.3. Changes in ecosystem processes in forests, including biodiversity along an altitudinal gradient extending from 400 to 3000 masl in relation to potential climate change scenarios.

Study 2. Socio-ecological Adaptation

2.1. Perceptions of stakeholders regarding climate change impacts, threats and strategies for socio-ecological adaptation in managed forest ecosystems along an altitudinal gradient extending from 400 to 3000 masl.

2.2. Management approaches for socio-ecological adaptation to climate change

Education Area

With regard to education in CATIE’s Graduate School, the Chair is responsible for the academic coordination of the Master in Management and Conservation of Tropical Forests and Biodiversity, giving courses related to this field of study. These are:

- Economic, ecological and social considerations in sustainable human development: an interdisciplinary approach
- Conservation Ecology and Biology

Of equal importance is the supervision of students. Each year, chair faculty members serve as professor advisors or thesis committee members for at least ten students, at both master's and doctoral levels (e.g. see the IGERT 2 project through link for research). The chair leader is also a member of the Doctoral Committee of the CATIE Graduate School.

Outreach Area

Training
In the area of projection, the Chair supports training activities that make another important contribution to the training of human resources in the region, with special emphasis on international strategic courses:

- Protected Areas: Buffer Zones and Biological Corridors in Landscape Ecosystem Management
- Diversified Management of Natural Tropical Forests

Outreach also involves chair personnel in technical assistance or specialized advising activities, especially in the field of ecological monitoring as a tool for natural resource management.

**Ecological monitoring as a management tool**

One of the initiatives that the Chair has actively supported is the proposed Program for Monitoring the Protected Areas and Biological Corridors of Costa Rica (PROMEC-CR). The implementation of this program is considered one of the efforts needed to move the country forward toward meeting the goals of the Convention on Biological Diversity (CBD).

Personnel of the CATIE Chair for Ecology led the preparation of the proposal, which involved technical literature reviews, interviews with experts and a consultation workshop to define the program’s conceptual framework. From this conceptual framework a methodological proposal was defined that encompassed everything from the elements of PROMEC-CR to the level of indicators, which were shared and discussed with stakeholders.

The proposal contains goals, objectives, indicators, methodological protocols and an implementation plan for the Program, all embodied in four documents: the Manual of Objectives, Indicators and Protocols (Finegan and Sesnie 2006), the Technical Reference Document (Finegan and Céspedes Agüero 2006), the Implementation Plan (Finegan 2006), and an Executive Summary The program is currently in the implementation phase. The first report on the status of conservation in the country is expected during 2013, and a consolidated plan for implementation of the program from that year on is being prepared. Currently this work is done in collaboration with the Kenton Miller Latin American Chair for Protected Areas and Biological Corridors.