

## PhD opportunity – CIRAD & CATIE

### Topic

MODELLING THE BIODIVERSITY RECOVERY TRAJECTORIES IN DISTURBED TROPICAL FORESTS IN LATIN AMERICA.

### Supervision and location

Main supervisors: Dr Marie Ange Ngo Bieng (UR Forests and Societies, CIRAD - CATIE); Dr Bryan Finegan (Unit Forests and Biodiversity in productive landscapes, CATIE)

Co-supervisors: Dr Géraldine Derroire (UMR EcoFoG, CIRAD) and Dr Bruno Héroult (UR Forests and Societies, CIRAD).

The PhD candidate will be based partly at CATIE (Turrialba Costa Rica), partly at UMR Ecofog (Kourou, French Guyana) and partly in Montpellier (France). For the first two years, provisional schedule is nine months a year at CATIE (Ngo Bieng & Fiengan), and three months a year at Ecofog (Derroire). The organization of the third year will likely be 6-months in Montpellier (Héroult) and 6-months at CATIE.

Expected start date around October/November 2020.

### To apply

Please send your application as one single pdf file to Marie Ange Ngo Bieng (marie-ange.ngo\_bieng@cirad.fr) and Géraldine Derroire (geraldine.derroire@cirad.fr) **before April 15, 2020**. Application must include (1) a CV, (2) a cover letter expressing your interest for this position, (3) a transcript of MSc grades (when available), (4) a written example of your recent scientific work (publication or MSc thesis for example), (5) name and contact information with 2-3 recommendations letters.

### Context and rationale

Tropical forests play a major role in biodiversity conservation: they host 50-70% of the terrestrial species. They account for nearly half of the world's forest ecosystems, 7% of the land area and play a crucial role in the provision of many ecosystem services (carbon sequestration, provision of drinking water, provision of wood and non-timber forest products<sup>1</sup>). These forests have been disturbed (logging and other human-induced degradation), resulting in a significant increase in post-disturbance complex landscapes, representing nearly 2/3 of the current tropical rainforest areas<sup>2</sup>. In a global context of biodiversity erosion, investigating the response of these hyperdiverse ecological systems to anthropogenic disturbances is a crucial issue to predict their fate in a world of increasing pressures.

An increasing number of studies, both on production and secondary forests, show the capacity of these forests to gradually recover their diversity after disturbance, although the recovery of composition is uncertain and long<sup>3,4</sup>. A high variability in recovery trajectories and recovery time is also highlighted, due

<sup>1</sup> Diversity enhances carbon storage in tropical forests. Poorter et al. Global Ecology and Biogeography. 2016

<sup>2</sup> Status of tropical forest management. ITTO Technical Series N°. 38. 2011

<sup>3</sup> Resilience of tropical dry forests – a meta-analysis of changes in species diversity and composition during secondary succession. Derroire, G. et al. Oikos. 2016.

<sup>4</sup> Biodiversity recovery of Neotropical secondary forests. Rozendaal et al. Sciences advances.2019

to a high stochasticity and various factors including disturbance intensity and type, stage maturity of plots and environmental variables (climate, soil and topography)<sup>5</sup>.

The PhD work will contribute to understanding biodiversity trajectories in disturbed forests, specially taking into account the recovery dynamics of the diversity of used forest species with commercial value, and more specifically timber species. The presence of these species allows the maintenance of the value of these forests while reducing the risk of their conversion to other land uses more profitable in the short term (agriculture, livestock)<sup>6</sup>. The knowledge produced will allow building "regional" hypotheses on the natural dynamics of biodiversity recovery in production and secondary forests. It will also help in defining rules for the sustainable management of logged species, and set up specific restoration plans within these disturbed landscapes.

## Methods

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In order to characterize and model natural dynamics of tree diversity recovery in production and secondary forests, in Latin America, the PhD will study the influence of factors related to (i) the disturbance characteristics, (ii) the historical contingency in each plot, and (iii) biophysical local and regional conditions. The work will benefit from data coming from the TMFO (Tropical Managed Forest Observatory) and the OEFO (Observatory of Forest ecosystems in Costa Rica), gathering all together #200 permanent plots where (i) all trees above 10 cm of HBD have been inventoried and identified and (ii) with at least 4 inventories and over at least 10 years.

The PhD student will model diversity trajectories using innovative Bayesian modeling tools. Much attention will be paid to methodological issues of uncertainty propagation, heterogeneous data assimilation and scaling issues.

## Funding

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We have secured half of the PhD candidate salary through Cirad funding. The subject has been selected for the funding of the other half by the Doctoral school ABIES. During the second half of May and June 2020, the selected candidate will work with the supervision team to prepare for ABIES selection, which will be based on the candidate skills and adequacy with the subject.

## Required qualifications and skills

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- MSc degree in quantitative ecology, biostatistics and/or mathematical modelling
- Experience in working in a tropical environment
- Good level of written and spoken English, a working level in Spanish and French is also desirable

## Selected References of the supervising team

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- Rozendaal, D.M.A. et al., 2019. Biodiversity recovery of Neotropical secondary forests. *Science Advances*, 5, eaau3114.
- Chain-Guadarrama, A. et al. 2018. Potential trajectories of old-growth Neotropical forest functional composition under climate change. *Ecography*, 41(1): 75-89
- Poorter, L., van der Sande, M., T., Arets, E. J. M. M. et al. 2017. Biodiversity and climate determine the functioning of Neotropical forests. *Global Ecology and Biogeography*, 26 (12): 1423-1434
- Derroire, G. et al. (2016) The Effects of Established Trees on Woody Regeneration during Secondary Succession in Tropical Dry Forests. *Biotropica* 48.
- Derroire, G. et al. (2016) Resilience of tropical dry forests – a meta-analysis of changes in species diversity and composition during secondary succession. *Oikos* 125.
- Finegan F. et al. 2015. Does functional trait diversity predict above-ground biomass and productivity of tropical forests? Testing three alternative hypotheses. *Journal of Ecology* (103) 191-201.
- Marcon, E. and Hérault, B. (2015) entropart : An R Package to Measure and Partition Diversity. *J. Stat. Softw.* 67, 1–26
- Ngo Bieng M.A. et al. 2013. Diversity and spatial clustering of shade trees affect cacao yield and pathogen pressure in Costa Rican agroforests. *Basic and Applied Ecology*, 14 (4): p. 329-336.

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<sup>5</sup> Second Growth - The Promise of Tropical Forest Regeneration in an Age of Deforestation. Univ. of Chicago. Chazdon. 2014.

<sup>6</sup> Agricultural expansion and its impacts on tropical nature. *Trends in Ecology & Evolution*. Laurance et al. 2014