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More case studies from around the globe
Edited by Pritpal S. Soorae

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The restoration of the large blue butterfly to the UK

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Introduction

The large blue butterfly (*Maculinea arion* L, sometimes known as *Phengaris arion*) occurs in small populations across the Palaearctic from England to Japan. With five congeners, it became an iconic flagship species in invertebrate conservation - and one of three initial IUCN global priorities for butterflies - owing to its beauty, extreme rarity and rapid decline, combined with a fascinating life-cycle that involves feeding on *Thymus* or *Origanum* flowerheads for 3 weeks of the larval stage before becoming a social parasite of *Myrmica sabuleti* ant colonies, in whose nests it lives for 11 - 23 months, acquiring 98% of its ultimate weight by preying on ant brood (Thomas & Settele, 2004).

The Large blue has declined across its known range, and is listed as 'Near Threatened' by the IUCN, downgraded from 'Vulnerable' following successful conservation in the UK. In Europe it is 'Endangered' at continental and EU27 scales, and an Annex II (Berne Convention) and Annex II/IV (European Habitats Directive) species. It became extinct in the UK in 1979 despite 50 years' of conservation efforts, but was successfully re-introduced from 1982 onwards, once ecological research had identified the key driver of decline (specificity to the ant *M. sabuleti*, which was disappearing due to agricultural changes) and how to rectify this (Thomas, Simcox & Hovestadt, 2011).

Adult large blue © D. J. Simcox

Goals

- Goal 1: Understanding the species' ecology and population dynamics, and identifying the drivers of decline.

- Goal 2: Identification and targeted habitat management of potential re-introduction sites in the light of Goal 1, including some sub-optimal sites predicted to become optimal under climate warming.
- Goal 3: Self-sustaining (meta-) populations of the Large blue established across landscapes in former regions on restored and newly-created sites.
- Goal 4: Annual monitoring all large blue, food-plant and ant populations by scientists and volunteers plus, on selected sites, monitoring of changes in other UK Biodiversity Action Plan species characteristic of their ecosystem.
- Goal 5: Promotion of public access to selected sites, plus websites, blogs and frequent media cover to promote the project to the wider public.
- Goal 6: Extension of the project to encompass all five threatened species of *Maculinea* across Europe.

Success Indicators

- Indicator 1: Identification of *Myrmica sabuleti* as the large blue's sole host, and the ability to restore high densities of this ant to former sites under new regimes of habitat management.
- Indicator 2: Identification of suitable donor populations of large blue, physiologically adapted to UK environments under current and up-to-2^{o}C warmer climates.
- Indicator 3: Development of methods to rear large numbers of (cannibalistic) large blue larvae for release on restored sites.
- Indicator 4: Establishment of a wide-ranging consortium of statutory and voluntary conservation bodies, land-owners and scientists dedicated to conserving the large blue butterfly as a UK species.

Project Summary

Feasibility: Since the 1920s, early attempts to conserve the UK's declining large blue butterfly populations failed owing to a lack of knowledge of the main driver of decline and to the mistaken identification of other factors, notably butterfly collectors, as the culprits. In the 1960s all interested organizations and land-owners formed a Joint Committee for the Conservation of the Large Blue Butterfly, creating a dedicated consortium to co-ordinate all aspects of the program, which meets twice-yearly and oversees the project to this day. Early surveys located all remaining sites for the butterfly, protecting most from fundamental destruction but failing to stem local extinctions. Ecological research by the Nature Conservancy and the Institute of Terrestrial Ecology (now CEH) in 1972 - 1977 revealed that: (i) large blue larvae survive only with *Myrmica sabuleti* ants rather than with any *Myrmica* species, as had been previously supposed; (ii) *M. sabuleti* had disappeared from most sites due to a relaxation or abandonment of grazing of semi-natural grasslands, causing the turf to grow too tall for this thermophilous ant, which was replaced by morphologically-similar, but unsuitable, congeners. Unfortunately, this information came too late to save the last UK colony from extinction in 1979.

Management experiments on the National Trust's Dartmoor site (X) showed that regulated grazing during spring and autumn, coupled with annual scrub clearances, caused a rapid recovery of *M. sabuleti*. However, physiological

experiments suggested that surviving Large blue populations in Europe consisted of different races adapted to local environments: the next obstacle was to locate a donor population that was both suited to UK conditions and sufficiently large for permission to be granted to export. Laboratory trials suggested that butterflies on Öland (Sweden) were suitable: an initial field trial, made in 1982 by releasing pre-adoption larvae on (the now-enlarged) site X, confirmed both similar survival to the local phenotype in UK *M. sabuleti* nests and an adult emergence that exactly coincided with the narrow window in the UK when *Thymus* is suitable for egglaying (Thomas, Simcox & Clarke, 2009).

Implementation: After encouraging feasibility tests, an increasing number of partners pledged to manage potential sites to restore or create optimum habitat for the Large blue on former UK breeding areas in four of the five historical strongholds for the species: the Cotswolds, Poldens (Somerset), Dartmoor, and the Atlantic coast of Devon and Cornwall (Bourn, 1995; Simcox & Bourn, 2006). Initial progress was slow, with many setbacks when managers struggled to understand or impose the demanding grazing and scrub-clearance regimes, but gained momentum during the 1990s following the establishment of some exceptionally large populations of large blue coupled with an increase in the abundance of other threatened species on managed sites. By 2011, nearly 100 sites were under active grassland management regimes aimed wholly or partly at creating and maintaining large blue habitat, of which about 60 meet the minimum criteria to support the Large blue. A few sites were successfully designed and created 'from scratch' on new railway constructions on Network Rail land; some others are designed to be sub-optimal under current climates but to become optimal in warm years and if UK climates warm by up to 2^{o}C. Other key land-owners include the Somerset and Gloucestershire Wildlife Trusts, the National Trust, the Clarke Trust, Natural England and private farmers subsidized through Higher Level Stewardship Schemes.

Following the restoration of apparently suitable habitat, two further transfers of 245 and 581 large blue larvae were made in 1984 and 1991 from Sweden to three UK sites on Dartmoor, the Poldens and Cotswolds, the last being unsuccessful. Although about 25 new colonies were established through natural spread, long-distant dispersal is rare in this species, so further introductions of 200 - 300 pre-adoption larvae were made to three distant sites in the Poldens (1995 - 2000), to two sites on the Atlantic coast of Cornwall and Devon, and to two Cotswolds sites, using livestock from the burgeoning colonies in the Poldens.

Key to the success of the program to date has been the harmonious collaboration of a wide body of conservationists and scientists, directed by a full-time Project Leader who encourages and instructs participants in appropriate techniques, briefs land-owners and negotiates grants for individual sites, makes new introductions, and so on. The leader is also part of a scientific team studying pure and applied questions arising from the ecology and conservation of this fascinating species. The science arm has been crucial to implementing the program through: (i) generating ever-more precise knowledge of how to maintain populations under current and predicted environmental conditions; (ii) each new

Restored habitat at Collard Hill © D. J. Simcox

discovery generates considerable publicity; (iii) similar initiatives involving all five *Maculinea* species have been established across Europe under the EU Framework projects MacMan and CLIMIT; (iv) contributing substantially to the considerable costs. Other major contributions in funding have come from in-kind contributions made by the above organizations, CEH, and Butterfly Conservation and their volunteers; an annual grant (until 2011) from Natural England (and predecessors); SITA, Lottery and Higher Level Stewardship grants; and limited commercial sponsorship. Nevertheless, dramatically reduced funding is today the main threat to maintaining or expanding the program.

Post-release monitoring: Annual monitoring by scientists and volunteers occurs in the egg or adult stage of the butterfly on all core sites and most (in some years all) peripheral ones. Recent censuses indicate that colonies have been restored or have spread naturally to 38 sites, although some are small and subject to periodic extinctions (and recolonizations if near core populations), following climatically poor (e.g. drought) years or mismanagement. On the other hand, three UK populations are among the largest known worldwide for this 'Near Threatened' species; two populations have flourished unaided for 20 generations to date. Only in the Poldens has a true meta-population been established across a landscape, but proposals to replicate this elsewhere are underway.

Monitoring of *Thymus* and ant populations also occurs annually on most sites, together with change on other species on a subset of sites. This reveals welcome increases, under this targeted management, by a range of other threatened species that are characteristic of these habitats.

Major difficulties faced

- Uncertain and often inadequate funding.
- Frequent changes in land managers necessitating regular training of new staff.
- In one region, efforts have been hindered by a few statutory and NGO officials who have been reluctant to accept the concept of habitat restoration underpinned by scientific evidence. Consequently many potential sites here have continued to suffer a steady decline in biodiversity.

Major lessons learned

- Management decisions have been informed by a scientific understanding of the ecology of the target species and those with which it interacts.
- The project has benefitted greatly from a harmonious multi-disciplinary collaboration of statutory bodies, non-statutory bodies, NGOs and volunteers, encompassing practical and executive conservationists, land-owners, scientists, industrialists, and the media.
- The project – in its modern form - has been running for nearly 40 years and has evolved gradually as lessons have been learnt from successes and setbacks.

Success of project

Highly Successful	**Successful**	Partially Successful	Failure
	√		

Reason(s) for success/failure:

- The large blue is securely re-established in the UK, following extinction in 1979, and supports some of its largest known populations in the world, enabling its global status to be downgraded from Vulnerable to Near Threatened.
- The largest-scale and most successful project to date involving the targeted conservation of a declining IUCN-listed insect.
- The populations established in the Poldens match – or exceed – the largest known historically in the UK, and greatly exceed previous records from Somerset.
- Viable metapopulations of populations have yet to be established across landscapes in three former UK regions, hence a project ranking of 'successful' rather than 'highly successful'.

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