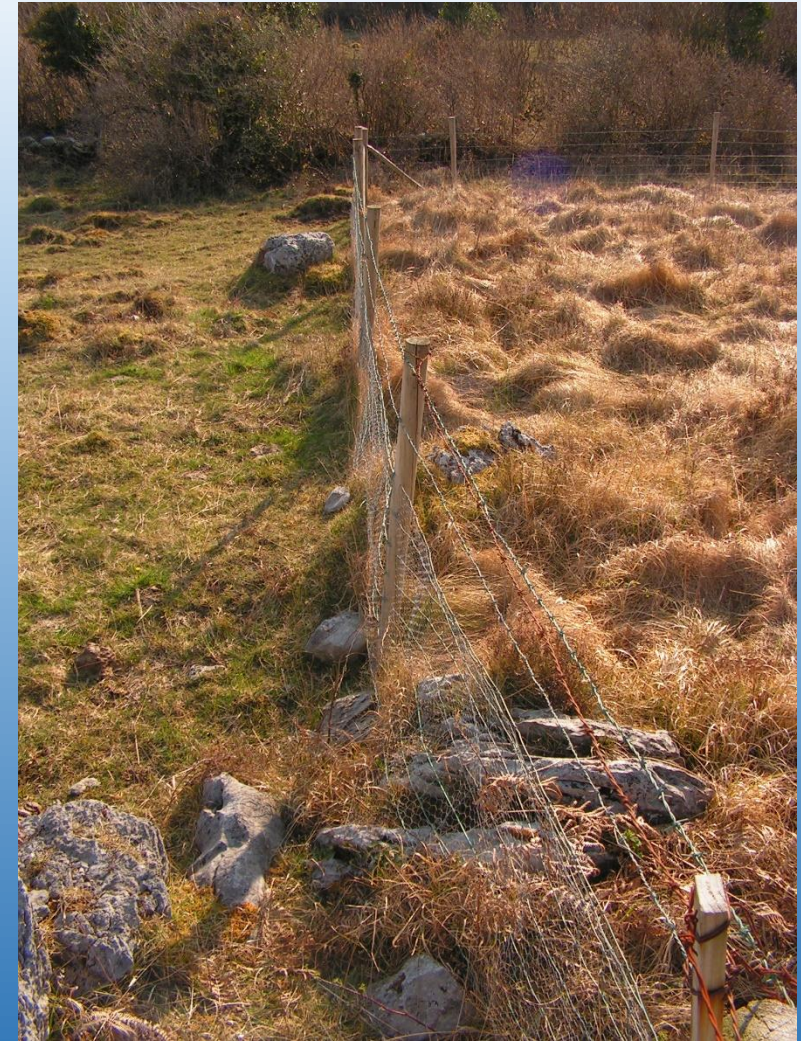


Use of long-term grazing exclosures to investigate effects of abandonment on a range of habitat types

Dr Maria Long MCIEEM
Grassland Ecologist, NPWS



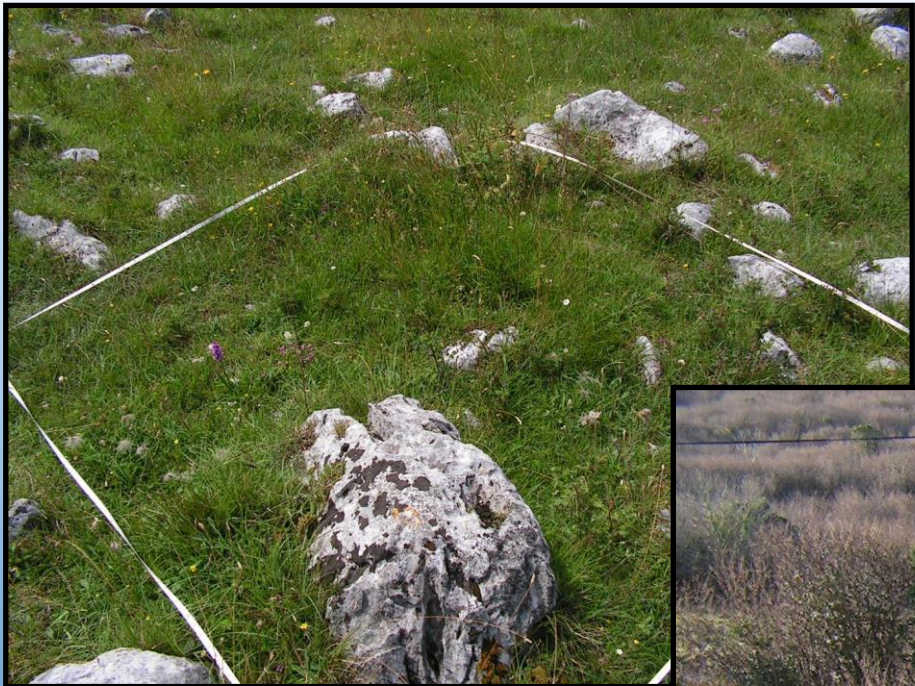
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- Intro to the study sites
- PhD findings
- Findings from the other studies



- Overall key messages, incl. implications for conservation management decisions





Hypothesis: Cessation of grazing will have an effect on biodiversity

Method:
Investigate experimentally
the responses among
plant and mollusc
communities to the
removal of grazing using
fenced enclosures

Main grazers:
Cattle + feral goats



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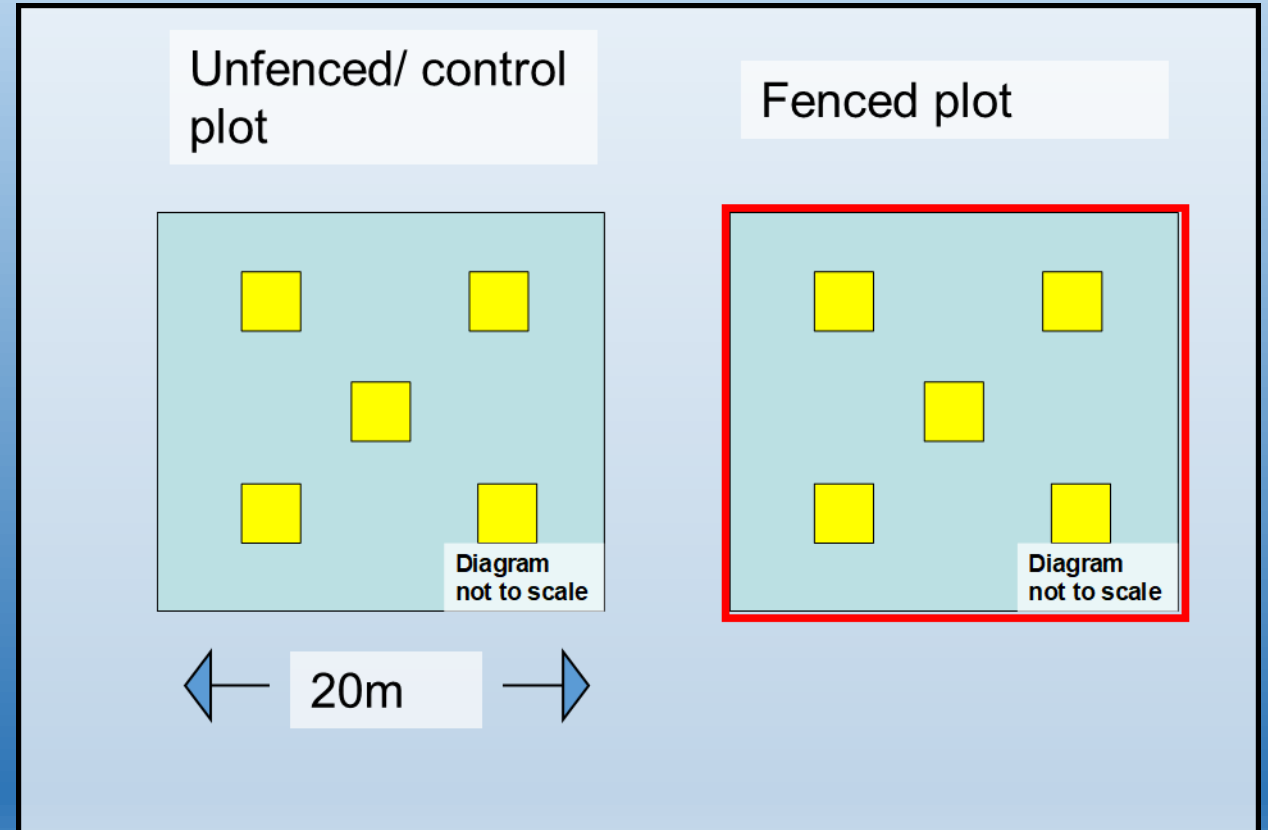
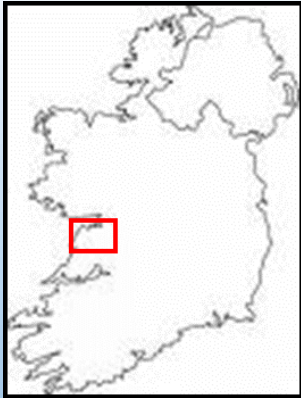
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3 habitats: woodland, scrub and grassland

- Four replicates of each habitat type, so **12 sites** in total





WOODLAND



SCRUB



GRASSLAND



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Studies carried out at the site network:

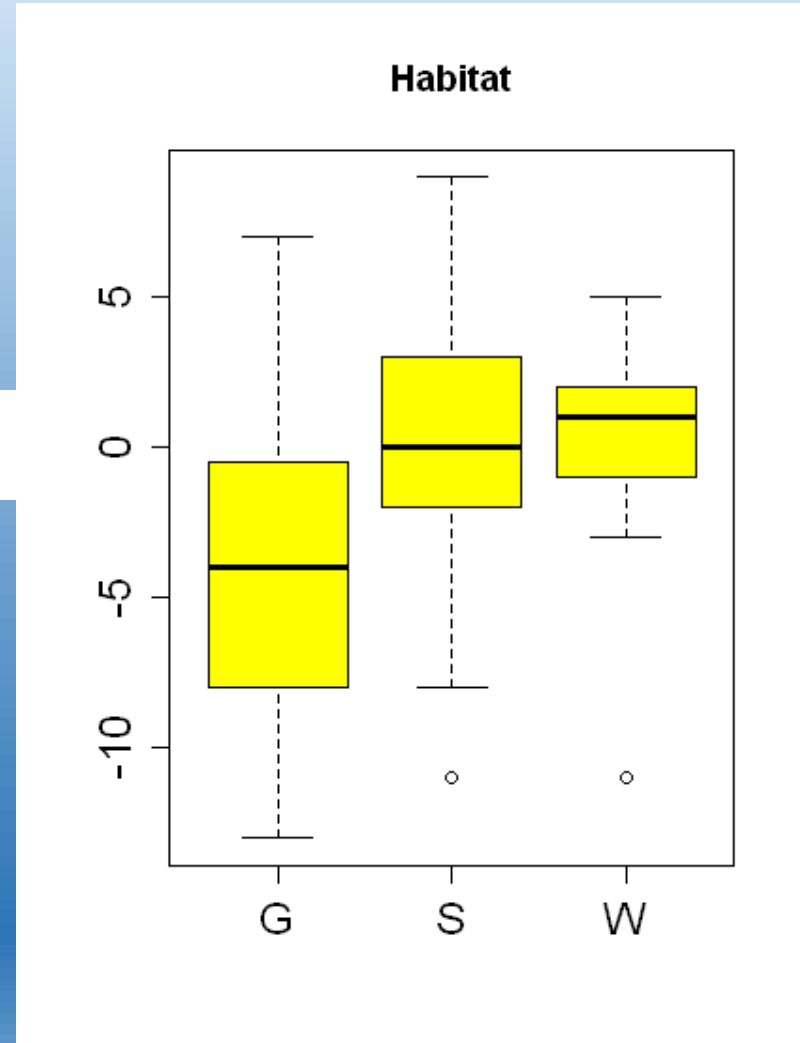
- PhD – all quadrats at all sites (=120) – full plant and molluscan surveys – in both 2006 and 2008.
- Concurrent MSc and undergrad (UREKA) projects:
 - Anthill vegetation – grassland, scrub sites (undergrad, 2007)
 - Soils – all sites (undergrad, 2008)
 - Lichens (on hazel) – scrub, woodland sites (MSc, 2008)
 - Bryophytes – all sites (MSc + undergrad, 2009)
- MSc studies since then:
 - 2012 – grassland vegetation re-surveyed
 - 2013 – woodland (vegetation and molluscs) re-surveyed
 - 2018 – woodland vegetation re-surveyed



PhD - vegetation results

- 144 species recorded overall
(~1,000 native spp. in Ireland)
- 2x2m quadrats: 13-49 species
- 20x20m plots: 42-96 species

Change in
species richness





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Findings: grassland (Slieve Carran)

	Yr 1	Yr 3
F1	3	0
F2	3	0
F3	3	0
F4	3	0
F5	2	0
mean	2.8	0

	Yr 1	Yr 3
C1	3	15
C2	3	10
C3	3	15
C4	3	5
C5	3	15
mean	3	12

Euphrasia agg.
- eyebright



Euphrasia salisburgensis
© Jenny Seawright



Findings: grassland (Slieve Carran)



Rhinanthus minor
Yellow rattle

% cover	Yr 1	Yr 3
F	2	0
C	2	9

Other species similarly lost completely:
Linum catharticum (fairy flax)
Odontites vernus (red bartsia)

- All annuals
- Three of four hemi-parasitic



Molluscan work



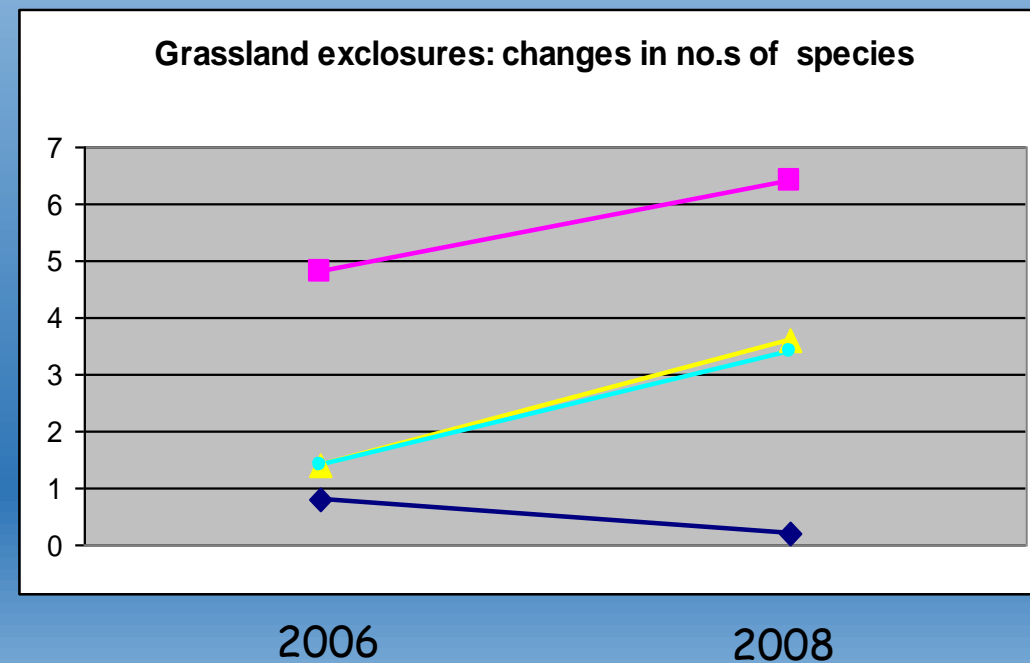
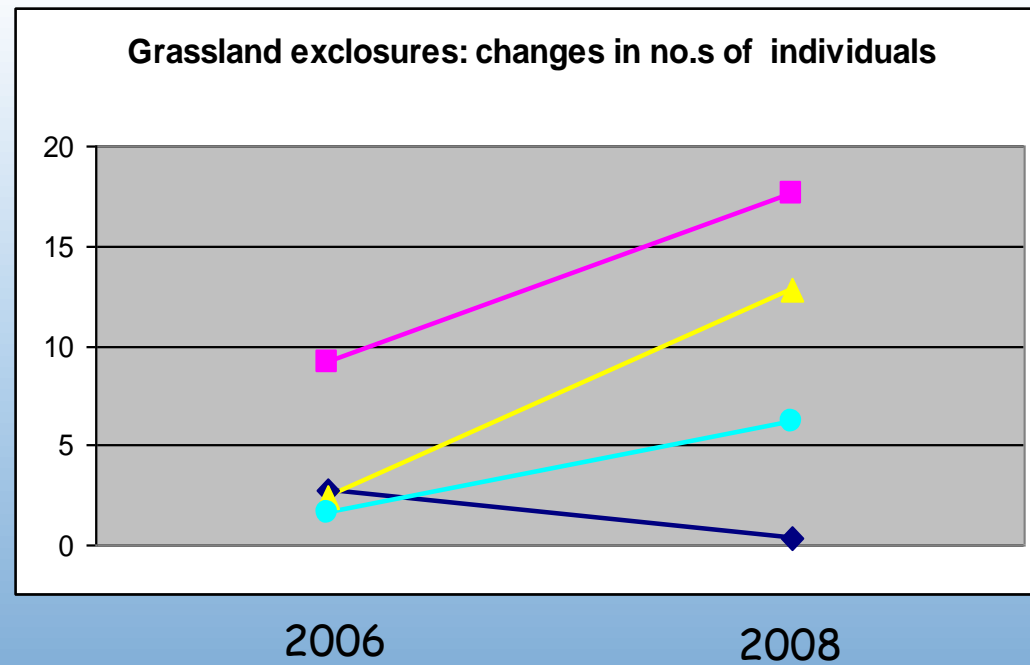
- 30 species recorded overall
- Mean no. snail shells per quadrat: 10
- But... mean no. *live adults* only 2.5
(5 immature, 2.5 long dead)



Grazing exclusion experiment... results

Litter increased by 62% (average) across grassland exclosures

- Site 1
- Site 2
- Site 3
- Site 4



Findings: woodland

Glenquin (or Father Ted's!)

Study site



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Findings: woodland



Ivy (*Hedera helix**) (now *H. hibernica*)

Mean % cover (+/- S.E.)

Fenced plot:

Yr 1: 11.4 (+/- 2.7)

Yr 3: 30 (+/- 5.1)

Control plot:

Yr 1: 34 (+/- 12.3)

Yr 3: 40 (+/- 13.6)

Bare earth

Mean % cover

Fenced plot:

Yr 1: 20.6

Yr 3: 0.8

Control plot:

Yr 1: 20

Yr 3: 11.4



Overall PhD findings ...

Plants:

- **Grassland:** no grazing = bad news for plant biodiversity
- **Woodland:** needs a longer time-scale for study....
but, in short-term:
no grazing = increase biodiversity (herb layer)
- **Scrub:** mixed picture – very heterogeneous habitat!

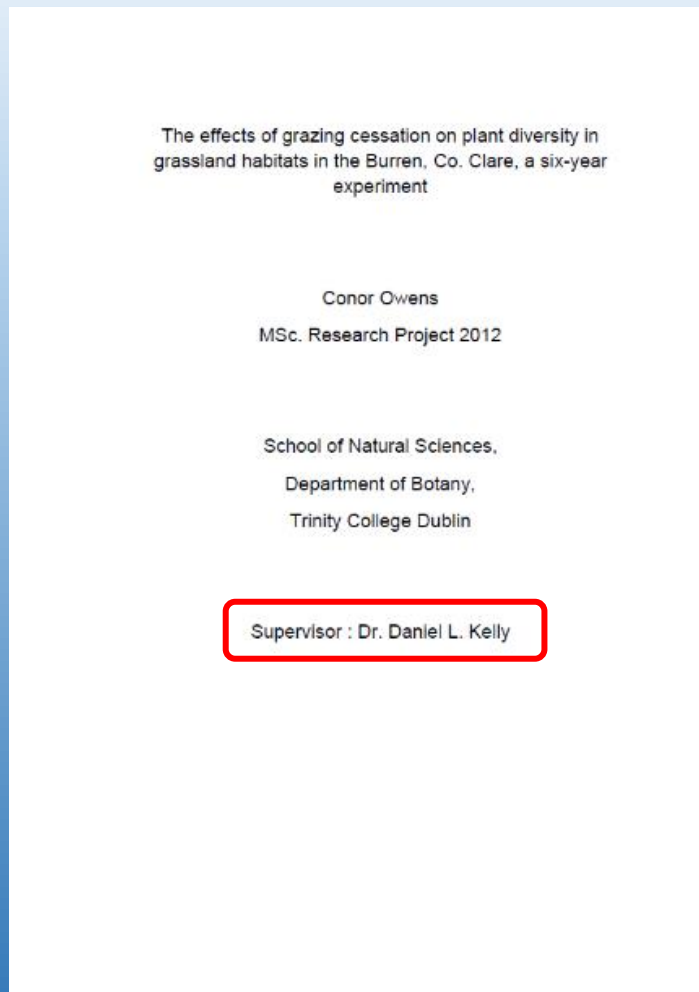


Molluscs:

- **Grassland:** large increase in volume of litter = increase in good mollusc habitat = increase in snails
- **Woodland + Scrub:** effects are more mixed/subtle
(and/or longer-term study needed?)

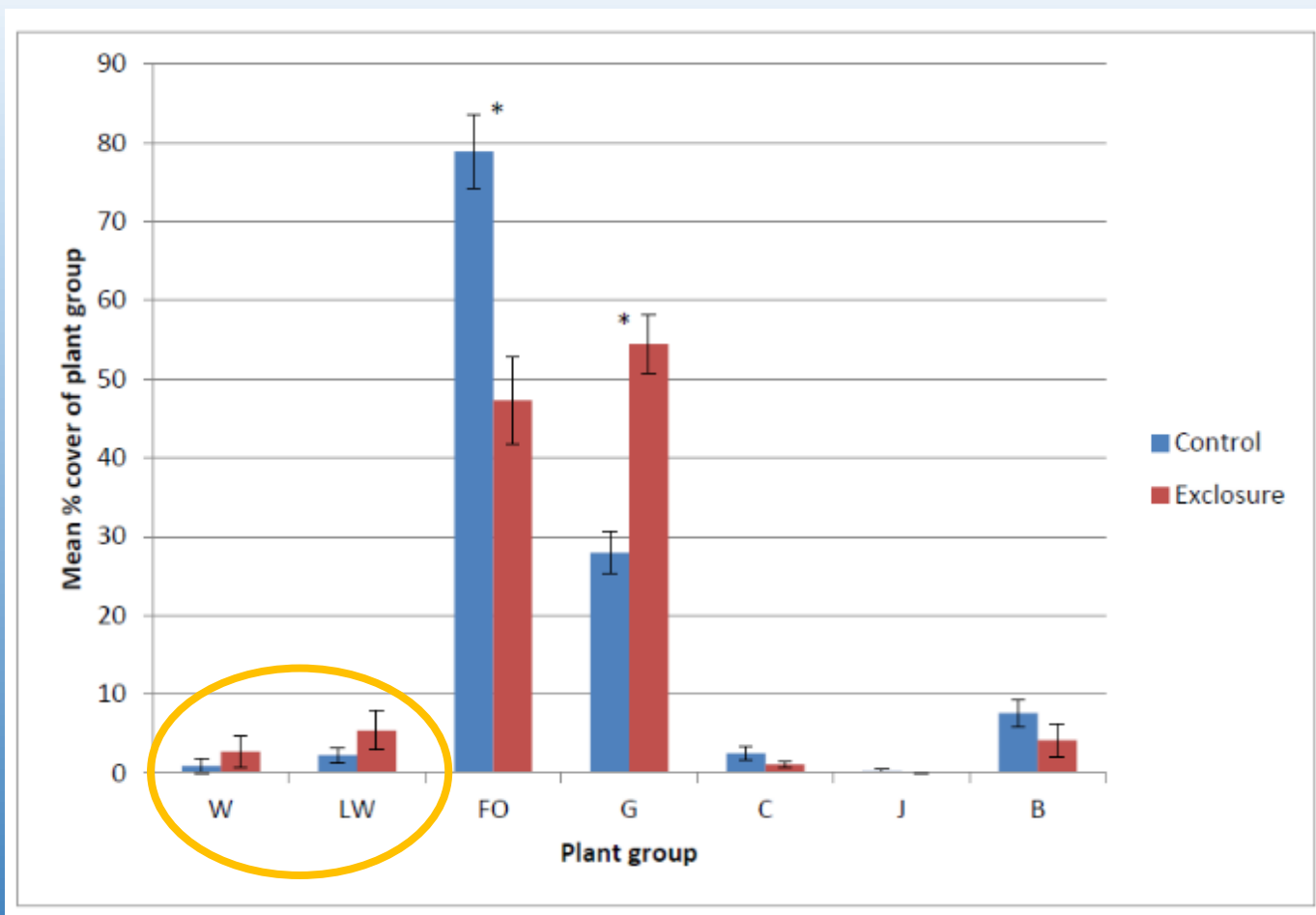


- 2012 – grassland plant diversity MSc
- Six years since plot establishment in 2006
- Four study sites
- Two key questions:
 1. Does abandonment continue to have a negative influence on species richness?
 2. Is abandonment facilitating succession to scrub and woodland?



Fence removed by farmer at one site



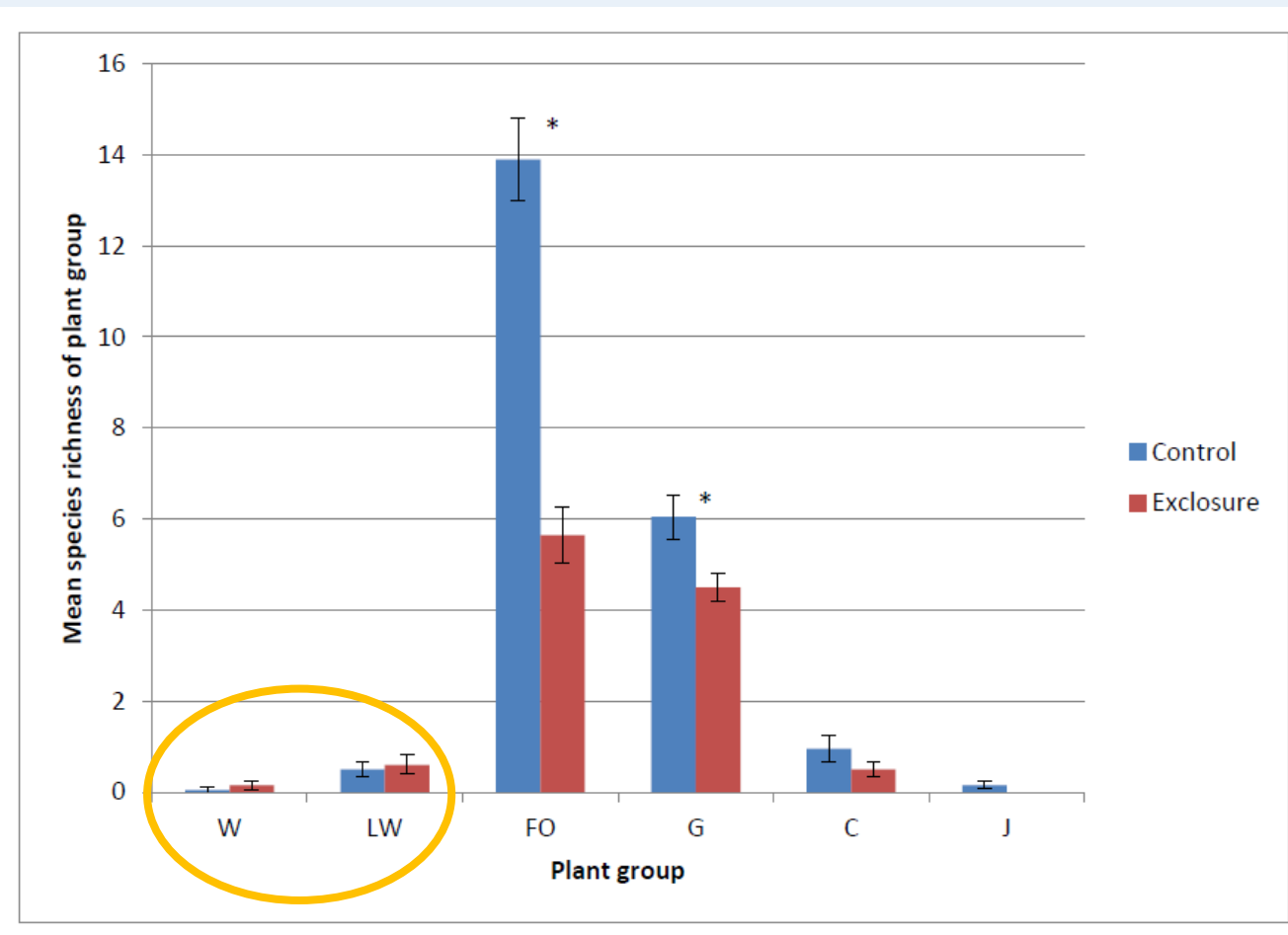


What's driving the differences observed?

= large shift in relative cover of forbs and graminoids

W – woody
 LW – low woody
 FO – forb
 G – grass
 C – Carex
 J – Juncus
 B – bryophyte





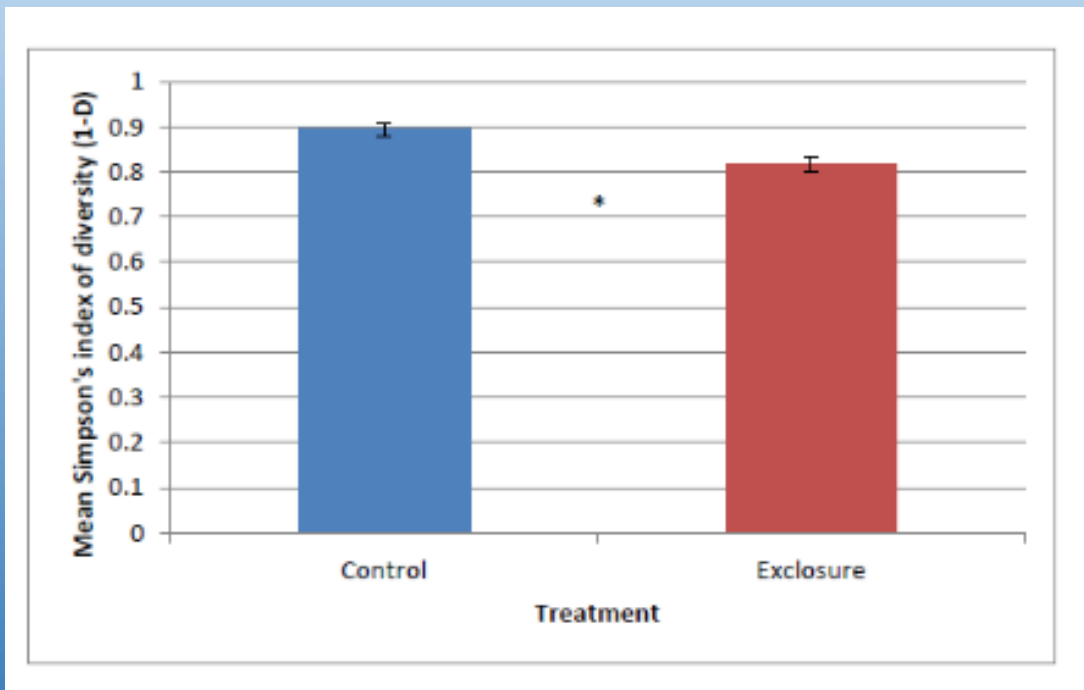
What other differences observed?

= shift in species richness, particularly in forbs and graminoids

W – woody
 LW – low woody
 FO – forb
 G – grass
 C – Carex
 J – Juncus
 B – bryophyte



What other differences observed?
= drop in diversity



Summary –

- Forb diversity and cover both decrease dramatically
- Grass cover increases dramatically, but diversity decreases
- Woody species double in cover and increase (a little) in diversity
- Note – litter not measured during MSc, but noted to be almost 1m deep in places inside exclosures!
- Next steps? Re-survey grasslands – hopefully later this year



Two woodland MSc studies
focused on vegetation –
2013, 2018

**The Effect of Grazing Cessation on Plant Diversity in
Woodland Habitats in the Burren, Co. Clare: A Seven Year
Experiment**



Student Name: Sheila Murphy
Student .Number: 12322519
Supervisor: Dr. Daniel Kelly
MSc Biodiversity and Conservation

**Examining the long-term effects of grazing cessation on vegetation in
woodland habitats in the Burren, Co. Clare**



Maura Dougherty
MSc. Environmental Science

Student Number: 16304917
Supervisor: Stephen Waldren
Word Count: 11,239
2018



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2018 study - 12 years after exclosures erected

Three research questions:

1. Has the removal of grazers had a negative influence on species richness, evenness or diversity?
2. Is tree regeneration affected by grazing cessation?
3. Has the removal of grazers changed the species composition of the woodland communities?



- Species richness significantly lower in fenced plots
 - Similar trend for evenness and diversity, but not significant
- Environmental variables:
 - Height of ground vegetation - significantly greater in fenced plots
 - Moss cover – sig diff – greater in controls
 - Leaf litter - sig diff – greater in controls

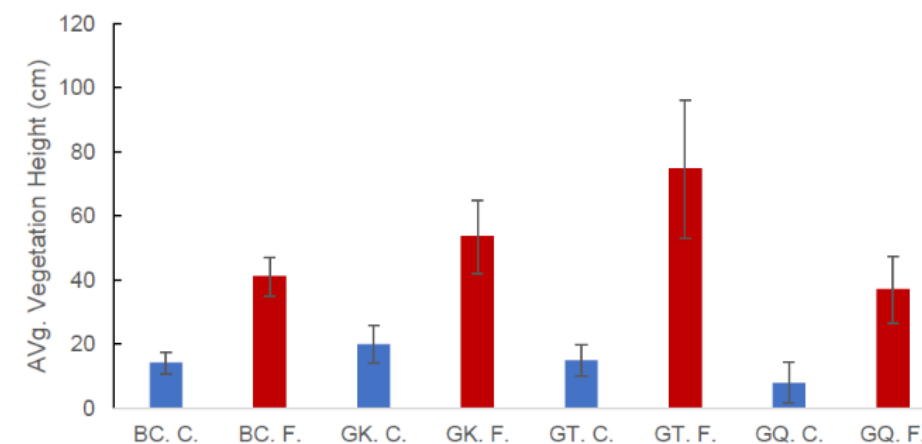


Figure 10: Average vegetation height (cm) for the four woodland sites- Ballyclery (BC), Glencolumbkille (GK), Gortlecka (GT), and Glenquin (GQ)- and the associated site type (C= control, F=fenced). The standard deviation for each grouping was calculated and is seen through the error bars.



Effects on regeneration?

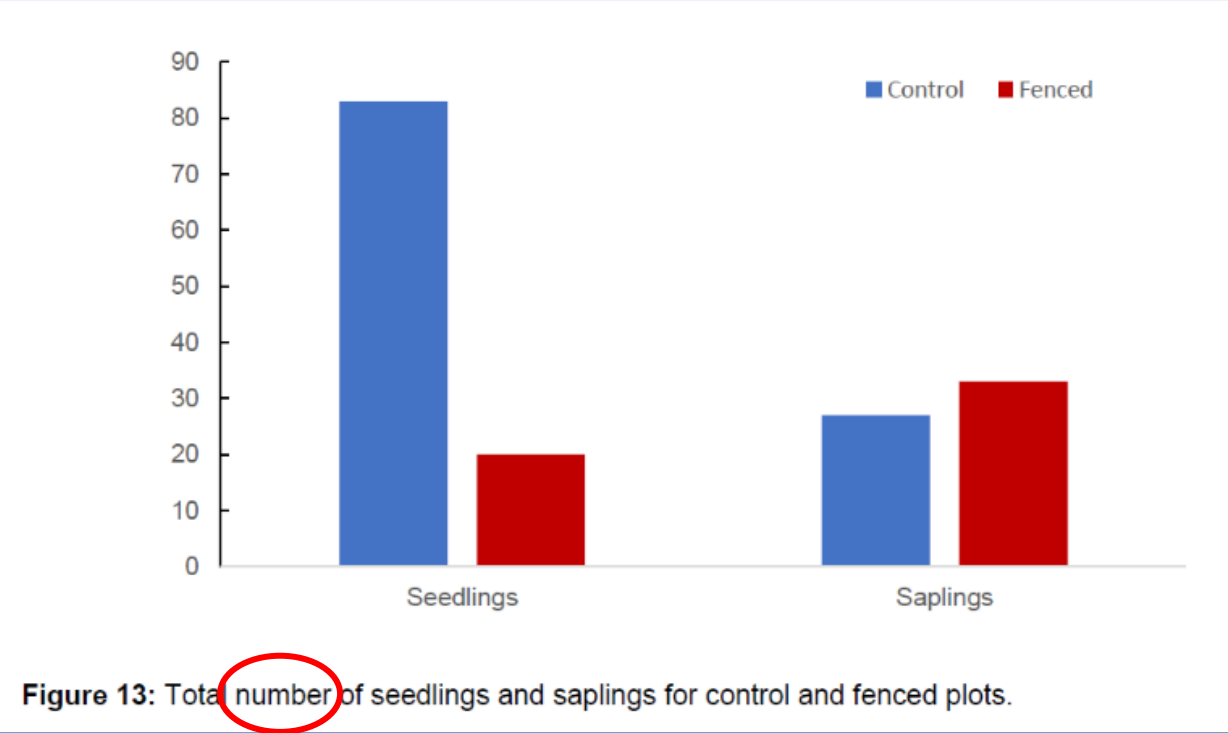


Figure 13: Total number of seedlings and saplings for control and fenced plots.

One site driving seedling pattern (Ash seedlings)

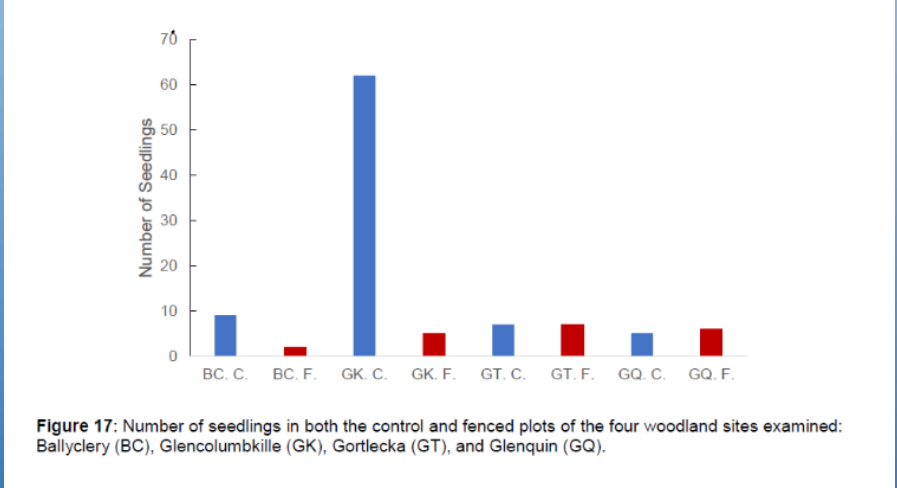


Figure 17: Number of seedlings in both the control and fenced plots of the four woodland sites examined: Ballyclery (BC), Glencolumbkille (GK), Gortlecka (GT), and Glenquin (GQ).



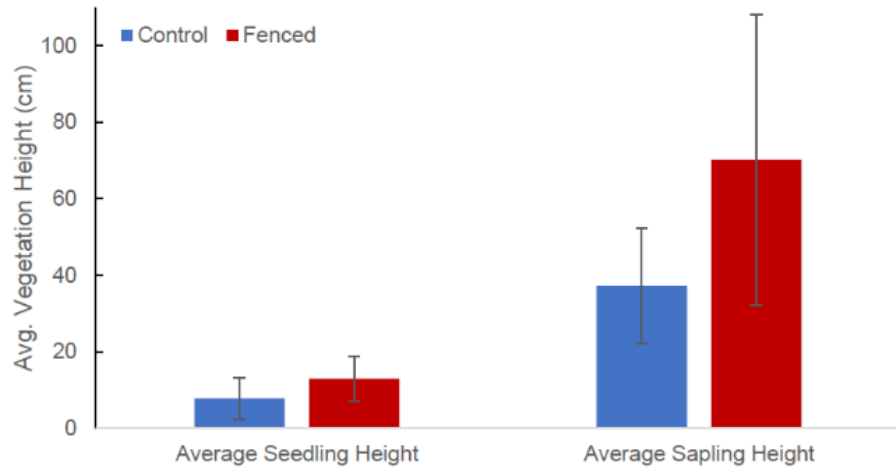
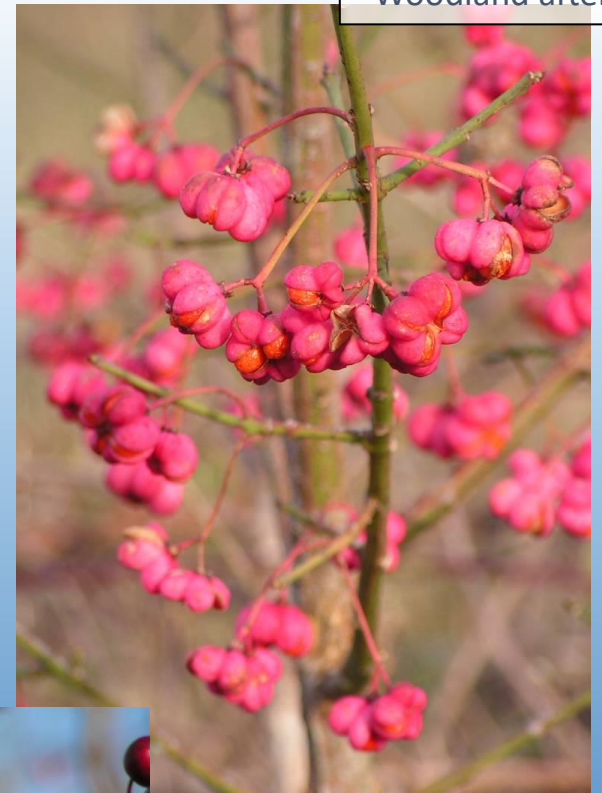


Figure 14: Average sapling and seedling height (cm) for all control (n=20) and fenced plots (n=20)



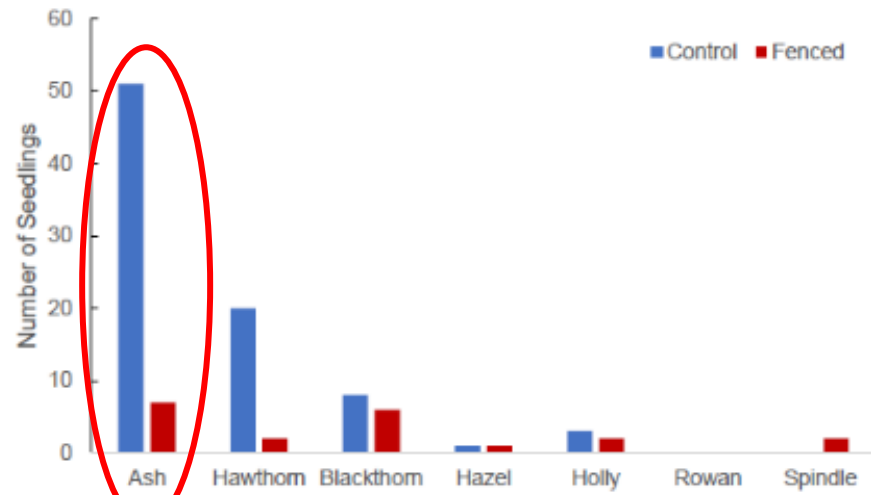


Figure 15: Number of seedlings broken down by species type for 20 control and 20 fenced quadrats examined.

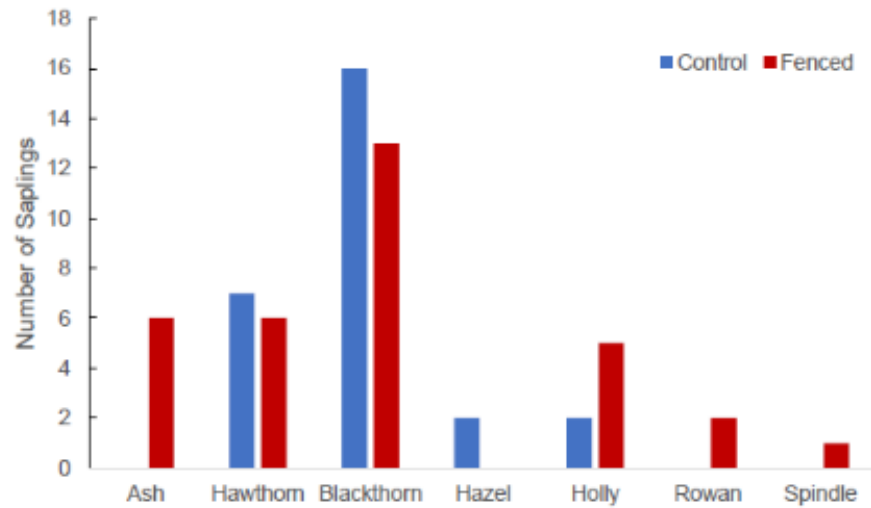


Figure 16: Number of saplings broken down by species type for 20 control and 20 fenced quadrats examined.

Seven species:
 Ash, Hawthorn, Blackthorn,
 Hazel, Holly, Rowan, Spindle

Indicator species analysis was used to identify which species, if any, were 'indicators' of groups of samples (in this case - experimental treatment).

Table 7: Indicator species and associated indicator value and p value for control plots

Species	Indicator value (%)	p*
<i>Veronica montana</i>	30	0.0198
<i>Sesleria caerulea</i>	24	0.0448

Table 8: Indicator species and associated indicator value and p value for fenced plots

Species	Indicator value (%)	p*
<i>Rubus fruticosus</i>	87	0.0002
<i>Hedera helix</i>	77	0.0006
<i>Sanicula europaea</i>	25	0.0448

MRPP- quantify the difference between the suites of species in the control and fenced plots

Low p value, and high negative T => significant difference between the plant communities in the fenced and control plots, and strong separation

Table 9: Multi-response permutation procedure (MRPP) results including the relative distance within the control and fenced groups and between the two groups.

Multi-Response Permutation Procedures (MRPP) Results	
Sørensen (Bray-Curtis) Control Distance	0.792
Sørensen (Bray-Curtis) Fenced Distance	0.5703
Observed δ	0.681
T	-10.19
p	1.40E-07
A	0.0713

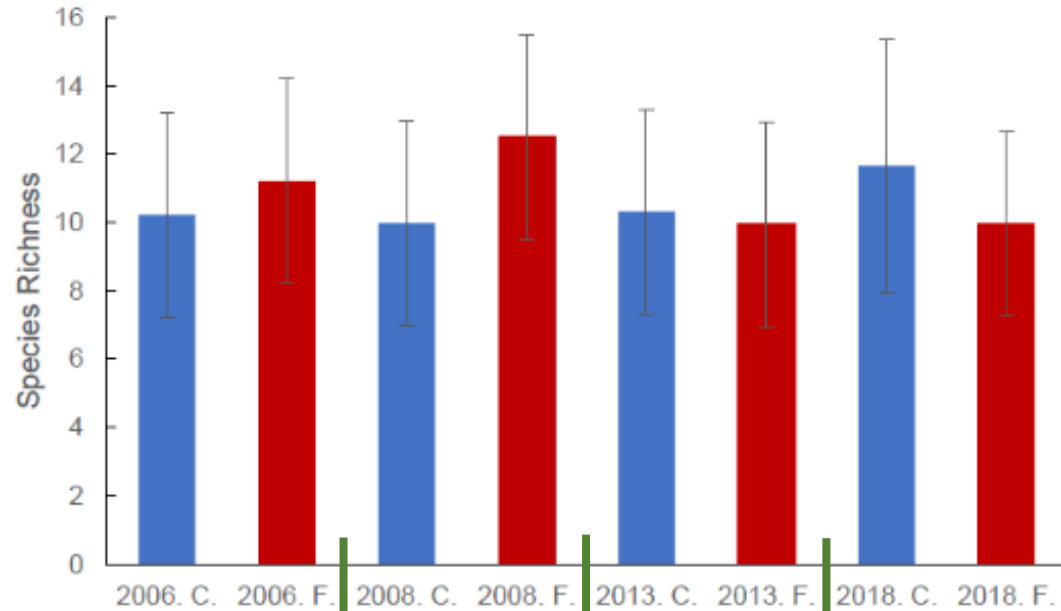


Figure 25: Average species richness in 2006, 2008, 2013, and 2018 in both control and fenced plots with calculated standard deviation for 2018 and a standard deviation of ± 3 for 2006, 2008, and 2013. Control plots are indicated in blue and fenced in red (C=control and F=fenced).





2018



Overall conclusions, each with implications for conservation management decisions:

- Changes can be remarkably quick (e.g. grasslands within two years)
- Outcomes different for different organisms – e.g. plants and molluscs in grasslands
- Study sites on private lands are vulnerable
- Changes need to be tracked over long periods of time (e.g. woodland species richness - initial spike, subsequent decline)
- Nuance is important – no grazing is bad for biodiversity in woodlands, but heavy grazing is also bad
- Scrub – it's complicated! (... watch this space)





Dense-flowered orchid,
Neotinea maculata

Twitter: @GrasslandsIrl

Email: maria.long@chg.gov.ie (soon: @housing.gov.ie)

Website: <https://www.npws.ie/research-projects/grasslands>

PhD thesis download:

<http://www.tara.tcd.ie/handle/2262/77573>

With great thanks to:

- Prof. Daniel L. Kelly – supervisor of most of the projects
- Dr Stephen Waldren – supervisor of M. Dougherty MSc

The MSc students whose work I featured:

- Conor Owens and Maura Dougherty

All the other students who have worked on the plots also!



Spring gentian,
Gentiana verna



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