

HISTORY OF ESTABLISHMENT ATTEMPTS WITH THE LARGE COPPER BUTTERFLY *LYCAENA DISPAR* (HAWORTH) (LEP.: LYCAENIDAE)

MARK R. WEBB¹ AND ANDREW S. PULLIN²

¹*Biology Division, School of Sciences, Staffordshire University, College Road, Stoke-on-Trent.,
Staffordshire ST4 2DE.*

²*School of Biological Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT.*

THE LARGE COPPER butterfly, *Lycaena dispar* is famous amongst British lepidopterists as the first documented case of an extinction and subsequent re-introduction in the UK. In fact it has received worldwide attention as the first ever case of active insect conservation (eg. New, 1991; New *et al.*, 1995). Since 1909 (Verral, 1909), there have been numerous attempts to establish *L. dispar* populations, and in particular using the north-west European *L. d. batavus* (Oberthür), in both the UK (see Duffey, 1968) and The Netherlands (see Bink, 1970). However, despite this long history, none of these establishment attempts has resulted in a viable, self-sustaining population, and under the strictest definitions, they can all be considered as having failed.

The longest running attempt has taken place at Woodwalton Fen, now a National Nature Reserve, Cambridgeshire. A population has in effect been resident there since its original introduction in 1927, albeit via the protection of larval stages in some years and regular re-enforcement from captive stock (Duffey, 1968; Duffey & Mason, 1970; Duffey, 1977). However, despite this long history, the lack of any sightings of adults on the reserve in 1994 or 1995 would suggest that the colony resulting from the latest (1987) re-establishment is now extinct (Pullin, McLean and Webb, 1995).

Although insect establishment attempts have been catalogued before, notably by Oates and Warren (1990), no treatment of *L. dispar* has proven comprehensive. In particular we felt that at this stage in *L. dispar*'s conservation history, with preliminary experimental releases in the Norfolk Broads under way, an account of previous attempts should be published, and that is what this paper aims to provide.

All attempts are listed below in chronological order. Necessarily, the amount of detail included for different attempts varies, as this is dependant upon the information provided in the original published (or unpublished) accounts. Unfortunately the majority of establishments have been poorly recorded and monitored, a recurrent problem within the field of butterfly conservation (Oates and Warren, 1990).

1909. Wicken Fen, Cambridgeshire.

G.H. Verral released "a few" *L. d. rutilus* Werneburg larvae, apparently obtained from Captain E.B. Purefoy, who had collected in the Berlin Marshes, Germany. This establishment attempt was in effect a field

experiment, as Verral was interested to see if there was a reversion to the (extinct) English *L. d. dispar* (Haworth) form, once the butterfly was once again present at an English site. The attempt failed and although there are no details available, this was assumed to be because the intended foodplant, *Rumex hydrolapathum* Hudson, was scarce (Verral, 1909; Committee, 1929; Riley, 1929; Ford, 1945; Duffey, 1968).

1913. Greenfields, County Tipperary, Republic of Ireland.

Captain E.B. Purefoy introduced German *L. d. rutilus*, collected from the marshes north of Berlin, into this site, which was a small bog that had been prepared via the planting out of the foodplant, *R. hydrolapathum*. 120 larvae were released in May 1913 and in the summer of 1914 about 400 imagines were also released, having been reared from 700 larvae collected from the same German site. This colony survived until 1936, and no reasons for its demise are given. However an attempt to establish *L. d. batavus* at the same site in 1942 eventually failed (in 1955) because the fen became unsuitable, presumably as the result of hydrosereal succession and subsequent scrub encroachment. Therefore it is possible that this was the reason for the extinction of the original colony of *L. d. rutilus* (Committee, 1929; Ellis, 1951; Duffey, 1968). Interestingly, an adult *L. d. batavus* was recorded in Ireland in 1970, although this was believed to be an escapee that had flown 130 miles from its release site (Heal, 1970). Although this probably was an escapee, it is likely that it was from a source much closer to Heal. The maximum recorded distance moved by adult females in The Netherlands is something in the order of 30 kilometres (van Swaay, *pers. comm.*).

1926. Woodbastwick Fen, Bure Valley, Norfolk Broads.

550 *L. d. rutilus* pupae, of German origin, but obtained from the Irish colony at Greenfields, County Tipperary, were placed in cages at Woodbastwick Fen. Upon eclosion, the imagines were released onto the fen. The colony only survived until 1928, and the attempt was thought to have failed because docks were only to be found along waterways, and were not favoured as oviposition sites by the females (Ellis, 1951, 1965; Duffey, 1968). It is noteworthy that Oates and Warren (1990) recorded that the colony survived until 1931, differing from the 1928 date given in other published accounts.

1927. Woodwalton Fen, Cambridgeshire.

Previous attempts at establishing *L. dispar* in the British Isles had all used *L. d. rutilus* and had all been unsuccessful in the long term. The discovery of *L. d. batavus* in Friesland, The Netherlands, in 1915 excited British entomologists keen on restoring *L. dispar* in the UK because of both morphological and ecological similarities between the extinct *L. d. dispar* and the newly discovered Dutch race. In both respects, the English and Dutch races shared more in common with each other than either did with *L. d. rutilus*. Therefore, subsequent to the discovery of *L. d. batavus*, the

Committee for the Protection of British Lepidoptera, a branch of the Entomological Society of London (now the Royal Entomological Society) decided to attempt to establish a population at Woodwalton Fen (Committee, 1929).

In late 1926, scrub was cleared from 8.8 ha of Woodwalton Fen and large numbers of *R. hydrolapathum* were planted, in preparation for the arrival of *L. d. batavus*. In 1927, 38 adults (25 males and 13 females) of Friesian *L. d. batavus* (Wittpen, 1928) were released by Captain E.B. Purefoy in the prepared area which has been known ever since as the "Copper Fields" (Compartments 37 and 39), (Committee, 1929). Although the following winter (1927-1928) saw an extensive and prolonged flood on the reserve, lasting for approximately 60 days (Purefoy, 1929), larval overwintering survival was good, and resulted in over 1000 adults on the wing in the summer of 1928. Although unrecorded, it is possible that Purefoy released further stock in order to reinforce this population on one or two occasions (see Duffey, 1968). Certainly, some females were subsequently re-captured in order to establish a captive stock, which has remained extant and resident on the fen to this day. It is noteworthy that 75% of the population were reported lost to *Phryxe vulgaris* Fallen. (Diptera: Tachinidae), and furthermore, two pupal parasites were identified; namely *Pimpla brassicae* and *Anisobas hostilis* Grav. (Hymenoptera: Ichneumonidae) (Committee, 1929).

This introduction of *L. d. batavus* appeared to be successful, as the population survived until 1969, a total of 42 years. However, it did so under the auspices of careful and intensive population and habitat management. The larvae and pupae were protected from natural enemies by being kept in muslin cages, and the adults released after emergence. Also large numbers of *R. hydrolapathum* were planted out on the reserve, and areas of peat were "scraped" in order to create germination sites for the foodplants. Seed was scattered in these areas (Mason, Bowley, Harold and Duffey, *pers. comm.*; Duffey, 1968, 1971, 1977). The extinction of this population was attributed to severe summer floods in 1968 which drastically reduced oviposition because the foodplants were almost completely submerged and therefore obscured from ovipositing females (Duffey and Mason, 1970).

1930. Leckford, Near Stockbridge, Hampshire.

In 1930 John Spedan Lewis wrote to the Lepidoptera Protection Committee of the (Royal) Entomological Society asking for approval to establish *L. d. batavus* on his private estate. This approval was granted and a release apparently took place on the River Test, although no documentation was released, and the attempt was presumably unsuccessful (Oates and Warren, 1990).

1930. Wicken Fen, Cambridgeshire.

Twenty-two years after Verral's attempt at establishing *L. d. rutilis* at Wicken Fen, Captain E.B. Purefoy retried, this time using *L. d. batavus*.

Three acres of Wicken Fen were planted with docks during the winter of 1929/30 and "sufficient numbers" of "half-grown" *L. d. batavus* larvae were put out during May 1930 on marked plants. Unknown numbers were also released in 1931 or 1932. Interestingly, almost complete winter survival was recorded (Purefoy, 1931). Apparently a series of "bad seasons" reduced its abundance during the late 1930s, but it still survived in numbers on Adventurer's Fen. In fact the population survived until Adventurer's Fen was ploughed (in 1942) in order to plant potatoes during World War II.

1930. Lower Kennet Valley, Berkshire.

No information whatsoever is available concerning this attempt, apart from the fact that it apparently took place and that *L. d. batavus* was used (Oates and Warren, 1990).

1934. "Denmark".

A colony of *L. dispar* was known to exist in Denmark between 1934 and 1948. Bink (1970) presumed this to have been the result of an introduction, however it would appear possible that it was native *L. d. rutilis*, as the range of this subspecies includes neighbouring Germany (Settele, 1990; Ebert and Rennwald, 1991) and a single population, discovered in 1983, survives in Finland (Mikkola, 1991).

1939. Raamsloot, near Eernewonde, Friesland, The Netherlands.

The Dutch entomologist Dijkstra released 35 pupae and an unrecorded number of eggs of *L. d. batavus*. He also released "larvae" in 1940 at the same site. Apparently the population survived until at least 1955. Hydroseral succession in this marsh area (1000 ha) was deemed responsible for the population's eventual extinction (Bink, 1970).

1942. Greenfields, County Tipperary, Republic of Ireland.

L. d. batavus from the introduced population at Woodwalton Fen was released in 1942 by Captain E.B. Purefoy on the site which had been used for a previous establishment attempt with *L. d. rutilis*. This new colony persisted until 1955, when neglect of the marsh resulted in the habitat becoming unsuitable (Duffey, 1968).

1949. Wheatfen Broad, Yare Valley, Norfolk Broads.

In 1948 the Insect Protection Committee decided to try to establish a population of *L. d. batavus* in the Norfolk Broads. They believed it unlikely that the insect had survived the Second World War in Holland and moreover, Woodwalton Fen was then threatened with drainage. "Two dozen" larvae were released at Wheatfen Broad near Surlingham in the Yare Valley (Ellis, 1951). Furthermore, it was perceived that the site had advantages over Woodwalton Fen, because it was liable to shorter, less severe winter floods than those experienced at Woodwalton (Ellis, 1965). The colony apparently fared well until high tides inundated the area in April 1951 (Oates and

Warren, 1990), at a time when herbivory from the introduced coypu (*Myocaster coypus* L.) population was possibly contributing towards a decline in the abundance of the *R. hydrolapathum* foodplants (Ellis, 1965; see also Smith, 1995).

1964-65. County Down, Northern Ireland.

H.G. Heal tried to establish *L. d. batavus* at an undisclosed site in the province, although the attempt apparently failed because of inclement weather (Oates and Warren, 1990).

1970. Woodwalton Fen, Cambridgeshire.

In 1970 a large scale release was made to re-establish the Woodwalton *L. d. batavus* population using captive reared stock. In each of the next three years, 1971-73, the surviving fen population was augmented with further material from the captive stock, and in 1976 the distribution of eggs covered a wider area than any seen since the fen became a National Nature Reserve in 1953, owing to the improved management of additional compartments not previously managed for the butterfly (Duffey, 1977). Interestingly, Heath, Pollard and Thomas (1984) reported that an extant population existed on the fen in 1984, when all protection of spring larvae from natural enemies and population re-enforcements were ceased in 1979. However, any apparent initial success was short-lived, because although the population may have survived for a number of years, it experienced large annual reductions in size before reaching very low levels and eventually becoming extinct (Harold, and McLean, *pers. comm.*).

1987. Woodwalton Fen, Cambridgeshire.

A further large release of imagines was carried out in 1987, and observations of this population showed its behaviour to be comparable to that found by Duffey (1977), ie. again there were substantial annual reductions in size (McLean, 1991a, 1991b; Pullin, McLean and Webb, 1995). Unfortunately this latest attempt at re-establishing *L. d. batavus* on the fen was deemed a failure in 1994, with the lack of any sightings during that year. Interestingly, although the population experienced large annual reductions in size, as seen during earlier attempts at this site, it appeared to "bottom out, and indeed did survive for a number of years at a very low density. It was hoped that selection over the previous few seasons would favour the survival of the remaining few, however three consecutive inclement winters, with prolonged and extensive flooding, were probably responsible for the eventual demise observed (Bowley and McLean, *pers. comm.*).

However the captive population of *L. d. batavus* at Woodwalton Fen has in effect been unmanaged, with respect to conservation genetics, throughout its 68 year history, and so might be expected to suffer from problems relating to loss of genetic diversity, reduction of reproductive fitness and ability to survive in the wild. Nonetheless, there are possible ameliorative effects of the rather haphazard management of the Woodwalton captive

population. Firstly, for a large number of years, the population was kept outside, on the fen, in wire mesh cages designed to exclude natural enemies (Mason, *pers. comm.*) and so any adaptation to greenhouse conditions would be limited to more recent generations. Secondly, from time to time the captive population was mixed, albeit quite randomly, with individuals from the resident "wild" population on the fen (Harold, *pers. comm.*). Although this "wild" population was founded from the captive population, it was kept separate for many years and may have benefited from more "natural" selection pressures. Certainly the genetic status of the population at Woodwalton Fen remains in question, a conclusion which has been highlighted by recent studies (Webb, 1995; Webb and Pullin, 1996a, 1996b).

To our knowledge, the above list is probably as comprehensive as any could be, although it is possible that other establishment attempts were not published or publicised in any way, and so are not included here. For example, there was an unpublished attempt to establish *L. dispar* on a private estate at Ashton Wold, Cambridgeshire (M. Rothschild, *pers. comm.*). Furthermore, Oates and Warren (1990) record that "recent" attempts at establishment have taken place in the Dalby Marsh area of North York Moors, although no details are available. It is desirable to provide information as to whether any given establishment attempt constitutes an introduction or re-establishment, as this is a distinction important within conservation ecology (Oates and Warren, 1990; Morris and Thomas, 1990). However, debate around the historical distribution of *L. d. dispar* in the UK (see Webb, 1995), makes it impossible to make statements about individual sites. In effect, the only attempts that are without doubt *de novo* introductions are the Irish examples, and all others have taken place within the former biogeographical range, although an individual site may or may not have been formerly occupied.

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