**School of Natural Sciences, Trinity College Dublin**

**Opportunities for self-funded Masters by Research (MSc)**

The **School of Natural Sciences** (<https://www.naturalsciences.tcd.ie>) comprises the Disciplines of [Botany](http://www.tcd.ie/Botany/), [Geography](http://www.tcd.ie/Geography/), [Geology](http://www.tcd.ie/Geology/), [Zoology](http://www.tcd.ie/Zoology/) and the [Centre for the Environment](http://www.naturalscience.tcd.ie/CENV2006/index.php). It is one of the largest schools in the [Faculty of Engineering, Mathematics and Science](http://www.ems.tcd.ie/) and hosts biological, physical and social scientists. The School currently accommodates 40 academic staff, ca. 25 postdoctoral research fellows and ca. 164 postgraduate students (including 89 research and 75 taught students). The School of Natural Sciences is one of the first in Ireland to hold an Athena SWAN bronze award for addressing issues in gender inequality. The School’s taught programmes are varied as the School offers moderatorships (undergraduate degrees) in Environmental Sciences, Botany, Earth Sciences, Geography, Geology, and Zoology and contributes to other moderatorships including Neurosciences, Geography and Politics (http://www.naturalscience.tcd.ie/undergraduate/). The School also has a major commitment to graduate teaching and supervision and currently hosts three taught MSc. programmes (<http://www.naturalscience.tcd.ie/postgraduate/>).

Trinity College Dublin is embarking on an ambitious project to expand education and research activities as part of its **E3 Initiative (Engineering, Environment and Emerging technologies) (**<https://www.tcd.ie/e3/>). This comprises three Schools: Natural Sciences, Computer Science & Statistics, and Engineering, and recognises the importance for humanity of addressing the challenge of sustainable technological development. With the E3 initiative, Trinity promotes the vision of a society where the interdependence between technological innovation and our natural capital is advanced by world-leading research, education and entrepreneurship. The E3 initiative will position Ireland at the forefront of research in Science, Technology, Engineering, and Mathematics (the STEM disciplines), that are crucial for future economic competitiveness. It will educate scientists and engineers for employment in existing and new technology sectors, equip them with the skills and attributes to lead in the creation of new businesses.

Drawing on the wide expertise of the academic community at Trinity and its excellence in delivering high-ranking research the School of Natural Sciences is embarking on a new post-graduate **Masters by Research (MSc) programme** that will train graduates to be able to raise and answer fundamental questions required to address on-going issues experienced by our planet. These include sustainability, evolution of earth history, biodiversity, and climate change. This new two-year programme seeks highly motivated applicants who are self-funded or have access to research funds.

**Scholarships available**

Scholarships of up to €3,000 are available. To be considered for a scholarship you must submit a 200 word statement on “How I will contribute to our Trinity College Dublin community”, along with your offer letter number from Trinity College Dublin. Submissions should emailed to [E3.team@tcd.ie](mailto:E3.team@tcd.ie)

Applications for the scholarships will close on the 6th March 2020 and successful candidates will be notified by the 31st March 2020.

**Research opportunities:**

These are listed below by staff name where details of specific projects or indicative research areas are provided. Please contact the staff member direct should you wish to apply or discuss potential research projects within the indicative areas listed.

**Name**: Professor Yvonne Buckley

**Contact email**: [buckleyy@tcd.ie](mailto:buckleyy@tcd.ie" \t "_blank)

**Webpage**: [https://www.tcd.ie/Zoology/research/groups/buckley/](https://www.tcd.ie/Zoology/research/groups/buckley/" \t "_blank)

**Research interests**: ecology, population biology, demography, environmental decision making, conservation

**Indicative subject for Masters research**:

1) population biology of *Plantago lanceolata* worldwide (data science & demography),

2) environmental drivers of zoo animal demography (data science & demography),

3) biodiversity planning for large infrastructure projects (biodiversity survey, planning biodiversity enhancements, policy)

**Name**: Dr Pádraig Carmody

**Contact email**: carmodyp@tcd.ie

**Webpage**: [https://www.tcd.ie/research/profiles/?profile=carmodyp](https://www.tcd.ie/research/profiles/?profile=carmodyp" \t "_blank)

**Research interests**: African development, geopolitics

**Indicative subject for Masters research**: The roll-out and geopolitics of fifth generation (5G) mobile technology in Africa

**Name**: Dr Quentin Crowley  
**Contact email**: [crowleyq@tcd.ie](mailto:jeremy.piggott@tcd.ie" \t "_blank)   
**Webpage**: [https://www.tcd.ie/Geology/people/crowleyq/](https://www.tcd.ie/Geology/people/crowleyq/" \t "_blank)  
**Research interests**:  Environmental change through time, which includes both natural and anthropogenic systems. My research has developed new methodologies for mapping and modelling radon and has developed tools to support public health and housing legislation to protect the general population from the harmful effects of ionising radiation.

**Indicative subject for Masters research**:

*Environmental Exposure, Radon and Human Health:* Radon is a harmful pollutant which emanates as a gas from rocks, soil and water. It is an intermediate daughter product in the U-238 decay chain and is radioactive. Radon may accumulate indoors and exposure to both it and it’s daughter products (e.g. Po-210, Po-218) is associated with an elevated risk of developing lung cancer. As such radon is classified as a Class I carcinogen. Globally, it is the second most common cause of lung cancer after tobacco smoking. Ireland has a population weighted average indoor radon concentration of 98 Bq m-3, which is considerably higher than a global average of around 40 Bq m-3. Domestic radon exposure causes approximately 300 lung cancer cases in Ireland per annum, with an estimated economic cost of more than €400 M. This project will develop new methodologies to constrain radon distribution in natural and built environments with a view to lowering the national radon-related health burden.

**Name**:  Profs. Anna Davies, Iris Moeller, Mary Bourke

**Contact email**: [daviesa@tcd.ie](mailto:daviesa@tcd.ie" \t "_blank)

Webpage: [https://www.tcd.ie/Geography/people/](https://www.tcd.ie/Geography/people/" \t "_blank)

**Research interests**: climate change adaptation; natural hazards management; coastal geomorphology; Climate policy; citizen-science and science-policy interactions; public participation

**Indicative subject for Masters research**:

*RE-TREAT: Demonstrating benefits of climate adaptation by landward relocation of critical infrastructure and coastal community developments:* Managing the liminal zone between land and sea is notoriously challenging. Dynamic coastal processes and associated erosion or deposition of sediment often associated with extreme storm events are juxtaposed with an ever more intense human use of the coastal space. Globally more than 200 million people live less than 5 meters above sea level. Critical infrastructure (e.g. railway lines, industry) is often located near the shore. Climate change constitutes an unprecedented additional challenge for coastal communities, policy makers, and planners. Scientists agree that we are locked into sea-level rise for centuries to come. Relocating people and assets from coastal zones is highly contentious but is already a reality for some communities. There is then an urgent need to develop innovative approaches that can incorporate scientific, political, legal, economic, environmental and ethical considerations in open debate about planning the futures for vulnerable coastal zones across Europe and wider afield. RE-TREAT will work with challenge owners and communities in Dublin, Wexford, Suffolk, and Gwynedd through deliberative workshops to provide a framework for structuring and developing multi-stakeholder dialogue to achieve sustainable solutions for coastal adaptation. We will deliver a framework to identify impacts of landward relocation of human land use and guidance for designing multi-stakeholder consultations.

RE-TREAT challenges the paradigm of negative connotations around landward relocation (surrender to the seas, admitting defeat, etc.) and encourages nuanced discussion about landward relocation and additional inter􀆟dal/coastal space creation. This includes the opportunities it brings for supporting resilient ecosystems, encouraging socio-environmental innovation, and developing coastal spaces as a shared resource. We will closely engage with existing Climate-KIC partners, such as the Greater London Authority and Sustainable Na􀆟on Ireland.

**Name**: Dr Ian Donohue

**Contact email**: [ian.donohue@tcd.ie](mailto:ian.donohue@tcd.ie" \t "_blank)

**Webpage**: [https://www.tcd.ie/Zoology/research/groups/donohue/](https://www.tcd.ie/Zoology/research/groups/donohue/" \t "_blank)

**Research interests**: Ecology, Ecological stability, resilience, global environmental change, multiple stressors, marine and freshwater ecology

**Indicative subject area for Masters research**: Global environmental change and the stability of ecosystems. I am keen to take on a student that will run a set of experiments in our state-of-the-art mesocosms and / or in the field (coastal rocky shores, lakes or rivers) to examine the ecological responses to a range of stressor combinations and recovery from them, with the aim of developing and testing predictions about the stability properties of ecosystems.

**Name**: Dr Andrew Jackson

**Contact email**: [jacksoan@tcd.ie](mailto:jacksoan@tcd.ie" \t "_blank)

**Webpage**: [https://www.tcd.ie/Zoology/research/groups/theoretical/members/andrew-jackson.php](https://www.tcd.ie/Zoology/research/groups/theoretical/members/andrew-jackson.php" \t "_blank)

**Research interests**: Theoretical Ecology; Behavioural Ecology; Foraging Ecology; Predator-prey interactions; Perception (in particular vision); Food-webs.

**Indicative subject for Masters research**: I am broadly interested in two main areas of research.

**1) Visual Perception and manoeuvrability**. I am to develop a simulation model of visual systems to explore the biological phenomenon called the Flicker Fusion Threshold which essentially determines the frame of the eye. This project will use computer and robotic vision models to construct an in silico system in which we can explore the costs and benefits of running visual systems at different detection rates. One aim is to then use this model to explore how constraints on visual tracking affects the outcomes of predator-prey interactions in situations where relative manoeuvrability of the agents is key. This project will run alongside an empirical project testing athletes visual temporal resolution and linking it to performance. The project has potential application in robot vision, artificial reality and virtual reality systems.

**2) Ecological Complex Systems.** In this on-going project we are using dynamic systems modelling and Boolean functions to understand how ecological food-webs of interconnected individuals and species give rise to emergent properties of the system, and how the behaviour and in particular the stability of these systems scale with size and complexity. This project will compliment an on-going 4-year research project that includes a postdoc and a PhD student.

**Essential**: for these potential Research Masters projects I am seeking applicants with strong quantitative skills, preferably with backgrounds in physics, mathematics, engineering, computer science or other as appropriate. These projects would suit students coming from these numerical subjects who want to move into ecology and evolution.

**Name**: Dr Pepijn Luijckx

**Contact email**: Luijckxp@tcd.ie

**Webpage**: [https://www.tcd.ie/Zoology/research/groups/luijckx/](https://www.tcd.ie/Zoology/research/groups/luijckx/" \t "_blank)

**Research interests**: Epidemiology and Evolution Infectious Diseases, Genetics, Coevolution and Evolution of Sexual Reproduction.

**Indicative subjects for Masters research**:  
1) How does global warming affect disease ecology and evolution?  
2) How does genetic diversity affect disease outbreaks and evolution?  
3) What genes underlie resistance and tolerance to diseases and parasites?  
4) Why does sexual reproduction exist despite well-known costs?

**Name**: Professor Jennifer McElwain

**Contact email**: jmcelwai@tcd.ie

**Webpage**: <https://www.tcd.ie/Botany/people/jmcelwai/>

**Research interests**: Palaeobotany, plant evolution, plant-atmosphere interaction, plant-climate interaction

**Indicative subject for Masters research**:

*Ireland’s Oldest Forests - Reconstructing climate, atmospheric composition, carbon sequestration potential and ecology of Ireland's Oldest Forests from ~380 million years ago*

*Supervisors* Prof McElwain TCD  
*Co-supervisor* - Dr Parkes National Museum of Ireland (NMI)

*Objectives*To use extensive and understudied fossil plant collections of Late Devonian aged (Frasnian 382 to 372 mya) fossil *Archaeopteris* forests housed within the NMI to reconstruct some of the world’s oldest forests, their paleoatmosphere and paleoclimate.

*Description of project*The Late Devonian was a time of major plant evolutionary transition with the appearance in the fossil record of the first true trees with lignified trunks and the emergence of forests with more complex ecological structure. It is characterized as a time of largescale C cycle perturbation as atmospheric CO2 declined from levels more than ten times higher than present to values as low as the Quaternary glacials. The exact timing of this major atmospheric and climatic transition is poorly constrained and there is a notable paucity of *p*CO2 estimates for the Late Devonian. *Archaeopteris* cuticle is poorly preserved in the Kiltorcan flora, however original carbonaceous leaf material is well-preserved on many specimens on which δ13C paleo-CO2proxy methods can be applied. Fossil pollen is also well-preserved suggesting than dispersed cuticle is likely retrievable using bulk sediment maceration.

*Research Plan* The research student will use multidisciplinary approaches to reconstruct paleo-CO2 from fossil *Archaeopteris* δ13Cand fossil stomatal data. The first detailed taphonomic investigation of the flora will be undertaken. Leaf morphometric, elemental mapping methods and FTIR will be applied to the flora to assess the taxonomic and ecological diversity evident among nearly 3000 well-preserved fossil leaf specimens

**Name**: Professor Iris Moeller

**Contact email**: moelleri@tcd.ie

**Webpage**: <https://www.tcd.ie/Geography/people/staff/irismoeller/>

**Research interests**: Prof Moeller is a coastal geomorphologist working on how physical and biological processes interact at the coast, particularly in the intertidal zone (the area between tidal high and low water). She uses these insights to work with others within and beyond the discipline of Geography to develop integrative solutions for a coastal environment in which people are protected from flooding and erosion whilst also taking advantage of the many benefits healthy ecosystems have for humans. The monitoring and understanding of long-term coastal morphodynamics (the link between coastal landforms and the processes shaping them) forms a key component of her work, as does how we use these insights to adapt to a changed environmental future through climate change, sea-level rise, and altered storm frequency/severity.

**Indicative subject for Masters research**: Decadal-scale dynamics of open coast salt marshes: lessons from a comparative geographical analysis.

**Name**: Professor Paula Murphy

**Contact email**:[paula.murphy@tcd.ie](mailto:paula.murphy@tcd.ie" \t "_blank)

**Co-supervisor**: Dr Rebecca Rolfe

**Contact email**: [rebecca.rolfe@tcd.ie](mailto:rebecca.rolfe@tcd.ie" \t "_blank)

**Webpage**: [https://www.tcd.ie/Zoology/research/groups/murphy/](https://www.tcd.ie/Zoology/research/groups/murphy/" \t "_blank)

**Research interests**:

* The genetic regulation of embryonic development
* The integration of mechanical forces and genetic regulation of skeletal development.
* Relating gene expression patterns to morphological changes in developing embryos

**Indicative subject for Masters research**:

*The development of functional Tendons*

Tendons play an important role in the musculoskeletal system connecting muscle to bone, translating skeletal muscle contractions into body movement. Tendons have a very important structure-function relationship, arising from specific cells (tenocytes) early in development, when they align themselves in the correct position and switch on expression of tendon specific genes. However, these early developing tendons do not have the mechanical properties required to transmit mechanical loads and effect loadbearing movement until much later, but little is known about what happens during the transition from non-load bearing (soft) tendon precursors to mechanically robust functional tendons, or how the transition is controlled. Tendon injury is a major cause of pain and debilitation with limited possibilities for effective therapy at present. Currently stem cells can be induced to differentiate into tenocytes but do not progress to form load-bearing tendons.

This project investigates how functional tendons are formed and how the process is regulated. In particular it addresses the importance of mechanical stimulation from embryo movement on tendon maturation by experimentally altering movement in chick embryos. To find out the molecular mechanisms involved in the response of embryonic tendons to movement we will use site-specific CRISPR/Cas9 gene-editing techniques to interfere with molecular pathways known to be involved in mechanotransduction, therefore testing the importance of these mechanisms for tendon maturation. By improving our understanding of normal tendon development we will produce the knowledge needed to inform new therapeutic approaches for rebuilding tendons following injury and disease.

**Name**: Dr Susan Murphy

**Contact email**: susan.p.murphy@tcd.ie

**Webpage**: [https://naturalscience.tcd.ie/people/murphs64](https://naturalscience.tcd.ie/people/murphs64" \t "_blank)

**Research interests**: Theory and practice of development cooperation; gender, social inclusion and development; climate justice

**Indicative subject for Masters research**:

1)  Implementing the sustainable development goals: Transformation and trade-off

2) Examining policy architecture, interconnection and coherence: Monitoring performance, connections and interdependencies between SDG NIPS (Sustainable development national implementation and monitoring plans) & CA NDCs/NAPs (Climate Action Nationally Determined Contributions / National action plans)

**Name**: Dr Nicholas Payne

**Contact email**: **[paynen@tcd.ie](mailto:paynen@tcd.ie" \t "_blank)**

**Webpage**: **[https://www.thepaynelab.com/](https://www.thepaynelab.com/" \t "_blank)**

**Research interests**: thermal biology, marine ecology, metabolic scaling

**Indicative subject for Masters research**: how does metabolic scaling regulate distribution patterns of species?

**Essential**: for these potential Research Masters projects I am seeking applicants with strong quantitative skills, preferably with backgrounds in physics, mathematics, engineering, computer science or other as appropriate. These projects would suit students coming from these numerical subjects who want to move into ecology and evolution.

**Name**: Dr Jeremy J. Piggott  
**Contact email**: [jeremy.piggott@tcd.ie](mailto:jeremy.piggott@tcd.ie" \t "_blank)   
**Webpage**: https://www.tcd.ie/Zoology/research/groups/piggott/  
**Research interests**:  Aquatic ecology, including the determinants of biodiversity structure and function from genes to ecosystems, the combined influence of multiple anthropogenic stressors on communities and ecosystems, and the management and conservation of biodiversity and ecosystem services in the face of global change.  
**Indicative subject for Masters research**:

*Multiple Stressors in Freshwaters under Global Change:* Freshwaters provide essential services to humans but are one of the World’s most degraded and threatened ecosystems. Climate change and its impacts are likely to become the dominant driver of biodiversity loss and changes in ecosystem functioning by the end of this century, but how the drivers of climate change will interact with the multiple stressors that already impact ecosystems remains one of the largest uncertainties in projections of future biodiversity change. This project will utilise theoretical and experimental approaches to disentangle stressor interactions to be able to better manage or restore damaged ecosystems in the face of global change.

**Name**: Dr Marcin Penk

**Contact email**: [penkmr@gmail.com](mailto:penkmr@gmail.com" \t "_blank) **Webpage:** [https://www.tcd.ie/Zoology/research/groups/piggott/lab%20group/marcin.php](https://www.tcd.ie/Zoology/research/groups/piggott/lab%20group/marcin.php" \t "_blank) **Research interests**: Aquatic Ecology, Ecosystem Functioning, Anthropogenic Stressors

**Indicative subject for Masters research**: Water quality regulation through benthic processes in rivers.

**Name**: Dr Patrick Wyse Jackson

**Contact email**: [wysjcknp@tcd.ie](mailto:wysjcknp@tcd.ie)

**Webpage**: <https://www.tcd.ie/Geology/people/wysjcknp/>

**Research interests**: Palaeontology, History of Geology, Dimension and Decorative stone.

**Indicative subject for Masters research**: Palaeoecology and stratigraphy of Palaeozoic bryozoans.