

## PHD PROPOSAL FOR THE DOCTORAL SCHOOL « Ecologie, Géosciences, Agronomie, ALimentation »

### GENERAL INFORMATION

<b>Thesis title:</b> Resisting climatic stress due to genetically or phylogenetically distant neighbours: from the tree to the forest
<b>Acronym:</b> REVOLT
<b>Disciplinary field 1:</b> Ecology <b>Disciplinary field 2:</b> Agronomy
<b>Three keywords:</b> phenological plasticity, resilience and resistance, pest
<b>Research unit :</b> Ecobio: Ecosystems, Biodiversity, Evolution
<b>Name of the thesis director:</b> Andreas Prinzing <b>Email address of the thesis director :</b> andreas.prinzing@univ-rennes1.fr <b>Name of the thesis co-supervisor 1 (if applicable):</b> Matthew D Potts <b>Email address of the thesis co-supervisor 1 (if applicable):</b> mdpotts@berkeley.edu <b>Name of the thesis co-supervisor 2 (if applicable):</b> Freerk Molleman <b>Email address of the thesis co-supervisor 2 (if applicable):</b> fremol@amu.edu.pl
<b>Thesis grant (funding origin and amount):</b> NA
<b>Contact(s) (mailing address and E-mail):</b> Université Rennes 1, Campus Beaulieu, bât. 14 A, 35042 Rennes
<b>Recruitment process:</b> Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website <a href="#">here</a> . This information is needed for proposal publication. <input checked="" type="checkbox"/> <b>Doctoral school contest</b> <input type="checkbox"/> <b>Interview</b> <input type="checkbox"/> <b>Other (indicate) :</b>

**All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name\_Unit\_Subject Acronym\_EN.pdf**

#### ED EGAAL

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## SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

### **Socio-economic and scientific context : (10 lines)**

The climate is becoming increasingly hot and dry in France, which threatens forest trees: the plasticity or resistance of their seasonal phenology is insufficient in the face of climate change. As a consequence, the forest ecosystem is neither resistant nor resilient to current climate change. To deal with this problem, foresters are trying to adapt forests by planting tree species or genotypes that are more resistant to future climatic conditions. These species and genotypes are introduced from warmer and drier regions. However, introductions of new species or genotypes risk to trigger biological invasions. For this reason, forest management strategies favoring the resistance or resilience of native genotypes and species would be preferable. We propose such strategies, taking into account the interactions between trees via the natural enemies shared among trees, in particular among evolutionarily closely related trees. The work therefore contributes to an evolutionary ecology of the forest ecosystem, applied to management under climate change.

### **Assumptions and questions (8 lines)**

In addition to climatic stresses, trees risk being attacked by their natural enemies. The presence of natural enemies on a given tree can be favored by neighboring trees sharing similar traits, and therefore the same natural enemies. Similarity of traits often results from an evolutionary proximity, either genetic between congeners or phylogenetics between species. We have been able to show that an evolutionarily distant neighborhood can reduce enemy pressure. We hypothesize that this reduced enemy pressure in an evolutionarily distant neighborhood increases the resistance or plasticity of trees to climate change. This effect of an evolutionary distant neighborhoods could emerge during tree ontogeny and during forest succession, and ultimately increase the resilience of the entire forest.

### **The main steps of the thesis and scientific procedure (10-12 lines)**

We will start by focusing on the sessile oak (*Quercus petraea*) and study whether the neighborhood affects the tree's capacity to resist climate change or to respond in a plastic way, and whether this effect is explained by a decrease in enemy pressure in a neighborhood that is genetically or phylogenetically distant. We will then extend the analysis to species of an earlier successional stage, i.e. species which are often less attacked by natural enemies, and therefore potentially less favored by a phylogenetically distant neighborhood. We will also extend the analysis to seed and seedling stages, stages often attacked by rodents which forage over large areas and concentrate on seeds or seedlings of a tree when it is within a phylogenetically distant neighborhood. Such a neighborhood could therefore lower the resistance or climatic plasticity of seeds or seedlings. Finally, we will test whether the resistance or climatic plasticity of trees increases the resistance or resilience of the entire forest to climate change, taking into account forests of different successional stages, and forests limited rather by the recruitment of seeds or seedlings or rather by adult growth.

### **Methodological and technical approaches considered (4-6 lines)**

Analysis of exceptional available data bases: (i) networks of permanent plots, such as RENECOFOR (102 sites, for 29 years observation of tree growth and phenology, their enemy pressures, species composition, soil and climate), and the RENNES FOREST with 24 trees whose neighborhood has been monitored for 11 years, and (ii) common garden experiments, among others PlantaComp comprising a total of 2.5 million trees of different species from 134 European localities, planted 31 years ago, replicated under different abiotic constraints, and partially genotyped and followed in growth, bud break, and pressure from enemies.

### **Scientific and technical skills required by the candidate**

Knowledge of ecology, evolutionary biology, plant-animal interactions, or forestry. Knowledge of data processing and quantitative analysis. Driving licence.

## THESIS SUPERVISION<sup>1</sup>

<b>Unit name:</b> Ecosystems, Biociversity, Evolution	<b>Team name:</b> NA
<b>Unit director name:</b> Prof. Joan van Baaren	<b>Team director name:</b> NA
<b>Mailing address of the unit director:</b> joan.van-baaren@univ-rennes1.fr	<b>Mailing address of the team director:</b> NA
<b>Thesis director</b> Surname, first name: Prinzing, Andreas Position: professor Obtained date of the HDR (Habilitation thesis to supervise research): NA Employer: University Rennes 1 Doctoral school affiliation: Egaal Rate of thesis supervision in the present project (%): 40% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50% (ends in 2/22) + 70% Number of current thesis supervisions/co-supervisions: 2	
<b>Thesis co-supervisor 1 (if applicable)</b> Surname, first name: Potts, Matthew Position: professor Habilitation thesis to supervise research: equivalent <input checked="" type="checkbox"/> yes <input type="checkbox"/> no If yes, date diploma received: NA Employer: University of California, Berkeley / University Rennes 1 Doctoral school affiliation: Egaal Rate of thesis supervision in the present project (%): 30% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): Number of current thesis supervisions/co-supervisions:	
<b>Thesis co-supervisor 2 (if applicable)</b> Surname, first name: Molleman, Position:	

<sup>1</sup> In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Habilitation thesis to supervise research  yes  no If yes, date diploma received:

Employer:

Doctoral school affiliation:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

**Private partner (if CIFRE funding, private funding,...)**

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

**International partner (if Cotutelle thesis)**

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

**Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)**

*Please provide the following information for each PhD students supervised*

Surname, first name: Barbe, Lou

Date of PhD beginning and PhD defence: 10/2014 - 12/2017

Thesis supervision: co-direction [33%] with V. Jung and C. Mony

Professional status and location : postdoctoral teaching assistant

Contract profile (post-doc, fixed-term, permanent): fixed-term

List of publications from the thesis work:

Barbe, L., Mony, C., Jung V., Uroy L., **Prinzing A.** 2020. Associational decomposition: After-life traits and interactions among decomposing litters control during-life aggregation of plant species. *Functional Ecology* 34, 1956-1966.

Barbe, L., **Prinzing, A.**, Mony, C., Abbott, B. W., Santonja, M., Hoeffner, K., Guillocheau, S. Cluzeau, D., Francez, A.-J., Le Bris, N. and Jung, V. Opposing effects of community assembly maintain constant litter decomposition over a 25-years grassland chronosequence. *Ecosystems* 23: 124-136.

Barbe L., Mony C., Jung V., Santonja M., Bartish I. & **Prinzing A.** (2018). Functionally or phylogenetically distinct neighbors turn antagonism among decomposing litter species into synergy. *Journal of Ecology* 106:1401-1414.

Barbe, L., Jung, V\*, **Prinzing, A\*** (\* these authors contributed equally), Bittebière, A.-K., Butenschoen, O. & Mony, C. (2017) Functionally dissimilar neighbors accelerate ecosystem functioning of two focal plant species: experimental evidence on decomposition of grass litter. *New Phytologist*. 214, 1092-1102.

Surname, first name: Berrached, Rachda

Date of PhD beginning and PhD defence: 12/2013 – 12/2017

Thesis supervision: co-supervision, director: L. Kadik at Univ der Alger

Professional status and location: docent at Université Mouloud Mammeri Tizi-Ouzou

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

Berrached, R., Kadik, L., Ait Mouheb, H. & **Prinzing, A.** (2017). Deep Roots Delay Flowering and Relax the Impact of Floral Traits and Associated Pollinators in Steppe Plants. *Plos One* 12: e0173921.

Surname, first name: Ait Mouheb, Hocine

Date of PhD beginning and PhD defence: 12/2013 – 6/2019

Thesis supervision: co-supervision, director: L. Kadik at Univ der Alger

Professional status and location : docent at Université Yahia Fares de Médea

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

Ait Mouheb, H., Kadik, L., Albert, C.H., Berrached, R., & **Prinzing, A.** (2018). How do steppe plants follow their optimal environmental conditions or persist under suboptimal conditions? The differing strategies of annuals and perennials. *Ecology and Evolution* 8: 135–149.

Surname, first name: Labarrere, Bastien

Date of PhD beginning and PhD defence: 10/2013 - 1/2017

Thesis supervision: co-direction [20%] with F. Hennion

Professional status and location : private sector

Contract profile (post-doc, fixed-term, permanent): fixed-term

List of publications from the thesis work:

Labarrere, B., **Prinzing, A.**, Dorey, T., Chesneau, E., Hennion, F. 2019. Variations of secondary metabolites among natural populations of Sub-Antarctic *Ranunculus* species suggest functional redundancy and versatility. *Plants* 8 (7), 234.

Surname, first name: Deniau, Maud

Date of PhD beginning and PhD defence: 10/2013 - 12/2016

Thesis supervision: co-direction [50%] with V. Jung

Professional status and location : school teacher in biology

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

Deniau, M., Béchade, B., Pihain, M., Jung, V., Brunellière, M, Gouesbet, V. & **Prinzing, A.** 2021. Seeds and seedlings of oaks should avoid phylogenetically isolated, old adults to escape mammals and mollusks. *Annals of Botany*.

Deniau, M., Vincent, J., Le Lann, C., Kellner, H., Béchade, B., Morra, T., **Prinzing, A.** (2018) Janzen-Connell patterns can be induced by fungal-driven decomposition and compensated by ectomycorrhizal fungi accumulated under a closely related canopy. *Functional Ecology* 32: 785–798.

Deniau, M, Jung, V., Le Lann, C., Morra, T., Murray, P. & **Prinzing, A.** (2017) Janzen-Connell patterns are not the result of Janzen-Connell process: oak recruitment in temperate forests. *Perspectives in Plant Ecology, Evolution and Systematics* 24: 72-79.

Surname, first name: Kelley, Lisa

Date of PhD beginning and PhD defence: 7/2014-05/2017

Thesis supervision: co-direction [50%] with N. Peluso

Professional status and location : Assistant Professor, University of Colorado, Denver

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

Kelley, L.C., S.G. Evans, and **M.D. Potts**. 2017. Richer histories for more relevant policies: 42 years of tree cover loss and gain in Southeast Sulawesi, Indonesia. *Global Change Biology* 23:830-839.

Kelley, LC. 2018. The politics of uneven smallholder cacao expansion in Southeast Sulawesi, Indonesia: A Critical Physical Geography of agricultural transformation. *Geoforum*, 97: 22-34.

Kelley, LC, and Prabowo, A. 2019. Flooding and land use change in Southeast Sulawesi, Indonesia. *Land* 8(9): 139.

Surname, first name: Luskin, Matthew

Date of PhD beginning and PhD defence: 8/2011-05/2016

Thesis supervision: 100%

Professional status and location : Lecturer, University of Queensland

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

Luskin, M.S., E.D. Christina, L.C. Kelley, and **M.D. Potts**. 2013. Modern hunting practices and wild meat trade in the oil palm plantation-dominated landscapes of Sumatra, Indonesia. *Human Ecology*. DOI: 10.1007/s10745-013-9606-8.

Luskin, M.S., J.S. Brashares, K. Ickes, I.-F. Sun, C. Fletcher, S.J. Wright and **M.D Potts**. 2017. Cross-boundary subsidy cascades from oil palm degrade distant tropical forests. *Nature Communications* 8: 2231.

Luskin, M.S., J.S.H. Lee, D.P. Edwards, L. Gibson and **M.D. Potts**. 2018. Study context shapes recommendations of land-sparing and sharing; a quantitative review. *Global Food Security* 16:29-35.

Surname, first name : Sille Holm

Date of PhD beginning and PhD defence: 3.09.2012 - 28.10.2019

Thesis supervision : co-supervision, director : Toomas Tammaru

Professional status and location : University of Eastern Finland

Contract profile (post-doc, fixed-term, permanent): postdoc,

Liste des publications issues de ce travail de thèse :

Holm, S, Davis, RB, Javoš J, Öunap, E, Kaasik, A, **Molleman, F**, and Tammaru, T. (2016). A comparative perspective on longevity: the effect of body size dominates over ecology in moths. **Journal of Evolutionary Biology**, 29: 2422–2435.

Holm S, Javoš J, Öunap E, Davis, Kaasik A, **Molleman F**, Tasane, Tammaru T: Reproductive behaviour indicates specificity in resource use: phylogenetic examples from temperate and tropical insects, **Oikos**, vol. 127, nr 8, 2018, s. 1113-1124, DOI:10.1111/oik.04959

Holm S, Javoš J, Kaasik A, Öunap E, Davis RB, **Molleman F**, Roininen H, Tammaru T 2019: Size-related life-history traits in geometrid moths: a comparison of a temperate and a tropical community. **Ecological Entomology** ; DOI:10.1111/een.12747

Holm J, Javoš J, **Molleman F**, Davis RB, Öunap E, Roininen H, Tammaru T 2019: No indication of high host-plant specificity in afrotropical geometrid moths. **Journal of Insect Science**; 19(3)., DOI:10.1093/jisesa/iez028

#### Five main recent publications of the supervisors on thesis subject:

Pihain, M. Gerhold, P., Ducouso, A., **Prinzing, A**. Evolutionary response to coexistence with close relatives: increased resistance against specialist herbivores without cost for climatic-stress resistance. *Ecology Letters*. 22: 1285-1296.

Hidasi-Neto, J., Bailey, R.I, Vasseur, C., Woas, S., Ulrich, W., Jambon, O, Santos, A.M.C, Cianciaruso, M.V. & **Prinzing, A**. Understanding forest trees as islands: why phylogenetic isolation may increase and age decrease diversity. *Journal of Biogeography* 46: 158-169

Gerhold, P., Carlucci, M.B., Procheş, S., **Prinzing, A**. (2018). The deep past controls the phylogenetic structure of present, local communities. *Annual Review of Ecology, Evolution, and Systematics* 49: 477-499.

**Prinzing A.**, Ozinga, W. Brändle, M. Courty, P.-E. Hennion F., Labandeira C., Parisod C., Pihain, M., Bartish I. (2017) Benefits From Living Together? Clades Whose Species Use Similar Habitats May Persist as a Result of Eco-Evolutionary Feedbacks. *New Phytologist* 213: 66-82.

Yguel, B.; Jactel, H.; Pearse, S. I.; Moen, D.; Winter, M.; Hortal, J.; Helmus, R. M.; Kühn, I. Pavoine, S.; Purschke, O.; Weiher, E.; Violle, C.; Ozinga, W.; Brändle M.; Bartish I.;

**Prinzing, A.** (2016) The evolutionary legacy of diversification predicts ecosystem function. *American Naturalist* 188: 398-410

Kohyama, T.S., **M.D. Potts**, T.I. Kohyama, K. Niiyama, T.L. Yao, S.J. Davies, D. Sheil. 2020. Trade-off between standing biomass and productivity in species-rich tropical forest: Evidence, explanations, and implications. *Journal of Ecology*. DOI: 10.1111/1365-2745.13485

Bukoski, J.J., A. Elwin, R.A. MacKenzie, S. Sharma, J. Purbopuspito, B. Kopania, M. Apwong, R. Poolsiri and **M.D. Potts**. 2020. The role of predictive model data in designing mangrove forest carbon programs. *Environmental Research Letters* <https://doi.org/10.1088/1748-9326/ab7e4e>

Butsic, V., T. Kuemmerle, L. Pallud, K.J. Helmstedt, L. Macchi and **M.D. Potts**. 2020. Aligning biodiversity conservation and agricultural production in heterogeneous landscapes. *Ecological Applications* 3:e02057

Holland, T., W. Stewart, and **M.D. Potts**. 2019. Source or Sink? A comparison of Landfire- and FIA-based estimates of change in aboveground live tree carbon in California's forests. *Environmental Research Letters* 14 074008.

Helmstedt, K.J. and **M.D. Potts**. 2018. Valuable habitat and low deforestation can reduce biodiversity gains from development rights markets. *Journal of Applied Ecology* 55:1692-1700.

**Molleman F**, Javoiš J, Davis RB, Whitaker MRL, Tammaru T, Prinzing A, Öunap E, Wahlberg W, Kodandaramaiah U, Aduse-Poku K, Kaasik A, Carey JR 2019: Quantifying the effects of species traits on predation risk in nature: A comparative study of butterfly wing damage. **Journal of Animal Ecology** ; DOI:10.1111/1365-2656.13139

Aduse-Poku K, **Molleman F**, Oduro W, Oppong SK, Lohman DJ, Etienne RS 2017: Relative contribution of neutral and deterministic processes in shaping fruit-feeding butterfly assemblages in Afrotropical forests. **Ecology and Evolution**; 8(1). DOI:10.1002/ece3.3618

**Molleman F** 2018: Moving beyond phenology: New directions in the study of temporal dynamics of tropical insect communities. **Current science**; 114(5)., DOI:10.18520/cs/v114/i05/982-986

**Molleman F.**, Depoilly A., Vernon P., Müller J., Bailey R., Jarzabek-Müller A. & Prinzing A. (2016) The island rule of body size demonstrated on individual hosts: phytophagous click-beetle species grow larger and predators smaller on phylogenetically isolated trees. **Journal of Biogeography** 43, 1388–1399

**Molleman F.**, Halali S. & Kodandaramaiah U. 2020: Brief mating behavior at dawn and dusk and long nocturnal matings in the butterfly *Melanitis leda*. **Journal of Insect Behaviour** 33, 138–147. <https://doi.org/10.1007/s10905-020-09753-x>

## THESIS FUNDING

**Origin(s) of the thesis funding:** MENRT

**Gross monthly salary:** 1 769 Euros

**Thesis funding state :** Non acquired



Funding beginning date/Funding ending date: October 2021

Date: 23.3.2021

Name, signature of unit director:

Joan VAN BAAREN  
Directrice de l'UMR Ecobio



Name, signature of team director: NA

Name, signature of thesis project director:

