Callum J. Macgregor

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Research interests

I am an entomologist and ecologist, with a strong interest in the evolutionary ecology of organisms, in relation to both the abiotic factors impacting upon them and their biotic interactions with other species. I am keen to apply my skills in sampling insects and detecting interspecific interactions (including by DNA-based methods) to the study of environmental change. I am interested in how ecological networks are altered by environmental change, and the evolutionary and coevolutionary responses of the interacting organisms that they comprise. Although most of my research to date has focussed on Lepidoptera, I also have experience of surveying other insects and birds.

Education and qualifications

2013-2017 **PhD in Biology**, Newcastle University (transferred from University of Hull (2013-2015) with the move of my university supervisor).
Thesis: The importance of moths as pollinators, and the effects of artificial light at night (see appendix 1); submitted, *viva* scheduled June 2017.

2013-2015 **Post Graduate Certificate in Research Training**, University of Hull

2010-2013 **BA (Hons 2.i) Biological Sciences**, University of Oxford (Brasenose College)
Dissertation: Factors affecting the distribution and abundance of a rare British moth, *Shargacucullia lychnitis.*

2003-2010 **A Levels**, Kimbolton School, Cambridgeshire
Biology (A*), Geography (A), Mathematics (A); AS Level Chemistry (A)

Publications

C.J. Macgregor, D.J. Hoare, M.S. Parsons and O.T. Lewis (2017) Interspecific competition and host-plant patch qualities affect the distribution and abundance of a rare British moth, *Cucullia lychnitis*. *Journal of Insect Conservation*, doi: 10.1007/s10841-017-9963-5.

C.J. Macgregor, D.M. Evans, R. Fox and M.J.O. Pocock (2016) The dark side of street lighting: impacts on moths and evidence for the disruption of nocturnal pollen transport. *Global Change Biology,* doi: 10.1111/gcb.13371.

C.J. Macgregor, M.J.O. Pocock, R. Fox and D.M. Evans (2015) Pollination by nocturnal Lepidoptera, and the effects of light pollution: a review. *Ecological Entomology*, **40**, 187-198.

C.J. Macgregor, M.J.O. Pocock, R. Fox and D.M. Evans (submitted) Street lights influence the success and quality of pollination in a nocturnally-pollinated plant. *Ecology & Evolution.*

C.J. Macgregor, D.M. Evans, R. Fox and M.J.O. Pocock (in preparation) An adjusted approach to estimating sampling completeness of interactions in ecological networks. *bioRxiv/PLoS ONE.*

C.J. Macgregor, J.J.N. Kitson, R. Fox, C. Hahn, D.H. Lunt, M.J.O. Pocock and D.M. Evans (in preparation) Construction, validation and application of nocturnal pollination networks in an agroecosystem, using both microscopy and DNA metabarcoding. *Methods in Ecology and Evolution.*

P. Banza, C.J. Macgregor*, D.M. Evans, R. Fox, M.J.O. Pocock and A.D.F. Belo (in preparation) Fire alters structure of Mediterranean nocturnal pollination networks. *corresponding author

Selected recent conference presentations and posters

Royal Entomological Society 2017 PG Forum: DNA metabarcoding of nocturnal pollination. **Winner, Best Talk.**

British Ecological Society 2016 Annual Meeting: DNA metabarcoding of nocturnal pollination.

Royal Entomological Society 2016 Annual Meeting: Street lighting and moth-pollination bioassay.

Future 4 Butterflies (Wageningen, Netherlands): Impacts of street lighting on moths and pollination.

National Moth Recorders' Meeting 2016: Impacts of street lighting on moths and pollination **(invited speaker)**.

British Ecological Society 2015 Annual Meeting: Impacts of street lighting on moths and pollination. **Runner-up, Anne Keymer Prize** for Best Student Talk.

International Dark-sky Association 2015 AGM (Phoenix, Arizona, U.S.A.): Impacts of street lighting on moths and pollination **(invited speaker, international meeting)**.

Royal Entomological Society 2015 Annual Meeting (Dublin, Ireland): Impacts of street lighting on moths and pollination.

Scientific skills

Fieldwork

- **Field-sampling insects**: light-trapping and transect sampling of moths, butterflies and others
- **Captive rearing of Lepidoptera**: from eggs and larvae to adults
- Bioassays: use of phytometers to measure effects on pollination
- Bird identification, including by song: have participated in the Breeding Bird Survey
- Working in at-risk situations, including lone working, night working, road verges
- Maintenance of field equipment, including electricals and generators, and manual handling

Analysis

- **Statistical analysis in R**: analysing large data sets; GLMMs; diversity and community composition using Vegan; ecological networks using bipartite
- **Bioinformatics using Linux and Python**: handling and analysis of NGS sequence data

Labwork

- **DNA metabarcoding**, including extraction, PCR, and sequencing with Illumina MiSeq
- **Sampling pollen** by fuchsin gel swabbing and identification using light microscopy

Scientific engagement

- My first-author papers have been:
    - **Best Paper** in *Ecol Entomol* (2014–15), and **Editor's Choice** in issue
    - **highest Altmetric** of all time in *Ecol Entomol*, 12th highest of all time in *Global Change Biol,* and both in **top 0.5%** of all papers tracked by Altmetric (05/04/2017)
    - Featured in national newspapers in the UK and on Canadian national radio
- Runner-up, **Anne Keymer Prize** for Best Student Talk (BES Annual Meeting 2015, Edinburgh) and winner, **Best Talk** (RES PG Forum 2017, Sheffield)
- Active participant in scientific peer review; 10 reviews on Publons to date (05/04/2017)

Public engagement

- My articles for The Conversation have been republished by, among others, *The Guardian* and IFLScience, accruing over **85,000 reads** to date (05/04/2017).
- I have been interviewed about my research on **BBC1 television** and **BBC Radio 5Live**
- **Evening seminars** presented to Hull Naturalists and Natural History Society of Northumbria

Other skills

- Holder of a full, clean British **driving licence** and Member of the Institute of Advanced Motorists

Additional relevant employment

Webmaster	Lampbrush Chromosomes – https://projects.exeter.ac.uk/lampbrush/ (June 2011 to present) Responsible for a complete update of the site's layout, format and content in the summer of 2011, which had to be achieved within a strict deadline. Ongoing role to update the website (summarising past and current research on lampbrush chromosomes) promptly as and when required.
Research assistant	SPARC Europe, Open Access Citation Advantage Service (November to December 2014) Responsible for documenting and summarising recent studies investigating whether or not there is a citation advantage for Open Access articles as part of an update to the OpCit project (http://sparceurope.org/oaca/).

Teaching experience

During my PhD I have been fully involved in teaching undergraduate and Masters students:

- Presented a **seminar** on my career in research to first-year undergraduates
- **Demonstrated** on courses including laboratory practicals, field courses (**designed and led** a practical exercise on floral diversity), and computer-based courses on statistics.
- Took and passed the University of Hull's "**Postgraduate Researchers' Introduction to Teaching**" course (2015), helping me to communication with students when demonstrating.
- Took on four undergraduates as volunteer **lab and field assistants**, helping them to gain valuable experience of ecological research.

Administrative experience

In years 1–2 of my PhD, I served as **Chair of the Postgraduate Committee** in the University of Hull School of Biological, Biomedical and Environmental Sciences, a role that included leading the organisation of the annual Postgraduate Research Day conference.

As an undergraduate, I held a number of administrative and leadership positions:

- **Student Representative** (1st year), Joint Consultative Committee for Biological Sciences, University of Oxford; worked with senior academics to improve course structure and content
- **Charities Representative**, Brasenose College Junior Common Room; managed termly charitable donations on behalf of college undergraduates
- **Webmaster**, Oxford University Student Union Environment and Ethics Committee

Professional memberships

Associate Member of the Royal Society of Biology
Student Member of the British Ecological Society and the Royal Entomological Society

Interests

I enjoy a range of extra-curricular activities, many of which relate to biology and the outdoors. These include recreational(!) moth-trapping, monitoring butterfly transects, and birdwatching, as well as hill-walking, running, and rock climbing.

References

Dr Darren M. Evans (PhD supervisor)
Network Ecology Group
School of Biology
Newcastle University
Newcastle upon Tyne, U.K.

Mr Richard Fox (PhD supervisor)
Head of Recording
Butterfly Conservation
Manor Yard, East Lulworth
Wareham, Dorset, U.K.

Dr Michael J.O. Pocock (PhD supervisor)
Biological Records Centre
Pywell Section
Centre for Ecology and Hydrology
Wallingford, Oxfordshire, U.K.

Prof Owen T. Lewis (Hons project supervisor)
Community Ecology Research Oxford
Department of Zoology
University of Oxford
Oxford, U.K.

Dr Dave H. Lunt (PhD collaborator)
EvoHull group
School of Environmental Sciences
University of Hull
Hull, U.K.

Appendix 1: Synopsis of PhD research

Supervisors: Dr D.M. Evans (Newcastle University), Dr M.J.O. Pocock (Centre for Ecology and Hydrology, Wallingford) and R. Fox (Butterfly Conservation)

NERC Industrial CASE Studentship (3.5 years) with Butterfly Conservation

Project reference: NE/K007394/1

Summary

Populations of moths (Lepidoptera) are in long-term decline, due to the effects of multiple drivers of environmental change. The role of moths in pollination has been been largely overlooked by studies of pollination systems. In this thesis, the global importance of moths as pollinators was examined using systematic literature review and field experiments. The effects of two drivers of environmental change that are of particular importance to moths (artificial light at night and fire) upon nocturnal pollen transport were investigated.

Evidence was collated from the literature that moths are important pollinators in tropical and temperate ecosystems globally. Using a range of experimental approaches including the development of a DNA metabarcoding approach to detecting and identifying pollen, it was found that moths make a substantial contribution to pollen transport in the U.K. and Portugal, with 23–34% and 70% respectively of individual moths carrying the pollen of a diverse selection of plants.

Artificial light at night was shown to affect nocturnal pollen-transport at the community level. In matched-pairs of lit and unlit sites, moth abundance at ground level was halved at lit sites but flight activity at the level of the light was 70% higher, with a consequent overall reduction in pollen transport at lit sites. Using a moth-pollinated phytometer, there was no difference in the likelihood of pollination between lit and unlit treatments, or between different lighting technologies, but flowers were more likely to be pollinated under full-night lighting than part-night lighting.

In an interaction-rich Mediterranean system, fire was shown to alter the structure of replicated pollen-transport networks, with post-fire networks having lower linkage density and robustness.

Overall, these results indicate that moths are an important component in pollination systems and may provide redundancy in the face of diurnal pollinator declines, and provide the first evidence that nocturnal pollination is disrupted by drivers of environmental change.