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PhD proposal :

How do forest diebacks drive tree-associated insect communities ?

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Abstract

The scenarios of climate change raise fears that forest dieback may increase in temperate forests in terms of frequency, magnitude and extent over the next decades. Ecological effects of forest diebacks remain poorly known. There are currently relatively few studies about the role of cambiophagous beetles in worsening dieback, and no study on the effects of both dieback and forestry dedicated to declining areas on forest insect biodiversity.

Forest dieback results in widespread weakening of trees and a gradual and profound transformation of the forest ecosystem at multiple nested spatial scales, from the tree canopy to the regional landscape. Forest dieback is thus likely to modify the habitat conditions of forest insect communities, particularly saproxylic communities.

The PhD project will address (i) the effects of dieback intensity on stand structure and saproxylic beetle communities, (ii) the modulation of these ecological effects by salvage logging in the declining plots and (iii) the interactions between cambiophagous beetles (potential aggravating factors) and dieback intensity.

The PhD work will be based on several case studies included in ongoing projects lead by the Biodiv team. In several forest contexts (silver fir in the Pyrenees, pedunculate oak and ash in the Center Val-de-Loire), these projects deal with the effects of the dieback intensity measured at different spatial scales (tree, stand, landscape) on the local response of wood-associated insect communities.

The PhD student will be strongly involved in the processing of recently collected data (Climtree and Buche projects) and will be responsible for the design, implementation and analysis of insect sampling over a gradient of declining oak forests (Canopy project), while participating in add-on components (genetic structure of cambiophagous insect populations, functional ecology of prey-insectivorous relationships, insects and tree ecophysiology ...).

Potential papers :

Tree-dieback and salvage logging as drivers of wood-associated beetle communities in mountain silver fir forests	Climtree	*Journal of Applied Ecology*	First author
Exploring diversity patterns of saproxylic beetles in declining oak stands with standardized habitat patches	Canopée	*Insect conservation and diversity*	First author
Forest diebacks and saproxylic beetle diversity : a focus on sap runs and declining canopies in oak trees	BUCHE	*European Journal of Forest Research*	Co-author
Effects of tree-dieback levels on buprestid beetle assemblages in temperate oak forests	Canopée	*Forest Ecology and Management*	Co-author
Experimental analysis of bird insectivory on declining oak trees	Canopée	*Functional Ecology*	Co-author
Insect species at stake from Ash dieback	Yggdrasil	*Ecological entomology*	Co-author
Inference of population structure of buprestid oak borers in declining forests from microsatellite data	Canopée		Co-author

Suggested references

Allen, C. D. et al. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. Forest Ecology and Management 259, 660-684

Anderegg, W.R.L. & J.A. Hicke, R.A. Fisher, C.D. Allen, J. Aukema, B. Bentz, S. Hood, J.W. Lichstein, A.K. Macalady, N. McDowell, Y. Pan, K. Raffa, A. Sala, J.D. Shaw, N.L. Stephenson, C. Tague, M. Zeppel. 2015. Tree mortality from drought, insects, and their interactions in a changing climate. New Phytol., 208 : 674-683

Brown, N., Jeger, M., Kirk, S., Williams, D., Xu, X., Pautasso, M., & Denman, S. (2017). Acute Oak Decline and Agrilus biguttatus: the co-occurrence of stem bleeding and D-shaped emergence holes in Great Britain. *Forests*, *8*(3), 87.

Fan, Z., Kabrick, J.M., Spetich, M.A., Shifley, S.R., Jensen, R.G. 2008. Oak mortality associated with crown dieback and oak borer attack in the Ozark Highlands. Forest Ecology and Management 255: 2297–2305

Haavik, L.J.; Flint, M.L.; Coleman, T.W.; Venette, R.C.; Seybold, S.J. 2015. Goldspotted oak borer effects on tree health and colonization patterns at six newly-established sites. Agricultural and Forest Entomology 17: 146–157

Lambert, J., Drenou, C., Denux, J.P., Balent, G., Cheret, V. 2013. Monitoring forest decline through remote sensing time series analysis. GIScience & Remote Sensing , 50, 4, 437–457

Maroschek, M., Seidl, R. & Netherer, S. L., M.J. . Climate change impacts on goods and services of European mountain forests. Unasylva 60, 76-80 (2009).

Mason, W. L., Petr, M. & Bathgate, S. Silvicultural strategies for adapting planted forests to climate change: from theory to practice. Journal of Forest Science 58, 265-277 (2012).

McDowell, N. G. & Allen, C. D. Darcy's law predicts widespread forest mortality under climate warming. Nature Climate Change, doi:10.1038/nclimate2641 (2015).

Sallé A., Nageleisen L.M., Lieutier F. (2014) Bark and wood boring insects involved in oak declines in Europe: Current knowledge and future prospects in a context of climate change. Forest Ecology and Management 328, 79-93

van Mantgem, P. J. et al. Widespread increase of tree mortality rates in the western United States. Science 323, 521-524 (2009).