

Digging scrapes to enhance silver-studded blue *Plebejus argus* habitat at Broadcroft Quarry, Isle of Portland, Dorset, England

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SUMMARY

Scrapes totalling 0.2 ha were dug and the excavated material was used to create windbreaks in an attempt to enhance silver-studded blue butterfly *Plebejus argus* habitat at a quarry in southern England. Populations of silver-studded blue and small blue *Cupido minimus* butterflies increased over the next two years; however, it is unclear whether management alone and/or recent favourable weather in winter and spring was responsible for these increases. The scrapes led to re-colonisation by black ants *Lasius alienus* and an increase in the silver-studded blue's foodplant, bird's-foot trefoil *Lotus corniculatus*.

BACKGROUND

The silver-studded blue *Plebejus argus* has a restricted distribution in the UK, but can occur in large numbers on suitable heathlands calcareous grasslands and within dune systems. Overall, the silver-studded blue has undergone a major decline throughout most of its range in the UK in the last 50 or so years.

Recently in Dorset (southern England), transect walks at ten sites showed significant declines in silver-studded blue populations at eight of these. Two sites which showed increases had some habitat management, mainly ride edge cutting of heather *Calluna vulgaris* and bell-heather *Erica* spp.

Ants are essential in the silver-studded blue life-cycle. The chrysalis is tended by black ants *Lasius alienus* in the spring, sometimes in their nests, and the adult butterfly is assisted by the ants as it emerges. Encouraging ants requires large areas of sparse grassland and bare ground where the sun can warm the soil.

This study describes how digging scrapes at Broadcroft Quarry, a calcareous site in Dorset, has provided habitat for the ants, thus enhancing breeding conditions for the silver-studded blue.

ACTION

Study site: Broadcroft Quarry on the Isle of Portland, Dorset, contains the second largest

colony of silver-studded blue butterflies in England. It is considered of particular importance to conserve the silver-studded blue at Broadcroft as the Portland colonies are considered a distinct 'Cretaceous' form of the butterfly.

It is an infilled quarry (5.5 ha) capped mainly with limestone and some clay, with an herb-rich flora typical of calcareous grassland. A total of 28 species of butterfly and over 140 flowering plants and grasses have been identified at the site. The nationally declining small blue butterfly *Cupido minimus* is also present at Broadcroft. This species requires short vegetation and disturbed ground for its larval food plant kidney vetch *Anthyllis vulneraria*, to establish and thrive. In 1994, 4.5 ha was set aside as a Site of Special Scientific Interest and it is currently managed by Butterfly Conservation.

Fixed point photography records have shown that over the past 10 years Broadcroft has been slowly losing its bare ground, thus suitable breeding habitat for the silver-studded blue has reduced in area. This has been due to the spread of bramble *Rubus fruticosus*, Clematis spp., and coarse grasses (false oat grass *Arrhenatherum elatius*, false brome *Brachypodium sylvaticum* and several larger fescue *Festuca* species). These plants had shaded out the larval food plant, bird's-foot trefoil *Lotus corniculatus*, and made conditions unsuitable for ants. The spread of the non-native *Cotoneaster horizontalis* is also a threat to the open, short, flora-rich sward.

Digging scrapes for ants and herb colonisation: The limits of the two silver-studded blue colonies on the site were accurately mapped from 1994 to 2003.

It is difficult for volunteers to dig out scrapes manually. Therefore in January 2003, a 13-tonne, 360° slew bucket excavator was used to dig out 26 scrapes within these colony boundaries totalling 0.2 ha in area. Alaska Environmental Contracting was responsible for excavation operations. They followed colour spray marks set by Butterfly Conservation as a guide to scrape boundaries. Their positioning meant that none of the more important habitat was damaged. These scrapes, located in two separate parts of the reserve, ranged in size from 3 x 16 m to 30 x 10 m (see Fig.1 for aerial photo of scrape locations). The depth of the scrapes was approximately 10 cm, but they were dug deeper if *Cotoneaster* roots were present in an attempt to locally get rid of this undesired plant. Where *cotoneaster* was

excavated, roots were dug and buried under 1.5 m of earth outside the colony boundaries. The effect of this mechanical scraping was to remove the rich topsoil, thus encouraging the establishment and development of a less competitive, low nutrient-requiring calcareous flora.

In June 2005, percentage cover of vegetation in 1 m² quadrats was monitored in each scrape. Also, four scraped sites and four non-scraped sites of habitat considered ideal for black ants, were compared for ant numbers. Sweet cake (a known ant attractant) was placed at each of the sites and left for 30 minutes. The number of ants was then estimated.

Creation of windbreaks: The shortage of shelter and variable surface topography on this exposed site was considered to affect habitat suitability for silver-studded blues. Therefore, the topsoil removed from the scrapes in 2003 was used to make banks for windbreaks. These

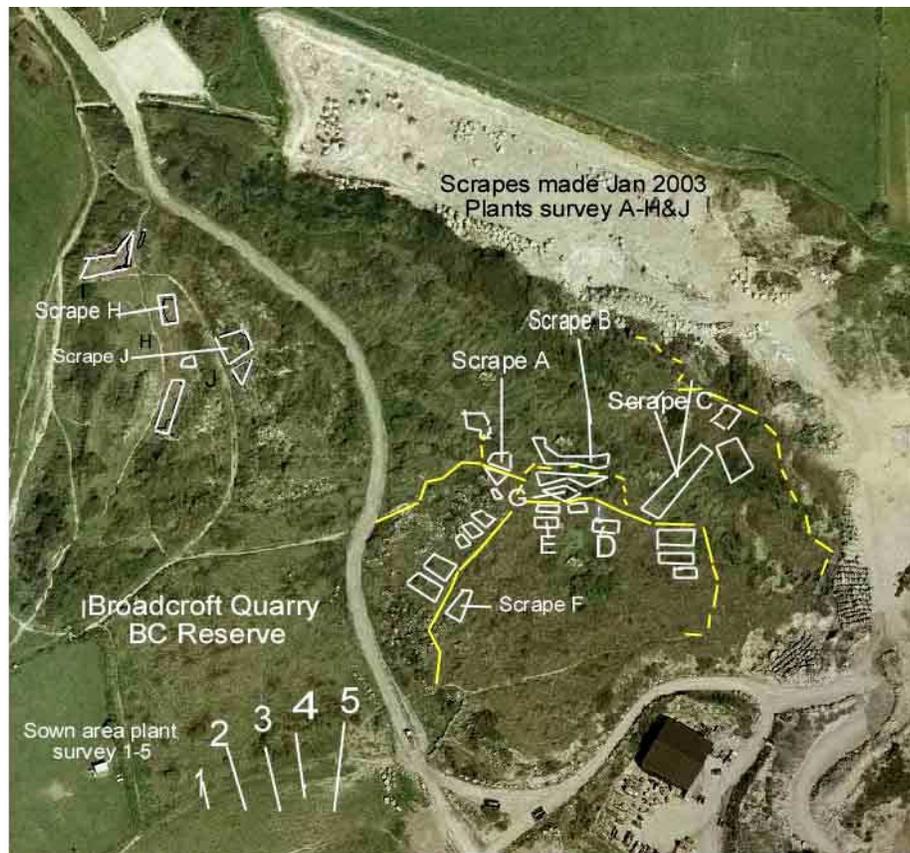


Figure 1. Broadcroft Quarry Reserve and the location of sites where scrapes were dug.

Table 1. Percentage cover of plant species in 1 m quadrats in scrapes at Broadcroft Quarry Butterfly Conservation Reserve in June 2005.

Plant species		Scrape									
Common name	Scientific name	A	B	C	D	E	F	G	H	J	
Grass spp.		7	1	5	15	10	10	5	10	7	
Cinquefoil	<i>Potentilla sp.</i>				5	2			5		
Great burnet	<i>Sanguisorba officinalis</i>	10	2				5				
Plantain	<i>Plantago spp.</i>		2				10	5	5	5	
Scarlet pimpernel	<i>Anagallis arvensis</i>										
Groundsel	<i>Senecio vulgaris</i>					3				5	
Bramble	<i>Rubus fruticosus</i>	2	10	5	3	20	10	10	<1	2	
Kidney vetch	<i>Anthyllis vulneraria</i>	2					5		4	5	
Restharrow	<i>Ononis sp.</i>										
Bird's-foot trefoil	<i>Lotus corniculatus</i>	3	10	10	12		10	3	5		
Black knapweed	<i>Centura nigra</i>										
Rose	<i>Rosa sp</i>						2				
Hawk weed oxtongue	<i>Picris hieracioides</i>			2		2			2		
Mouse-ear hawkweed	<i>Hieracium pilosella</i>					2	2				
Common melilot	<i>Melilotus officinalis</i>										
Yarrow	<i>Achillea millifolium</i>										
Old man's-beard	<i>Clematis vitalba</i>	1	3		15						
Greater bird's-foot trefoil	<i>Lotus pedunculatus</i>										
Prickly sowthistle	<i>Sonchus asper</i>	2	2		2		1		5	3	
Eyebright	<i>Euphrasia officinalis</i>	3	5	2	5				2		
Mayweed	<i>Matricaria sp.</i>			<1					5		
Clover	<i>Trifolium spp.</i>								1		
Black medick	<i>Medicago lupulina</i>	2	2				<1		4	10	
Weld	<i>Reseda luteola</i>	2				<1					
Common sorrel	<i>Rumex acetosa</i>										
Cranesbill	<i>Geranium spp.</i>			<1							
Spear thistle	<i>Cirsium vulgare</i>						2				
Creeping thistle	<i>Cirsium arvense</i>			<1							
Wild carrot	<i>Daucus carota</i>										
Wormwood	<i>Artemisia sp.</i>	4	1				2	2			
Self-heal	<i>Prunella vulgaris</i>										
Centauray	<i>Centaurium sp.</i>										
Milkwort	<i>Polygala spp.</i>			2	7						
Bristly Ox-tongue	<i>Picris echioides</i>		2	3				3	5		
Vipers bugloss	<i>Echium vulgare</i>								5		
Rough hawkbit	<i>Leontodon hispidus</i>			3				1			
Yellow-wort	<i>Blackstonia perfoliata</i>		2								
Buddleia	<i>Buddleja spp.</i>						2				
Daisy	<i>Bellis perennis</i>						<1				
Squinancywort	<i>Asperula cynanchica</i>						<1				

were created within the colony boundaries. Some topsoil was used as a substrate for plants that would provide nectar sources and roosting areas for the silver-studded blue. It had been observed at Broadcroft that the silver-studded blue used plants approximately two feet tall to roost. Surplus earth was deposited 50 m beyond colony boundaries.

A very flat clay area at the south end of Broadcroft, but not within the SSSI, was capped with limestone chippings in 1997. Four windbreaks were created using limestone donated by local staff from Hanson. They were curved, 0.5 m high and 20 m long. The raw limestone encourages establishment of key butterfly food plants like bird's-foot trefoil *Lotus corniculatus*, and kidney vetch *Anthyllis vulneraria*.

Additional scrub control: Since 1994, the Dorset branch of Butterfly Conservation, with funding support from English Nature, has controlled bramble by using hand loppers and a brushcutter. Between 1994 and 1996, Sycamore *Acer pseudoplatanus* and *Buddleia* spp. was cut down in a 1.5 ha area around the silver-studded blue colonies. The stumps were painted with a 2,4-D herbicide, and have not resprouted. No further herbicide was used.

A few patches of scrub have been left as nectar sources and to benefit birds and rabbits. The butterfly colony areas are cleared of brambles annually by Butterfly Conservation volunteers and effort has been concentrated at the scrapes since 2004. Other areas deemed important habitat have been cut every three years. Approximately 1 ha of the reserve (primarily on clay deposits) has never been cut.

Pollard Walk method for butterfly counts:

A fixed 1,060 m transect, divided into seven sections is monitored weekly between April and September. These sections vary in length, habitat type and management type. Transects are walked at a slow steady pace. The number of each species 5 m either side and 5 m ahead of the walker, are recorded on a standardized pro forma. Counts are only made during the day and when certain weather criteria are met (warm, bright, with light winds). In the analysis of transect data, weekly counts for each species are summed to calculate annual indices of abundance, which is an approximation of population size. If a week is missed, then the average between the previous and subsequent week is taken.

CONSEQUENCES

Effect of digging scrapes on vegetation: By 2005, there was no evidence of cotoneaster re-colonisation within the scrapes. There was however, some bramble re-growth, but this was kept under control by annual removal by Butterfly Conservation volunteers. There was an estimated 10% or less bramble cover in seven of eight scrapes surveyed in 2005. If deeper scrapes had been dug originally, this might have reduced the bramble further, but this was not done as there was concern over the amount of clay deeper down and removal of too much calcareous material. A major objective of the scheme was to encourage bird's-foot trefoil (the larval foodplant of silver-studded blue at this site). In 2005 it was present in seven of the eight scrapes monitored (Table 1).

Table 2. Comparison of the number of ants in sites that have been scraped sites with natural habitat at Broadcroft Quarry in June 2005.

	Scraped areas				Natural habitat			
	1	2	3	4	5	6	7	8
Scrape number								
Estimated Vegetation height (cm)	2	2	5	2	3	4	4	5
Bird's-foot trefoil present	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Signs of rabbits	Yes	Yes	Yes	Yes	Yes	Yes		
50 cm perch nearby	Yes	Yes						Yes
Bramble nearby	Yes	Yes	Yes					Yes
Ant numbers	10+	7	20+	7	15	15	7	20+
Part bare ground at or near site	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Effect of digging scrapes on ants: By 2005, bare ground was approximately 50% in scraped areas and ants had recolonised. When scraped areas were compared with 'ideal' habitat, the numbers of ants were slightly less in scraped areas (Table 2). As it was believed that retaining split limestone stone (resulting during topsoil removal) on the scrapes is an important factor for ant colonisation, the contract excavator driver achieved this wherever practicable.

Effect of digging scrapes on the butterfly population: The population of silver-studded blue had dropped from 664 in 1997, to only 39 in 2002. Since then, numbers have increased with 220 recorded in 2005. The small blue population has also increased at Broadcroft. However, these increases of small and silver-studded blue populations have been observed throughout Dorset and may be due to recent dry winters and springs which have benefited over-wintering survival and breeding, rather than a response to habitat management. Figure 2 and Table 3 show the annual population size of silver-studded blue, small blue and common blue butterflies from 1992 to 2005.

Conclusions: The populations of silver-studded blue and small blue butterflies at Broadcroft have been increasing since 2002. However, it is unclear whether it is the management techniques of digging scrapes to enhance habitat and/or recent favourable weather in winter and spring which have led to this. Digging scrapes has certainly led to re-

colonisation by ants and an increase in the silver-studded blue's food plant, bird's-foot

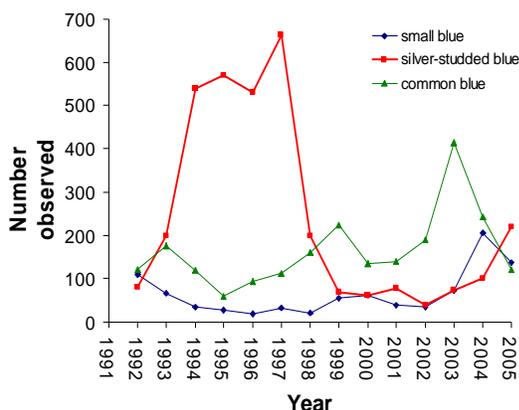


Figure 2. Annual indices of abundance silver-studded blue, small blue and common blue butterflies at Broadcroft Quarry reserve from 1992 to 2005.

trefoil. *Cotoneaster* has also been removed from scrapes but bramble needs annual control to stop its spread. Butterfly Conservation in Dorset is continuing to monitor this site and there is a plan to extend management to a third small colony present, through grass cutting and bramble control.

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Table 3. Annual indices of abundance of silver-studded blue *Plebejus argus*, small blue *Cupido minimus* and common blue *Polyommatus icarus* butterflies at Broadcroft Quarry Reserve, 1992 to 2005.

Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Small blue	110	66	34	28	19	32	20	54	62	38	35	73	206	137
Silver-studded blue	79	200	540	569	530	664	199	69	61	77	39	74	101	220
Common blue	121	177	120	60	94	111	160	225	136	139	190	413	243	121

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