

Richard Nair

Teaching Fellow, School of Botany, Trinity College Dublin

Tel: + 49 3641578986

Email Address: richard.nair@tcd.ie / rkfnair@gmail.com

Orcid ID: <https://orcid.org/0000-0002-6293-3610>

Summary:

I am interested in the bidirectional feedbacks between plant-soil systems and global change. My main research topics are phenology, roots, resource use and plasticity biomass allocation. I am interested in both natural and managed ecosystems and particularly concerned with the scalability of observational results and how process knowledge can be linked to large scale problems. I have used physical advances (e.g. novel isotope methods), new technologies (e.g. automated robotic sampling, machine learning for image analysis) and intellectual innovations aiming toward fundamental theory useful the models which underpin our potential to adapt to climate change.

Academic Appointments:

2022 (Nov) – present Teaching Fellow / Senior Research Fellow, **Trinity College Dublin**, Ireland

I am responsible for delivering lectures and practical sessions, also participating in a large multidisciplinary project where I contribute my contemporary biogeochemistry expertise to reconstruct deep time biogeochemical cycling. I also continue my own research and seek my own funds.

2017 (Jun) –2019 (Jun): Marie Skłodowska-Curie Individual Fellow, **Max Planck Institute for Biogeochemistry**, Jena, DE

I produced novel automated minirhizotron systems (field root cameras) designed for replicated field deployment and coordinated other root measurements at a Spanish field site, and worked on machine learning for image analysis.

2015 (Oct) – 2022 (Oct) Post-doctoral Scholar, **Max Planck Institute for Biogeochemistry**, Jena, DE

I began this position making root measurements and developing manual minirhizotrons which became the independent automated minirhizotron project in my MCIF. I have also took up responsibility for site-level interpretation from a unique 6 year ecosystem-scale fertilization experiment. These tasks have required a variety of skills, including data handling, image processing, complex statistics and machine learning, as well as field and lab skills for data collection parts of the project.

2014 (Oct) – 2015 (Apr): Research Assistant Nutrient Cycling in Forest Ecosystems, **University of Edinburgh**, UK

I performed analysis of N deposition effects on needleleaf forest ecosystems, and took part in teaching and student supervision.

Education:

2010 (Oct) – 2015 (Feb): PhD *Using Stable Isotopes to Investigate Interactions Between the Forest Carbon and Nitrogen Cycles*, School of Geosciences, **University of Edinburgh**, UK.

Supervisors: Prof Maurizio Mencuccini, Dr Mike Perks, Dr Pete Levy

I revealed flaws in standard understanding of forest N deposition effects and quantified a potential strong role of forest canopies in processing N deposition on global change scales with regional/global implications. I also developed methods for studying litter N fate and ¹⁵N-labelling biomass on large scales.

Richard Nair – Curriculum Vitae

2009 – 2010: MRes *Ecology and Environmental Management*, Dept. of Biology, **University of York**, UK. w/ project internship (Forest Research, Alice Holt Research Station, UK)

2005 – 2009: BSc. Hons. *Biology with a Year in Industry*, Dept. of Biology, **University of York**, UK. w/ placement year (Millennium Seedbank, Kew UK)

Peer-Reviewed Publications:

(# indicates joint first author)

1. Gomasasca U... **Nair, R.**, ... *et al.* Do leaf-level coordination principles propagate to the ecosystem scale? (accepted at *Nature Communications*)
2. **Nair, R.** (2023) Rooting vegetation models in realism *Global Change Biology*, <https://doi.org/10.1111/gcb.16699>
3. **Nair, R.**, Strube M., Hertel M., Kolle O., Rolo V., Migliavacca M. (2022) High Frequency Root Dynamics: Sampling and Interpretation Using Replicated Robotic Minirhizotrons. *Journal of Experimental Botany*, *erac427*, <https://doi.org/10.1093/jxb/erac427>
4. Luo Y... **Nair, R.**,... *et al.* (2022) Evergreen broadleaf greenness and its relationship with leaf flushing, aging, and water fluxes *Agricultural and Forest Meteorology* <https://doi.org/10.1016/j.agrformet.2022.109060>
5. # Ferraretto D., **Nair, R.**,... Shah N.W., Reay D., Mencuccini M., Spencer M., Heal K.V. (2022) Forest Canopy N Uptake Can Supply Entire Foliar Demand, *Functional Ecology* doi:10.1111/1365-2435.14005
6. Caldararu, S., ... **Nair, R.**,... *et al.* (2021) Long-term ecosystem nitrogen limitation from foliar ¹⁵N and a land surface model *Global Change Biology* <https://doi.org/10.1111/gcb.15933>
7. Besnard S... **Nair, R.**,... *et al.* (2021) Global sensitivities of forest carbon changes to environmental conditions *Global Change Biology* <https://doi.org/10.1111/gcb.15877>
8. Durso A.M., Morris K.A., **Nair R.K.F.** (2021) Subterranean refugium use by *Epidalea calamita* (Natterjack Toad) in a Dehesa ecosystem in Extremadura, Spain *Herpetology Notes* 14, 1203-1205
9. **Nair, R.K.F.**, Morris K, Migliavacca M, Moreno G, Schrupf M. (2020) Plant-Available N:P Alters Root Litter N Recycling in a Mediterranean Tree-Grass Ecosystem *Journal of Plant Nutrition and Soil Science* 183(4) 517-529
10. Luo, Y, ... **Nair, R.**, ... *et al.* (2020) Functional phenology changes after nitrogen and phosphorus fertilization through changing structure and physiology *Global Change Biology* 26(8) 4373-4400
11. Morris K. A., **Nair, R.K.F.**, Moreno G, Schrupf M, Migliavacca M. (2019) Fate of N additions in a Multiple Resource Limited Mediterranean Oak-Savanna *Ecosphere* 10(11) e02921
12. **Nair, R. K. F.**, Morris K.A, Hertel M., Luo Y., Moreno G., Reichstein M, Schrupf M. & Migliavacca M. (2019) N:P Stoichiometry and Habitat Effects on Mediterranean Savanna Seasonal Root Dynamics *Biogeosciences* 16 1883-1901
13. **Nair, R. K. F.**, Perks, M. P., & Mencuccini, M. (2017). Decomposition Nitrogen is Better Retained than Simulated Deposition From Mineral Amendments in a Temperate Forest *Global Change Biology* 23(4) 1711-1723
14. **Nair, R. K. F.**, Perks, M. P., Weatherall, A., Baggs E.M. & Mencuccini, M. (2016). Does canopy nitrogen uptake enhance carbon sequestration by trees? *Global Change Biology* 22(2) 875-888
15. **Nair, R.**, Weatherall, A., Perks, M., & Mencuccini, M. (2014). Stem injection of ¹⁵N–NH₄NO₃ into mature Sitka spruce (*Picea sitchensis*). *Tree Physiology*, 34(10), 1130-1140.

Publications in Review:

(* indicates last author)

- A. Byakov P, ... **Nair R.**, ... *et al.* Semantic segmentation of plant roots from RGB (mini)rhizotron images— Comparison of established methods with an advanced deep-learning model (in review at *Plant Methods*)
- B. * Caldararu S... **Nair .R.** Beyond model evaluation - combining experiments and models to advance terrestrial ecosystem science (in review, at *Biogeosciences*)

Publications in Late Stage Preparation

- C. **Nair, R., et al.** Nitrogen Availability, not N:P Stoichiometry Drives Overall Carbon Use Efficiency of a Mediterranean Tree-Grass Ecosystem (submission to *Global Change Biology* intended January 2023)
- D. **Nair, R. et al.** Day-night root dynamics are variable through the growing season (submission to *Nature Plants* intended Winter 2022-23)

Select Presentations:

- Nair R. Completely Automated Field Root Dynamics BES/IPME Plant Soil Ecosystems Group, Marseille, May 2022, Oral Presentation
- Nair. R *et al.* N:P imbalance effects on the seasonal C cycle in a Mediterranean Tree-Grass Ecosystem EGU General Assembly 2021, Online Display
- Nair. R Plant resource use and acquisition: Functional responses to global change University of Utrecht 2021, Online Oral Presentation (Invited).
- Nair. R Plant and Ecosystem Resource Use in a Changing World. Royal Holloway University 2021, Online Oral Presentation (Invited).
- Nair. R *et al.* Comparing the fate of N from fertilizer treatments and root litter turnover in a Mediterranean Savanna EGU General Assembly 2020, Online Display
- Nair. R Nutrient Acquisition (in the real world) University of Birmingham 2019, Oral Presentation (invited)
- Nair. R., *et al.* Linking ultra-fine timescale root dynamics to above-ground observations. EGU General Assembly 2019, Vienna, Austria, April 2019, Oral Presentation
- Nair R., *et al.*. Developing minirhizotron technology to study short-term root dynamics. EGU General Assembly 2018, Vienna, Austria, April 2018, Poster Presentation
- Nair, R., *et al.* Can Canopy Uptake Influence Nitrogen Acquisition and Allocation by Trees?, EGU General Assembly 2015, Vienna, Austria, April 2015, Oral Presentation
- Nair, R., *et al.* How big is the N_{DEP} effect on Forest C uptake?: Using ¹⁵N to re-evaluate the Forest Carbon Response to Nitrogen Deposition, BES PSE-PEPG Joint Meeting Carbon cycling- from plants to ecosystems, Manchester, UK, 2014, Oral Presentation

Funding Awarded:

Marie Skłodowska-Curie Individual Fellowship (H2020-2016) 'MrPARTs: MiniRhizotron: Phenology and Root Traits': € 159,460

Participation in Co-Proposed Projects:

* (**consortium member / working group co-lead**) **CLEANFOREST**: Joint Effects of Climate Extremes and Atmospheric deposition on European FORESTs (EU Cost Action, lead: Rosella Guerrieri, University of Bologna, IT)*
(**co-investigator**) **CAVENDySH**: Capturing VEgetation DynamicS with daily Hi-res imagery (VenμS VM5 Mission (ESA)), lead investigator Javier Pacheco-Labrador, Max Planck Institute for Biogeochemistry, DE)

Teaching and Supervision:

- **Co-Supervision PhD student** (Kendalynn Morris, Max Planck Institute for Biogeochemistry, defended 2020) investigating microbial responses to ecosystem stoichiometry treatments, respiration partitioning and carbon use efficiency
- **Co-Supervision PhD student** (Yunpeng Luo, Max Planck Institute for Biogeochemistry defended 2021) Nutrient effects on above-ground phenology through remote sensing
- **Hosted research stay (2018) and informal supervision** PhD student (Daniele Ferraretto, University of Edinburgh) using ¹⁵N labelled litter and ¹⁵N-deposition treatments in UK Sitka spruce forestry
- **Supervision of BSc-level research students** (fieldwork, analysis, project report/dissertation preparation) and student assistants (fieldwork, analysis).
- **Field demonstration/teaching**, Marie Curie 'TRUSTEE' Summer School, Majadas del Tietar, 2018

- **Lecturer**
 - *Team Design: Global Challenges* (4 practicals, 1st year Undergraduate), Trinity College Dublin, 2022
 - *Diversity and Systematics of Land Plants* (11 lectures, 3 practicals, 4th year Undergraduate), Trinity College Dublin, 2023
 - *From Organisms to Ecosystems* (6 lectures / 1 practical on global ecology and biogeochemistry, 1st Year Undergraduate) Trinity College Dublin, 2023
 - *Desk Studies* (supervision, 1 student)
 -
 - *Terrestrial Biosphere*, International Max Planck Research School for Global Biogeochemical Cycles (MSc equivalent), MPI-BGC Jena, 2022
 - *Professional Skills* (1 Lecture, 4th Year Undergraduate) University of Edinburgh, 2014
 - *Ecological and Environmental Analysis* (5 Lectures / 3 Practicals 3rd Year Undergraduate) University of Edinburgh 2014.
- **Tutor/Demonstrator** at 2nd year undergraduate to masters-level, courses, University of Edinburgh 2011-2015. Tutorial, Field, and Lab settings.
 - Courses included: *Ecological and Environmental Analysis, Principles of Ecology, Soil, Water and Atmospheric Processes* and field courses *Field Ecology, Ecological Science* and *Ecosystem Services: Ecosystem Dynamics and Function*

Scientific Service:

Guest Editor: Biogeosciences Special Issue ‘Ecosystem experiments as a window to future carbon, water and nutrient cycling’ (issue expected 2023)
Plant and Soil Special Issue ‘Responses of plant-soil interaction to atmospheric circulation’ (issue expected 2023)

Convenor: ‘Vegetation Functional Responses to Global Change Across Multiple Methods and Scales’ European Geosciences Union 2021,2022 ‘Advancing mechanistic understanding of vegetation ecosystem processes’ European Geosciences Union 2020

Reviewer: Nature, Nature Communications, Global Change Biology, New Phytologist, Soil Biology and Biochemistry, Plant and Soil, Tree Physiology, Biogeosciences, Plant-Environment Interactions, Atmospheric Environment, Agricultural and Forest Meteorology, STOTEN, Folia Geobotanica, Agroforestry Systems, Journal of Forestry Research, PeerJ, Forests, Agronomy

Community / Professional Service:

- Institute Diversity, Equity and Inclusion Officer (joint position, 2020-2022) *Responsibilities: organising seminar series, point of contact for DEI issues, liaison with institute management, infrastructure decisions.*
- Panel Judge IEEE (Institute of Electrical and Electronic Engineers) Trinity College Student ‘Threesis’ competition 2023.

Technical Skills:

- Programming:
 - Statistics, especially mixed effects models and generalized additive models (usually with R)
 - Image processing and analysis (usually with Python)
 - Machine learning including ensemble methods, deep learning (e.g. CNN computer vision), (usually with Python)
- Latex / BIBTEX
- Extensive field experience in use of trace gas measurement systems (e.g. coupled GC-IRMS mobile lab, Campbell Scientific TGA100 Tuneable Diode Laser, Li-8100A, Los Gatos Ultraportable Methane Analyser).
- Vegetation and soil science experimental design techniques and sampling, lab chemistry and safety skills

Richard Nair – Curriculum Vitae

- ^{15}N / ^{13}C / ^{18}O stable isotope methods (tracers and natural abundance)
- Field campaign planning, leadership and implementation

Select Training Courses:

- How To Say it Right! - Professional Communication in Science
- Leadership Competence for Scientists
- Steps into academic teaching – basics of good teaching
- Grant Writing + HorizonEurope specific training
- Project and Time Management
- Eddy Covariance Techniques
- Programming (Python, Julia)
- Gas Safety, Field Safety and First Aid
- Gas Chromatography

Membership of Professional Bodies:

European Geosciences Union, British Ecological Society