

Introducing red clover *Trifolium pratense* to former arable fields to provide a foraging resource for bumblebees *Bombus* spp. at Dungeness RSPB reserve, Kent, England

Allcorn R.I. Akers P. & Lyons G.

Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2GL, UK

SUMMARY

Hay and cuttings rich in red clover *Trifolium pratense* were added to five former arable fields and established well in four of them (present in over 10% of 2 x 2 m² quadrats).

BACKGROUND

Since the 1950s *Bombus* bumblebees have undergone significant declines both in abundance and distribution throughout the UK. These declines are some of the most severe declines of any group of wildlife in Britain. The short-tongued bumblebees have suffered the least, whilst the long-tongued species have undergone the most severe declines in distribution. Recent studies have revealed the importance of various leguminous plants, especially red clover *Trifolium pratense*, for many bumblebee species. This study describes the spreading of red clover seed and hay rich in clover on former arable land in order to try and increase nectar sources for bees.

ACTION

Study site: The introduction of red clover to provide a source of nectar for *Bombus* bees, was undertaken at Dungeness RSPB reserve (National Grid ref: TR 067185), Kent, southeast England.

Addition of red clover: Two sources of red clover were identified. Originally, hay bales, rich in red clover, were obtained from nearby farms whilst, later, red clover-rich sward was cut and collected on the reserve itself. The bales and cuttings were spread over four former arable fields in July 2000 (Field 24), August 2001 (Field 27) and April 2003 (Fields 31 and 32). These fields were last cropped a year or so before the clover introduction, and still contained patchy bare ground at this time.

Unfortunately, the numbers of hay bales used was not recorded. The origin, and therefore composition, of the hay varied between the compartments. All contained predominantly red clover but others contained varying amounts of other legumes but this was not recorded in a quantifiable manner. The fields were summer grazed by sheep, and more recently also by cattle, each year.

Vegetation monitoring: Monitoring of vegetation was carried out after seeding. The presence of red clover, other key leguminous nectar providing plants and undesirable weed species were recorded in 100 random nested quadrats in each field. Each nested quadrat contained a quadrat of 1 x 1 m and 2 x 2 m (4 m²), thus allowing comparisons of changes in frequency at two spatial scales. Comparisons were first made between the frequency of species in 4 m² quadrats between 2003 and 2006 (using Chi-square tests). If no significant differences were found, a comparison was then made between their frequencies in 1 m² quadrats between these years. This was done because, for example, if a species occurred in 98 out of 100 of the 4 m² quadrats in 2003, then it could have greatly increased in abundance but could still only occur in two more quadrats and therefore show no significant change in frequency. If this was the case, then its frequency in smaller (i.e. 1 m²) quadrats would be much more likely to identify this real increase in abundance. In practice, though, no species showed differences in frequency in the 1 m² or 2 m² quadrats.

Table 1 a-e Comparisons of the frequency of legumes and undesirable weed species in the fields at Dungeness on which red clover and other seed was spread, 2003 and 2006.

Figures show the numbers of 2 x 2 m quadrats in which the species was recorded, unless otherwise shown. * indicates the figures refer to comparison between the number of 1 x 1 m quadrats in which the species was recorded.

Pluses indicate a significant increase between 2003 and 2006: + = P<0.05, ++ P<0.01, +++ = P<0.001

Minuses indicate a significant decrease between 2003 and 2006: - = P<0.05, -- P<0.01, --- = P<0.001

Field 24A (spread in July 2000)

Species	% of quadrats in which present		Significant difference in frequency between years?
	2003	2006	
Legumes:			
Red clover <i>Trifolium pratense</i>	26	44	+
White clover <i>Trifolium repens</i>	84	65	
Bird's-foot trefoil <i>Lotus corniculatus</i>	5	5	
Meadow vetchling <i>Lathyrus pratensis</i>	3	25	+++
Tufted vetch <i>Vicia cracca</i>	0	1	
Common vetch <i>Vicia sativa</i>	21	43	++
Undesirable weeds:			
Creeping thistle <i>Cirsium arvense</i>	87	61	-
Spear thistle <i>Cirsium vulgare</i>	10	2	-
Common ragwort <i>Senecio jacobaea</i>	5	6	

Field 24B (spread in July 2000)

Species	% of quadrats in which present		Significant difference in frequency between years?
	2003	2006	
Legumes:			
Red clover <i>Trifolium pratense</i>	18	56	+++
White clover <i>Trifolium repens</i>	92	98	
Bird's-foot trefoil <i>Lotus corniculatus</i>	1	0	
Meadow vetchling <i>Lathyrus pratensis</i>	8	24	++
Tufted vetch <i>Vicia cracca</i>	13	18	
Common vetch <i>Vicia sativa</i>	10	33	+++
Undesirable weeds:			
Creeping thistle <i>Cirsium arvense</i>	91	94	
Spear thistle <i>Cirsium vulgare</i>	12	5	
Common ragwort <i>Senecio jacobaea</i>	4	36	+++

Field 27 (spread in August 2001)

Species	% of quadrats in which present		Significant difference in frequency between years?
	2003	2006	
Legumes:			
Red clover <i>Trifolium pratense</i>	55	90	++
White clover <i>Trifolium repens</i>	75	26	---
Bird's-foot trefoil <i>Lotus corniculatus</i>	2	3	
Meadow vetchling <i>Lathyrus pratensis</i>	8	36	+++
Tufted vetch <i>Vicia cracca</i>	10	14	
Common vetch <i>Vicia sativa</i>	17	67	+++
Undesirable weeds:			
Creeping thistle <i>Cirsium arvense</i>	94	37	---
Spear thistle <i>Cirsium vulgare</i>	18	0	---
Common ragwort <i>Senecio jacobaea</i>	15	27	

Field 31 (spread in April 2003)

Species	% of quadrats in which present		Significant difference in frequency between years?
	2003	2006	
Legumes:			
Red clover <i>Trifolium pratense</i>	34	11	++
White clover <i>Trifolium repens</i>	25	22	
Bird's-foot trefoil <i>Lotus corniculatus</i>	22	54	+++
Meadow vetchling <i>Lathyrus pratensis</i>	0	10	++
Tufted vetch <i>Vicia cracca</i>	1	1	
Common vetch <i>Vicia sativa</i>	0	0	
Undesirable weeds:			
Creeping thistle <i>Cirsium arvense</i>	90	55	--
Spear thistle <i>Cirsium vulgare</i>	43	38	
Common ragwort <i>Senecio jacobaea</i>	0	10	++

Field 32 (spread in April 2003)

Species	% of quadrats in which present		Significant difference in frequency between years?
	2003	2006	
Legumes:			
Red clover <i>Trifolium pratense</i>	25	2	---
White clover <i>Trifolium repens</i>	97	48	---
Bird's-foot trefoil <i>Lotus corniculatus</i>	17	19	
Meadow vetchling <i>Lathyrus pratensis</i>	15	15	
Tufted vetch <i>Vicia cracca</i>	5	3	
Common vetch <i>Vicia sativa</i>	0	0	
Undesirable weeds:			
Creeping thistle <i>Cirsium arvense</i>	98	90	
Spear thistle <i>Cirsium vulgare</i>	54	19	---
Common ragwort <i>Senecio jacobaea</i>	19	0	---

A large number of quadrats were necessary due to the patchy distribution of these leguminous species. Limiting recording to these few key species made monitoring of individual quadrats relatively rapid, and this could be carried out by volunteers with relatively little botanical expertise. The quadrat surveys were undertaken between the 22 July – 13 August 2003 and between 5 - 20 July 2006. Common vetch *Vicia sativa* was difficult to detect in 2003, as it had mostly finished flowering and died back and could only be found by the presence of its characteristic spirally black dried pods.

No vegetation monitoring was undertaken prior to spreading, although it is almost certain that very little, if any, red clover was present in any of the fields prior to seeding.

CONSEQUENCES

The frequencies of leguminous nectar plants and undesirable weed species in the fields are shown in Tables 1a-e.

Overall, red clover and other legumes established well on the former arable fields. It is, though, impossible to know whether the seed of these species was introduced amongst hay or already present in the seedbank. Most leguminous species increased in abundance between 2003 and 2006, apart from in Field 32, where both red and white clover *Trifolium*

repens decreased in abundance over this period. Creeping thistle *Cirsium arvense* was abundant in all fields, but tended to decrease in abundance or remain at a similar level between 2003 and 2006. Common ragwort *Senecio jacobaea* (an undesired species due to toxicity to livestock) increased in two fields and declined in one over the same period.

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