

forest management. The success or failure of managed forests in Southeastern Australia is dependent on the density of *Eucalyptus* stems after stand establishment. We studied the influence of density on the diversity of the understorey species and found that light has a bigger impact on the species composition of the forest rather than the density of the species.

Intact forest landscapes: how to conciliate forest management and conservation efforts under FSC certification in Brazilian Amazon

Edson Vidal¹, Nathalia Ribeiro², Isabel Garcia-Drigo², Marco Lentini³, Leonardo Sobral²

¹Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo Piracicaba, Brasil; ²Instituto de Manejo e Certificação Florestal e Agrícola, Piracicaba, Brasil; ³WWF Brasil, Sao Paulo, Brasil (edson.vidal@usp.br; nathalia@imaflora.org; isabel@imaflora.org; marcolentini@wwf.org.br; leonardo@imaflora.org)

Maintenance of large natural forest landscapes is paramount to protect biodiversity, but also to reduce carbon emissions from deforestation and forest degradation. Intact Forest Landscapes (IFLs) are defined as unbroken portions of natural ecosystems within the current global forest extent, showing no signs of significant human activity, and vast enough to effectively maintain biodiversity. In 2015, the Forest Stewardship Council (FSC) has introduced the concept of IFLs in the new Principle, Criteria and Generic Indicators for certification. Hence, certified forest managers have to identify the IFL portion in their forest management units to design and apply specific management strategies. The present study analyzed spatial data to enlighten the scale and territorial domains where IFLs are found in Brazilian Amazon. We also demonstrate the proportion of IFLs within certified Forest Management Units (FMU). In addition to these analyses, we performed a survey to reveal the challenges to manage IFLs portions from FSC certificate holders and experts perspective. Results showed a significant proportion of IFLs within certified forests in federal or state forest concessions more than in private lands. The primary challenge is how to develop the IFL portions while maintaining its values and ensuring protection. While the market for ecosystem services and non-timber forest products are uncertain, a more stringent Reduced Impact Logging (RIL) model is defended as one of the best management strategies to conciliate sustainable forest management and conservation within IFL areas.

Development of dipterocarp rainforests after timber harvesting challenge the current slow recovery paradigm

Jan Falck¹, Daniel Lussetti¹, Petter Axelsson², David Alloysius³, Ulrik Ilstedt¹ 

¹Swedish University of Agricultural Sciences, Dept. of Forest Ecology and Management, Umea, Sweden; ²Forest Ecology and Management, Umea, Sweden; ³Yayasan Sabah, Tawau, Malaysia (jan.falck@slu.se; daniel.lussetti@slu.se; petter.axelsson@slu.se; david.alloysius@gmail.com; ulrik.ilstedt@slu.se)

Timber harvesting in tropical rainforests is under debate partly because of the natural recovery of stand structures are believed too slow to provide a sustainable provision of timber, and maintenance of biodiversity and carbon storage potential. We present a long-term study of selective logging in a virgin tropical rain forest in Sabah, North Borneo, Malaysia, starting in 1992 and re-measured every second year up to 2017; 25 years after logging operation, forest plots harvested with supervised logging and climber cutting (SLC) - which aim to minimize damage to the residual stand have improved stand recovery compared to the conventional practices, and restored the number of trees with DBH 10 cm and above, the number of harvestable trees (DBH 60 cm and above), as well as the number of germlings, seedlings and saplings, to a level almost equivalent to the mean numbers of trees in virgin control plots. The growth rate of dipterocarp species in SLC was 5 m³ha⁻¹yr⁻¹ and in 2017, the number of species recorded in all diameter classes was nearly the same as in control plots. In general, recovery was faster than expected after such logging operation, which usually kill or damage many trees for every tree logged. Our results stress the need for wider evaluation of economic and carbon potential of managed dipterocarp forests. Comparisons with other land use options should consider improved logging methods and the possibility of faster above ground volume and carbon recovery.

Economic and environmental potential benefits of charcoal production from logging residues in sustainable forest management in the Brazilian Amazon

Camila Thiemy Dias Numazawa¹, Dmitry Schepaschenko², Andrey Krasovskii², Stephan A. Pietsch²

¹Universidade de São Paulo, São Paulo, Brasil; ²International Institute for Applied Systems Analysis, Laxenburg, Austria (numazawacamila@gmail.com; schepd@iiasa.ac.at; krasov@iiasa.ac.at; pietsch@iiasa.ac.at)

Under sustainable forest management principles, primary data from 13 forest plots located in the western Brazilian Amazon were adopted to calibrate and estimate projected net primary productivity (NPP) and the net measure of ecosystem exchange (NEE) using the complex BioGeo Chemistry model (BGC-MAN) approach. The purpose of this study was to show the potential economic and environmental benefits associated with charcoal co-production from part of the logging residues (LR). The analysis was done for five scenarios: the legal reserves (reference scenario), one cutting cycle over the whole period, three timber rotation periods of 30-year, and the last two scenarios complemented with collecting part of the woody LR ≥ 10 cm for charcoal production. For each case, we simulated the NPP and the NEE over a time-horizon of 120 years. Results indicated an economic gain for charcoal production using woody LR ($\approx 77\%$ of total LR) which could reach $\approx 46\%$ of the total stem value. Additionally, we found that in scenarios where LR were harvested the biomass recovered faster. The benefits would not only consist of the generation of new income and promoting new jobs, but also lead to increased NPP and NEE by removing part of the LR to assist the forest regrowth. The Brazilian Forest Code strategy could focus on maximizing the economic gain to ensure exploitation viability while implementing the reduction of logging intensity necessary for full forest recovery within cutting cycles. This could be associated with carbon credit incentives.

Floristic analysis to subsidize forest management planning in the Amazon Forest region

Mariana Oliveira¹ , Marilice Cordeiro Garrastazu¹ , Evaldo Muñoz Braz² , Patricia Póvoa de Mattos² , Nelson Carlos Rosot¹ 

¹Universidade Federal do Paraná, Curitiba, Brasil; ²Embrapa Florestas, Colombo, Brasil (marianaferraz.floresta@gmail.com; marilice.garrastazu@embrapa.br; evaldo.braz@embrapa.br; patricia.mattos@embrapa.br; nerosot@ufpr.br)

The objective of this study was to characterize the horizontal structure of a primary Amazon Forest, with emphasis on three commercial species, using conventional methods and Geographic Information System. The study area consists of an approved management plan, in Santa Carmem, MT, Sinop Microregion, with 1,024 ha, where all trees with a diameter of 1.30 m (DBH) ≥ 30 cm were measured. We calculated densities, frequencies and absolute and relative dominances, as well as the importance and coverage value indexes, using 1 ha plots. Kernel Density and Dispersion Analysis AT species level were obtained with ArcGIS. Among the 36 species observed, *Qualea* spp. presented the highest values for all analyzed parameters. *Goupia glabra* and *Dipteryx odorata* were, respectively, the fourth and sixth in importance index value. The area was classified as low diversity by Shannon Index. It was observed a higher concentration of individuals in commercial diametric classes (DBH 50 cm), concluding that the area presents potential to be sustainably managed. The estimates obtained by spatial analysis

for both density and dispersion were similar to those observed in the conventional estimatives, however, as the first method considers the geographic coordinates of each tree, it is suggested that it is more accurate than the second, that estimatives are generated at plot level.

B1e: TREES ON THE MOVE: SEED SOURCING, GERMINATION, GENETIC ADAPTATION AND ASSISTED MIGRATION IN A CHANGING CLIMATE

Origin, genetic variation and genetic change of non-native forest trees in their introduced range

Charalambos Neophytou¹ , Marcela van Loo^{1,2} , Elisabeth Pötzelberger¹ , Hubert Hasenauer¹ 

¹Institute of Silviculture, Department of Forest and Soil Sciences, University of Natural Resources and Applied Sciences (BOKU), Peter-Jordan Str; 82, 1190, Vienna, Austria, ²Department of Botany and Biodiversity Research, Faculty of Life Sciences, University of Vienna, Rennweg 14, 1030, Vienna, Austria (charalambos.neophytou@boku.ac.at; marcela.van.loo@univie.ac.at; elisabeth.poetzelberger@boku.ac.at; hubert.hasenauer@boku.ac.at)

Non-native tree species play an important role in European forestry which may even increase in future due to climate change. Environmental adaptation depends on genetic variation and this is true for non-native species, too. Here, we explore the origin, genetic variation and genetic change over time, observed in the introduced range of such species. First, we focus on Douglas-fir (*Pseudotsuga menziesii*), a species with a prominent position in Central European forestry. Marker based genetic analysis indicated that a relatively small part of the native range served as seed source for most of 67 European Douglas-fir study stands spread across Germany and Austria. Moreover, a comparison between adult trees and natural regeneration revealed a significant reduction of genetic diversity in the younger generation. Second, we examine the outcome of genetic analysis in populations of tree of heaven (*Ailanthus altissima*), a species with an invasive character. Whereas results from chloroplast DNA markers do not suggest multiple origins, we observed a significant population genetic structure at nuclear microsatellites in our study area in Eastern Austria. We attribute this pattern to repeated founder effects. Third, we present current results on the origin and genetic variation of Northern red oak (*Quercus rubra*) in introduced European populations. We conclude that drift is a major factor shaping the genetic variation in the introduced range. Since introduced populations constitute an important seed source, special caution should be exercised when establishing seed stands and seed orchards, but also during seed harvesting, in order to avoid genetic erosion.


Assisted migration of *Araucaria araucana* in Chile to safeguard genetic diversity of populations in the face of climate change / Migración asistida de la *Araucaria araucana*, en Chile, para salvaguardar la diversidad genética de sus poblaciones ante la presión del Cambio Climático

Roberto Ipinza¹, Jorge Gonzalez², Braulio Gutierrez², Hernan Soto², Marcos Barrientos¹, Maria Paz Molina², Andres Bello³, Patricio Rojas⁴, Sabine Muller-Using^{4,5}, Fernando Santibañez^{6,7}, Juan Andres Celhay⁸, Dante Corti¹, Richard Velasquez⁵

¹Instituto Forestal, Valdivia, Chile; ²Instituto Forestal, BioBio, Chile; ³Consultor, Concepcion, Chile; ⁴Instituto Forestal, Santiago, Chile; ⁵SIMEF, Valdivia, Chile; ⁶Universidad de Chile, Santiago, Chile; ⁷INFODEP Santiago Chile ⁸CMPC, Los Angeles, Chile (roberto.ipinza@infor.cl; jgonzalez@infor.cl; bgutierr@infor.cl; hsoto@infor.cl; mbarrientos@infor.cl; mmolina@infor.cl; beduan13@hotmail.com; patricio.rojas@infor.cl; smuller@infor.cl; fersantiba@gmail.com; juan.celhay@cmpec.cl; dcorti@infor.cl; richard.velasquez@simef.cl)

La *Araucaria araucana* (Molina) K. Koch (*Araucaria*) es una especie emblemática del bosque nativo chileno, se distribuye en la costa y en la cordillera de los Andes (desde los 37°30' a los 40°03' S). La *Araucaria* está asociada a prácticas ancestrales y alimentación del pueblo pehuenche, declarada monumento natural, protegida por la convención CITES y constituye un patrimonio nacional que contribuye a la belleza escénica del paisaje en las regiones de La Araucanía, Biobío y Los Ríos. La *Araucaria* está catalogada como una especie vulnerable y recientemente las poblaciones costeras han sido declaradas en vías de extinción en el actual escenario de cambio climático. El estrés integral del cambio climático, actúa como un factor de predisposición que disminuye la vitalidad y es luego atacada por innumerables poblaciones de microorganismos e insectos, lo que finalmente se expresa en un Daño Foliar de la *Araucaria* (DFA). Este fenómeno está amenazando su adaptación, su potencial evolutivo y por ende su supervivencia. Por esta razón, se realizó el rescate genético en toda el área de distribución a través de la técnica conocida como "Migración Asistida", donde se colectó semilla de 418 madres, se viverizaron y luego se plantan las familias, estructuradas como ensayos de progenies y procedencias, en lugares donde las proyecciones de cambio climático en los próximos 50 años le dan más posibilidades de supervivencia a la especie. Por otro lado, estas nuevas poblaciones podrán generar germoplasma para recuperar áreas afectadas por el DFA.

Stability of species and provenance performance following translocation into diverse restoration communities

Nicolò Camarretta¹ , Peter A. Harrison¹, Tanya G. Bailey^{1,2}, Neil Davidson², Arko Lucieer³, Mark Hunt¹, Brad M. Potts¹

¹University of Tasmania and ARC Training Centre for Forest Value, Hobart, Australia; ²Greening Australia, Hobart, Australia; ³University of Tasmania, Hobart, Australia (nicolo.camarretta@utas.edu.au; p.a.harrison@utas.edu.au; tanya.bailey@utas.edu.au; ndavidson@greeningaustralia.org.au; arko.lucieer@utas.edu.au; mark.hunt@utas.edu.au; b.m.potts@utas.edu.au)

Assisted migration is increasingly integrated into conservation and restoration strategies. For long-lived species such as trees, future climate models are being used to guide translocation decisions to develop resilient plantings better adapted to future climates. In restoration, this involves strategies such as climate-adjusted provenancing, aimed at enriching local plantings with seed genetically adapted to future climates predicted for the planting site. However, translocation decisions rarely consider the extent to which biotic interactions modify performance. This is particularly important as species and provenance translocations are not made in isolation but embedded in diverse and even novel communities. We here examined how species and provenance performance are affected by community composition using two focal eucalypt species planted under six community treatments, in a degraded agricultural landscape in Tasmania, Australia. These community treatments differed in the species planted as immediate neighbour to the focal plant, and co-plantings comprised of same species, same genus or one of three different genera. Six years after planting, there were significant differences between the focal eucalypt species and among their provenances for measured performance traits, while their interactions with community treatments were not significant. Provenance differences in both species were mainly due to non-local provenances experiencing greater insects and frost damage and having higher mortality than the local provenances. Home-site altitude predicted provenance performance, and the extent to which up-slope translocations impacted provenance performance differed between focal species, regardless of the community composition.