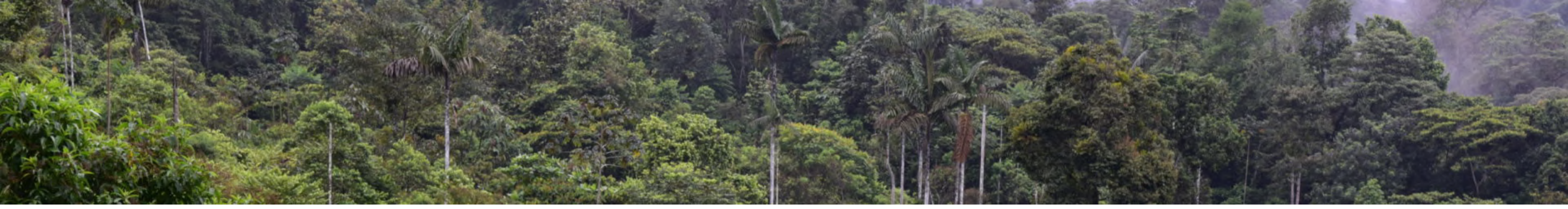


REASSEMBLY Newsletter

Reassembly of species interaction networks – Resistance, resilience and functional recovery of a rainforest ecosystem (DFG Research Unit FOR 5207)

#4, December, 2025

Contents

Figure 1: The upper snapshot was made by one of the reviewers and shows Nico outside the meeting room, waiting for the final decision of the review panel to be transferred to him. Nico felt that this took forever, and indeed the panel was closed with more than half hour delay. Another reviewer took the other photo with many happy faces after we all heard the good news.

1 Project speaker's column

Nico Blüthgen, TU Darmstadt

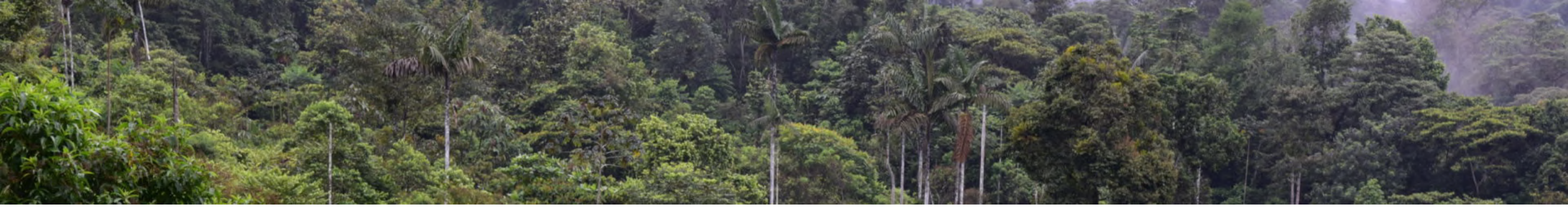
¡Cuatro años más: nuevas oportunidades!

Reassembly's first funding phase is over – and the second phase will soon begin for most subprojects or has already begun for some of us. Time to reflect what we have learned and achieved, and what we aim to achieve. And: what has worked well and is worth continuing – and what should we improve in the future? You can read – within and between the lines – the answers to these important questions in this newsletter, which provides insights from young researchers offering different perspectives. Here's my viewpoint.

The on-site evaluation of the project by the German Research Foundation (DFG) and international experts from 15-20th June 2025 was an intense experience for many of us, but it went remarkably well. Special thanks are due to Dr Sonja Ihle, programme director for the DFG, who provided intensive support for this Research Unit from the very first outset several years ago and throughout the evaluation process. In Canandé we gave oral presentations and held intensive discussions, poster defences, and went on several car trips and hikes through the forest. We showcased distinctive forest features observed numerous species both day and night. We particularly emphasised the experiments, including the old P-REX and the new T-REX designs which had been prepared using treelets of various species that had begun to grow in the new plots. We also presented the tree nursery, a pilot rainout shelter and data loggers. And our fantastic lab.

Alongside the impressive 449-page written proposal, our achievements and plans convinced the review panel. As a result, we will now be fully funded for the second phase (Fig. 1). This application was a huge team effort, and we all share in the success of this evaluation. This successful team includes scientists from Germany and Ecuador, students, PhD candidates, Jocotoco staff, local team members and parabiologists – everyone played an important role. This team spirit has carried us through the first four years, and it became again clearly evident during the evaluation, as confirmed by the review panel. We can all be proud of this team.

Our first funding phase was a novel scientific endeavour for both the applicants and the PhD candidates and postdocs. None of us had previously focused on the natural regeneration of tropical rainforests, but together we were able to cover many important aspects of this dynamic forest ecosystem. Over four years, we achieved unique results – for the first time we were able to measure the recovery of so many different taxa and ecosystem components. Together, these findings thus substantially contribute to our understanding of the dynamics of tropical forest ecosystems. Different aspects have been summarized in a remarkable number of individual papers, and several syntheses have emerged already – submitted or already available as preprints, and soon to be readable in different journals. To date, 49 papers have been published from Reassembly including the preprints, and this number is still growing rapidly. A



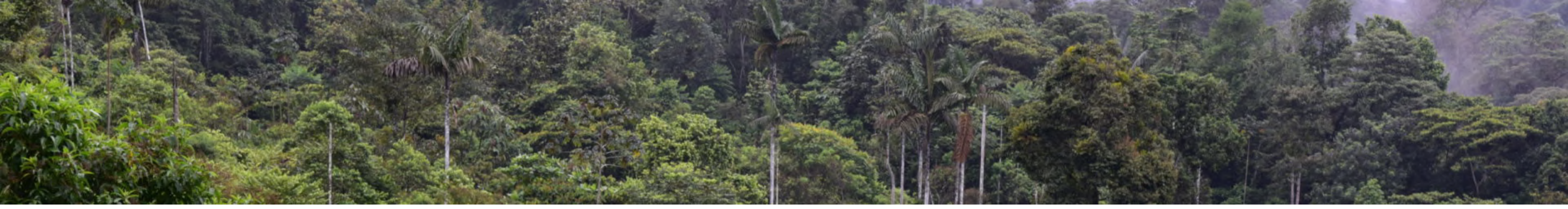
dozen PhD theses have been successfully defended or will be defended soon.

Figure 2: T-REX is a well-designed experiment with 16 tree species for the second phase, following our P-REX experiment in the first phase. But it simply cannot be synonymized with *Tyrannosaurus rex*! The old dinosaur may thus need a new abbreviation to avoid confusion ;) This photo was shared by one of the reviewers after arriving in Quito airport and this male (as predicted from its location) was not sighted again since then.

Since we started this project from scratch, a huge amount of effort went into implementing the entire study design prior to the first application four years ago. Martin and I started with a small team in 2017 and undertook three field trips to identify suitable plots that would fit the overall design. Moreover, two PhD candidates, Phil and Karen, started well before Reassembly and used a set of preliminary plots to conduct research on ants and dung beetles. They gained experience and analysed data which helped us to modify the design and improve the final spatial setup. Just before the Research Unit began, 64 plots were available, with a balanced distribution of cacao and pasture legacies of a comparable age, located across the entire landscape and neither clustered nor significantly biased by elevation. This design cost us dearly in terms of time, patience and exhaustion. However, the benefits soon outweighed the daunting task. Many of our manuscripts' reviewers, other colleagues and our scientific advisors all praised this design and the large sample size of statistically independent plots. So did the review panel. If we could offer advice to others starting a new project, it would be that it pays off to put effort into the design. The tears and sweat dried, and later we appreciated what we had achieved. The tears were particularly due to some misunderstandings, logistics, communication issues, minor conflicts and social problems in the first year, but these issues were resolved. Sweat can dry, too – but is always replaced by more sweat the next day. It is worth reading our first Reassembly newsletter again in which these experiences have been compiled, and where experience has led to a learning process. Not only the number and wide distribution of plots, but also the size of the plots was challenging. The 50 by 50 m had been recommended as minimum size by initial reviewers from their comfortable office desks. This was particularly daunting for the for the team responsible for measuring and labeling all the 7542 trees. The plots were not flat like they appear on a map or screen, and many parts were hard to access. Tree identification took much longer than anticipated – almost two years – which is not surprising given that the cumulative plot size was larger than that of any other project in the Neotropics. It was exhausting – and rewarding. Would we recommend reducing the number or size of plots in the future? No ;)

Whether our perturbation-recruitment experiment (P-REX) in 30 plots was worth the laborious effort still remains to be seen. P-REX had a difficult start where several projects were not ready and required re-disturbance, mud flow complicated the design. Most papers about P-REX still need to be published. For the new Tree Function Recovery Experiment (T-REX, Fig. 2-3), we learned that we need to organize everything about a year in advance, and we involved almost all subprojects in the planning even much earlier. It's also an experiment that everyone can use at any time, as trees only grow larger. T-REX allows us to compare all associations, interaction partners and processes across 16 tree species, and even the same individuals. For P-REX the main challenge was the need of a simultaneous starting point for everyone, as the disturbance effect fades out otherwise.

Figure 3: The *actual* T-REX in Cedeño. Some of the trees now reaching 12 m height. Photo by Chocó lab



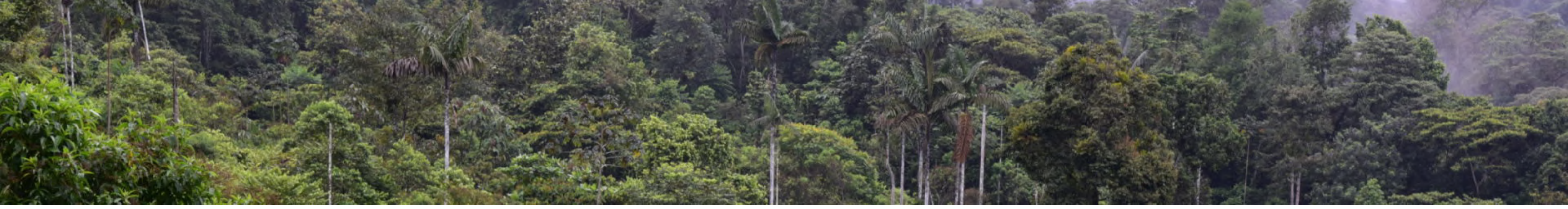
So, the overall study design paid off, whereas the large experiment remains to be evaluated. How about the team structure, communication, rules of procedure, meetings, workshops??? I have the impression that these worked out really well, too. But individual opinions may differ here, as always in life. I am looking forward to hearing and reading the views of everyone else.

Figure 4: Reassembly team after receiving the news of the approval of the second phase

In my view, the tight connection and interplay with Jocotoco and local people was and still is a key feature of our success. I have stated in previous newsletters, but would like to reiterate this point. I am not aware of any other conservation organisation or NGO that is as successful or as well accepted and embedded in local communities in Canande and many other reserves, while also being so supportive of scientists and science. Without their overall support, research over several years and in such a large area would have been impossible. Without the Chocó Lab – our research station which we implemented together with Jocotoco – we would not have gotten very far. Our close collaboration with Jocotoco was also evident during the review process, where the reviewers showed equal interest in the conservation context and the Jocotoco organisation as they did in the fundamental research on Reassembly. Not surprising. Many thanks to Martin and all the other Jocotoco staff.

Figure 5: Orchid: *Oncidium pichinchense*

So let's move on – let's continue. Four more years – sweat not tears! Full of great new opportunities. And then we'll see what happens thereafter.



SP: Coordination Module

Edith Villa Galaviz, TU Darmstadt

Reassembly continues

We did it! Reassembly is now at the end of the first phase, though not the last, as we will continue for another four years. After months of preparation, long hours, and a surprisingly enjoyable evaluation (yes, I´m speaking for myself), and that brought us together rather than breaking us (hope I´m *not* speaking just for myself), we got the green light!

The preparations were exhaustive and chaotic, but thanks to the individual strengths and team spirit of all of the members: early researchers, supervisors, and the Chocó lab the evaluation was successful (Fig. 6). I ironically had a great time in Canandé during the evaluation; ignoring the small detail that my job and my team were on the line (nothing major, of course), the field trips with tropical ecology experts and DFG members, who also happen to be lovely humans, were fantastic. And honestly, seeing Reassembly actually working as a team felt great.

Figure 6: The evaluation of the first phase of Reassembly included poster sessions where we have the oportunity to discuss one of one the individual parts of Reassembly with the examiners and also with other members of Reassembly

For this Newsletter, I asked the members of Reassembly to reflect on their journey over these four years, the findings that impressed them the most, and what they learned through the process. I joined Reassembly in May 2023 during the project's toughest period, and I learned from that experience, discovering soft skills I never imagined I had. That said, I´ll focus on the things I enjoyed doing this year (saving the tea for my horror novel... just kidding).

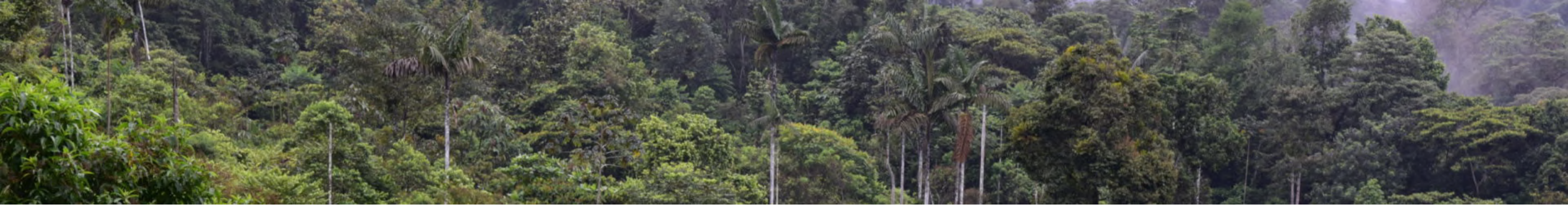
This year, I opened the project´s Instagram account. Coming from the Facebook era, where I mostly just repost memes. It may sound silly, but I was completely lost at first, especially when it came to handling an institutional account. But I managed, the account looks decent, and I actually enjoyed creating videos and posts based on our research. So, this year, I learned to be a content creator and social media manager (Fig. 7).

Figure 7: Cover image of the first video created for the project's Instagram account. The video highlights the importance of species interactions in sustaining forest ecosystems.

Multidiversity... multiple perspectives

Because of my dual role, where I often end up doing "everything, everywhere, all at once", my work over the past 2.5 years hasn't followed the typical path of a postdoc developing one large, continuous project. Instead, I focused on a synthesis examining niche turnover across 18 ecological communities. The strength of this study lies not in particularly novel questions but in the scope of its dataset, thousands of species spanning multiple community types, and in the method used to determine niche, which helps overcome the lack of ecological information that is common in tropical systems. Even within this apparent simplicity, several findings surprised me.

In the revised version of the manuscript, now incorporating the reviewers' comments, I added an analysis of multidiversity, an index that combines the diversity values of all communities into a single measure. This complements the niche-based analyses I discussed in an earlier newsletter. Together, these approaches allowed me to examine recovery at two ecological scales: a broad, community-wide scale captured by multidiversity, and a finer, community-specific scale that describes how many species occur early in recovery, which species arrive later,



and which persist across multiple stages of recovery. This last category consists of generalist species, and although generalists are known to be common in tropical forests, I did not expect them to be so prominent in the context of forest recovery.

Figure 8: Ecological research is enriched when multiple perspectives focus on the same system. Just as different cameras capture different details of the same organism.

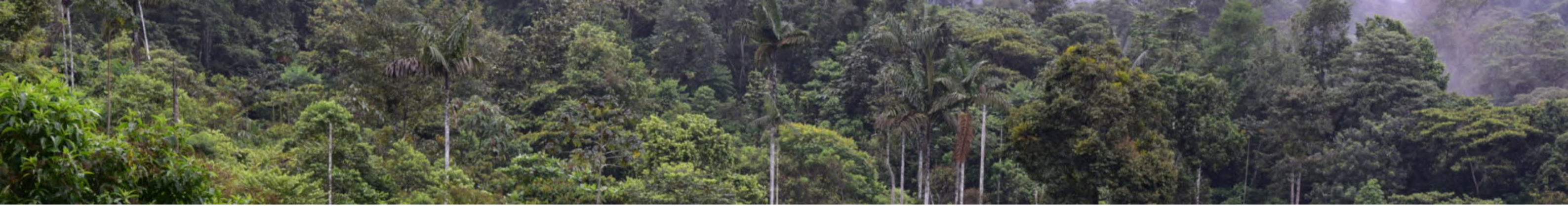
What surprised me even more was realising that their prevalence cannot simply be attributed to the idea that these species "use resources available everywhere." When writing the manuscript, I was careful not to overinterpret the patterns, not only because such conclusions would be irresponsible without further research, but also because many context-dependent factors likely contribute, local forest management practices, the amount of surrounding forest, and other landscape-level processes. As predictable as it may sound, the influence of these factors truly varies from one community to another, and acknowledging that variation is essential.

These findings also made me reflect on a belief I have long held: that conservation actions should be informed by multiple communities rather than focusing on a few charismatic ones. The results reinforce this point. While multidiversity increases with years of recovery, suggesting a positive overall trend, some individual communities host a much higher proportion of species that depend on mature forest conditions. This contrast implies that effective conservation and restoration planning must operate at both scales: using broad patterns to understand general recovery, while also tailoring specific actions to safeguard species with particular habitat requirements (Fig. 8). Although this may sound obvious in theory, it is not always applied in practice. Many policy decisions still rely on coarse indicators such as tree cover or the condition of a single community, which do not capture the complexity of the ecosystems. So, I join the position that information on multiple communities is needed for more realistic policy-making.

Final thoughts

We are now in an enriching transition period, with members from the first phase gradually overlapping with those from the new phase. I would like to call this an IDH moment, but all the reviewers of my paper told me that we don't have the conditions to test the Intermediate Disturbance Hypothesis in Reassembly. If you are unfamiliar with this hypothesis, the Intermediate Disturbance Hypothesis was proposed in 1978 by the American biologist Joseph H. Connell. In simple terms, it suggests that when disturbance is at an intermediate level, we tend to see the highest number of species. This happens because moderate disturbance creates a mix of conditions that allows species that prefer high, low, and everything in between levels of disturbance to coexist.

Nobody wants unhappy reviewers, so let´s just say we are entering a "richness transition". Not because disturbance is decreasing, quite the opposite, we are preparing for another roller coaster of emotions. The good news is that we´re definitely better prepared for it than we were in 2021.



Never do variable selection! (Opinionated about Statistics, Episode 1)

Carsten F. Dormann, Uni Freiburg

This is a newsletter reflecting on the first phase of the Research Unit. To me, the level of statistical competence was surprisingly high among the PhD candidates, and the nice experimental design made many analyses very logical and stringent. One of the topics that kept popping up here and there, however, I thought would benefit from a clear statement. Here it is.

If I had to select one point to change in all applied statistical textbooks, ecological or not, then it would be this: Never do variable selection when hypothesis testing.[1]

Why?[2]

First, let's take a step back. Statistics covers three activities: data exploration, hypothesis testing ("inference" is the technical term) and prediction. Only inference is interested in p-values, because only there do we have actual (theory-derived) hypotheses. Often, regrettably, p-values are also presented in exploration ("There is a significant pattern in the data": what would be a meaningful hypothesis to this trivial statement?), but they shouldn't be. Rather, exploration would yield something like importance rankings, which would then *lead to* a hypothesis to be tested *with new data*. Prediction, again, should not have p-values; what would they mean? "The value is significantly different from 0?" means what exactly when predicting temperatures or species richness?[3]

Okay, now we have that out of the way, here's the point: if we have an hypothesis and a design by which our data were collected (experimentally or observationally), we can write down the model *before* collecting any data. And we should. And once we have the data: fit that model, inspect the p-values, reject null or alternative hypothesis, done. (Yes, yes, we may have to adapt the distributions after model diagnostics, or so.) Hypothesis testing is the best possible situation we can be in, statistically, because our hypothesis *determines* the model. There is no fiddling around with the model structure, no nothing, just fit it and be done.[4]

Regrettably, many textbooks, and in particular those used by our generation of ecologists[5] suggests to remove insignificant predictors in a model. So here comes my point again: **DON'T EVER USE MODEL SELECTION FOR INFERENCE.**[6] It is wrong in several ways. And don't only take my word for it. Here's why.

The main thing to realise is that the software does not know what you have done before you ask it to fit the final model. It takes a model that may emerge from any kind of poor behaviour on the side of the analyst and fits it "at face value", as "prescribed" (as Harrell 2015 calls it). Hence, the software cannot know whether you initially started with 10,000 models (using dredging) and filtered it down to the best model. The final model tests the hypothesis: "the predictors have an effect on the response", even if it should test the hypothesis "well, there were data, and I had no idea what to do with them, so I played around until I found this rather nice-looking model, and now tell me whether this heavily customised model would be cool". Because the final model has no memory of what you did to get there, it cannot accommodate any variable selection step.

The second thing to realise is that (except in balanced experimental designs without covariate) *all* predictors are to some extent correlated. That means, if you have two slightly correlated predictors, X_1 and X_2, and you fit a model with only X_1 in it, then the effect of X_2 will be partially also in the model, by the degree of correlation with X_1. That is, if X_1 were irrelevant, and X_2 were important, then X_1 could well prove significant, if it is correlated enough with X_2.

If you now remove predictor X_2 from a model, this "transfer of effect" happens. As a consequence, the estimate (slope) of X_1 will be biased (because it is no longer the effect of X_1 only, but the effect of X_1 plus a bit of X_2, if you catch my drift), the standard error will be smaller (because the uncertainty where to put the overlapping effect of X_1 and X_2 would be removed), and hence the p-value (resulting from the division of slope by SE) will be biased, too (and always downwards!). Meaning: if you remove a variable from a model, your p-values are wrong. Fullstop. End of discussion.

Yes, you can use simulations to find our *how* wrong the p-value is (see our last book on how to do that). Yes, you can read papers (there are not many) on "post-selection inference" (e.g. Kuchibhotla et al. 2022) and how to correct for the selection bias (only to find that the easiest way is to avoid it altogether). But, no, I will NEVER accept a paper that tests a hypothesis using model selection. It is that serious. The effect may be small, or it may be large. We typically do not know (because we are not told of the correlation among predictors). It certainly is biased.

There are other statistical malpractices in ecology, but they have to be killed one by one. Next on my list: (1) Using the same model for hypothesis testing and prediction. (2) Wasting data on data exploration because one is too lazy to read old papers that have the hypotheses laid out for me. (3) "Estimates without standard errors is equivalent to lying."[7] (4) Data snooping. (Don't get me started!)

If this were a research unit aiming at something other than hypothesis testing (with our wonderful gradient design, our excellent experiments), I would add another few sentences on when model selection is permissible or even indicated. — OK, since you asked: Model selection is fine for exploration (as long as you keep away from any form of drawing inferences from it), and a particularly good idea for making predictive models (because it reduces prediction variance, one of the two elements of prediction error). Indeed, shrinkage (= regularisation) is always used in machine- and deep learning, *because* it biases estimates to prevent extreme predictions (if you want to read about it, here are a few terms: lasso, model averaging, drop-out layer).

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[1] Aka model selection, aka feature selection. All the same thing.

[2] Largely to avoid the shame of being a silly ass. As one comment on stack overflow put it: "Model selection is considered something of a joke among statisticians." I don't want to be the butt of that joke.

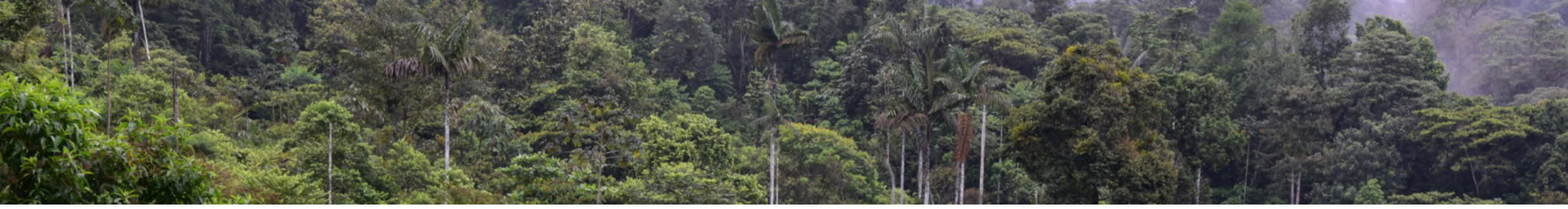
[3] In cases where a prediction serves the purpose of testing an hypothesis, this would be permissible.

[4] I gloss over a few details such as what happens if our design is compromised or if we know some covariates are colliding with experimental factors. That is stuff ignored in most analyses I know of, so let's not get side-tracked by it.

[5] The earlier generations had no statistics education, and the next generation seems to be disinterested in having hypotheses and theory.

[6] Let me know if I should also increase the font size and change the colour to make this statement unmissable.

[7] Quote from an unknown statistician.



SP1: Theory and modelling

Timo Metz, TU Darmstadt

Introduction

Many things happened this year. After submitting the synthesis paper I have been working on the past 2 years in December 2024 I wrote my PhD thesis and prepared for the defense in June 2025. I was also allowed to revise the synthesis paper two times after review, which took a significant amount of time. I also attended the conference of tropical ecology in Amsterdam together with many other members of REASSEMBLY, and even won the second Merian award for my talk on the synthesis project of REASSEMBLY.

The synthesis project

In the synthesis project that I have been leading, now called "Biodiversity resilience in a tropical rainforest", we calculated recovery times, resistance, return rates and relative recovery after 30 years for all taxa that are studied in REASSEMBLY. I am happy to say that, up to this point, the paper is still under consideration and we were invited for two revisions so far. Remarks by the reviewer included to focus more on differences for the legacy effects, since we had beautiful data of plots with cacao and pasture land-use legacy. Resolving this difference gave the paper more depth and we were actually able to show that recovery for many taxa is faster in former cacao plantations than pastures. The general message, however, still stands: Recovery of most taxa is very quick, and after 30 years there is a significant recovery of abundance and diversity of most taxa, but also the composition recovered well, but not as much. For full recovery, also of species composition, many decades are required. Nevertheless, this finding raises hope for tropical forest recovery, as we could see that even complex ecosystem attributes such as composition may recover for many taxa, and abundance and diversity, that are linked to ecosystem productivity and functioning, do so even remarkably fast.

The PhD thesis and defense

After submitting the synthesis project and before working on the revision I was writing my PhD thesis and defended it. In the end, I did an interdisciplinary PhD in physics and biology, which was fitting quite well to my interdisciplinary research under supervision of Barbara Drossel, who is a theoretical physicist and Nico Blüthgen, who is an ecologist. The writing and learning process was very intense, but being finished with the PhD was also very rewarding. Fitting to my interdisciplinary PhD, my two working groups at TU Darmstadt (physics of complex systems and ecological networks) cooperated and made me the most beautiful PhD hat (a typical German tradition) I could possibly imagine. It even had a small chronosequence on it, and of course multiple beautful animals that can be found in the rainforest. I am very happy about it. You can see a picture of it (and a happy me with it on my head) in Fig. 9 and 10.

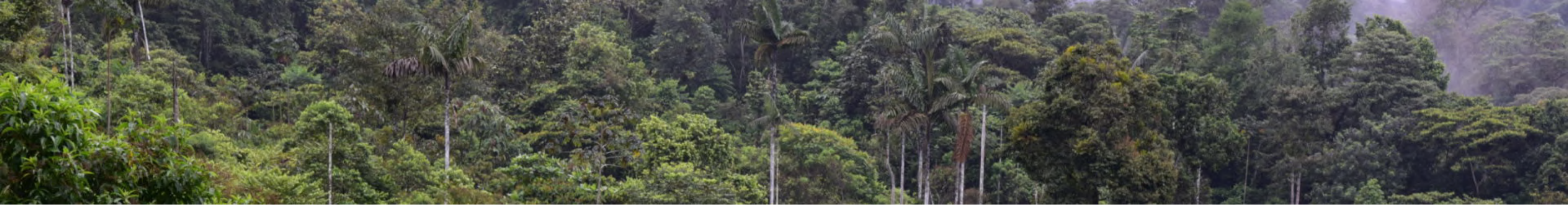
Reflections

I remember quite well the first meeting we had in Palmengarten in Frankfurt in November 2021 to kick-off the REASSEMBLY project. It is hard to believe at this point I did not even yet know Nico, the project's speaker who become my mentor later on and with who I spend countless hours to work on the synthesis project of REASSEMBLY. I also remember how nervous I was, because of meeting so many new people and also because of the respect I had to enter a new field of research. Hardly could I know at this point how much REASSEMBLY would give me in terms of fun and experiences. After the initial kick-off meeting, many more meetings followed. I most fondly remember the meeting we had in the Bavarian Forest, where we had epic hikes early in the morning and late in the afternoon, and also the meeting we had in Quito and the Reserva Maquipucuna last year. These meetings where inspiring scientifically, but I specifically liked the activities and social components of these meetings.

Figure 9: My beautiful PhD hat

Figure 10: Happy after my thesis defense

In REASSEMBLY, I really welcomed the chance to interact with people from different fields and different countries. I have the impression the research unit gave me an exceptional scientific education beyond what most PhD students can expect if they are not part of such a unit. It felt like there was an expert for anything in the unit to learn from, and I had the impression soon the PhD students became experts in their specific fields as well. I think this is a great and outstanding achievement. For me, as I am mostly working theoretically and computationally, this

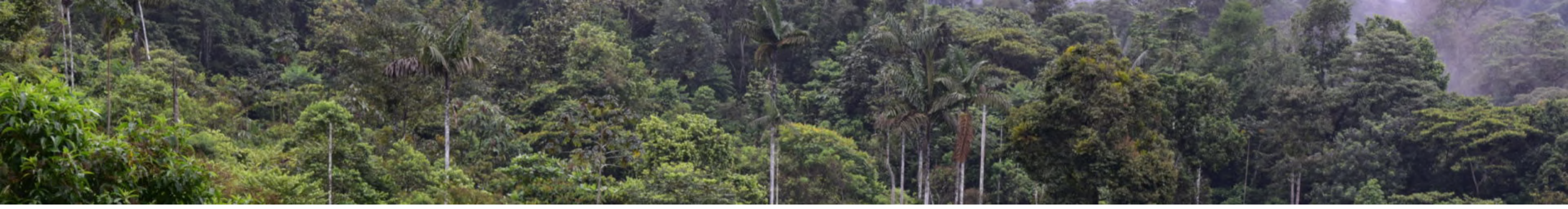


expertise of empirical scientists was extremely helpful to do my very interdisciplinary work.

During my PhD I also had the chance to go to the field to our beautiful research station in Reserva Canandé two times for multiple weeks. These trips helped me significantly to learn more about tropical ecology and it was great to see how the actual field work is done. As a theoretician, it gave me the change to significantly enhance my ability to work with the data that was taken in the field and to make the most out of it. I think it was an extraordinary opportunity for me to learn tropical ecology from both a very theoretical and also an applied perspective in this research unit.

Outlook

As of November 2025 I started a position as a postdoc at the La Kretz Center for California Conservation Science at the University of California, Los Angeles. The position is planned to have a duration of 2 years. I will continue working on the effect of disturbances on ecosystems, mostly from a theoretical perspective but including field data and collaborating with empirical ecologists. More specifically, I will be working on the effect of different forest management strategies on the resilience of Californian forest ecosystems to wildfires. My work will again be very applied and focussed on conservation. In that regard, I will work together with The Nature Conservancy, a major NGO from the US. I still hope to stay in contact with all the researchers from REASSEMBLY and I also hope to visit the beautiful Reserva Canandé again, which I am sure will have a special place in the heart of everyone involved in this project.



SP1: Predicting Interaction Frequency in Plant-Pollinator Networks

William J. Castillo, Uni Freiburg

What we do

Plant-pollinator interaction networks represent fundamental ecological systems where the frequency of species interactions is hypothesized to be predictable from species traits and abundances. This study conducted a comprehensive analysis of 14 pollinator-flower visitation networks worldwide to evaluate the predictability of interaction frequencies using species abundances, traits, and phylogenetic or taxonomic positions as predictors.

Introduction

Understanding the factors that structure ecological interactions represents a fundamental challenge in ecology. Plant-pollinator networks exemplify bipartite interaction systems where the frequency of interactions between plant and pollinator species is thought to reflect species traits, abundances, and evolutionary relationships [1]. Previous research has extensively examined the presence or absence of interactions (e.g., [4, 2, 3]), but fewer studies have focused on predicting quantitative interaction frequencies.

The predictability of interaction frequencies has important implications for ecosystem stability, conservation biology, and understanding the resilience of mutualistic networks under environmental change. This study aimed to determine whether interaction frequencies could be predicted in validation networks using information on species abundances, traits, and phylogenetic (plants) or taxonomic (animals) positions. We hypothesized that predictive quality would deteriorate with increasing spatial and temporal distance from training networks and that changes in pollinator or plant composition would negatively affect model performance.

Method

The analysis incorporated 14 global studies of pollinator-flower visitation networks with strict inclusion criteria requiring quantitative networks replicated in space and/or time and sufficient information for constructing phylogenetic or taxonomic trees. For each case study, we assembled interaction networks, trait data, abundance measurements, and phylogenetic/taxonomic information.

Predictor variables included:

- **Abundance:** External when available, otherwise marginal totals from the network
- **Traits:** Functional characteristics such as nectar depth and proboscis length
- **Phylogenetic/taxonomic information:** Evolutionary relationships using phylogenetic trees for plants and pseudo-phylogenetic trees based on taxonomy for pollinators

We employed multiple statistical modeling approaches including neural networks and randomForest for predicting interaction frequencies. The training and validation strategy employed spatial and temporal cross-validation on data pooled across respective dimensions. Each case study was analyzed separately before synthesizing trends across all studies.

Results and Discussion

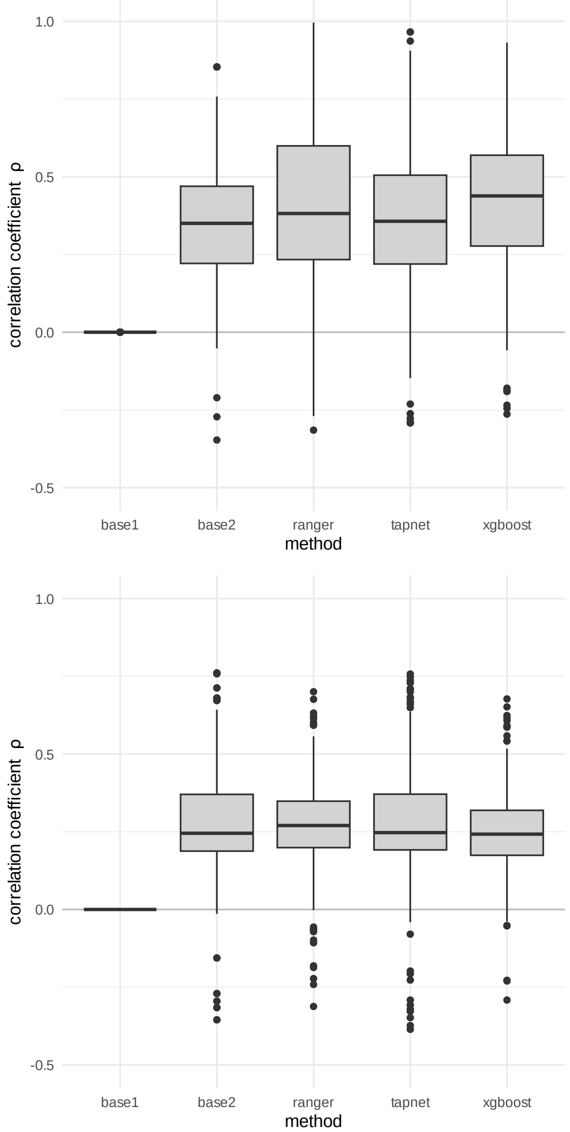
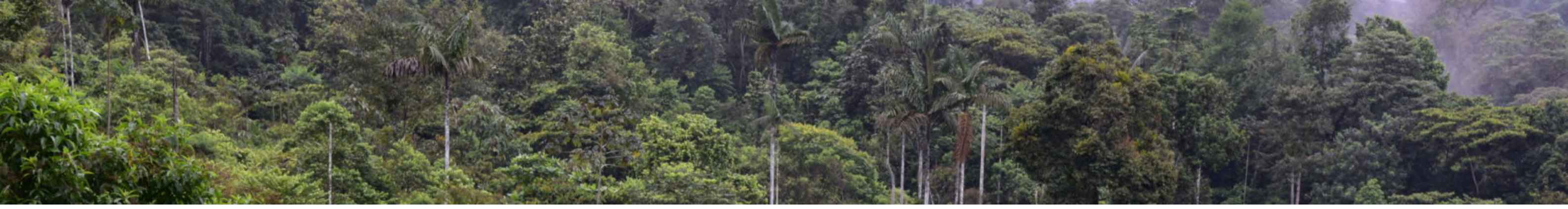


Figure 11: Predictive performance of five methods: interactions-based Baseline 1, abundance-based Baseline 2, Ranger as implementation of RandomForest, Tapnet, and XGboost. Cross-validation testing was performed on the models in time (top) and space (bottom). The correlation between prediction and observation was measured using Spearman's ρ.

The challenge of predicting interaction frequencies in plant-pollinator networks is underscored by a comprehensive analysis across multiple global case studies. The overarching finding is that predictability is low to moderate, with models achieving only limited success despite incorporating a rich set of potential predictors. This synthesis reveals that ecological network dynamics are governed by a strong primary driver—abundance—tempered by high levels of stochasticity and minimal influence from generalizable trait-matching rules across the scales examined (Fig. 11).

Species abundance was the most dominant predictor of interaction frequency. Simple, parameter-free benchmark models that relied solely on the cross-product of plant and pollinator abundances were as successful as far more complex machine-learning and trait-based models. This finding is consistent with ecological theory and simulations that suggest specialization, and thus the predictive power of traits, is only a



significant factor when floral resources are abundant. In the real-world systems studied here, the sheer numerical presence of species appears to overwhelm the subtle effects of trait complementarity (e.g., proboscis length matching corolla depth) and phylogenetic relationships. Consequently, adding trait and phylogenetic (plant) or taxonomic (pollinator) information provided minimal predictive improvement beyond what abundance alone could explain.

Attempts to scale predictions across all 14 studies using a "leave-one-study-out" cross-validation approach were unsuccessful, demonstrating no predictive ability (Fig. 11). This suggests that, although models may capture general principles within a given study's context, these principles are not applicable to different systems, locations, or methodologies. This low level of transferability suggests the significant impact of local, unmeasured factors and methodological heterogeneity.

The modest predictability observed here can be attributed to several key limitations inherent in the data and methodology. The networks were heterogeneous, constructed using different protocols and sampling intensities, which can introduce false-negative errors and noise, particularly acute in the smaller networks that were analyzed. The unavoidable use of marginal network totals as proxies for missing external abundance data may also have introduced an optimistic bias. Together, these factors suggest that the models were attempting to find a general signal in data where local context and stochasticity were paramount.

Conclusions

This study reveals the profound challenges in predicting interaction frequencies in plant-pollinator networks despite incorporating comprehensive ecological information. The overall conclusion is that interaction frequencies are primarily driven by species abundances with minimal generalizable influence from traits or evolutionary relationships. The system appears fundamentally stochastic, potentially reflecting the complex interplay of abiotic factors, behavioral plasticity, and local ecological conditions.

Encouraging consistent data collection protocols and reporting practices will facilitate improved comparative analyses across study systems. As more high-quality datasets become available, meta-analytical approaches may reveal patterns obscured in this current synthesis.

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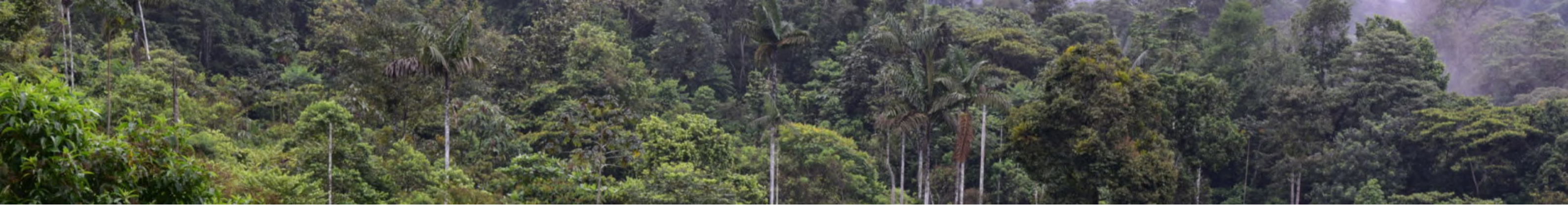


SP2: Leaf litter and understory processes - Decomposition and predator-prey networks

Arianna Tartara, TU Darmstadt

The doctorate journey

It feels a bit strange to say "this was the last year." There is definitely a bittersweet flavour to reaching the end of my PhD. Well, almost the end, but close enough to see it coming. The "bitter" part comes from remembering how everything started: diving into a completely new topic (biology and ecology), often wondering whether I had made the right life choices by leaving Denmark and the chemistry world behind, and trying to settle into Covid-era Germany while juggling long field trips and personal health issues. It was… intense.

But then came the first small "sweet" achievements: designing my own experiment from scratch, discovering that I could actually analyze my own data, starting to understand scientific discussions, and presenting at my first conferences. Even so, these moments were often overshadowed by impostor syndrome, endless self-criticism, and the constant feeling that I wasn't fast enough, good enough, or knowledgeable enough compared to others.

During the last year something changed, though, and things finally started to click. I started to notice that I knew more and more what I was doing. I was not afraid of scientific debates anymore. Quite the opposite, I realized I was looking forward to other people's criticism and comments on my work, or I was longing for questions after my presentations. It felt good to defend my arguments with confidence and to use all the tools I'd learned to test my hypotheses, analyze data, or even dive into other people's datasets and ideas.

And then there came my first first-author manuscript. The whole process was long, overwhelming, and full of things I had no idea how to do. But I made it through (hopefully it gets published!), and currently that I'm working on two more manuscripts, the difference is huge. Everything feels easier, faster, smoother, and with far fewer doubts whispering in the back of my head. It's been an incredibly steep learning curve, but I think I'm finally starting to see the plateau ahead… or at least a gentler slope.

Figure 12: Myself presenting at the symposium of the Faculty of Biology of TU Darmstadt. On the screen a group photo of the core SP2 team, with Karla and Leo.

My PhD thesis and research output

My thesis is built around three main chapters, each now becoming a manuscript I hope to share soon:

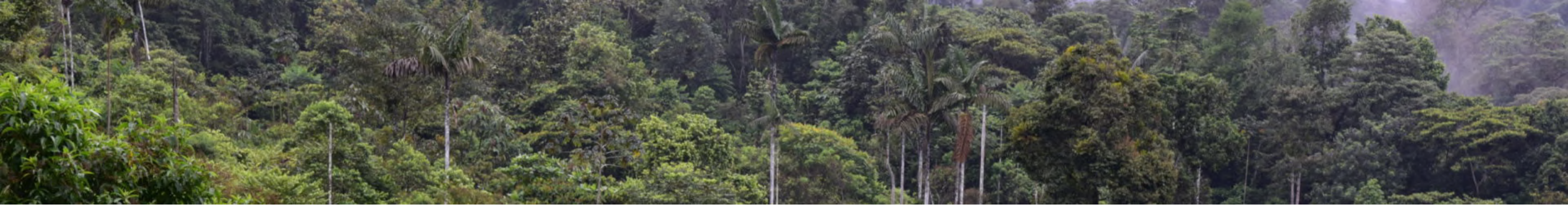
- Decomposition paper: It is already submitted, reviewed, revised, and sent back, fingers crossed! I'm genuinely proud of this one, especially after addressing the reviewers' comments.
- Poison frog alkaloids and diet paper: I am waiting for final comments from the senior author (Ralph Saporito, US). Honestly, I never thought I'd even manage to collect enough data to write half a manuscript, so reaching this stage already feels like a win. If it gets published, I'll be thrilled: it's a small but meaningful piece of the original chemical-ecology vision of my project. I don't regret that the project shifted; on the contrary, I'm happy with the direction things took. I got to explore many methods and topics that I wouldn't have touched if the project had stayed strictly on the original track. Now I know much better what my research interests are, what are not, what I'm good at, and where I want to grow.
- Leaf litter arthropod community paper: This is looking at how leaf-litter arthropods recolonize disturbed patches (PREX) and how this changes along a forest-regeneration chronosequence.

Each chapter surprised me in different ways, but together they taught me that ecosystems are way more resilient, but especially more context-dependent, than I ever expected. And they reminded me that creative experimental design and persistent data wrangling can get you much further than initial plans might suggest.

Final thoughts on Reassembly

Over the past four years, I picked up an unexpected mix of skills: from field logistics in tropical forests to statistical modelling marathons, from chemical analyses to community-ecology workflows, from managing collaborations to simply learning how to survive messy datasets and even messier schedules. I've learned to be more independent, more flexible, and more confident in my own scientific judgement. I've experienced to organize and lead teams as well as to be functionally and actively part of one. I think these skills will stay with me no matter where I go next, either inside or outside academia.

As a final thought, it's been an intense yet incredibly rich ride: I learned a lot, met amazing people, discovered magical places, and grew in ways I never imagined, both professionally and personally. Every part of it has left a mark, and all of it comes with me and shape the person I am today.



SP2: Food webs and alkaloid defenses - frogs and litter fauna

Karla Neira Salamea
MfN/HU, Berlin - UDLA, Quito

Behind the Papers: A Year of Slow Science

One year ago, in December 2024, I wrote in this newsletter that I had submitted my first paper. At that point, the fieldwork was already finished, and a much less visible stage of the scientific process began: analyzing data, writing, rewriting, and learning to live with a waiting period that is largely out of the researcher's control. After nine months without news, the first response from the journal arrived in September. Major revisions were requested. One reviewer provided very positive and constructive comments that helped strengthen the manuscript. The second was more critical, questioning several methodological decisions—particularly the use of a chronosequence—and suggesting a completely different analytical approach for frog communities. It was not an easy review to read, even though my supervisor said it wasn't harsh. I spent a month working intensively on the response. I did not change the core of the study, but I included additional analyses to show that, even when using more complex methods, the data told the same story: frog diversity increases as forests regenerate. The manuscript has now been resubmitted and I am once again waiting for an update.

Particularities of a Unique Community

In parallel, I advanced the second paper, which examines functional diversity in frogs. This has been a particularly demanding yet stimulating part of the project, as it goes beyond documenting how many and which species are present to understanding what they do in ecosystems and how their traits shape community structure. In amphibians, this perspective is still relatively underexplored, offering room for innovative contributions despite the challenges it entails. Moreover, the constantly evolving taxonomy and phylogeny of frogs, with new species being described and evolutionary relationships frequently revised, adds complexity but also provides a valuable opportunity to produce research that is both timely and impactful.

When we started the project, we expected poison frogs to be the main protagonists. We assumed that their toxins and their interactions with leaf-litter arthropods would structure much of the ecological dynamics. The forest, however, told a different story. The communities are strongly dominated by frogs of the genus *Pristimantis*. This group shows enormous diversity and a strong adaptive radiation in the Chocó. Understanding who these frogs are, how they live, and what they require has been one of the greatest challenges of the project.

During my bachelor's thesis, I thought their success was mainly due to the fact that they do not depend on water bodies to reproduce—and in part, this is true. *Pristimantis* frogs have managed to colonize a wide range of environments, from lowlands to páramo ecosystems. However, I now know that this explanation is incomplete. Their broad distribution does not mean simple requirements. *Pristimantis* depend on humid soils, stable microhabitats, and very specific conditions to protect their eggs. Far from being "simple" frogs, they rely on a very fine environmental balance and appear to regulate much of what happens in the forest.

The third paper focuses on the diet of leaf-litter frogs. Seemingly simple questions have revealed remarkable complexity. Frogs consume an astonishing diversity of invertebrates, ranging from a few relatively large prey items to hundreds of tiny organisms such as mites, springtails, small ants and even snails. One of the main limitations is that many of these organisms have not been formally described and may even be new to science, making their identification and ecological interpretation particularly challenging. Despite this, their diets will help reveal part of the interaction network that sustains the forest from the ground up. This final paper aims to close the loop of the project by linking communities, functions, and interactions.

All of this highlights how much space there still is for discovery, whether in studying frog ecology or finding the specialists needed to shed light on their unknown processes. It is a challenging journey, but also a truly inspiring one.

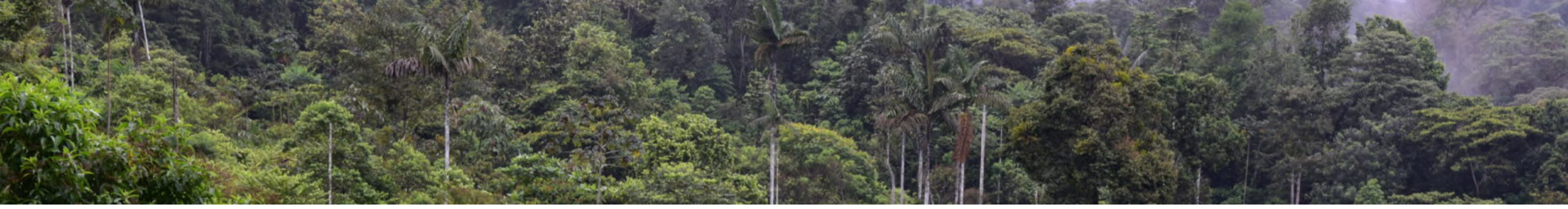
New Connections, New Horizons

This year also included important opportunities for exchange. I attended the European Conference on Tropical Ecology as part of the Reassembly team, as well as the first Ecuadorian Congress of Herpetology in Loja. Sharing experiences with other scientists, especially early-career researchers, was highly stimulating. In that context, I noticed a clear gap between ecology and herpetology as disciplines. Frogs (and other amphibians and reptiles) are rarely discussed in ecological conferences, and ecological processes are seldom central in herpetology meetings. There is still much to integrate and understand.

Another highlight of this year was that I got elected as a board member of the newly formed Ecuadorian Herpetology Network (REH, Red Ecuatoriana de Herpetología). I take on this role with enthusiasm and with the hope of contributing to a more connected and collaborative herpetological community.

Figure 13: Presenting my research at the First Ecuadorian Conference of Herpetology in Loja, Ecuador

Amidst all of this, something completely unexpected happened. Part of my work was featured by GEO Magazine Germany, which became interested in the research on forest frogs and in the photographs taken in the field by nature photographer Javier Aznar. One picture of me taken by him was later shared by National Geographic on its Instagram account. It was surprising to see how far this work reached and to witness the interest of people from very different backgrounds in frogs, forests, and conservation. This experience reinforced the idea that science can have an impact beyond academia when it connects with broader audiences.

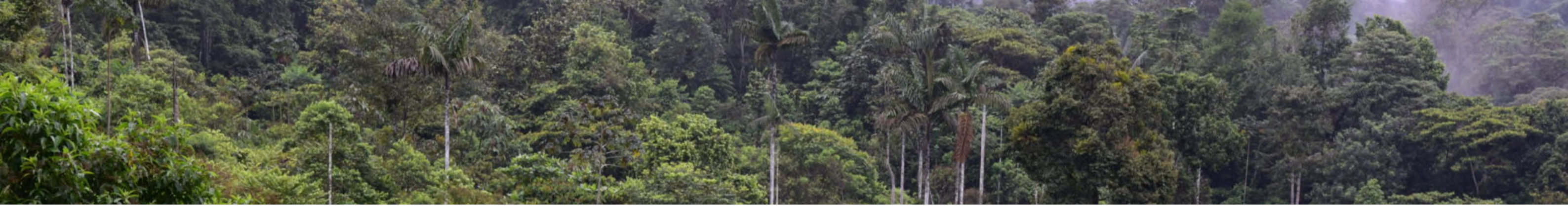


Closing a Chapter, Opening the Next

Guiding students was also an important part of this journey, even if it was not always visible. Officially, I supervised one Ecuadorian bachelor's student and genuinely enjoyed supporting his learning process. Unofficially, I also worked closely with master's students. Discussing ideas, providing feedback, and building knowledge together is part of academic work that I genuinely enjoy, as reflected in the very positive feedback from the students I advised. I would have welcomed the opportunity to formally supervise more students, as teaching is one of the most rewarding aspects of this work—sharing knowledge while learning together.

After navigating the analytical, methodological, and logistical challenges of the project, I now feel a strong sense of confidence: I know that I am capable of carrying out complex work and sustaining long, uncertain processes. This project also gave me the tools and judgment to approach future work with greater independence and clarity.

Working with Reassembly allowed me to study frog ecology in tropical forests on the coast of Ecuador—exactly the work I imagined doing as an undergraduate student. It meant learning to adjust questions, work within limitations, and understand highly diverse systems—perspectives that will shape any future work I undertake. This newsletter marks the end of a project phase, though not an abrupt one. I take with me analytical tools, field experience, solid lessons, and valuable collaborations, as well as a clearer understanding of the forests where I worked and of how to approach ecological questions in tropical systems. Beyond the scientific work, I carry with me deep friendships that grew during this project and extended far beyond Canandé—friendships built on shared work, mutual support, and trust, and that I know will last well beyond this stage.



SP3: Plant-pollinator interactions

Ugo Mendes Diniz, Technische Universität München

The end (and new beginning) of SP3

After five long and productive fieldwork campaigns, 600 traps, 25000 insects, 4000 interactions, and what has now probably been hundreds of hours of data cleaning (not done yet) and analysis, SP3 is nearing the end of its first phase. I could not be happier with what we have achieved in these years, especially regarding the representativeness and quality of the taxonomically curated dataset gathered. This achievement has only been made possible by the incredible entomological and bioinformatic expertise of my supervisors, Sara Leonhardt, Alex Keller, and Gunnar Brehm, from whom I have learned a great deal. So far, this incredible amount of data has provided us with insights not only into the resilience of pollinator communities and their interaction networks reassemble (final manuscript in preparation!), but also shed light on some corners of pollination ecology that we did not expect at first.

For instance, we were able to expand on the ecology of nocturnal bees (*Megalopta*) by providing information on their diet via molecular pollen data and the first report on the effect of habitat loss for this elusive and fascinating functional group of bees: **Low resilience to deforestation in nocturnal bees is counteracted by a broad resource range and reliance on pioneers. *Apidologie*, 2025**

While we are still at nocturnal pollinators, we could also show how settling moths, a megadiverse functional group of moths that is normally neglected in pollination studies, accounts for a large proportion of interactions with plants, and may even be regarded as keystone pollinators that enhance network connectivity: **The neglected pollinators: settling moths are keystone floral visitors essential to network connectivity and tropical forest recovery. *Proceedings of the Royal Society B*, 2025**. This paper has brought a nice representation from our final pollinator and interaction dataset:

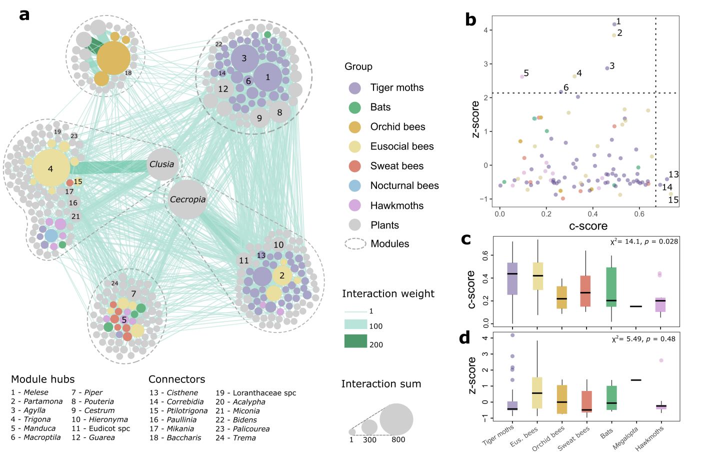


Figure 14: The interaction network between pollinator and plant genera we gathered from Canandé and Tesoro Escondido. Note how important these settling moths (tiger moths) are, and how they connect different network modules (parts of the network where interactions are stronger, dotted circles). They tend to have a high c-score (how well they connect modules) and a high z-score (how well they connect their own module).

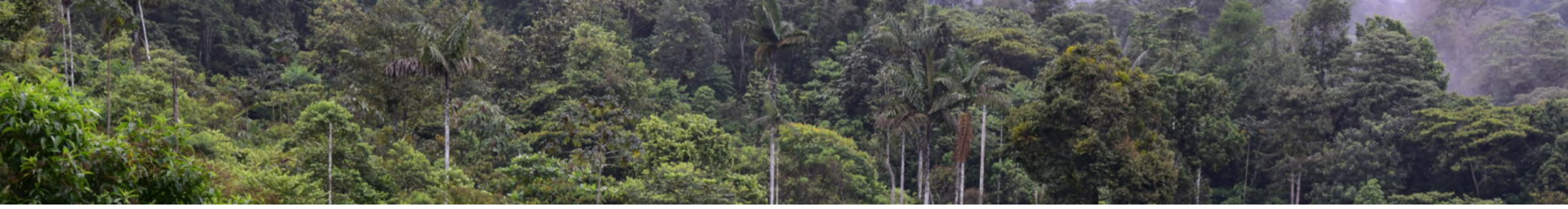
Besides, using our cool bow-and-arrow method to set traps in the canopy, we could also see the great relevance of the vertical structure of the forest as a driver of pollinator communities and interaction networks, as many pollinators seem to be found in canopies (preparing to resubmit). Together with students, we could also show how floral resources recover along the chronosequence (submitted) and improve allometric models for predicting the proboscis length of tropical bees, which I hope will be very valuable for future bee research: **Improving allometric models to estimate the proboscis length of tropical bees. *Biological Journal of the Linnean Society*, 2025**.

Although the synthetic manuscript where I plan to bring together SP3's main messages is still being worked on (clearly some productive procrastination was happening with the papers above), I believe that the subproject has concluded its mission with grace. We could show that pollinators, these beautiful and valuable little beings that we so often take for granted, can withstand quite a blow when it comes to habitat loss (some groups more than others). However, too little forest cover and the loss of old primeval forests with dense canopies may have long-lasting effects on these animals, their interaction networks, and ultimately the continuity of pollination in the landscape. Now, SP3 can continue into phase 2 with a fresh approach to insect sampling, new plots, and renewed ideas for sampling floral resources. I say goodbye to the project, but not without having learned a few lessons:

- Keeping data clean and legible is **HARD** and should be done since the very first day of data collection (people **WILL** look into your data and eventually be confused).
- Trap nests will get moldy **VERY** fast and only get wasps (do not recommend).
- We owe much more to forests (and savannas, and grasslands, and wetlands...) than we realize, and to the people who live from them and to protect them.
- Fieldwork in the rainforest is hard and often feels disheartening when you're there, but might come to be the best time of your life once you look back.
- A collaborative research unit like Reassembly is probably one of the best things that can happen to an early-career researcher.

I also say goodbye with incredible gratitude to my supervisors and to the many people who made this project possible: Jender, Katrin, Julio, Lady, Bryan, Leo, Jeff, Yadira, Adriana, Sabine, Kathi, Julia, Kilian, Maxi, Kevin, Annika, my colleagues in Freising, and many others. To the next student who takes over SP3, **good luck and lots of bees! (and moths, and bats, and hummingbirds...).**

Figure 15: Sunset in the Chocó, outside of Yadira's house in Tesoro Escondido. Photo: Shao Xiong Chui



SP4: Seed dispersal and its important role in forest recovery

Anna Rebello Landim, Senckenberg Biodiversity and Research Centre

After two years of fieldwork and one year dedicated to data analysis and manuscript writing, 2025 was a year of finalizations. My work focused on completing the analyses of data collected between 2022 and 2023 and finalizing the manuscripts derived from it. I successfully published the first two chapters of my PhD and submitted the third. I also handed in my PhD thesis, closing an important stage of my research on the recovery of seed-dispersal interactions and functions in tropical forests.

Conference participation

In February, I attended the European Conference for Tropical Ecology in Amsterdam (24–28 February), where I presented a talk titled "*How seed-dispersal interactions drive the recovery of tropical forests*" (Fig.16)- My presentation was part of the Reassembly session "Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions." It was inspiring to see how different Reassembly subprojects connect and complement one another, revealing the broader picture of tropical forest recovery. The conference was also a great opportunity to reconnect with former colleagues from Senckenberg, exchange ideas, and strengthen collaborations.

Figure 16: Anna presenting at the European Conference for Tropical Ecology, Amsterdam 2025.

Publications

Functional connectivity of animal-dispersed plant communities (*Proceedings of the Royal Society B, 2025)*

In this study, we developed a trait-based simulation framework to explore animal-mediated seed dispersal between forest patches. The simulations showed that seed abundance and diversity decreased with distance from undisturbed forests, whereas a higher resource diversity attracted more frugivorous birds and increased seed arrival. The structure of the seed-dispersal network also influenced the simulation results: in less specialized networks, where plant species share dispersers, a more diverse set of seeds reached degraded patches. These findings highlight that seed dispersal between forest patches depends on both local and landscape factors, as well as on the structure of seed-dispersal networks. Increasing fruit resource diversity near remnant forests could help to attract avian seed dispersers and enhance seed dispersal into degraded areas.

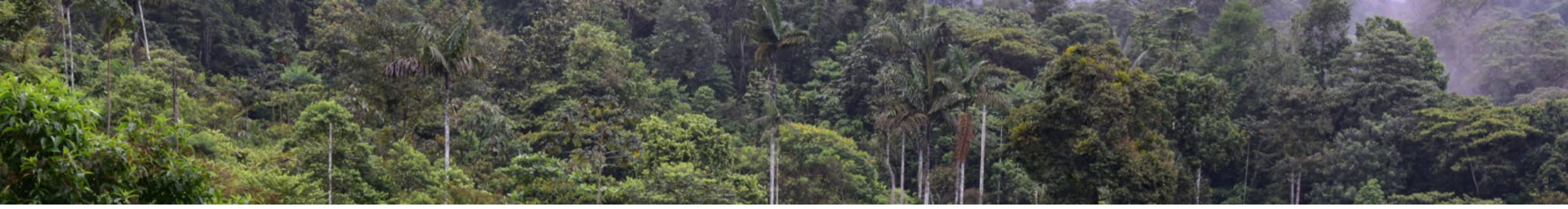
Recovery of the functional diversity of seed-dispersal interactions after deforestation (*Current Biology, 2025)*

Using field data collected across the 62 Reassembly plots, we investigated how long it takes for the functional diversity of seed-dispersal interactions to recover after deforestation. We found that seed-dispersal interactions recovered after about two decades. Importantly, recovery times were longer and more uncertain in less-connected forest patches, indicating that the connectivity to forest sources plays a key role in restoring ecological processes. These results show that the recovery of seed dispersal depends not only on species presence but also on the re-establishment of their interactions and emphasize the need for long-term restoration strategies to maintain ecosystem functioning.

Functional recovery of the seed rain (*under review)*

In this study, we investigated how local forest structure (the complexity of vegetation within a plot) and forest connectivity (the amount of surrounding forest and proximity to old-growth stands) influence the functional recovery of the seed rain mediated by seed-dispersal interactions. The analyses showed that local forest structure mainly affected the functional diversity of the seed rain: structurally complex forests harbored diverse interactions, which in turn increased the functional diversity of seeds within a patch. Forest connectivity, on the other hand, influenced the functional composition of the seed rain. Connected forest patches hosted more interactions involving large animals and received more large seeds of plant species from late-successional habitats. Together, these findings indicate that local forest structure and landscape-level connectivity shape distinct but complementary aspects of the functional recovery of the seed rain. Restoration strategies in tropical forests should therefore consider both spatial scales to ensure the re-establishment of seed-dispersal interactions and functions.

Figure 17: Missing the Chocó! Photo by Eike Lena Neuschulz.



SP4: Bat assemblages and seed dispersal networks

Santiago Erazo, U Ulm, Germany – PUCE, Quito-Ecuador

Getting closer and closer

In our lives, as in ecosystems, change is the only constant. We are subject to dynamic changes, driven, among other things, by modifications to our physical and social environment. Just like the different species and communities we study, we have to adapt and find a balance in the face of changes and challenges that arise. But we understand that to get there, we have to go through a process whose success — to use a word that often accompanies our scientific answers — "depends" on many factors. Some will be within our reach, and we can manage them as best we can, but there will always be factors that we cannot control or that escape our control.

This year, the main change was moving to Ulm, Germany, to continue analyzing my data and writing the corresponding articles. This change brought new challenges and a new process that I am learning to manage and overcome. This process can be enriching, but it can also work against us, especially when it comes to time. Time is infinite, but our time to experience, learn, teach, share, to "live" is limited and relative. How can we not talk about time? Knowing that part of our project is to understand ecological processes over time. Furthermore, interestingly, I live in Ulm, the city where Albert Einstein, author of the Theory of Relativity, was born.

Overall, I can say that I'm getting closer and closer, enjoying and learning along the way. Although I am aware that I still have a lot of work ahead of me, I consider it to have been a productive year. In addition to working on my research, I had the opportunity to continue collaborating with other subprojects on the development of various publications, thus adding further contributions to the project as a whole.

My research project

Ecosystems and biological communities are constantly changing as environmental and biophysical conditions change. Human activities can alter, accelerate, or limit these natural changes, and their effects on biodiversity can be complex and even contradictory. Habitat loss as a result of human activities is one of the main threats facing ecosystems and biodiversity. Specifically, tropical rainforests are suffering rapid habitat loss with large extensions of land transformed into agriculture. This change in land use can lead to structural and functional changes in the ecosystem and its biological communities. Faced with these threats, one of the challenges in ecology and conservation is to understand the processes of change and recovery of biodiversity. In this context, the main objective of our research is to examine the Compositional recovery of phyllostomid bat assemblages and the seed dispersal network in the Chocó lowland rainforests of northwestern Ecuador. Below, we will present the main results of our research obtained so far.

In the study, with a sampling effort of 6138 mist-net hours in 186 capture nights, we captured 2558 individuals from 42 species of the family Phyllostomidae. We examined the compositional recovery of the phyllostomid bat assemblages along a regeneration gradient, within and between land-use legacies (pasture and cacao plantations). Among the main results, we find that land-use legacy influences the pattern of diversity recovery of the phyllostomid bat. The cacao legacy reached global mean diversity in its early regeneration (< 15 years), while the pasture legacy reached it in its late regeneration (≥ 15 years). Furthermore, the diversity of cacao plantations is the only category that does not differ from the diversity of old-growth forests. This can be attributed to the fact that its forest structure, although simple, is stable and can generate a relative balance in its diversity. Nevertheless, when we evaluated the community composition, we found that cacao plantations and pastures are not different from each other, but both are different from old-growth forests. The old-growth forest is significantly different from all regeneration gradients. However, we observed that their dissimilarity to old-growth decreases in the late regeneration categories of both pasture and cacao plantations.

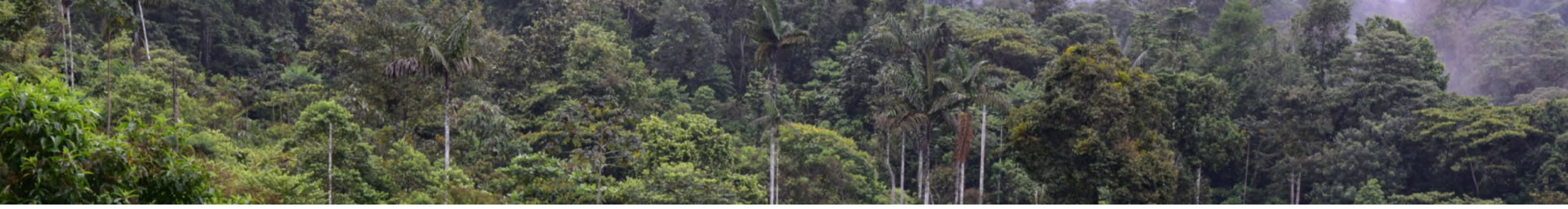
We evaluated the seed dispersal network. It was possible to identify more than 1000 interactions (bat-seed) between 21 species of bats and 44 types of seeds. We are still working on the analyses; however, preliminary results showed that land-use legacy also influences the seed dispersal network. This research contributes to a better understanding of the compositional recovery of phyllostomid bat assemblages and the seed dispersal network in human-modified tropical systems, important knowledge to generate management plans before and after human modifications.

A journey called Reassembly

This journey called Reassembly turned out to be full of experiences, learning, and growth, both personal and professional. The main setting and starting point for this journey was Canandé, Esmeraldas, in the Chocó lowland rainforests of northwestern Ecuador. This megadiverse ecosystem never ceased to amaze us with its beautiful landscapes, waterfalls, and sunsets. The setting was surrounded by magical little towns such as Hoja Blanca and La Yuca.

The structure of Reassembly, made up of a multidisciplinary and multicultural group, indirectly resulted in a type of "ecological network," formed by different modules or subprojects, with different levels of interaction and specialization. The type and degree of interaction can depend on many factors, just as ecological interactions depend on a combination of factors, such as functional traits and ecological niche. At Reassembly, our interactions were diverse and complex, involving people from different disciplines, countries, and cultures. As part of the process, it was possible to work with people from the community at different stages of the project. Overall, we were able to meet and interact with wonderful people, making it a learning process for everyone.

Figure 18: Reassembly sunset - Canandé, Esmeraldas, Ecuador



SP5: Tree seedling recruitment and herbivore interactions during forest recovery

Eva Tamargo López, Marburg University

Reassembly-SP5 Wrapped

2025 has been a period of transitions and closures for our team. To date, six master students have successfully defended their theses and graduated within the Reassembly SP5 team during the project's first phase, with the last master's student being nearly done submitting. Thanks to the dedicated work of Lady Condoy, Miguel Tacuri, Elis Martinelli, Lukas Werner, Franziska Scheele, Claudia Eberspach, Niko Ioannidis, Stella Drechsler, and Marko Hügel, we gained understanding in:

1) How tree-seedling communities recover across a forest chronosequence in the Ecuadorian Chocó, and how this recovery is related to the prior land use for both taxonomic and functional characteristics;

2) The influence of the adult tree communities in the recovery of conspecific individuals within seedling communities;

3) The impacts of anthropogenic perturbations and terrestrial mammal exclusion on the tree-seedling establishment, when controlling for local and landscape conditions (fig.19);

4) The recovery of the arthropod communities along the chronosequence; and

5) The role of landscape and local conditions in shaping the tree-seedling herbivore interactions.

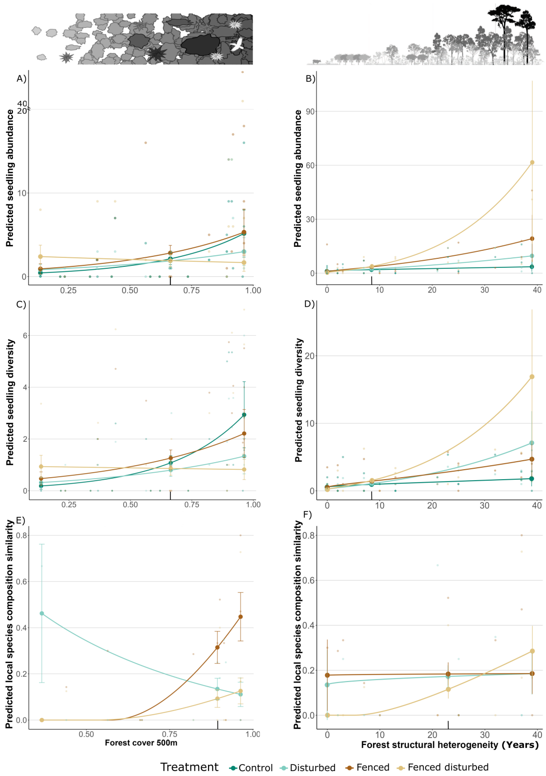


Figure 19: Influence of landscape (Forest cover 500 m) and local (Forest structural heterogeneity) conditions on the tree-seedling abundance (Figures A and B), species diversity (Figures C and D), and species composition similarity among the treatments in the plot (E and F). Experimental treatments are determined with colours, and the median Forest cover and Forest structural heterogeneity in the plots are marked with a vertical line on the X axis. Standard errors are shown with whiskers at the lowest, highest, and median point of the independent variable.

All this teamwork, along with the guidance of Nina Farwig, Katrin Heer, Sybille Unsicker in collaboration with María José Endara and David Donoso, has led to the submission of one publication, which reports the differential recovery of tree-seedling communities according to the prior land use of the forest they are established in. Additionally, we have drafted a second paper, that focus on the influence of landscape and local conditions on the recovery of tree-seedling communities in concert with the P-REX experiment. Sheding light on how these landscape and local conditions can have both direct and indirect effects (through seed-rain) in the recovering tree-seedling communities. Working on these drafts has taught the patience sometimes required in our careers, emotions mixed with the excitement of learning new statistical methodologies, such as structural equation models. It has also increased my knowledge in how functional traits shape the tree communities across all life stages, from seed, to seedling and adult.

SP5 Roadshow: tropical ecology conferences in 2025

Conquering my fears, 2025 turned out to be a year full of exposure and growth. In February, we were able to present our work at the gtö conference held in Amsterdam, along with most of the Reassembly team. This was both a fun and significant experience for me, since I participated in the organization of a conference session, predominated by talks from the Reassembly unit. Our session attracted so much interest that the assigned room was overflowing! Following this success, I had the opportunity to attend the ATBC in July (fig.20). This was an important experience for me, since it is the largest conference I have attended so far, and it was inspiring to me to see experts who focus their work not only on science, but on its applications for nature conservation. Being in such a conference allowed me to get in contact with experts from the Latin American community, and this made me come back with fresh ideas and perspectives I hadn't considered before.

Figure 20: Presentation at ATBC in Oaxaca, Mexico

Best wishes for the second phase

June was packed with great news. After lots of preparation, we brought the DFG reviewers all the way to the Ecuadorian Chocó forests in Canandé, to show them firsthand all the work the Reassembly team has being doing in this amazing ecosystem (fig.21). That week was full of stress, planning, and hard work, but also hope and team work. It was refreshing to realize professors have a human side too - they can feel nervous and need practice as well! At the same time, I also saw how it is to be part of a supportive team, which gives feedback and support. All the stress paid off in the end, when we got the amazing news that the project will be extended with four more years of funding for all the subprojects!

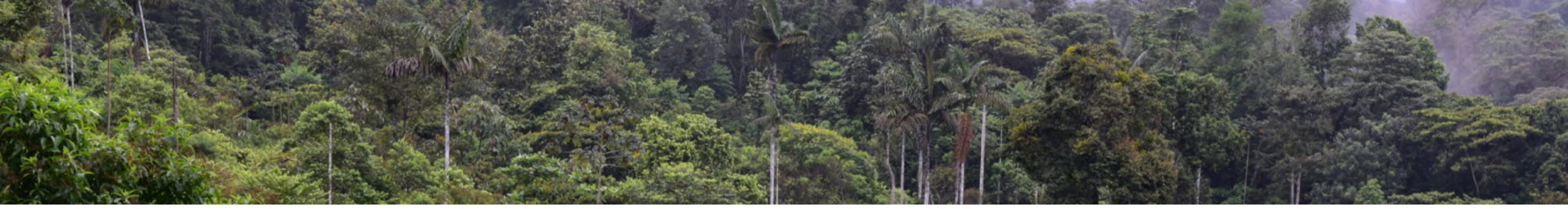
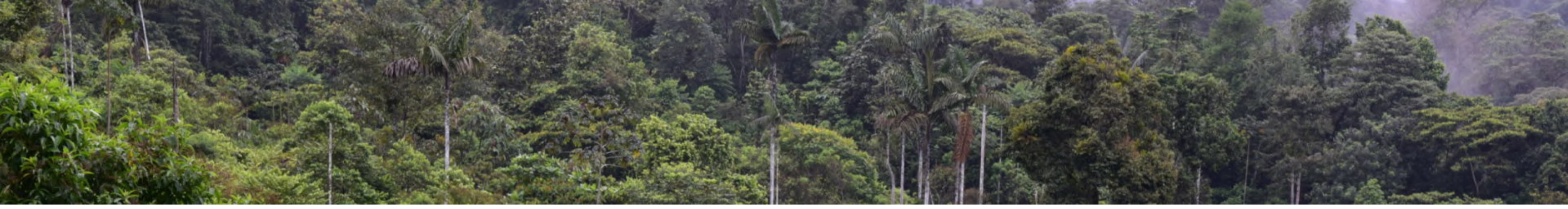


Figure 21: Excursion to cacao plot to show the reviewers the tree-seedling monitoring

I'm really looking forward to seeing where this next phase takes us, the adventures ahead, and I'm ready to give my best to help make the upcoming Reassembly phase even better. And of course I am ready to see the stunning Chocó Forest one more time!

Last objectives

My main goal right now is pretty clear: finish my PhD thesis! That includes completing the second and third manuscripts for submission. So, stay tuned for future updates!



SP7: Interactions between saproxylic insects and consequences for wood decomposition

Nina Grella, Universität Bayreuth

Conferences and Scientific Exchange

My last year began with the European Conference of Tropical Ecology (GTÖ) in Amsterdam where I presented our work on "Drivers of ant and termite alate distributions during nuptial flights along a tropical forest recovery gradient." In this second chapter of my PhD we showed that ants and termites are not limited to disperse into forests of different regeneration ages during nuptial flights. However, after colony founding, we found an effect of forest age on ant but not on termite assemblages. By analyzing the dispersing and sessile stages of these social insects we showed that habitat filtering seems to play an important role for species assembly after disturbances rather than dispersal limitation.

Later in the year, September brought me to Würzburg for the Annual Meeting of the Ecological Society of Germany, Austria and Switzerland (GfÖ). Here, I presented findings on "Dead wood specialization and co-occurrence patterns of saproxylic insects along a tropical forest regeneration gradient." In this third chapter of my PhD, we showed that saproxylic (dead wood dwelling) ant, termite and beetle diversity recovers with forest regeneration age. We also demonstrated that networks of the three insect taxa with five different host tree species maintain high specialization levels independent of regeneration age. Additionally, we discussed ant, termite, and beetle co-occurrence patterns in dead wood showing that most species co-occur neutrally in dead wood.

Beyond the conference presentations, much of 2025 was devoted to transforming months of fieldwork and analysis for these two projects into published manuscripts. In the final month of 2025 I started the most significant writing task of my PhD: synthesizing four years of research, countless field observations, and multiple manuscripts into a coherent doctoral thesis.

Surprises and New Perspectives

When I began this PhD, I imagined ecosystem recovery as a relatively straightforward process: clear the land, stop using it for agriculture, and trees grow back, bringing animals and other organisms with them. But the reality is more complicated, and finding explanations for the observed patterns was sometimes more difficult than I imagined.

I have also been pleasantly surprised by the power of synthesis work and collaborative research. The ability to combine data from every team within our project has allowed us to tackle questions that no single researcher could address alone. When we bring together information on plants, insects, vertebrates, and ecosystem processes, we can begin to capture the many dimensions of forest regeneration and draw a greater picture than the single observations we make in the field.

Four Years of Learning and Growth

These four years have transformed me in ways I could not have anticipated. While my bachelor and master studies introduced me to research and gave me technical skills, it was during the PhD that I truly internalized the scientific method. I now understand what it means to formulate hypotheses, design experiments, grapple with ambiguous data, revise interpretations based on new evidence, and draw conclusions with appropriate humility about what we can and cannot claim to know.

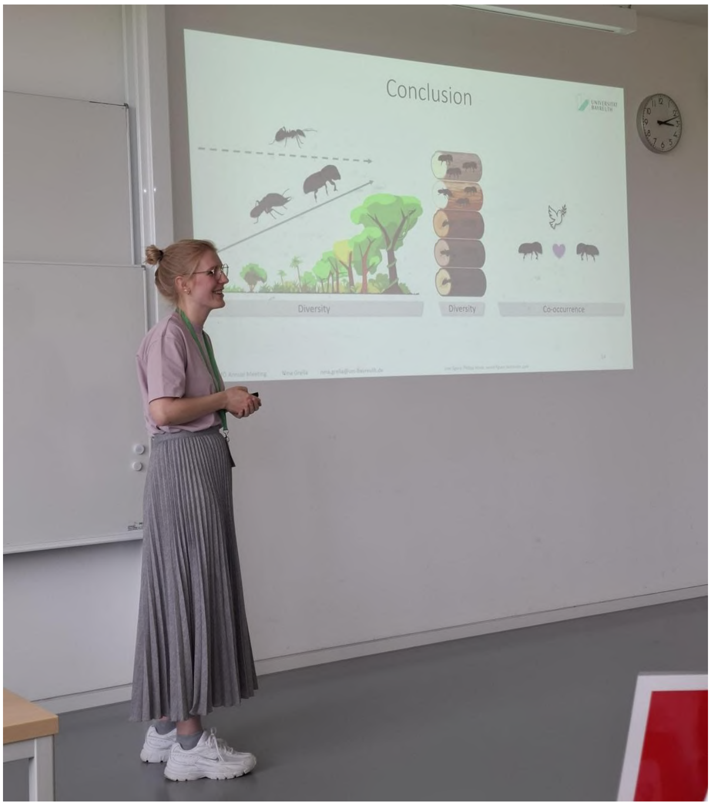
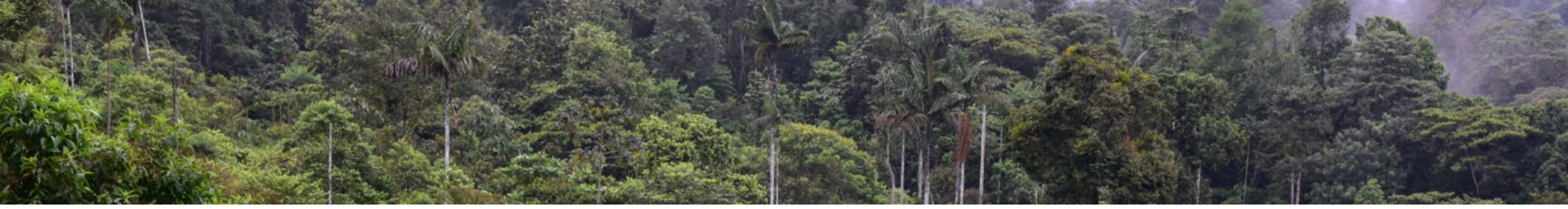


Figure 22: Nina presenting at the GfÖ conference

Spending extended periods in the field taught me about the fragility of these forests in the face of human disturbances, and their remarkable resilience when given a chance to recover. No amount of reading could have conveyed these lessons. I am very grateful for the precious opportunity to experience the awesomely beautiful Chocó rainforest, to wake to the calls of howler monkeys, to watch mist rise from the canopy at dawn, and to follow trails of leaf-cutter ants processing vegetation.

Living and working in Ecuador has been equally transformative. I have been welcomed into a rich culture, formed friendships that transcend language barriers, and gained perspectives that will influence how I approach conservation and research throughout my career. The collaborative nature of the REASSEMBLY project showed me that good science emerges from teamwork, from combining diverse perspectives, skills, and expertise.

As I close this chapter of my life, I carry with me not just data and publications, but a transformed understanding of ecology, of scientific practice, and of my own capabilities.



SP7: Interactions between saproxylic insects and consequences for wood decomposition

Ana Sofía Falconí López, Julius-Maximilians-Universität Würzburg

The final steps of my PhD journey

2025 marked a year of transitions—scientifically, personally and geographically. The biggest transition happened in February 2025, when I moved from Ecuador to Germany—not for a short stay, but to close a very significant chapter. This year has been a journey in every sense of the word. After years of fieldwork, countless hours looking at beetles, fungi and pieces of deadwood across the Ecuadorian Chocó, and many months of data analysis and writing, this was the year when everything finally came together. I spent most of it moving between the last steps of my manuscripts, discussions within the REASSEMBLY team, and the final push to finish my thesis *"Species communities along a recovery gradient in the tropics – with a focus on deadwood."* (Fig. 23).

Figure 23: Thesis defence

As part of the SP7 team, my work focused on understanding how different saproxylic groups—beetles and fungi—interact with each other, and how these interactions shape wood decomposition along forest recovery. Much like my colleague working on termites and ants, I found myself fascinated by how dynamic, interconnected and surprising deadwood communities can be when you look closely.

Conference participation

One of the highlights of the year was attending the European Conference for Tropical Ecology in Amsterdam. It felt inspiring to present my talk within the REASSEMBLY session, surrounded by colleagues whose work I had followed since the start of the project. Seeing how our subprojects fit together—ants, termites, birds, fungi, beetles, deadwood, bees, seedlings—made the "big picture" of tropical forest recovery more vivid and meaningful. It was also a wonderful opportunity to reconnect with old friends and meet new collaborators who share a passion for tropical ecology (Fig. 24).

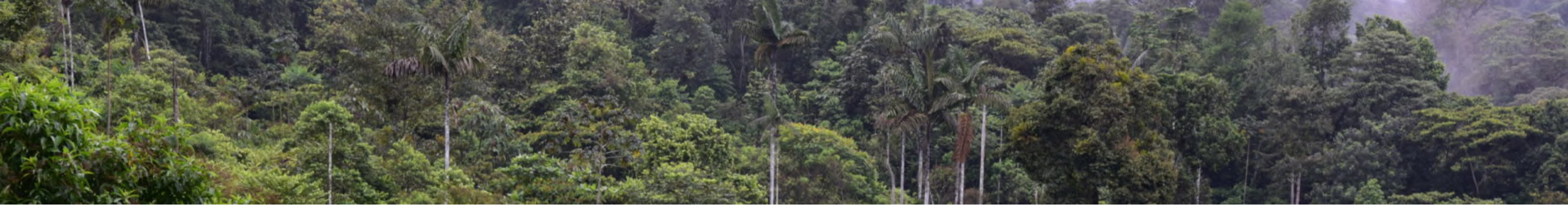
Figure 24: Amsterdam-GTÖ conference

Thesis defence and special moments

The most memorable moment of the year was undoubtedly my PhD defence. I was incredibly fortunate that my family could travel to Germany to be with me on that day—something I will always treasure. Sharing that day with them, my supervisors, and friends made the achievement feel much bigger than an academic milestone—it felt like a shared victory (Fig. 25).

Figure 25: At my PhD defence, together with my family and supervisor

Another very special moment came when my colleagues from the Bavarian Forest National Park and the University of Würzburg surprised me with a handmade graduation hat, keeping alive a tradition I



had long admired. The hat included little details from my fieldwork in Ecuador—tiny beetles, fungi, cows, cacao trees, and even painted pieces of deadwood—which made it even more meaningful. It also carried small symbols of my year in Germany: hikes through the Bavarian Forest, shared moments with friends, local fairs, sports, and all the moments that shaped this final chapter (Figs. 26 and 27).

Figure 26: Graduation hat

Figure 27: The hat included little details from my fieldwork in Ecuador and my life in Germany this year

Research of 2025

Wood-inhabiting fungi: diversity, specialization, and assembly along recovery

If fungi could speak, they would tell a story far more complex than a simple "more forest, more species." What we discovered turned out to be much more intricate—and more interesting—than the simple patterns I once expected:

1. Rare fungi increased strongly with forest recovery, but diversity did not peak in old-growth forests—surprisingly, it declined slightly at the very end.
2. Fungal specialization (who colonizes which tree species) remained remarkably stable across the recovery gradient. Even after decades of disturbance, specialization was not lost.
3. Community patterns followed a U-shaped curve: agriculture and old-growth forests showed the most structured fungal communities, while late-recovery forests were surprisingly "messy."
4. In old-growth forests, spatial processes—patch dynamics—dominated, meaning that fungi behave like little colonizers and competitors in a fine-scale mosaic of logs, rather than responding mainly to microclimate or host traits.

In short: Tropical fungal communities are highly diverse, surprisingly stable in their host preferences, and shaped by subtle spatial processes that persist even after 40 years of forest recovery.

Saproxylic beetles: abundance, richness, and host networks along recovery

Beetles told a slightly more optimistic story:

1. Beetle abundance and species richness increased steadily with forest recovery. Old-growth forests hosted the most beetles and the most species.
2. Network complexity also increased, meaning recovering forests rebuild not just species, but ecological interactions.
3. Rare interactions (beetle–tree combinations that happen only once) reappeared early in recovery, suggesting that forests begin regaining their ecological structure sooner than expected.
4. Specialization did not decline linearly. Instead, agriculture and late-regeneration forests showed the highest specialization, while early regeneration and old-growth forests were more generalized—an intriguing non-linear pattern.
5. Logs of low-density wood hosted higher effective diversity, even if fewer individuals emerged, showing that "soft" substrates host richer beetle communities.

In short: Beetle communities recover faster than expected—both in numbers and complexity—highlighting the resilience of tropical deadwood ecosystems.

Highlights

Beyond the defence, 2025 included many rewarding moments: finalizing my manuscripts, deepening collaborations within SP7 and across REASSEMBLY, and participating in discussions that strengthened the synthesis of our broader research goals. It was also a year of learning to navigate the final stages of a PhD—balancing precision with closure, and excitement with nostalgia.

Outlook

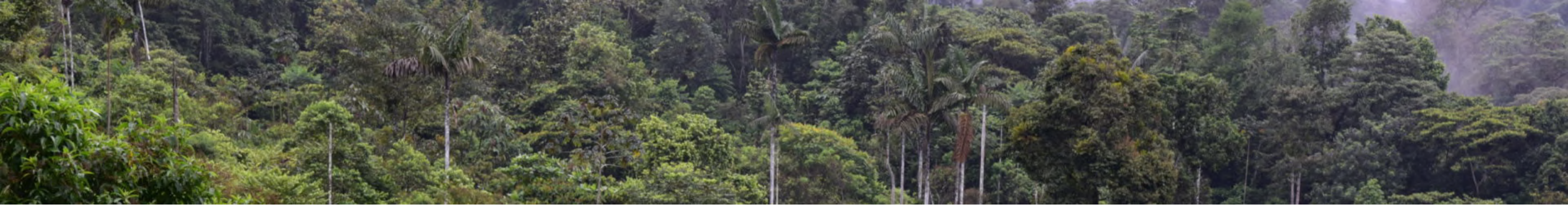
As I step into the next chapter, I hope to continue working where forest recovery, biodiversity, and species interactions meet—ideally still within the tropics. I am excited to explore opportunities that allow me to keep contributing to science while staying close to fieldwork, collaboration, and long-term ecological research.

Acknowledgements

I am deeply grateful to the REASSEMBLY community for shaping my scientific growth over these years. A very special thanks to my supervisor and the SP7 team for their support, patience and enthusiasm. I am also thankful to the Bavarian Forest National Park for welcoming

me so warmly. Finally, none of this would have been possible without the constant love and support of my family—whether from Ecuador or right beside me on my defence day

Figure 28: SP7 team and my colleagues in the Bavarian Forest National Park



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