

<b>Institution:</b> The Open University		
<b>Unit of Assessment:</b> B7 Earth Systems and Environmental Sciences		
<b>Title of case study:</b> Research into floodplain-meadow ecohydrology supports impact in policy, management and practice for biodiversity and natural flood management		
<b>Period when the underpinning research was undertaken:</b> 2000-2020		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Prof David Gowing Ms Emma Rothero Dr Yoseph Araya	Professor of Botany Outreach coordinator Lecturer in Ecology and Environmental Sciences	2000–present 2008–present 2004–2009, 2012–present
<b>Period when the claimed impact occurred:</b> 1 August 2013 - 31 December 2020		
<b>Is this case study continued from a case study submitted in 2014? N</b>		
<b>1. Summary of the impact</b>		
<p>Open University (OU) research on floodplain-meadow vegetation has led to a significant shift by conservation charities, governmental agencies, community groups, and landowners in their approach to conservation of rare floodplain-meadows. The change has been co-ordinated through the multi-partner Floodplain Meadows Partnership (FMP), conceived and led by Professor David <b>Gowing</b> of the OU as a vehicle for knowledge transfer. The FMP has engaged with practitioners (through site visits, training events, website) and produced a <a href="#">technical handbook</a> to make research accessible. As a result, changes to policy, professional practice, and site management have occurred, leading to enhanced biodiversity and improved flood-risk management.</p>		
<b>2. Underpinning research</b>		
<p>Floodplain meadows are highly valued both for their biodiversity and their utility in managing flood risk. They were formerly a major land use on floodplains across northern Europe and they have a potential future role in mitigating climate-change through their ability to produce biomass without artificial inputs and to sequester carbon in their soils. They are very dynamic systems and the composition of their vegetation responds to the prevailing hydrological regime. The precise mechanism by which the hydrological regime determines their diversity was poorly understood. This gap has impeded the ability to manage land jointly for biodiversity and Natural Flood Management (NFM). Professor <b>Gowing</b> and his team have sought to address this gap. Two major research findings on floodplain meadows underpin our impact:</p>		
<b>1. Hydrological niches underpin species coexistence:</b>		
<p>Meadow plant communities are diverse because their component species have differential tolerances to soil waterlogging and drying. The OU team defined the favoured hydrological regime of 99 plant species in a report commissioned by DEFRA <b>[O1]</b>. This report provides base data which enables management decisions to be based on scientific evidence. Many species have specialised their hydrological niche relatively recently in evolutionary time, suggesting that the communities we see today have co-evolved. Such co-evolved communities are likely to sustain greater diversity than plant communities assembled artificially. Research by the OU team supports the idea of conserving the community as an entity in its own right rather than conserving just the target species within it <b>[O2]</b>.</p> <p>The OU team also found that the segregation of hydrological niches first shown in English Floodplain Meadows is mirrored in the wetland communities of the South African fynbos. This led them to make the case that hydrological niche segregation is a fundamental mechanism by which species coexist <b>[O3]</b>. They were further able to refute the criticism, generated by the neutral theory of evolution, that the link between plant community composition and hydrological regime is actually driven by spatial relationships and is therefore not significant. The resulting paper helped establish hydrological niche segregation as a generally accepted mechanism of species coexistence <b>[O4]</b>.</p>		

**2. Consistency of management is key to maintaining species richness:**

How land managers decide when to cut their meadows is centred on competing models of meadow management (prescriptive vs. responsive). When managers combine approaches, with limited evidence available, the result is inconsistency. Our research has demonstrated advantages of the responsive model [O5].

Their importance for biodiversity conservation and both mitigation of (carbon sequestration) and adaptation to (flood risk management) climate change prompts their restoration. From a meadow-restoration scheme survey, we found that a significant factor determining the success of restoration was consistency of management. Based on this, they were able to define the sufficient and consistent management that is a feature of successful restoration schemes [O6].

**3. References to the research**

- O1. Gowing, D.J.G.**, Lawson, C.S., Youngs, E.G., Barber, K.R., Rodwell, J.S., Prosser, M.V., Wallace, H., Mountford, J.O., and Spoor, G. (2002) [The water-regime requirements and the response to hydrological change of grassland plant communities](#). Final Report of project BD1310, Defra, London.  
[A report in public domain, but not a journal article. No DOI, no citation report. This report triggered further research by Defra that informed the Environmentally Sensitive Area schemes. Its appendices hold raw data on the requirements of individual species, which are still widely accessed via the [www.floodplainmeadows.org.uk](http://www.floodplainmeadows.org.uk) website.]
- O2. Silvertown, J., McConway, K., Gowing, D.J.G.**, Dodd, M.E., Fay, M., Joseph, J., and Dolphin, K. (2006) Absence of phylogenetic signal in the niche structure of meadow plant communities. *Proceedings of the Royal Society of London, Series B.* 273(1582), 39–44. <https://doi.org/10.1098/rspb.2005.3288>. [This article has led to discussion within conservation organisations about the need to place emphasis on conserving rare plant communities in addition to rare plant species, which had been the preoccupation for British conservationists.]
- O3. Araya, Y.N., Silvertown, J., Gowing, D.J.G.**, McConway, K.J., Linder, H.P., and Midgley, G. (2011) A fundamental, eco-hydrological basis for niche segregation in plant communities. *New Phytologist*, 189(1), 253–258. <https://doi.org/10.1111/j.1469-8137.2010.03475.x> [The ideas in this article have led to many researchers in other habitats exploring the role hydrology may play in niche segregation; even amongst trees in tropical forests (e.g. Jung, E.Y., Gaviria, J., Sun, S. *et al.* Comparative drought resistance of temperate grassland species: testing performance trade-offs and the relation to distribution. *Oecologia* **192**, 1023–1036 (2020). <https://doi.org/10.1007/s00442-020-04625-9>).
- O4. García-Baquero, G., Silvertown, J., Gowing, D.J.G.**, and Valle, C.J., (2016) Dissecting the hydrological niche: Soil moisture, space and lifespan. *Journal of Vegetation Science*, 27,2, 219–226. <https://doi.org/10.1111/jvs.12353> [This article has been important to the wider field of plant ecology because it refutes the contention of the neutral theory (Hubbell, S.P. (2001). *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press. ISBN 9780691021287) that the patterns are spatially rather than hydrologically driven. The result is a building block for the wider acceptance of niche theory as an alternative to neutral theory for explaining species coexistence.]
- O5. McGinlay, J., Gowing, D.J.G.**, and Budds, J. (2016) Conserving socio-ecological landscapes: An analysis of traditional and responsive management practices for floodplain meadows in England. *Environmental Science and Policy*, **66**, 234-241. <https://doi.org/10.1016/j.envsci.2016.07.008> [This paper represents the first attempt to systematically gather evidence of the factors driving managers of this habitat and is a resource for those designing management schemes.]
- O6. Rothero, E., Tatarenko, I., and Gowing, D.J.G.** (2020) Recovering lost hay meadows: An overview of floodplain-meadow restoration projects in England and Wales. *Journal for Nature Conservation*, **58**, 125925. <https://doi.org/10.1016/j.jnc.2020.125925> [A recently published over-view of restoration of this habitat at a national level demonstrating the choice of technique is less important than the care taken to deliver it.]

**Funding background** The FMP received GBP3.9m in funding over 14 years from 54 different organisations. Many are repeat funders. Examples of funding received include: DEFRA (2002-2005) GBP97,742; Leverhulme (2005-2007) GBP84,822; Darwin Initiative (2007-2010) GBP325,000; Esmee Fairbairn Foundation (2008-2021) GBP885,663 and John Ellerman Foundation (2015-2018) GBP105,395.

#### 4. Details of the impact

The FMP consists of representatives from all organisations in the UK with an active interest in conserving the habitat and has objectives to share research findings, encourage better management and restoration of floodplain meadows through policy change, site management change and training.

Establishing the FMP in 2007 has led to research findings being translated into accessible formats aimed at practitioners and policymakers through newsletters (circulation 1000), a website, conferences, 270 site visits (430 land managers), and documents [C1] to inform practice, for example:

- Research reviews to statutory bodies, e.g. '[A review of the ecology, hydrology and nutrient dynamics of floodplain meadows in England](#)' and '[A Review of the Calthion in England and Wales](#)' each offering a hydrological perspective on wet grassland plant communities, expanding the range of described communities.
- Technical guides, e.g. '[Floodplain Meadows: Beauty and Utility](#)' and '[Guide to Floodplain Meadows](#)' providing practical management advice.
- Seventy-six consultant reports to Government, NGOs, and commercial organisations (housing developers and gravel companies), e.g. 'Clifton Ings and Rawcliffe Meadows SSSI: hydrological and plant community modelling,' applying **O1**, **O2**, **O3**, and **O4** to a specific context.

Specific impacts of the FMP were evaluated through a workshop involving the FMP Steering Group [C2], and questionnaire surveys of conservation practitioners, land managers, and FMP Ambassadors [C3, C4].

#### Impacts on policy

- i. Our research on hydrological niches [O1, O2, O3] has changed the way in which the **Environment Agency (EA)** approaches floodplain wetlands, and has led to a change in its policy on Natural Flood Management (NFM), which in turn has shaped the text of the Government's 25-year Environment Plan (pp. 52, 57–59) [C5].

*"If the FMP project had not existed, the authors [...] would not have been able to authoritatively advocate floodplain meadows as an effective natural flood-management measure [...] (and grasslands) probably wouldn't have featured as explicitly in 25 year plan [...] so we have done amazingly well actually, to help shift balance of awareness/knowledge of the roles played by species rich wet grassland"* National Policy Advisor, EA, now retired [C5, p.1].

- ii. **Flood Alleviation Scheme Managers, river engineers, and conservation practitioners** across England can now use restoration of wet grassland as an NFM technique because of this policy. An example is a Flood Alleviation Scheme in York, which uses a floodplain meadow SSSI for NFM, using our research to inform floodwater management [C6].

*"This FMP research, and the Environment Agency's Policy document [...] helped us to realise that not only could we protect most of the species-rich grassland in the scheme, but also instigate the restoration of similar habitat in the rest of the flood storage area, thereby delivering enhanced biodiversity and natural flood management"* (Project Manager, Environment Agency) [C6].

- iii. Our Calthion report to **Natural England (NE)** (drawing on **O1** and **O3**) led to a change in NE's "Guidelines for the Selection of Biological SSSIs" [C1, C5]. Twenty percent of new grassland Sites of Special Scientific Interest (SSSI's) designated since 2014 have been

based on this report, giving those areas legal protection [C1, C2, p.2, Section 3.1]. The practitioner software tool 'MAVIS' (52 downloads/month) has been changed as a result to include the plant communities we described [C7]. This is used by **conservation professionals** to assess a site's botanical conservation value. As a result, floodplain sites can now be more accurately described and defended from development.

### Impacts on management and restoration activity on floodplain meadows

By reinforcing the central role of hydrology in structuring plant communities [O1, O2, O3, O4] and the importance of consistent management [O5, O6], we have changed:

- i. Management plans by **NE staff** at the five sites designated under European Legislation as Special Areas for Conservation (SAC), for their floodplain meadow plant community [C1].

*"As a result of these changes in management plans, Natural England are confident that these sites are moving towards being managed appropriately and have been able to more accurately report their status to the European Commission in 2019 for the [six yearly review of the European Habitats Directive](#)."* Senior Specialist – Grasslands, Natural England [C1].

- ii. Site-management activity by **land managers**, leading to enhanced biodiversity. 87% of managers changed their approach to site management, 82% to hay-cut timing, and 48% to water management [C3, pp.2-3, graphs 2&3].

*"An area of floodplain meadow adjacent to the study site is now under increasingly sympathetic management and should be considered worthy of statutory designation. The study [by FMP Ambassador] has elevated the importance of this site on a national (i.e. Wales) level"* FMP Ambassador and then Director of Radnorshire Wildlife Trust [C3, p.24].

- iii. Methods for restoration of meadows by **land managers** leading to more successful outcomes. 61% of managers changed their approach to floodplain-meadow restoration methods and 52% to post-restoration management [C3, p.2, graph 2].

*"FMP gave post-restoration advice at Oundle Lodge Meadows [...]. A better understanding of the relationship between flooding and hay-cut timings in relation to nitrogen and phosphorus availability gave us valuable information in how we can tweak hay-cut timings to better improve the botany of the meadows".* Grazing Officer, Wildlife Trust [C3, p.8].

### Impacts on practitioners and delivery of professional services, enhanced performance

We have run 3 phases of a 3-year training programme creating '**FMP Ambassadors**'. This programme is aimed primarily at professional conservation staff, covering the scientific methods used by the FMP to understand sites, supporting Ambassadors to study a site of their choosing, report their findings and advise others locally. This programme includes 47 individuals in 33 counties working for 38 different organisations [C8]. This has led to:

- i. Improved knowledge within the **professional conservation sector**. 94% of Ambassadors have enhanced their skills in ecohydrology of floodplain meadows [C4, p.5, graph 3.1].

*"I have become a known expert within Yorkshire Wildlife Trust to be consulted on such matters".* FMP Ambassador [C4, p.13, row no 3].

*"My understanding of the processes involved in floodplain meadows, their ecohydrology, skills in monitoring and handling data and think through solutions have all significantly improved my ability to deliver improvements to land management in practice".* FMP Ambassador [C4, p.13, row no 11].

- ii. Skills developed within the **professional conservation sector**. 94% of trainees stated their organisation was benefitting from their learning [C4, p.13, graph 8]. All of them reported a better understanding of management and restoration concepts [C4, p.6-7, graph 3.5) and 88% have given advice to others locally [C4, p.7-8, graph 4].

*“The long-term data being collected on-site is highly beneficial, something hugely lacking in Ireland for this habitat [...]. I have trained in other staff [...] and liaised with ecologists directly involved in grassland management. I am soon to meet the leading grassland ecologist in Ireland to discuss floodplain management.”* FMP Ambassador [C4, p.14, row no 3].

*“Having been involved in training some of the Ambassadors myself and during my own work, it is very clear to me that they are fully engaged in the learning and concepts and that the FMP has been instrumental in changing their approach to management and developing their skills”* Field Studies Council Biodiversity Manager (now retired) [C8].

### **Impacts on the environment: Protection and Restoration of Floodplain Meadows**

Impacts on the **environment (biodiversity)** have been achieved through:

- i. Provision of consultancy advice (based on **O1, O2, O3, O4**) to commercial companies (e.g. Smith and Sons Ltd. gravel company, Hills Quarry Products Ltd., Persimmon Homes) through planning permissions to ensure gravel extraction and housing development do not change the hydrology of legally protected sites [C9]. In all cases, the legally-protected sites have retained their botanical diversity in the face of adjacent development.
- ii. Protection of national and internationally protected meadows through changes in management (based on **O5**), resulting in conserved or increased species diversity [C3, C10]. 51% of practitioners reported that species diversity on their sites had increased, 49% reported that habitats for pollinators had improved, and 79% reported that species-rich habitats had been retained.
- iii. More floodplain meadow restoration projects are being delivered [O6]: 72% of practitioners have started or are considering restoration projects [C3, p.17, graph 4.2].

*“With invaluable advice from Floodplain Meadows Project we have initiated the Thames Wildflower Meadow Restoration Project - a partnership of landowners restoring meadows along the Upper Thames”* Joint owners of a floodplain meadow and instigators of a community project – The Thames Valley Wildflower Meadow Restoration Project [C3, p.28].

In summary, our research has reached the user community through the FMP. We have changed policy, such that wet grasslands are now an NFM measure, being used in flood-alleviation schemes and more sites have received legal protection. We have changed behaviour amongst practitioners and their organisations, resulting in better management and long-term conservation of the habitat. We have increased the amount of restoration activity and extent of the habitat.

### **5. Sources to corroborate the impact**

- C1. Letter from Natural England.
- C2. FMP Steering Group Impact Evaluation Report (2018).
- C3. Questionnaire responses from landowners and managers.
- C4. Questionnaire responses from Ambassadors.
- C5. Natural Flood Management/Environment Plan - Environment Agency.
- C6. FMP research used in Flood Alleviation scheme in York letter.
- C7. Amendments to the [MAVIS](#) practitioner tool.
- C8. Letter from Field Studies Council.
- C9. Case studies on protection of environment from quarrying and housing development.
- C10. Case studies on stable/improved plant communities.