Helena Vallicrosa

Postdoc researcher | Swiss Federal Institute of Technology (EPFL) and Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) | Academic age: 3 years and 3 months

Webpage: https://helenavallicrosa.github.io/   **Email**: helena.vallicrosa@epfl.ch

I am a terrestrial ecologist focusing on plant **elemental ecology** and evolution; biogeochemical cycles between atmosphere, soil, and vegetation; and its response to global change scenarios. My approaches range from local to global scales, combining **computational science** and field experiments, including **big data** and **artificial intelligence algorithms**. My goal is to increase our understanding on elemental ecology and use it to model species distribution and global change impacts in vegetation.

Education

PhD in Terrestrial Ecology (Cum Laude) - Universitat Autònoma de Barcelona, Spain.
Nov. 2021 – Sept. 2017. Dissertation: *Global change and forest nutrient stoichiometry. The foliar elemental composition of woody plants and its drivers. Supervisors: Prof. Josep Peñuelas and Prof. Jordi Sardans. (*http://hdl.handle.net/10803/674539*).*

Master's degree in Terrestrial Ecology and Biodiversity Management - Universitat Autònoma de Barcelona, Spain
Sept. 2017 - September 2016. *Major in Terrestrial Ecology. Dissertation: Niche modeling of Catalan endemic species.*

Degree in Environmental Biology. Universitat Autònoma de Barcelona, Spain
June 2016 – Sept. 2012. *Major in plant biology*

Research experience

Swiss Federal Institute of Technology (EPFL) and Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). Lausanne, Switzerland.
2023-Current. Postdoc associate. *Plant Ecology Research Laboratory. Advisor: Prof. Charlotte Grossiord*

Massachusetts Institute of Technology (MIT). Boston, United States of America.
2021-2023. Postdoc associate. *Civil and Environmental Engineering department. Advisor: Prof. César Terrer.*

Center for Ecological Research and Forestry Applications (CREAF). Barcelona, Spain.
2017-2021. Doctoral researcher. *Global Ecology Unit. Supervisors: Prof. Josep Peñuelas and Prof. Jordi Sardans.*

National Institute of Agronomic Research (INRA), Kourou. French Guyana.
2019. Scientific visit. *N and P fertilization experiment in tropical plots. Leaves and soil samples collection, processing, and analysis. Imbalance-P project field campaign.*

Animal Biology, Vegetal Biology and Ecology Department (BABVE). Universitat Autònoma de Barcelona, Spain.
2017. Master's thesis. *Niche modeling of endemic species. Supervisors: Prof. Miquel Ninyerola and Prof. Llorenç Sáez.*

Sao Paulo Botanical Garden, Sao Paulo, Brasil
2016. Internship. *Providing field and lab support. Supervisors: Prof. Eduardo Pereira Cabral and Dr. Laís Petri.*

Universidade Presbiteriana Mackenzie's Herbarium. Sao Paulo, Brasil
2015. Internship. *Identification, classification, and maintenance of new samples. Advisor: Prof. Ricardo Rosario.*

Universidade Presbiteriana Mackenzie. Sao Paulo, Brasil
2016-2015. Degree's exchange. *Awardee of the Santander's Iberoamerican Grant.*

Teaching
Applied Ecology (ENV-422) – Swiss Federal Institute of Technology (EPFL)
Fall 2024-present. Instructor and course designer. *Lecture in the management of the wolf. In charge of providing support on computational analysis and collaborating in field and lab support.*

Introduction to R and Geographic Information Systems (GIS) – MIT OpenCourseWare
Fall 2023. Instructor and course designer. *Online open-access course that provides students with tools and concepts for working with R. It includes the R basics, linear and linear mixed models, and how to use Geographic Information Systems (GIS) in R. Fully available on YouTube (~30.000 visualizations):* https://www.youtube.com/playlist?list=PLUl4u3cNGP602LxEgWcCyo89B2Q-zg8gm

Carbon cycle and Ecosystem ecology – Massachusetts Institute of Technology (MIT)
Spring 2023 and spring 2022. Teaching assistant. *Lecture about the role of nutrients in the carbon cycle, R programming, and using R to solve ecological problems (including AI models, GIS, statistics, and data curation)*

Mentoring
Master thesis – Swiss Federal Institute of Technology (EPFL)
February 2025 – June 2025. Student: Anna Halloy. *Title: The burden of big genome sizes in plant distribution*

Master project – Swiss Federal Institute of Technology (EPFL)
Spring semester 2025. Student: Juan Pablo Martinez. *Title: Global maps of plant N, P and K limitation.*
Fall semester 2024. Student: Roméo Rouzier. *Title: Evolution and acclimatization of plants from intensive and extensive agricultural soil under extreme conditions.*
Fall semester 2024. Student: Yanik Haas. *Title: Assessing the impact of drought and heat on soil and microbial biomass C and N in Swiss grasslands.*
Spring semester 2024. Student: Anna Halloy. *Title: Biogeochemical niche and its relation to the environmental niche and genome size*
Spring semester 2024. Student: Adrien Signoret. *Title: Monitoring the N-cycle under temperature increase and soil water reduction*

Master project – Massachusetts Institute of Technology (MIT)
Summer 2023. Student: Chelsea Hu *Title: Where to plant trees for an optimal carbon sequestration*

Summer Internship Program – Massachusetts Institute of Technology (MIT)
Summer 2023. Students: Akshaj Ghanta, Candela Viladomat, Shiv Varma, Srisai Vuppuluri

Scientific publications

2025

[17] **Vallicrosa, H**., Fleischer, K., Delgado-Baquerizo, M., Fernández-Martínez, M., Cerny, J., Tian, D., Kourmouli, A., Mayoral, C., Grados, D., Lu, M., and Terrer, C. (2025) Nitrogen deposition and climate drive plant nitrogen uptake while soil factors drive nitrogen use efficiency in terrestrial ecosystems, **EGUsphere [preprint]** https://doi.org/10.5194/egusphere-2024-3661

2024

[16] **Vallicrosa, H.,** Johnson, K.M., Gessler, A., Etzold, S., Ferretti, M., Waldner, P., Grossiord, C. (2024) Temperature and Leaf Form Drive Contrasting Sensitivity to Nitrogen Deposition Across European Forests. **Science of the Total Environment**, 955, 176904. https://doi.org/10.1016/j.scitotenv.2024.176904

[15] Dechant, B., Kattge, J., Pavlick, R., Schneider, F., Sabatini, F., Moreno-Martinez, A., Butler, E., Bodegom, P. v., **Vallicrosa, H**., et al. (2024): Intercomparison of global foliar trait maps reveals fundamental differences and limitations of upscaling approaches, **Remote Sensing of Environment,** 311, 1, 114276. https://doi.org/10.1016/j.rse.2024.114276

[14] Yuan, J., Wu, F., Peng, C., Peñuelas, J., **Vallicrosa, H**., et al. (2024). Global spectra of plant litter carbon, nitrogen and phosphorus concentrations and returning amounts. **Journal of Ecology**, 00, 1–13. https://doi.org/10.1111/1365-2745.14250

[13] Lugli, L., Fuchslueger, L., **Vallicrosa, H**., Van Langenhove, et al. (2024). Contrasting responses of fine root biomass and traits to large-scale nitrogen and phosphorus addition in tropical forests in the Guiana shield. **Oikos** e10412. https://doi.org/10.1111/oik.10412

2023

[12] Sardans, J., Llusià, J., Ogaya, R., **Vallicrosa, H.,** Filella, I., et al. (2023), Foliar elementome and functional traits r elationships identify tree species niche in French Guiana rainforests. **Ecology**. 104 (11):e4118. https://doi.org/10.1002/ecy.4118

[11] **Vallicrosa, H**., Lugli, F.L., Fuchslueger, et al. (2023). Phosphorus scarcity contributes to nitrogen limitation in lowland tropical forests. **Ecology**. 104 (6): e4049. **https://doi.org/10.1002/ecy.4049**

There is significant debate around whether the tropics are P-limited or both N and P-limited. This is important to predict the potential of the tropics to keep being a C sink and to better understand the functioning of tropical ecosystems. In this paper, I show proof of both N and P limitation, and I emphasize the role of soil phosphatases. I suggest that

plants invest large amounts of N in phosphatases to provide them with P, which is very scarce in tropical soils. This would explain why the tropics can be N-limited as well. I performed the field and lab work, designed the research, analyzed the data, interpreted the results, and wrote the manuscript.

2022

[10] **Vallicrosa, H.** (2022) Beyond nitrogen and phosphorus. **Nature Ecology and Evolution**, 6, 1056-1057. https://doi.org/10.1038/s41559-022-01788-x

[9] **Vallicrosa, H.**, Sardans, J., Maspons, J., & Peñuelas, J. (2022) Global distribution and drivers of forest biome foliar nitrogen to phosphorus ratios (N:P). **Global Ecology and Biogeography,** 31, 861– 871. https://doi.org/10.1111/geb.13457

[8] Verryckt, L. T., Vicca, S., Van Langenhove, et al. (2022) Vertical profiles of leaf photosynthesis and leaf traits and soil nutrients in two tropical rainforests in French Guiana before and after a 3-year nitrogen and phosphorus addition experiment **Earth System Science Data**, 14, 5–18. https://doi.org/10.5194/essd-14-5-2022

2021

[7] **Vallicrosa, H.**, Sardans, J., Maspons, J., Zuccarini, P., Fernández-Martínez, M., Bauters, M et al. Global maps and factors driving forest foliar elemental composition: the importance of evolutionary history (2021). **New Phytologist**, 233 (1), 169-181. https://doi.org/10.1111/nph.17771

Nutrients are considered important cofactors on land carbon (C) sinks since a big percentage of the earth might be nutrient-limited. Therefore, knowing the patterns of nutrient limitation is crucial to providing accurate global C models. This paper provides global maps of foliar N, P, and K concentrations for woody plants using artificial intelligence algorithms (neural networks). It also determines that at least 60% of the variability of foliar elemental composition is explained by evolutionary history effects. Therefore, this paper details global distribution patterns of foliar elements, assisting in understanding nutrient limitation patterns as well as the important role of species identity and phylogeny in determining elemental composition. I created and curated the database, performed the research, interpreted the results, generated the figures, and wrote the manuscript.

[6] Van Langenhove, L., Depaepe, T., Verryckt, L. T., **Vallicrosa, H.**, et al. (2021). Impact of nutrient additions on free-living nitrogen fixation in litter and soil of two French-Guianese lowland tropical forests. *Journal of Geophysical Research: Biogeosciences*, 126, e2020JG006023. https://doi.org/10.1029/2020JG006023

[5] **Vallicrosa, H**.; Sardans, J.; Ogaya, R.; Fernández, P.R.; Peñuelas, J.(2021). Short-Term N-Fertilization Differently Affects the Leaf and Leaf Litter Chemistry of the Dominant Species in a Mediterranean Forest under Drought Conditions. **Forests** 2021, *12*, 605. https://doi.org/10.3390/f12050605

[4] Sardans, J., **Vallicrosa, H**., Zuccarini, P. *et al.*(2021*)* Empirical support for the biogeochemical niche hypothesis in forest trees. **Nature Ecology and Evolution** 5, 184–194 (2021). https://doi.org/10.1038/s41559-020-01348-1.

The biogeochemical niche hypothesis seeks to explain species/genotype niches and distribution based on species elemental composition. It simplifies the classic ecological niche theory into chemical elements amounts and proportions that are easily quantifiable.

In this paper, we provided empirical proof of this hypothesis and certified that species can be recognized by their elemental composition, similar to a chemical fingerprint. Most of the elemental composition is explained by shared ancestry, and the rest by environmental conditions and species coexistence. In this paper I gathered and curated the data, developed the statistical analysis, created tables and figures, and revised the manuscript.

2020

[3] Li, X., Sardans, J., Gargallo-Garriga, A., Asensio, D., **Vallicrosa, H.**, Peñuelas, J. (2020). Nitrogen reduction processes in paddy soils across climatic gradients: Key controlling factors and environmental implications, **Geoderma**, 368, 2020, 114275, https://doi.org/10.1016/j.geoderma.2020.114275.

[2] Penuelas, J., Fernández-Martínez, M., **Vallicrosa,** et al.(2020). Increasing atmospheric CO2 concentrations correlate with declining nutritional status of European forests. **Communications Biology** 3, 125. https://doi.org/10.1038/s42003-020-0839-y

2019

[1] Wang W, Sardans J, Wang C, et al. (2019) The response of stocks of C, N, and P to plant invasion in the coastal wetlands of China**. Global Change Biology**. 2019 Feb;25(2) 733-743. doi:10.1111/gcb.14491. PMID: 30346103.

Invited talks

III Meeting of the Iberian Ecological Society (SIBECOL) – Pontevedra (Spain)
June 2025. *Session: TS(2)9. The flow of elements and the functioning of the biosphere. Title: The burden of big genomes in plant distribution.*

RU Forest Dynamics Meeting – Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)
December 2024. *Nitrogen impacts in European forests and Swiss grasslands.*

Institute of Plant Sciences Colloquium – University of Bern (Switzerland)
October 2024. *Studying the impact of global change on seed germination and plant early stages: an approach from plant elemental ecology.*

ReClean seminar series – Bern (Switzerland)
March 2024. *Plant elemental ecology: understanding plant nutrient flows in a global change context. Link:* https://mediaspace.epfl.ch/media/

Congresses and seminars

EGU general assembly 2025 – Vienna (Austria)
April 2025. Presentation. *Vallicrosa, H., Mariotte, P., and Grossiord, C.: The role of plant-soil-microbe interactions on nitrogen cycling under drought and warming in grasslands. EGU General Assembly 2025, Vienna, Austria*

EGU general assembly 2024 – Vienna (Austria)
April 2024. Presentation. *Vallicrosa, H. and Grossiord, C.: Nitrogen deposition effect on tree growth depends on climate, tree size, and leaf habit, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-4053, https://doi.org/10.5194/egusphere-egu24-4053 , 2024.*

AGU general assembly 2022 – Chicago (United States of America)
December 2022. Presentation. **Vallicrosa, H**., Terrer, C. How much N are plants taking yearly from the soil? AGU General Assembly 2022, oral presentation, 12-16 Dec.

EGU general assembly 2020 – Vienna (Online)
May 2020. Presentation. **Vallicrosa, H**., Sardans, J., Zuccarini, P., Maspons, J., and Peñuelas, J.: Neural Networks to estimate world forest foliar elemental composition and stoichiometry, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-8994, https://doi.org/10.5194/egusphere-egu2020-8994 , 2020

I Meeting of the Iberian Ecological Society (SIBECOL) – Barcelona (Spain)
February 2019.

Grants and awards
Ambizione – SNSF
Under review. March 2026 – February 2030. Applicant. GlftEd: Global change impacts in plant recruitment, an Elemental ecology approach. Amount requested: 966'222

Spanish Ministry of Innovation and Technology – Spanish Governament
Collaborator. October 2024 – September 2026. Project BRYOELEM: Elemental composition of bryophytes to investigate competition and land plant colonization. Amount awarded: 87'500 €

Thesis "Cum laude" distinction – Universitat Autònoma de Barcelona
September 2021.

Iberoamerican grant – Santander Bank
2015. Awarded to sustain exchanges during the undergrad program. 3'000 €

Courses taken
Kaufman Teaching Certificate Program (KTCP) - MIT
50h. Spring 2023. *Interactive workshop series intended for late-program graduate students and postdocs interested in academic careers or developing skills to support their teaching at MIT.*

5th Training Course on New Advances in Land Carbon Cycle Modeling - Cornell
72h. May 2022. *Lead by Yiqi Luo and Lifen Jiang. New theory on land carbon storage dynamics, matrix approach to land carbon, nitrogen, and phosphorus modeling. Data assimilation system with both flux- and pool-based observations. Deep learning and machine learning to enhance process-based research. Ecological forecasting.*

Gender perspective in research – Universitat Autònoma de Barcelona
4h. November 2020.

Introduction to a meta-analysis in ecology - Universitat de Barcelona
4h. February 2019. *Workshop in the 1st meeting of the Iberial Ecological Society & XIV AEET Meeting.*

Other services and skills

Reviewer
27 verified peer-reviews. *Journals: Global Change Biology (3), Plant and soil (3), Forests (3), Biogeosciences (2), Ecology letters (2), Functional ecology (2), New Phytologist (2), Current Climate Change Reports (1), Geoderma (1), Nature communications (1), Nature Ecology and Evolution (1), Nature plants (1), Oikos (1), Plant biology (1), Plant diversity (1), Water research (1).*

Scientific outreach
Radio collaboration, podcast collaboration, science, school talks and diversity activities. *For further information and links to the resources please check my personal webpage: https://helenavallicrosa.github.io/*

Other skills and tools
- Programming language: Broad experience in R
- Languages: Catalan (Native), Spanish (Native), English (Fluent), Portuguese (Fluent), French (Basic)