

Project number: 5584
Funding source: DAFF RSF 06

Date: Sep 2012
Project dates: Oct 2006 – Jun 2011

An evaluation of existing and potential measures to sustain an increased biodiversity and water quality on Irish farms



Key external stakeholders:

Agri-environment policymakers
Participants in agri-environment schemes and extensive farmers
Environmental NGOs

Practical implications for stakeholders:

Intensification of agriculture over the last number of decades has resulted in a loss of ecological heterogeneity and has contributed to the loss of biodiversity, resulting in significant implications for wild species of flora and fauna.

Biodiversity conservation on farmland is critical to international, EU and CAP policy objectives and will mainly depend on effective agri-environment schemes. Measures involving field and watercourse margins affect almost all farmers who join Agri-Environment Schemes. This study evaluated the effectiveness of existing and potential field and watercourse margin measures from a biodiversity and water quality point of view.

Field margin measures developed by this project have now been included in the new Agricultural Environment Options Scheme (AEOS). Furthermore, results relating to the impact of cattle access drinking points on water quality will inform policy-makers when designing future prescriptions for AE schemes or cross-compliance regulations.

Main results:

- Minimal-change management approaches (currently adopted in many agri-environment schemes), such as fencing and/or the cessation of nutrient inputs, are unlikely to produce swards of conservation value.
- Current guidelines in relation to fencing of riparian management are not promoting and enhancing farmland biodiversity. A variety of grassy, scrubby and woody habitats in these margins appropriately managed would benefit the biodiversity of riparian margins and associated habitats.
- There is no one solution to appropriate management for all field and watercourse margins. Site specific management is required to conserve existing species and habitat diversity and promote new habitat development

Opportunity / Benefit:

Details from this study will aid policy-makers with the design of future agri-environment schemes and measures. A measure demonstrated in this study relating to the temporary fencing of field margins has been included in the new Agricultural Environment Options Scheme (AEOS).

The results from this study indicate that current AEOS prescriptions in relation to watercourse margins are not promoting riparian biodiversity. Our results relating to the impact of cattle access drinking points on water quality and biodiversity could help inform policy-makers when designing prescriptions for AE schemes or cross-compliance regulations.

The results from this study will also be of benefit to the scientific community in giving a greater insight into the biodiversity associated with field and water-course margins. Furthermore, a number of species new to Ireland have been recorded which will help scientists when trying to map the distribution of certain species.

Collaborating Institutions: University College Dublin; University College Cork

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A steering committee was established for this project

1. Project background:

Intensification of agriculture over the last number of decades has led to a dramatic change in agricultural production methods. This in turn has resulted in a loss of ecological heterogeneity and has contributed to the loss of biodiversity, resulting in significant implications for wild species of flora and fauna. In an effort to halt the decline in biodiversity, the Rural Environmental Protection Scheme (REPS) was initiated in Ireland in 1994 as the Irish government's response to the EU Agri-environmental Regulation. Since its establishment over 4 billion euro has been paid to farmers under REPS (and Agri-Environment Options Scheme).

Carey et al, (2003) stated that agri-environment schemes need to be accountable and provide value for money. A study by Kleijn and Sutherland (2003) into the effectiveness of European agri-environment schemes found that 46% of studies found few or no benefits associated with the scheme.

REPS addressed the protection and maintenance of field and watercourse margins by incorporating a number of measures (1, 2, 3, 5, 6, 9, SM4). Measures involving field and watercourse margins affect almost all farmers who join REPS. Despite this, little empirical research has been undertaken in Ireland examining the effect these measures have on biodiversity and environmental factors such as water quality.

Field margin measures are a popular option in agri-environment schemes. However, most research on field margins to date has been conducted on arable systems. Grassland field margins in Ireland are not well researched.

Fencing watercourses to prevent bovine access became mandatory under REPS, for water quality and biodiversity reasons. However, despite being a compulsory measure since the early 1990s, little research has been undertaken in relation to evaluating the effectiveness of such a measure under Irish conditions.

The present study aimed to evaluate the effectiveness of existing field and watercourse margin measures from a biodiversity and water quality point of view. This was achieved through both theoretical and practical studies. The study was a combination of relevant existing Irish and European studies and new knowledge based on an Irish context.

2. Questions addressed by the project:

- Are existing field and watercourse margin measures protecting and sustaining biodiversity and water quality?
- Are there potential new measures which could facilitate increased biodiversity within grassland field margins and watercourse margins on Irish farms?
- How feasible is it to implement and manage newly developed measures in an Irish context?

3. The experimental studies:

This project consisted of a number of concurrent experiments:

Grassland field margin experiment

The field margin experiments investigated a combination of establishment and management methods to enhance botanical and invertebrate diversity of experimental field margins in intensively managed grasslands (over a seven year period).

Three methods of field margin establishment were investigated (fencing, rotavation, or reseeding with a variety of seed mixtures). Subsequent sward management by either continuous grazing, periodical grazing or mowing was tested on a number of margin widths and designs.

The experiments were conducted on a number of sites within the research farm at Johnstown Castle, as well as on eight commercial farms in Wexford and Meath.

Plant abundance and diversity was assessed using quadrats and the Braun-Blanquet scale. Carabid and spider diversity and abundance were sample using pit-fall traps over a number of sampling periods. Earthworm abundance and diversity was assessed using a combination of mustard oil extraction and hand-sorting.

Riparian margin experiment

This experiment assessed the impact of vegetation type and subsequent management on riparian biodiversity. Farms in SE Ireland were selected for study with up to 42 sites being selected. Each site was dominated by grass, scrub or woodland vegetation, and was adjacent to a 1st or 2nd order stream. The abundance and diversity of plants, carabid, spiders, earthworms and small mammals was assessed. Changes in riparian biodiversity as a result of experimental cattle exclusion were also assessed

This final part of the riparian experiment evaluated the impact of cattle access drinking points on in-stream biodiversity and water quality. Variables such as, land-use, stream physical attributes, riparian vegetation etc. were recorded at each of 40 stream sites. Water chemistry measurements (total phosphorus, total nitrogen, ammonium, nitrate, dissolved oxygen, conductivity and temperature) were recorded at each site (up-stream and downstream of each access point), along with details in relation to sediment characteristics. Aquatic insects were sampled using a kick-sampling technique at riffle points up and down-stream of the access points.

4. Main results:

Grassland field margin experiments

Our results highlight that reseeded field margins with a wildflower mixture was the most successful establishment method to enhance plant species richness, with this effect persisting throughout the seven years of the experiment.

Grazing led to a significant, increase in plant species richness and had a positive effect for earthworm abundance and diversity. However, a reduction in grazing pressure resulted in an increase in abundance and species richness of most invertebrate groups studied.

Corner margins were slightly more effective than linear margins in enhancing botanical diversity. Spider species richness also showed a trend towards higher species richness in corner plots compared to linear plots.

Although margin width was not found to significantly influence plant species richness, there was increased herb cover and reduced abundance of noxious weeds in the wider seeded margins.

No single establishment treatment was best for overall invertebrate abundance and richness, as each taxon responded differently. Use of a range of establishment methods and subsequent grazing methods supports the highest diversity and abundance of plants and invertebrates.

Riparian margin experiment.

Our study highlighted the highly modified nature of streamside habitats in many agricultural catchments. Because of this modification there was little difference in the carabid communities between the three vegetation types, despite distinct floristic differences.

Riparian margins were found to be important habitats for a variety of species. Twenty of the 28 known Irish earthworm species, including rare and recently recorded species, were found during the survey of riparian margins highlighting the importance of riparian zones as habitats for earthworms. Riparian margins provide breeding and feeding sites for a number of small mammals. Significantly more mammals were caught in woodland dominated margins as opposed to those dominated by grass or scrub. The diversity of small mammals was lowest in woodland dominated margins. These results highlight the important role riparian margins play in farmland ecology and in agri-foodwebs.

The management practice of fencing agricultural streams at this scale is unlikely to significantly enhance riparian diversity at the farm, or the regional scale.

Removing the disturbance of cattle by fencing is unlikely to enhance the numbers or diversity of riparian specialists, because the colonisation of riparian habitats by specialists is hindered by the low diversity of species in adjacent areas.

Fencing of riparian margins (with no subsequent management) will likely lead to streamside being dominated by woody and scrubby vegetation, rather than grassy vegetation. Our results indicate that this would be unlikely to cause a significant reduction in the number of grassland specialist species. There could however be implications for other taxa (plants, small mammals, spiders etc.).

Our study found that cattle drinking access points did not have a significant impact on stream water quality or biological community structure in the sample of study streams. Cattle drinking access points were unlikely to further impact negatively on water quality in streams where water quality was of Q3 or less.

Complete exclusion of cattle from watercourses might not be the most cost-effective or environmentally effective measure in more intensive agricultural grassland systems, where water quality might already be impacted (\leq Q3).

Heterogeneity of habitats results in greater faunal and floral diversity. REPS riparian management guidelines do not promote heterogeneity of riparian habitats.

5. Opportunity/Benefit:

Details from this study will aid policy-makers with the design of future agri-environment schemes and measures. To date, a measure demonstrated in this study relating to the temporary fencing of field margins to promote biodiversity has been included in the new Agricultural Environment Options Scheme (AEOS).

The results from this study indicate that current AEOS prescriptions in relation to watercourse margins are not fulfilling their full potential in promoting riparian biodiversity. Our results relating to the impact of cattle access drinking points on water quality and biodiversity could help inform policy-makers when designing prescriptions for AE schemes or cross-compliance regulations.

The results from this study will also be of benefit to the scientific community in giving a greater insight into the biodiversity associated with field and water-course margins. A number of species new to Ireland have been recorded during this study. These records will help scientists when trying to map the distribution of certain species.

6. Dissemination:

Main publications:

Fritch, R.A., Sheridan, H., Finn, J.A., Kirwan, L. and Ó hUallacháin, D. (2011) Methods of enhancing botanical diversity within field margins of intensively managed grassland: a 7-year field experiment. *Journal of Applied Ecology*, 48, 3, 551-560.

Ó hUallacháin, D. and Madden, D. (2011) Riparian vegetated margins and small mammal communities: Implications for agri-environment schemes. *Tearmann, The Irish Journal for Agri-Environmental Research*, Vol 8, 15-24.

Ó hUallacháin, D. and Finn, J. (2011) Report from Teagasc Biodiversity Conference "Conserving Farmland Biodiversity: lessons learned and future prospects". *Tearmann, The Irish Journal for Agri-Environmental Research*, Vol 8, 77-90.

Regan, E., Nelson, B., McCormack, S., Nash, R., and O'Connor, J.P. (2010) Can we assess Ireland's insect species diversity and loss. *Biology and Environment*, vol 110b, 109-117.

Madden, D., McCormack, S., Ó hUallacháin, D. (2010) Ground beetles (Carabidae) from field margins in southeastern Ireland. *The Coleopterist* 19(2): 100

McCormack, S. (2010) *Medon apicalis* (Kraatz) (Staphylinidae) new to Ireland. *The Coleopterist*, 19; 102.

McCormack, S. & Guinan, M. (2010) *Oedemera nobilis* (Scopoli) (Oedemeridae) in Co. Waterford. *The Coleopterist*, 19; 103.

McCormack, S., Fritch, R., Madden, D., Leyvastre, A. and Ó hUallacháin, D. (2009) *Bembidion quadrimaculatum* (Linnaeus) (Carabidae) new to Ireland. *The Coleopterist*, 18; 201.

Popular publications:

Over 50 practical, popular and scientific presentations were completed throughout the study. A number of open days were also organized.

A Biodiversity Conference "Conserving farmland biodiversity: lessons learned and future prospects" was organised in Wexford (25th-26th May, 2011). Over 140 delegates registered for the conference and included a mixture of researchers, policy-makers, advisors and farmers (<http://www.teagasc.ie/publications/2011/996/index.asp>).

7. Compiled by: Dr Daire Ó hUallacháin, Dr John Finn.