

Experimental marsh fritillary habitat restoration project Avongovie, Islay





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COMMISSIONED REPORT

Commissioned Report No. 544

Experimental marsh fritillary habitat restoration project Avongovie, Islay

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COMMISSIONED REPORT

Summary

Experimental marsh fritillary habitat restoration project Avongovie, Islay

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Background

2008/9:

- Dunlossit staff gathered *Succisa pratensis* (devil's-bit scabious) seed from roadside verge habitat adjacent to the Avongovie abattoir in October 2008.
- Approx 1/3 of the seed was mixed with sand and sown the same day in four of the plots (see below).
- Approx 1/3 of the seed was sent to Scotia Seeds to test seed viability.
- The remaining seed was retained by Butterfly Conservation for spring sowing in 2009.

2009/10:

- The plots were all checked in late spring 2009. *Succisa* had germinated in of all those sown in the previous autumn (plots 2, 4, 6 & 8). The remaining four plots were sown (1, 3, 5 & 7).
- The plots were checked and minor repairs carried out in February 2010. The *Succisa* seems to be growing well, the largest rosettes from the autumn 08 sowing up to 8cm across.

2010/11:

- The plots all checked on 9th September 2010 and monitored on the 10th.
- *Succisa* plants were found in all plots.
- In some plots *Succisa* growth was vigorous, flowering well, and attracting abundant insect life, including butterflies.

2011/12:

- The plots all checked on 16th August 2011 and monitored on the 17th.
- *Succisa* plants were still present in all plots.
- Browsing of *Succisa* plants by deer was evident in the grazed plots.
- There has been a significant decrease in bare ground and a significant increase in 'other vegetation' since 2010.

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1. BACKGROUND TO THE PROJECT

This project sets out to find out whether 'marsh fritillary habitat' can be created on peatland formerly occupied by exotic conifers. In this case, it is quite possible that prior to the land being planted with conifers, it supported marsh fritillary habitat, which is still present nearby. The project will examine the effect of different sowing times of *Succisa* and the effect of deer grazing.

2. THE EXPERIMENTAL PLOTS

Conifers (approx 30-year old Sitka spruce) were felled in August-September 2008 and extracted to create a wide ride behind the new Avonvogie abattoir. Some brash remained on the site, the surface of which consisted of a highly disturbed wet soil/peat mixture.

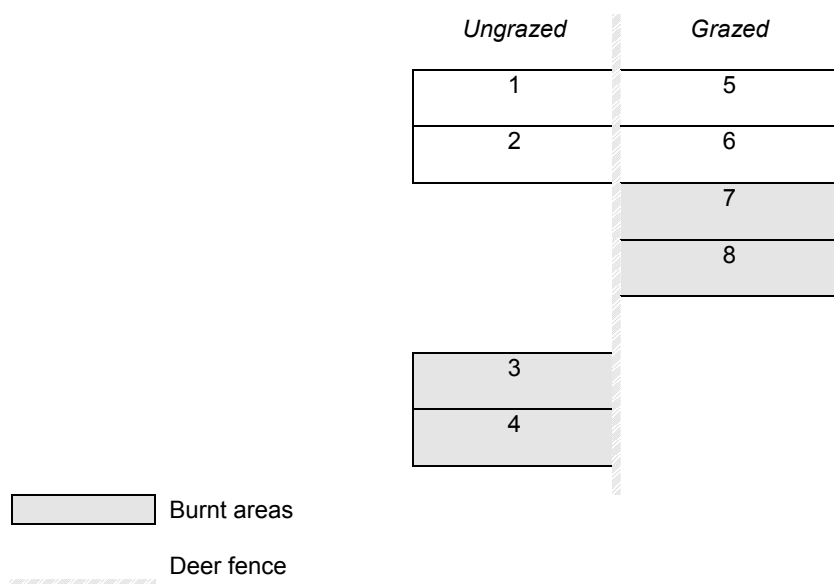
The plots were marked out on 20 October 2008 with stakes and twine, and were arranged on either side of the abattoir boundary fence, thus providing ungrazed and grazed plots (by red and roe deer). The plots consisted of bare peat/mud/water, sparse conifer brash, and small amounts of bryophytes (<1% cover) around the remaining tree stumps.

On both sides of the fence small amounts of conifer brash were burnt during the extraction process. The resulting burnt ground and ash provided an extra treatment in addition to the grazed/ungrazed, and autumn/spring sown treatments.

Thus eight plots (measuring approx 4m by 4m) were established, with the intervening ground acting as an unsown control. Areas of ground with large amounts of brash, or several stumps, or which were particularly wet were avoided.

- 1 Ungrazed unburnt, spring 09 sown
- 2 Ungrazed unburnt autumn 08 sown
- 3 Ungrazed burnt spring 09 sown
- 4 Ungrazed burnt autumn 08 sown
- 5 Grazed unburnt, spring 09 sown
- 6 Grazed unburnt autumn 08 sown
- 7 Grazed burnt spring 09 sown
- 8 Grazed burnt autumn 08 sown

Schematic diagram:



3. SEED COLLECTION & SOWING

Dunlossit staff helped gather *Succisa* seed from roadside verge habitat (occupied by Marsh Fritillary) adjacent to the Avonvogie abattoir on 20th October 2008. 540g of seed was collected.

The seed collected consisted mostly of intact seed heads. Some of these still had petals and the seed was still green, thus perhaps not fully mature. The seed was divided by eye into three.

Approx 1/3 of the seed was mixed with builders' sand to help separate the seed, to help sowing evenly over the plots, and to make it easier to see where seed had been sown. The seed/sand mix was sown later the same day in four of the plots, evenly across each plot.

Approx 1/3 of the seed was sent to Scotia Seeds to test seed viability, and the remaining seed was retained by Butterfly Conservation for over-winter storage to be sown in spring 2009. The seed was kept cool and dry overwinter (in the bottom of a refrigerator).

The final third of seed was sown, again as a seed/sand mix, on 1st May 2009.

4. MONITORING

A brief visit on 29th April 2009 found the plots to be intact after the winter, and *Succisa* to have germinated in the two grazed plots

The plots were all checked on 1st May 2009. *Succisa* had germinated in of those sown in the previous autumn (plots 2, 4, 6 & 8). The remaining four plots were sown (1, 3, 5 & 7)

The plots were checked and minor repairs carried out on 18th February 2010. The *Succisa* seems to be growing well, the largest rosettes from the autumn 08 sowing up to 8cm across. Photographs were taken.

Monitoring of the plots commenced in September 2010.

Each plot was divided into 25 2m x 2m sub-plots

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Five random numbers between 1 and 25 were generated for each of the eight plots using www.random.org (removing duplicates).

PLOT NO.					
1	1	3	6	7	11
2	1	3	19	23	25
3	4	9	13	20	22
4	5	13	16	20	25
5	4	8	10	18	25
6	1	11	21	22	24
7	3	9	12	16	22
8	1	5	12	15	17

The corresponding 2m x 2m squares were then sampled using a quadrat to estimate % cover to the nearest 5% in one of five categories: bare ground/water/tree stump, *Succisa*, *Juncus* spp (rushes), mosses and liverworts, 'other'.

'Other' vegetation in 2011 consisted of:

<i>Calluna vulgaris</i>	ling
<i>Digitalis purpurea</i>	foxglove
<i>Epilobium angustifolium</i>	rose-bay willowherb
<i>Galium saxatile</i>	heath bedstraw
<i>Holcus lanatus</i>	Yorkshire fog
<i>Hypericum sp</i>	St John's wort
<i>Picea sitchensis</i>	Sitka spruce
<i>Plantago lanceolata</i>	ribwort plantain
<i>Potentilla erecta</i>	tormentil
<i>Ranunculus flammula</i>	lesser spearwort
<i>Ranunculus repens</i>	creeping buttercup
<i>Salix capraea</i>	sallow
	grasses
	sedges

In 2011 the percentage cover for the five % cover categories was recorded for the same random squares as in 2010. The records were made on 17th August.

5. RESULTS

The full data from the plots monitored in 2011 are given in Appendix 2, together with the data for 2010.

Comparison of 2010 and 2011 results

The table below shows the mean and standard deviation percentage cover for the 40 samples from the eight plots from 2011, compared to that for 2010.

	Bare ground /water	<i>Succisa</i>	<i>Juncus</i> spp	Mosses	'Other'
2010	16.75 ± 4.88	11.93 ± 3.49	29.63 ± 8.23	29.63 ± 7.80	11.63 ± 4.27
2011	6.88 ± 2.95	9.50 ± 3.57	41.63 ± 9.54	21.38 ± 7.61	22.00 ± 6.04

Since 2010 there appears to have been a decline in bare ground/open water and an increase in *Juncus* and 'other vegetation', as might be expected as the plots mature. There also seems to have been a slight decline in *Succisa* and mosses.

The apparent differences were tested using the Wilcoxon rank sum test via the 'R' statistical package.

A comparison of bare ground/openwater gives a p-value of 0.0003424, and for 'other vegetation' the p-value is 0.0019.

Thus between 2010 and 2011 there was a significant decrease in bare ground/water in the plots, and an increase in 'other vegetation'.

The changes in % cover of *Succisa*, mosses and *Juncus* spp. between 2010 and 2011 were not significant ($p=0.1873$, 0.0591 and 0.0941 respectively).

Comparison of *Succisa* cover

The average percentage cover of *Succisa* under the three treatments was compared, again using the Wilcoxon test.

Grazed and ungrazed plots (plots 1, 2, 3 & 4 and 5, 6, 7 & 8): $p=0.4291$.

There is no difference in the % cover of *Succisa* in the grazed and ungrazed plots.

Unburnt and burnt plots (plots 1,2 5 & 6 and 3, 4, 7 & 8): $p=0.3246$

There is no difference in the % cover of *Succisa* in the unburnt and burnt plots.

Spring and autumn sown plots (plots, 1, 3, 5 & 7 and 2, 4, 6 & 8): $p=0.004456$

There is a highly significant difference between the spring and autumn sown plots.

% Cover of *Succisa*

	Plot numbers	Number of samples	Average % cover	Standard deviation
Autumn 08	2,4,6,8	20	13.75	13.3648
Spring 09	1,3,5,7	20	5.25	7.6906

6. DISCUSSION & CONCLUSIONS

***Succisa* germination**

Succisa rosettes (and larger plants) were found in all plots, showing that the seeds are able to germinate on the bare peat created by the removal of *Picea* trees from the site.

Thus germination was not prevented by grazing, burning or waterlogging, or storage over winter in cool, dry conditions.

Sowing date

The significant difference between the spring and autumn sown plots might be expected, as the autumn plots were sown about six months before the spring plots. This does however show that retaining the seed over the winter and sowing in the spring is not necessary.

The effects of deer grazing

That deer grazing had taken place was evident from the numerous droppings in the grazed plot, and also the vegetation height (although this was not measured). Deer grazing will also almost certainly affect the composition of the vegetation. The grazing of the *Succisa* that was observed this year does not seem to have affected its percentage cover.

Future monitoring

The experiment will have to run for several more years in order to discover whether long-term Marsh Fritillary habitat can be recreated where the land has had one crop of spruce. However the experiment shows that *Succisa* can germinate and grow successfully on newly-disturbed bare peat with very little shelter from the cold and wet. Growth can take place successfully in the presence of deer grazing (although the grazing pressure has not been quantified it is probably relatively light).

The Marsh Fritillary has recently had a good run of years in Scotland, and expanded into Morvern (where it used to occur) and new colonies have been recorded in south Kintyre, Cowal and Bute (Fox *et al.* 2010). There is thus even better potential now for restoring its range and taking advantage of restructured conifer plantations by (re)creating additional habitat. The signs from this experiment are encouraging in that *Succisa* can be introduced easily and cheaply onto former conifer plantation.

Monitoring should continue, perhaps every two or three years, to assess how the population of *Succisa* develops, and in particular, to see if the existing plants (that germinated on bare peat) can propagate via seeds in a maturing and coarsening vegetation (i.e. whether the regular waterlogging or the light deer grazing results in sufficient bare ground for germination).

It will also be very interesting to see if the Marsh Fritillary itself colonises the area.

7. REFERENCES

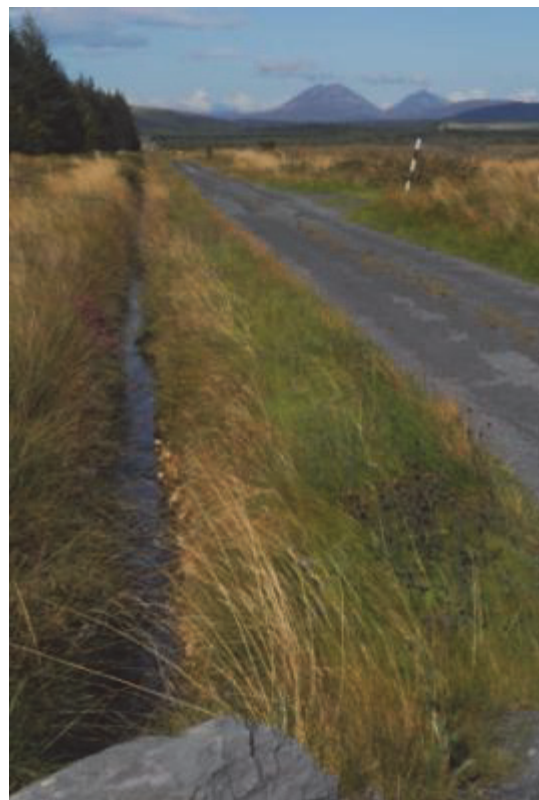
Fox *et al.* 2010. Provisional butterfly distribution maps for 2005-2010. Butterfly Conservation unpublished report, Wareham.

R Development Core Team. 2011. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/>.

APPENDIX 1 – PHOTOGRAPHS



The study site lies to the northwest (left in this photo) of the Avonvogie abattoir.



The roadside verges alongside Avonvogie have supported a small Marsh Fritillary colony for many years (taken Sept 2010).



Study site being cleared on spruce, 20/9/08



The ground flora was minimal, typical of that under dense Sitka (20/9/08)



Study site cleared with most brash burnt and deer fence erected in October 2008 (looking SW, abattoir on the left).



Study site looking northeast (abattoir on the right). Plots marked out with red baler twine.



Dunlossit Estate staff collecting *Succisa* seed from adjacent roadside verge, 20/10/08.



Succisa seed and flowerheads



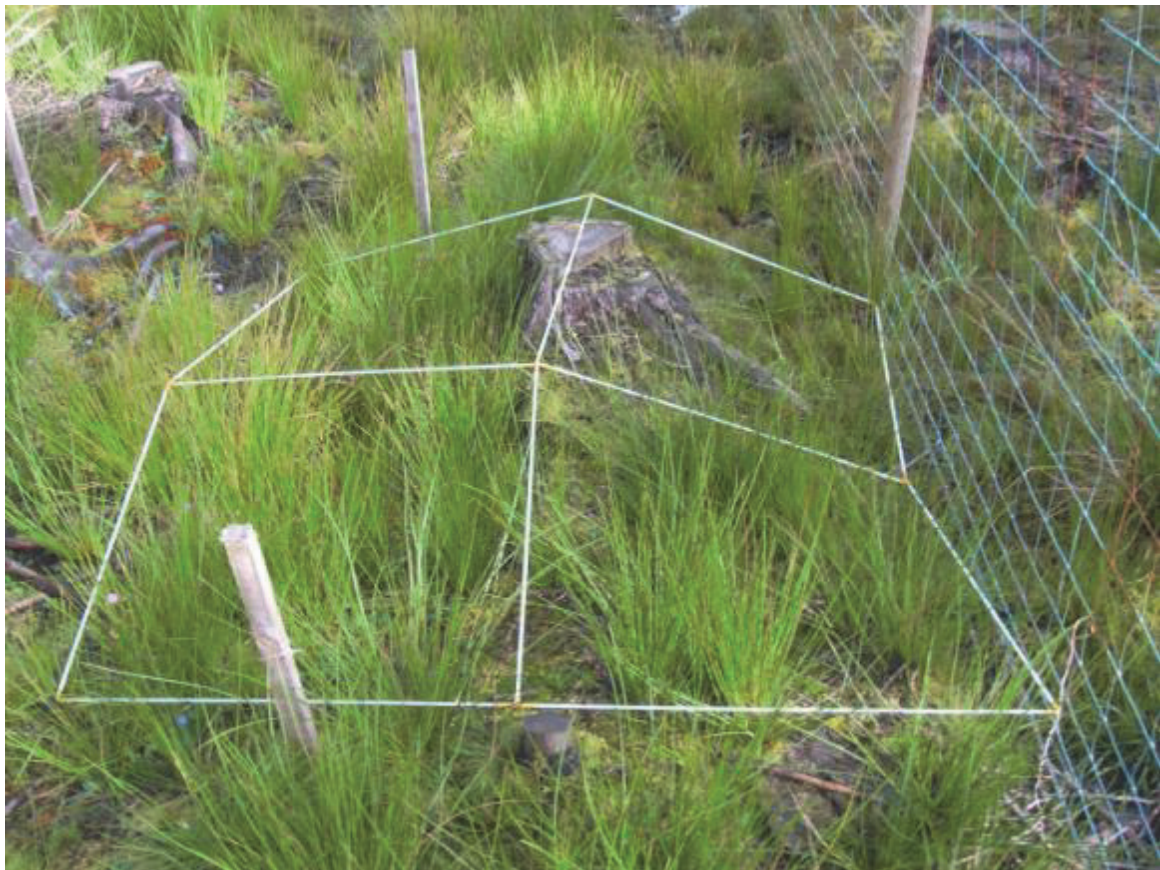
Succisa seeds, sown on 20 October 2008.



Plots 3 & 4 (ungrazed). An area where brush was burnt, also subject to waterlogging (taken Oct 2008).



Plots 5 in September 2010 (Grazed, unburnt)



Plot 7 in September 2010 (Grazed, burnt & waterlogged)



Plot 1, September 2010 (ungrazed, unburnt)



Plot 4, September 2010 (ungrazed, burnt & waterlogged)



Succisa plants flowering and looking healthy (taken Sept 2010).



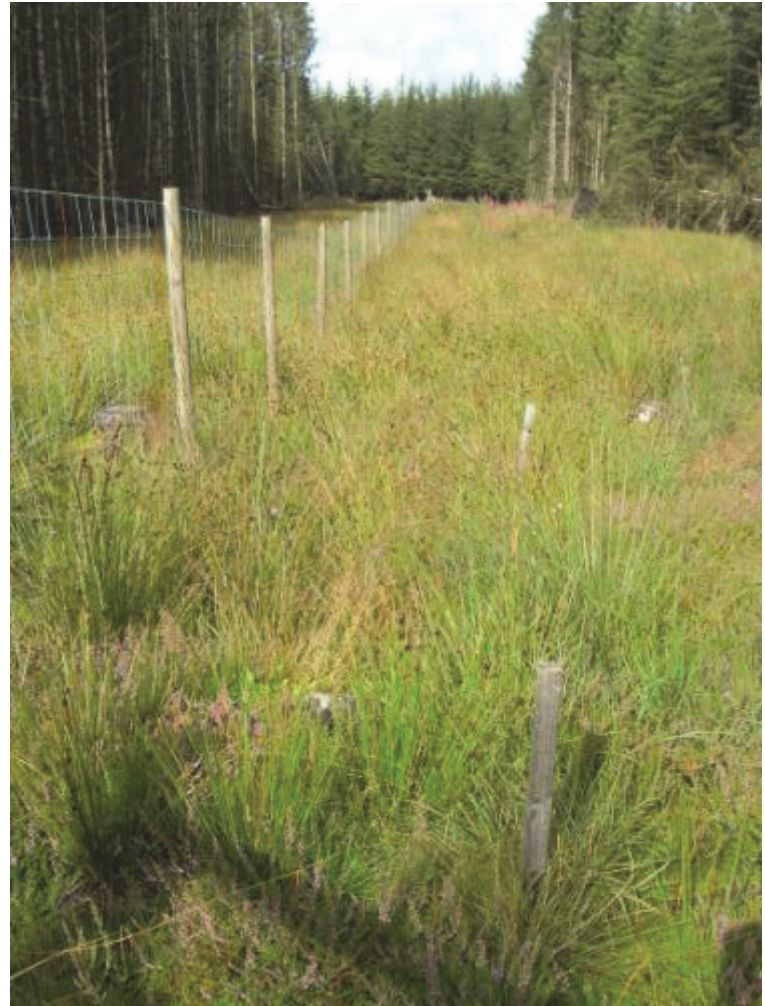
Vigorous *Succisa* a growth in plot 4 (taken Sept 2010).



Salix and *Epilobium angustifolium* growth, plots 3 & 4, 16/8/11



Calluna vulgaris and *Succisa pratensis*, plot 1, 16/8/11



Grazed plots (5,6,7 &8) and ungrazed plots (1,2,3 & 4) showing tall dense *Juncus* (looking north-east, 16/8/11).

APPENDIX 2 – QUADRAT DATA

2011

PLOT NO.	Random square	Bare ground /water	<i>Succisa</i>	<i>Juncus</i> spp	mosses	Other
1	1	0	0	10	70	20
	3	0	0	10	15	75
	6	10	0	5	75	10
	7	10	0	5	70	15
	11	5	0	5	40	50
2	1	0	30	0	40	30
	3	0	0	10	35	55
	19	0	15	10	5	70
	23	0	20	30	5	45
	25	0	5	20	45	30
3	4	5	0	95	0	0
	9	5	5	40	25	35
	13	0	5	80	0	15
	20	0	5	60	15	30
	22	0	30	30	0	40
4	5	0	15	75	0	10
	13	5	10	25	0	70
	16	0	60	10	0	30
	20	20	5	50	0	25
	25	20	0	60	0	20
5	4	0	0	75	15	10
	8	0	20	10	70	10
	10	10	0	5	75	10
	18	0	0	80	10	10
	25	25	10	10	40	15
6	1	25	10	15	30	20
	11	30	5	15	35	15
	21	5	10	85	5	5
	22	5	20	70	5	0
	24	0	10	60	15	15
7	3	0	5	90	0	5
	9	0	5	80	5	10
	12	0	5	85	5	5
	16	20	10	15	50	5
	22	0	5	75	5	15
8	1	30	0	55	0	15
	5	10	15	35	35	5
	12	0	20	65	10	5
	15	20	15	45	0	20
	17	15	10	60	5	10

Recorded 17/8/11

2010 DATA

PLOT NO.	Random square	Bare ground /water	<i>Succisa</i>	<i>Juncus</i> spp	Mosses	Other
1	1	40	0	0	40	0
	3	10	0	5	55	30
	6	30	0	0	65	5
	7	55	5	0	30	10
	11	15	0	0	75	10
2	1	30	10	0	55	5
	3	10	0	15	60	15
	19	10	15	45	15	15
	23	15	15	5	50	15
	25	10	10	10	60	10
3	4	0	30	55	10	5
	9	15	5	75	0	5
	13	0	10	85	0	5
	20	10	10	15	60	5
	22	5	40	40	0	15
4	5	0	50	30	15	5
	13	10	20	45	5	20
	16	0	5	10	0	85
	20	10	10	50	10	20
	25	10	5	75	5	5
5	4	30	2	20	30	20
	8	20	10	5	60	5
	10	10	10	20	55	5
	18	15	25	5	50	5
	25	10	15	20	50	5
6	1	60	5	5	20	10
	11	40	0	5	50	5
	21	10	10	50	15	15
	22	5	10	30	50	5
	24	20	20	20	35	5
7	3	10	10	30	30	20
	9	5	20	45	5	25
	12	10	5	55	25	5
	16	5	5	80	5	5
	22	5	5	5	70	15
8	1	25	0	70	0	5
	5	50	20	10	15	5
	12	0	30	60	5	5
	15	45	15	20	5	15
	17	10	20	70	0	0

Recorded 10/9/10

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