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About

Mark is an ecologist researching environmental change in freshwaters. His research group is focused on understanding how environmental stressors and climate change, especially extreme climatic events such as floods, droughts and heat waves, affect the structure and functioning of aquatic ecosystems. His group works empirically across a range of spatial and temporal scales, from laboratory microcosms to natural environmental gradients in real ecosystems, and has developed new state-of-the-art mesocosm facilities which enable novel interdisciplinary experimental approaches to be applied in areas of water science usually characterised by phenomenological study. Mark currently leads several NERC-funded research projects and supports a number of doctoral researchers and postdoctoral fellows. He also works actively with a growing network of colleagues in the UK and overseas.

Biography

Mark read Biology at UCNW Bangor, graduating with a B.Sc. (Hons) in 1993, then joined the research group of Professor Alan Hildrew at Queen Mary and Westfield College, University of London. His Ph.D. research at QMW (completed 1997) investigated the relationship between acidification-induced biodiversity loss and ecosystem processes in upland streams. He was then awarded a Royal Society Fellowship to work with Professor Mike Winterbourn at the University of Canterbury, New Zealand, from 1998-1999. With Mike he worked on growth and trophic ecology of NZ stream invertebrates. Thereafter, he held a NERC-Freshwater Biological Association Pioneer Research Fellowship, based here in the School of Geography, Earth and Environmental Sciences in Birmingham (with Prof. Sandy Milner, 1999-2003). He was appointed to a Lectureship within the School in 2003, completed a Postgraduate Certificate in Learning and Teaching in 2008, and was promoted to Senior Lecturer in 2013. Mark serves on the NERC Peer Review College (UK) and is an assessor for the Australian Research Council. He is an associate editor for *Ecology and Evolution*, and Treasurer for the Aquatic Group of the British Ecological Society.

Teaching

Mark has developed a broad teaching portfolio across the Geography and Environmental Science programmes, at both undergraduate and postgraduate levels. Currently, he contributes to the following courses:

GGM105 Tutorials and Fieldwork

GGM214 Ecological Systems (module leader)

BIO234 Ecology

GGM204 Techniques in Physical Geography

GGM201 Research Methods for Dissertations

Freshwater Environments Field Course (Bala; field course coordinator)

GGM503 River Ecology (module leader)

GGM504 River Restoration

GGM505 Advances in Water Science

GGM507 Research and Management of Rivers (module leader)

GGM508 River Environmental Management Dissertation

Undergraduate and Postgraduate Research Project Supervision

Postgraduate supervision

PhD students supervised as principal or co-supervisor:

Completed:

1. Dr Rebecca Harris. Completed 2006. The effect of experimental drought disturbance on macro-invertebrate assemblages in stream mesocosms. Funded by NERC-FBA. M.E. Ledger (lead), A.M. Milner (UoB).
2. Dr Helen Vincent. Completed 2009. Algae-herbivore interactions in stream food webs. Funded by NERC with CASE support from the Centre for Ecology and Hydrology. Dr M.E. Ledger (lead), Dr A.M. Milner (U of B) and Dr J. Murphy (CEH Dorset).
3. Dr Jessica Frame. Completed 2010. Biological barriers to the restoration of freshwater ecosystems Funded by GEES with support from the Centre for Ecology and

Hydrology. Dr. M.E. ledger (lead), Dr J.I. Jones (CEH Dorset), Prof S.J. Ormerod (Cardiff University) and Dr J.P. Sadler (U of B).

4. Dr Katie Aspray. Completed 2012. Freshwater biodiversity and ecosystem function in changing moorland landscapes. NERC OPEN CASE studentship with CASE support from Natural England. Dr L.E. Brown (lead), Dr J. Holden (University of Leeds), Dr M.E. Ledger (UoB), Dr C.P. Mainstone (Natural England).
5. Dr Ian Thornhill. Completed 2013. Water quality and biodiversity of urban ponds (funded by NERC with CASE support from the Macaulay Institute). M.E. Ledger (lead), Dr L. Batty (U of B) and Dr N. Friberg (Macaulay Institute).

Current:

1. Alex Poynter (2009-) Impacts of environmental stressors on the River Itchen Ranunculus community. Environment Agency funded. L. Batty, J. Bridgeman, M.E. Ledger (UoB), S. Medgett (EA).
2. Robert Fowler (2010-) Building for Biodiversity: managing and creating green infrastructure to maximise ecological services in our cities. EPSRC funded. J.P. Sadler (lead), M.E. Ledger & A. Bates (UoB).
3. Svein Harald Sønderland (2010-) Food web dynamics in recently deglaciated terrain. Self-funded. A.M. Milner (lead), M.E. Ledger (UoB).
4. Caroline Mullen (2011-) Biodiversity, species redundancy and ecosystem processes in a freshwater grazer assemblage: a functional approach. Centre for Ecology and Hydrology PhD Studentship. M.E. Ledger (lead), A.M. Milner (UoB), F. Edwards (CEH Wallingford).
5. Gavin Williams (2012-) Impact of extreme events on biodiversity-ecosystem functioning relationships in streams. NERC Project Student. M.E. Ledger (lead), L.Batty (UoB), M. Trimmer (QMUL), G. Woodward (ICL).

Research

I am a member of the Water Sciences Research Group, and have recieved funding for following ongoing research projects:

Drought impacts on the structure and functioning of stream ecosystems (DRI-STREAM) (/research/activity/water/projects/dristream/index.aspx)

NERC Standard Grant, £701k

Climate change is expected to alter the quantity of water entering rivers and streams, with potentially devastating impacts on the structure and functioning of these ecosystems. This project (led by Mark Ledger, in collaboration with Mark Trimmer at QM and Guy Woodward at ICL) uses novel mesocosm experiments to understand the ecological effects of hydrologic droughts in streams, with a view to predicting future change. Read more about DRI-STREAM here.

Hydrodynamics of microbial landscapes

NERC Standard Grant £750k

The way in which water flows across a surface is one of the most complex phenomena to model and predict accurately in the environment. This project (led by Greg Sambrook Smith, UoB) explores how microbes living in biofilms in freshwater environments influence the flow of water around substrate particles, with implications for biogeochemistry of natural systems and wastewater treatment.

Quantifying ecosystem resilience: catastrophic collapse and recovery of a large river food web

NERC Urgency Grant £65k

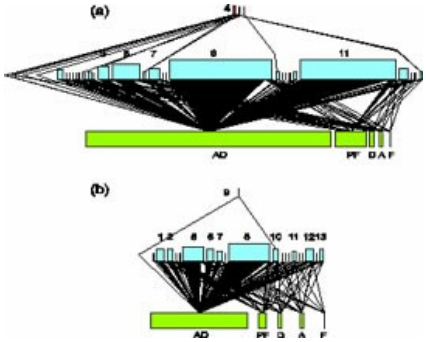
Mark is part of an interdisciplinary team investigating the ecological impact of a pesticide spill on the River Kennet. The project, which is funded by a NERC Urgency grant (led by Guy Woodward at ICL), takes a genes-to-ecosystems approach to establish the effect of the stressor across multiple

levels of organisation. This unique case study will yield invaluable new insights into of the fragility and resilience of natural systems, and especially of how pesticide effects are felt far beyond those of their usual target organisms.

The effect of contrasting disturbance regimes on the architecture and functioning of freshwater food webs

NERC Small Grant £30k

Environmental perturbations can cause non-random species loss in ecological communities, altering the architecture and functioning of food webs. Research funded by a NERC small grant (Ledger and Milner CoPIs) revealed how stream drying caused by drought affected secondary production and energy flow through the food web. This ongoing research collaboration with Lee Brown (Leeds), Francois Edwards (CEH Wallingford) and Guy Woodward (ICL) has recently been published in Nature Climate Change (see below).



Other activities

Administrative Responsibilities

Chair, Environmental Change Outdoor Laboratory (ECOLAB) working group (2013-).

School Environment, Health and Safety Coordinator (2012-)

Admissions Tutor - Environmental Science and Management (2007-2012, 2013)

Career Liaison Tutor (2004-2007)

Member, College Health, Safety and Environment Committee

Member, College Marketing and Recruitment Committee

Publications

Key Publications

Stewart, R.I.A., Dossena, M., Bohan, D.A., Jeppesen, E., Kordas, R.L., **Ledger, M.E.**, Meerhoff, M., Moss, B., Mulder, C., Shurin, J.B., Suttle, B., Thompson, R., Trimmer, M., Woodward, G. (2013). Mesocosm experiments in ecological climate change research. *Advances in Ecological Research*, 48, 71-181.

Ledger, M.E., Brown, L.E., Edwards, F.K., Hudson, L.N., Milner, A.M., Woodward, G. (2013). Extreme climatic events alter complex food webs: evidence from a mesocosm drought experiment. *Advances in Ecological Research*, 48, 343-395.

Ledger M.E., Brown L.E., Edwards F., Woodward G., Milner A.M. (2013) Drought impacts on the structure and functioning of complex food webs. *Nature Climate Change*, 3, 223-227.

Hudson, L.N., Emerson, R., Jenkins, G.B., Layer, K, **Ledger, M.E.**, Pichler, D.E., Thompson, M.S.A, O'Gorman, E.J., Woodward, G., Reuman, D.C. 2013. Cheddar: analysis and visualisation of ecological communities in R. *Methods in Ecology and Evolution*, 4, 99-104.

Ledger M.E., Harris R.M.L., Armitage P.D. & Milner, A.M. (2012). Climate change impacts on community resilience: experimental evidence from a drought disturbance experiment. *Advances in Ecological Research*, 46, 211-258.

Hagen, M., Kissling, W.D., Rasmussen, C., De Aguiar, M.A.M, Brown, L.E., Carstensen, D.W., Alves-Dos-Santos, I., Dupont, Y.L., Edwards, F.K., Genini, J. Guimarães Jr., P.R., Jenkins, G.B., Jordano, P., Kaiser-Bunbury, C.N., **Ledger, M.E.**, Maia, K.P., Flavia, M., Marquitti, D., Mclaughlin, O., Morellato, L.P.C., O'Gorman, E.J., Trøjelsgaard, K., Tylianakis, J.M., Morais Vidal, M., Woodward, G. & Olesen, J.M. (2012) Biodiversity, species interactions and ecological networks in a fragmented world. *Advances in Ecological Research*, 46, 89-210.

Woodward, G., Brown, L., Edwards, F.K., Hudson, L.N., Milner, A.M., Reuman, D.C. & **Ledger, M.E.** (2012). Climate change impacts in multispecies systems: drought alters food web size-structure in a field experiment. *Philosophical Transactions of the Royal Society B*, 367 (1605), 2990-2997.

Ledger, M.E., Edwards, F., Brown, L.E., Woodward, G. & Milner, A.M. (2011) Impact of simulated drought on ecosystem biomass production: an experimental test in stream mesocosms. *Global Change Biology*, 17, 2288-2297.

Brown, L.E., Edwards, F., Milner, A.M., Woodward, G & **Ledger, M.E.** (2011) Food web complexity and allometric scaling relationships in stream mesocosms: implications for experimentation. *Journal of Animal Ecology*, 80, 884-895.

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Ecological networks in a changing climate. *Advances in Ecological Research*, 42, 71-138.

Ledger, M.E., Harris, R.M.L., Armitage, P.D. & Milner, A.M. (2009) Realism of model ecosystems: an evaluation of physicochemistry and macroinvertebrate assemblages in artificial streams. *Hydrobiologia*, 617, 91-99.

Ings, T.C., Montoya, J.M., Bascompte, J., Blüthgen, N., Brown, L., Dormann, C. F., Edwards, F., Figueroa, D., Jacob, U., Jones, J. I., Lauridsen, R. B., **Ledger, M.E.**, Lewis, H.M., Olesen, J.M., Van Veen, F.F., Warren, P.H. & Woodward, G. (2009). Ecological networks – beyond food webs. *Journal of Animal Ecology*, 78: 253–269.

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Brown, L.E., Sherlock, C., Milner, A.M., Hannah, D.M. & **Ledger, M.E.** (2004). The influence of environmental variables on the distribution of diatom communities in an alpine proglacial stream, Taillon-gabietous catchment, French Pyrenees. *Pirineos*, 158, 73-85.

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