



Species Action Plan

LARGE HEATH
Coenonympha tullia

August 1997

Compiled by :

N. A. D. Bourn and M. S. Warren

**Butterfly Conservation
Manor Yard
East Lulworth
Wareham
Dorset
BH20 4QP**

Tel: 01929 400209

email: nbourn@butterfly-conservation.org

THIS PROJECT IS SUPPORTED BY



This species action plan is an unpublished working document produced by Butterfly Conservation to focus and co-ordinate the conservation of the Large Heath in the UK over the next five to ten years. It has been prepared under the *Action for Butterflies* project which is funded by WWF-UK, English Nature, the Countryside Council for Wales and Scottish Natural Heritage. The Action Plan was prepared in consultation with the following organisations in the hope that they will participate in the actions outlined: English Nature, Countryside Council for Wales, Scottish Natural Heritage, The National Trust, MAFF/FRCA, The Scottish Office, Forest Enterprise, Scottish Wildlife Trust, WWF-UK, ITE, National Trust For Scotland, RSPB.

Acknowledgements

We are grateful to the following for their comments at the Pathfinder meeting and / or on subsequent drafts; Harry Eales, Jenny Joy (Consultants), Frank Mawby, Peter Roworth, David Sheppard (English Nature), Adrian Fowles (Countryside Council for Wales), Martyn Giles (WOAD), Dave Phillips (Scottish Natural Heritage), Caroline Roberts (WWF), James Fenton (National Trust for Scotland), Tim Melling (RSPB), Peter Summers and Mark Shaw (NMS), Michael Harrison (MAFF), Rob Guest (Forest Enterprise), Alastair Sommerville (Scottish Wildlife Trust), John Hood (The Scottish Office) Mark Young (University of Aberdeen) and Trevor Boyd, Martin Wain, Richard Sutcliffe, and Paul Kirkland (Butterfly Conservation).

Butterfly Conservation (the British Butterfly Conservation Society) has an overriding objective to ensure a future for butterflies, moths and their habitats. In order to achieve this objective its aims are to:

- raise public awareness of the plight of our butterflies and moths and encourage public involvement in conservation.
- halt the decline of butterflies and moths and maintain or improve the present status of threatened species.
- improve the extent and suitability of key lepidoptera habitats and the environmental quality of the countryside as a whole for all lepidoptera species.
- work with and advise other conservation groups, local bodies and agencies on techniques of land management which favour butterflies and moths and related wildlife.
- acquire and manage habitats for butterflies and moths.
- encourage the research (both at amateur and professional levels) on butterflies and moths.
- support and encourage butterfly and moth conservation world-wide.

CONTENTS

	Page
Summary	4
Part 1 Overview	
1.1 Priority Statement	5
1.2 Broad Objectives	5
1.3 Legal Status	5
1.4 Status and Level of Biological Knowledge	6
Part 2 Biological Assessment	
2.1 Introduction	7
2.2 Ecology	8
2.3 Distribution and Population	10
2.4 Limiting Factors	11
2.5 Resume of Conservation to Date	12
Part 3 Actions and Work Programme	
3.1 Policy and Legislative	14
3.2 Site Safeguard and Acquisition	14
3.3 Land Management	15
3.4 Species Protection and Licensing	16
3.5 Advisory	16
3.6 International	16
3.7 Future Research, Survey and Monitoring	16
3.8 Communications and Publicity	17
3.9 Review	17
Abbreviations	18
References	19
Appendix 1 The distribution of the Large Heath.	22
Appendix 2 Regional surveys of the Large Heath.	23
Appendix 3 Conservation requirements of the Large Heath.	24

Summary

- The Large Heath is a relatively widespread species in the northern part of the UK but has suffered a severe decline and range contraction in the last century due to drainage of lowland peat bogs for agriculture. This decline continues in many areas and has been most marked in northern and western counties of England where the species is now very restricted, and its status in its remaining strongholds in north and west Scotland and Northern Ireland is unclear. The Large Heath is listed under Schedule 5 of the Wildlife and Countryside Act for sale only.
- The current rate of loss of colonies in the UK is estimated at over 25% per 25 years, although the species status is unclear in north Scotland and N. Ireland, where it appears to still be widespread. The national distribution map is now very much out of date and identification of core areas in each of its habitat types is required urgently to ensure appropriate conservation action for the species. A **medium** priority is afforded to the conservation action in this plan to protect and increase the number of Large Heath colonies in the UK. This priority will be reviewed when more accurate distribution data is available.
- The Large Heath inhabits lowland raised bogs (mosses), upland blanket bogs and damp, acid moorland; all of which are wet areas where the main larval food plant, Hare's-tail Cotton Sedge (*Eriophorum vaginatum*) occurs. Sites usually consist of a *Sphagnum* base, interspersed with mature tussocks of *E. vaginatum*, and an abundant growth of Cross Leaved Heath (*Erica tetralix*) which is the main nectar source for the adult (Melling, 1987; Joy, 1991). The Large Heath is characteristic of peatland and can in many ways be considered as an indicator of good quality peatland habitat.
- The main threats to the Large Heath are continued loss of lowland bogs due to drainage, succession to woodland, burning, overgrazing, peat extraction and afforestation.
- The immediate major objectives of the plan are to halt the decline of the Large Heath in the UK; to maintain viable networks of populations throughout its current range; and to conduct research on the distribution and ecology of the species to enable its effective conservation.
- The objectives of the plan will be achieved by determining current core areas of distribution of the Large Heath; ensuring the protection of extensive areas of its habitat; protecting the full range of geographic variation and improving and disseminating information on the habitat requirements of the species.
- The Action Plan covers the next ten years, will be monitored annually and reviewed as the situation demands.

Part 1 Overview

1.1 PRIORITY STATEMENT

The Large Heath was once widespread on lowland raised bogs (mosses), upland blanket bog and damp acid moorland throughout much of northern England, Scotland, Wales and Northern Ireland. It declined in the last century due to drainage of lowland peat bogs for agriculture. This decline continues in many areas. This decline has been most marked in northern and western counties of England (Cheshire, Lancashire [where the species is now very restricted], Northumberland and Cumbria), and it is declining in the south and east of Scotland. However, its status in its remaining strongholds of north and west Scotland and Northern Ireland is unclear. It is listed as a species of conservation concern (the 'long list') in Biodiversity: The UK Steering Group Report (DOE, 1995). Based on our current knowledge, **medium** priority should be afforded to conservation action to protect and increase the number of Large Heath colonies in the UK. This priority will be reviewed when we have more complete distribution data.

1.2 BROAD OBJECTIVES

1. Halt present decline in England, Wales, and south and east Scotland .
2. Review status in Scotland and N. Ireland.
3. Maintain viable networks of populations throughout its current range ensuring the conservation of the full range of geographic variation.
4. Conduct research on the ecology (particularly appropriate management) to enable its effective conservation.

1.3 LEGAL STATUS

The Large Heath is listed on Schedule 5 of the 1981 Wildlife and Countryside Act (for sale only) *. In N. Ireland it is listed under the Wildlife (Northern Ireland) Order 1985 which gives full protection, such that it is illegal to take, kill, possess, sell or advertise for sale this species.

*It is a criminal offence to sell, offer or expose for sale, or possess or transport for the purposes of sale, whether alive or dead, any wild specimen and parts or derivatives of them; or for anyone to publish or cause to be published any advertisement indicating or suggesting that they buy or sell such things.

Population	-size(abundance)	Now covered by 7 sites in the Butterfly Monitoring Scheme but only one site (Loch Garten) has records over a long time period (Pollard and Greatorex-Davies, 1997). Non BMS sites include two transects walked on Scottish Wildlife Trust reserves, one in Cumbria and one on Dyfi NNR in Wales.
	-trend, numbers	The total number of UK colonies is unknown. Many colonies are being lost in the south of its range.
	-trend, range	Formerly widespread, major decline in the south of its range. Current strongholds in Cumbria and Northumberland in England, Northern Ireland and north and west Scotland.
Knowledge of	-status	No up-to-date national data are available for this species. Location of large and medium colonies in each habitat type and of each geographic form needs to be identified.
	-trends	Historical review in GB estimates a rate of decline, in range, of over 25% in 25 years (Warren et al, in press). A review of sites in Northumberland found the rate of loss to be 20% during the period 1984-1996 (Eales 1995, 1996). A recent review in Wales has confirmed that the Large Heath has post 1990 records from 12 sites, a possible large decline (Eales, 1997; Melling pers. comm.). In Cumbria a survey of most recorded sites (40 out of 56) indicated a loss of 40% (24 sites with and 16 sites without Large Heath in 1996,) (Wain, 1997).
	-conservation requirements	Some ecological knowledge of its requirements but further research is required to identify appropriate management regimes.

Part 2 Biological Assessment

2.1 INTRODUCTION

The Large Heath occurs in lowland raised bogs (mosses), upland blanket bogs, and damp, acid moorland where the main larval food plant, *Eriophorum vaginatum*, Hare's-tail Cotton Sedge, occurs.

Large Heath colonies can be very large, numbering up to 15,000 adults although the majority are much smaller. The Large Heath occurs throughout the bogs of Ireland and northern Scotland, the Outer Hebrides and Orkney, is more localised in lowland Scotland and is locally abundant in Northumberland and Cumbria. While once widespread further south on the mosses of Lancashire, Shropshire and mid and north Wales, and local in Yorkshire and Lincolnshire, the Large Heath is now found here only on a few isolated sites and is extinct in Cheshire, Durham, and the Greater Manchester and Merseyside areas.

Distinct forms and geographic variation

The Large Heath is one of the UK's most variable butterflies, and has been the subject of several studies on its phenology. The Large Heath occurs in two distinct forms based on spot patterns on the hind wing: *scotica* and *davus*. A third, intermediate form, *polydama* also occurs. In the north of Scotland and the Hebridean Islands the *scotica* form is found. This is the largest most uniform form with few spots and is considered a separate subspecies. In southern Scotland, Northumberland, Cumbria, Ireland, Wales, one site in the Pennines and in Yorkshire and Lincolnshire, the intermediate form *polydama* predominates. The *davus* form predominates in lowland England and is now restricted to the coastal plain south of the Lake District, in a small area on the Shropshire/Clywd border, and one site in lowland Lancashire. The most serious declines of the Large Heath, mainly over the last 300-400 years due to drainage and agricultural improvement have thus been of the *davus* form, which formerly occurred in Cheshire, the Greater Manchester and Merseyside areas and possibly Staffordshire.

This variation and the reasons for it have been well studied for many years (Howorth, 1803; Buckell, 1895; Rowland-Brown, 1919; Ford, 1945, 1949, 1954; Dennis, 1972; Porter, 1980; Dennis et al., 1984, 1986; Melling 1987). The avoidance of adult predation by birds, particularly Meadow Pipits produces and maintains this variation. It has been found that there was a strong correlation between the number and size of spots on different forms of Large Heath and the sunshine hours in June and July, when the adults are flying. In the south of its range, where the weather is generally warmer, adults are much more active, flying more frequently. This movement means they are attacked more frequently by Meadow Pipits and the presence of eye spots increase the chances of escaping such an attack by deflecting the blow away from the body of the insect. In the north, the weather is cooler so the butterflies spend less time flying, but perch on the ground. In these conditions, inconspicuous, unspotted *scotica* form individuals are more likely to survive. On intermediate sites there is a balance between avoidance and concealment which maintains the variable *polydama* form.

2.2 ECOLOGY

Life Cycle

The Large Heath is univoltine, flying from mid to late June to early August. However, there is considerable regional and altitudinal variation and in the far north or at high altitude, the emergence is delayed by up to a month. The peak flight period is usually in mid July. The pale yellow eggs are deposited singly on the dead stem of grass found at the base of mature tussocks of *E. vaginatum*. Within a week the eggs have rusty blotches and just prior to hatching, at about 15 days, they turn darker. The newly hatched larvae feed on the stems of *E. vaginatum* before overwintering as 3rd instar larvae. The larvae overwinter low down in *E. vaginatum* tussocks until late March when they continue to feed on *E. vaginatum* until in their 5th instar, pupating in late April or early May. Previously it was known that larvae of the Large Heath could survive both submergence and freezing and recent work by Joy and Pullin (1997) demonstrates that this is only for a limited period. They show that the mortality of Large Heath larvae increases when they are submerged for over seven days with no survival when the larvae were submerged for 108 days. Thus larvae survive during winter, or when water levels rise, by moving up the vegetation, not by remaining low, as had been previously thought. At some sites, such as Fenns and Whixall Mosses, water levels have been raised to facilitate the restoration of mires, and care should be taken not to raise water levels so high as to totally submerge tussocks of *E. vaginatum* for any length of time unless this foodplant is found on higher peat areas. However high water levels generally are important to maintain the habitat and a balance needs to be struck. The adults emerge 3 to 4 weeks later from mid June. Life expectancy (or residence time on site) of adult Large Heath has been calculated at 3-5 days, although some individuals can live as long as 21 days (Melling, 1987; Joy pers. comm.).

Early literature wrongly referred to the larva feeding at night and the foodplant as White Beak-Sedge (*Rhyncospora alba*) but there are many sites where this species is not present. In recent studies all observations of larvae feeding have been on *E. vaginatum* during the day (Melling, 1987; Joy, 1992). The only published account of the pupa in the wild describes a pupa suspended below a stem of Purple Moor Grass (*Molinea caerulea*), (Joy, 1992). This is similar to that described by Melling (1987) of captive-reared specimens observed hanging below vegetation.

In the far north, a small proportion of each population (approx. 5%), have a two year life cycle, with third instar larvae not feeding, but entering a second diapause in the summer before emerging to feed normally the following spring. Reared larvae from the south of its range, kept in the same conditions did not have this two year life cycle (Tim Melling, pers. comm.). In groups, such as the Zygaenids, where this life strategy is common, it is believed to be an adaptation to unpredictable weather during the flight period (Tremewan, 1990) but in the Satyrids such as the *Erebias* it is in response to a short growth period (Mark Shaw, pers. comm.).

Four species of parasitoids are known to attack Large Heath larvae in Britain. These are all endoparasitic Ichneumonidae: *Casinaria claviventris* (Holmgren) (Ichneumonidae), which kills the host as a final instar larva and spins a pale yellow/golden brown cocoon near the host

remains; *Hoplisemenus albifrons* (Gravenhorst) (Ichneumonidae), which delays final destruction of the host until it has pupated, the adult parasitoid then developing inside and emerging from the host pupa; *Aleiodes coxalis* (Spinola) (= *tristis* Wesmael) (Braconidae), which 'mummifies' the host as a ½ to ¾ grown larva and later emerges as an adult from the mummy; and *Diolcogaster abdominalis* (Nees) (Braconidae) which kills the host possibly before it is fully grown and leaves it to spin a pale somewhat woolly cocoon. *C. claviventris*, *H. albifrons* and *A. coxalis* are common species that occur in a wide range of habitats and hosts including the Small Heath (*Coenonympha pamphilus*) and in the case of *A. coxalis* several other Satyridae and the Essex Skipper (*Thymelicus lineola*). *D. abdominalis* is, in contrast, a rare and little known species. It has been reared from the Large Heath at one site (Meathop Moss, Cumbria) (Melling, 1987). It has also been found as an adult at several dissimilar sites in S. England (chalk grassland, woodland, salt marsh), indicating that the Large Heath is not its only host (M.R. Shaw, pers. comm.).

Habitats

The Large Heath inhabits lowland raised bogs (mosses), upland blanket bogs and damp, acid moorland. These are all wet areas where the main larval food plant, *E. vaginatum* occurs. Sites usually consist of a *Sphagnum* base, interspersed with mature tussocks of *E. vaginatum*, which allow the larvae protection from predators in the dense tussocks, the larvae quickly retreating to these areas if disturbed, and an abundant growth of Cross Leaved Heath (*Erica tetralix*) which is the main nectar source for the adult (Melling, 1987; Joy, 1991, 1992).

Lowland raised bogs (a habitat type of European importance and listed in the EC Habitats Directive) are found on river flood plains and other level areas with impeded drainage and are acid, poor in mineral nutrients and ombrotrophic. They are sustained mainly by rainwater, with a water level generally higher than the surrounding water table. National Vegetation Communities include M20a (*Eriophorum vaginatum* blanket and mixed mire - species poor sub community) and M18 (*Erica tetralix*- *Sphagnum papillosum* raised and blanket mire).

Upland blanket bogs (also listed in the Habitats Directive) consist of extensive bog communities or landscapes on flat or sloping ground with poor surface drainage in oceanic climates with heavy rainfall. This habitat is characteristic of western and northern Britain and Ireland and includes NVC communities M15 (*Scirpus cespitosus* - *Erica tetralix* wet heath), M17 (*Scirpus cespitosus* - *Eriophorum vaginatum* blanket mire), M19 (*Calluna vulgaris* - *Eriophorum vaginatum* blanket mire) and M20 (*Eriophorum vaginatum* blanket mire).

The Large Heath requires large tussocky clumps of *E. vaginatum* in wet conditions, conditions which depend on the maintenance and management of wet bogs. While many upland sites are sheep grazed and or burnt this is not an integral requirement for the habitat or of the Large Heath. Where grazing pressure, or burning frequency is too high, the tussocky structure of the vegetation is damaged and populations of the Large Heath will be reduced.

2.3 DISTRIBUTION AND POPULATION

Distribution

The Large Heath has a Holarctic distribution occurring as a chain of sub-species across central and northern Europe through Asia. The butterfly also spans the Bering Strait and is widespread in Canada and western USA. The Nearctic species, which is believed to form a species complex with the palearctic, occupies different habitats (drier grasslands, roadside verges etc.) than the palearctic species and is generally bivoltine (Melling, 1987). In Europe its main habitats are listed in Annex 1 of the EC Habitats Directive. The species has undoubtedly suffered from extensive habitat loss throughout Europe but its true status is unclear at present.

In Britain, the butterfly is now extinct in most of the Midlands and eastern England and has probably declined in central and northern Wales. In north England, N. Ireland and Scotland, the species is locally common but there have probably been substantial losses due to drainage and afforestation of its moorland habitat. The national distribution map (see Appendix 1) is now very much out of date. Recent county surveys show that the butterfly is still declining in the south of its range (e.g. Eales, 1995; Wain, 1997; Spencer 1996). Despite this decline, the lack of previous surveys ensures that new sites are still being discovered in Northumberland (Eales 1995; 1996). The results of a recent review of the status of the Large Heath in England and Wales is given in Table 1 and Table 2 below. In Scotland, the Large Heath is thought to be widespread (Thomson, 1980) with an almost continuous distribution in the Flow country and in the west. However, it is much more restricted in Aberdeenshire and Kincardine where it is found on lowland raised bogs and has suffered loss and fragmentation of its habitat such that populations are now isolated (M. R. Young, pers. comm.). Changes to moorland management, particularly afforestation, throughout large parts of Scotland suggests that many sites may have been lost before being fully surveyed.

Table 1 Status of the Large Heath in England (Source: Eales 1997)

County	Number of localities/ sites/ colonies*	Notes
Cheshire	0	Extinct c.1930
Cumbria	43 colonies	Surveyed in 1996/97 - 40% loss of historical records pre 1996
Durham	0	Extinct c.1860
Greater Manchester	0	Extinct c.1905
Lancashire	2 localities	
Lincolnshire	1 locality	Site straddles Yorkshire boundary
Merseyside	0	Extinct c.1905
Northumberland	147 colonies	Surveyed 1995/6/7 20% loss between 1984 and 1996
Shropshire	3 sites	
Staffordshire	0	Extinct c.1930
Yorkshire	5 localities	1980+

* Locality defined as a general area
sites defined as a more localised area within a locality
colony defined as area within a site where Large Heath seen

Table 2 Status of the Large Heath in Wales post 1990.
(Source Eales, 1997; T Melling, pers. comm)

Watsonian vice county	Number of localities
Conway (v.c. 50)	4
Cardigan (v.c. 46)	2
Caernarfon (v.c. 49)	3
Meirionnydd (v.c. 48)	3

Population

There are three published studies on the mobility of the Large Heath which both indicate that mobility is generally low with the majority of individuals being recaptured in the immediate area in which they were first marked (Turner, 1963; Melling, 1987; Joy, 1992). The furthest distance an individual was recorded to have moved between captures was 450 metres (Turner, 1963). There are very few records of individuals away from the butterflies habitat although sightings up to a kilometre away do occur occasionally (H. Eales, pers. comm.). Populations can be very large, numbering up to 15,000 individuals, but definition of a colony is problematic in extensive open landscapes and may lead to problems when comparing studies that have not defined colonies or populations in a standard way. The low mobility of the majority of individuals in a population suggests that quite small barriers to movement can be used to separate colonies. Thus 500 metres of unsuitable habitat should be used to separate colonies, in the future, while realising that in extensive bog systems it is more realistic to define them as single populations. Small populations are known to survive on suitable areas as small as 1 hectare for many years (Summers, pers. comm.).

However, in many areas, the butterfly probably exist as metapopulations* which breed over a network of habitats which may be connected to some extent. Further research is needed though to determine the extent of connectivity and the long term viability of smaller, more isolated habitats.

2.4 LIMITING FACTORS

Historical

Reclamation of peatland habitats for agriculture.

Afforestation of peatland habitats.

Peat extraction.

* A metapopulation is a collection of local populations, connected by occasional dispersal, in which there are local extinctions and colonisations (Gilpin & Hanski, 1991).

Current and Future Limiting Factors

The drainage of bogs and consequent invasion of birch and pine.

Continuing afforestation

Inappropriate land management, particularly burning on wetter areas of moorland.

Overgrazing which removes the tussocky structure of the larval foodplant.

Continued commercial, large scale peat extraction.

Neglect, drying and consequent scrubbing up of sites, particularly those that have become isolated due to neighbouring land use changes such as afforestation.

Habitat fragmentation.

Water management which does not provide some drier areas as refugia for the larvae in winter.

Open cast coal mining which is proposed in some areas.

Large scale development on unprotected sites.

2.5 RESUME OF CONSERVATION TO DATE

Ecology and Conservation Requirements

It is only relatively recently that the most basic information on the ecology of the Large Heath was determined including identifying the main larval food plant as *E. vaginatum* (Melling, 1987; Joy, 1992). Much more detailed work is however still needed to determine specific habitat and management requirements.

A recent national review estimates a decline in range of 22% based on 10km grid squares recorded between 1940-69 and 1970-84, and actual colony loss is probably far higher (Warren et al., in press). In the last 3 years extensive surveys have been undertaken to enable a review of the status of the species in England. A review of sites in Northumberland found the rate of loss to be 20% during the period 1984-1996 (Eales, 1995; 1996). In Cumbria a survey of old sites indicated a loss of 40% this century, with the majority (50%) since 1970 (Wain, 1997). Of these 16 sites, 4 were lost before 1940, 2 between 1940 and 1969, 8 between 1970 and 1983 and one has been lost since 1984. Recent surveys in Wales have confirmed that the Large Heath is present on at least 12 sites (table 2). The status of the Large Heath in its strongholds in the north and west of Scotland and in Northern Ireland is not well known.

The Large Heath is quite well represented on reserves and was recorded on 33 NNRs in 1992, less than 10 Wildlife Trust reserves in 1984, 9 RSPB reserves in 1990, and 9 colonies were on land owned by the National Trust in 1995 (McLean et al., 1995; Steel and Parsons, 1989; Cadbury, 1990; Oates, 1995). The species is well represented on SSSIs in England with for example 32 of the 37 sites in Cumbria designated and all sites in Yorkshire.

On sites where rehabilitation of mires requires the raising of water levels, larval mortality will be high unless care is taken not to raise the water level above the top of *E. vaginatum* tussocks. This management technique may be particularly damaging if no higher peat is present in a suitable condition. A summary of conservation requirements of the Large Heath is given in Appendix 3.

Peatland conservation has been the subject of a high profile campaign by a consortium of wildlife, geological and archaeological organisations (the Peatlands Campaign Consortium) for several years. The campaign has highlighted the continued destruction of peatland sites (especially lowland raised mires) for the horticultural trade, and has promoted the use of alternatives to peat.

Current Studies

The survey and research work of Eales (1995, 1996) in Northumberland and Wain (1997) in Cumbria is continuing. The possible impact of water level management on the Large Heath has recently been studied by Jenny Joy and Andrew Pullin (Birmingham University, part funded by Butterfly Conservation). Currently little research is being undertaken on the Large Heath's ecological requirements.

Monitoring of Large Heath populations occurs on only a few sites at present, only 7 populations being covered by transects contributing to the national Butterfly Monitoring Scheme (see section 1.4).

Part 3 Actions and Work Programme

This section has been divided into the standard headings Policy and Legislative; Site Safeguard and Acquisition; Land Management; Species Protection and Licensing; Advisory; International; Future Research and Monitoring; Communications and Publicity; Review. Actions are given a low, medium or high priority. The lead organisation(s) concerned for each action is/are named.

Definition of Colony Size: Large = >1,000 adults; medium = 100-1,000 adults: small < 100 adults at Peak.

For key to abbreviations see page 18.

3.1 POLICY AND LEGISLATIVE

**Lead
organisation(s)
concerned**

Action 1 PRIORITY: HIGH

Take account of habitat requirements of Large Heath, and the potential for habitat restoration, when drawing up or revising prescriptions in relevant land management schemes and grants e.g. Habitat scheme, ESAs, Countryside Premium, Tir Cymen and Countryside Stewardship.

**SOAEFD,
MAFF, LDNP,
NNP, WOAD,
DANI.**

Action 2 PRIORITY: HIGH

Review existing planning permission for commercial peat digging with a view to avoiding further loss of Large Heath habitat and develop a scheme for national compensation for the revoking of planning permission for commercial peat digging.

**DOE,
DOE(NI),
SOAEFD.**

Action 3 PRIORITY: HIGH

Ensure forestry policy avoids further planting of lowland raised bogs and blanket bogs and that Woodland Grant Schemes are not funded on sites with Large Heath.

FA.

3.2 SITE SAFEGUARD AND ACQUISITION

Action 4 PRIORITY: HIGH

Designate as SSSI three large or medium colonies per area of search (or as many as exist if less than three), where this will help improve habitat management. Aim to ensure that the geographical variation of the Large Heath is covered.

**EN, CCW,
SNH,
DOE(NI).**

Action 5 PRIORITY: HIGH

Encourage protection of all colonies through management agreements and/or reserve acquisition in areas where declines have been occurring.

All

Action 6 PRIORITY: HIGH

Ensure all qualifying lowland raised mires are designated as SACs under the Habitats Directive.

**EN, SNH,
CCW.**

3.3 LAND MANAGEMENT

Action 7 PRIORITY: HIGH

Include needs of the Large Heath in site management statements on all SSSIs and ASSIs with colonies.

**SNH, EN,
CCW,
DOE(NI).**

Action 8 PRIORITY: HIGH

Encourage appropriate habitat management on all Large Heath sites including the maintenance of a high water table to protect peatland plant communities, but ensuring that there are higher, drier areas to act as refugia for Large Heath larvae.

All

Action 9 PRIORITY: HIGH

Ensure new forestry planting avoids known Large Heath habitat and that poorly known areas are surveyed prior to planting and avoided if the species is present.

**FE, FA,
DOE(NI),
SNH.**

Action 10 PRIORITY: MEDIUM

Restore sites by clearing trees and/or restoring the water table, where this will restore viable Large Heath habitat.

All

Action 11 PRIORITY: MEDIUM

Protect Large Heath habitats by discouraging inappropriate grazing and/or burning.

All

3.4 SPECIES PROTECTION AND LICENSING

No action proposed

3.5 ADVISORY

Action 12 PRIORITY: MEDIUM

Advise site managers and landowners of the importance of Large Heath habitat and the management requirements of the butterfly. **All**

3.6 INTERNATIONAL

Action 12 PRIORITY: MEDIUM

Encourage Government and conservation agencies to co-operate over the conservation of the Large Heath and its habitat, throughout its European range. **BC, JNCC.**

3.7 FUTURE RESEARCH, SURVEY AND MONITORING

Action 13 PRIORITY: HIGH

Collate all recent records, update national distribution map and determine core regions of distribution, including the full range of geographic variation of this species. **BC, ITE, JNCC etc.**

Action 14 PRIORITY: MEDIUM

Conduct further research into the conservation ecology of the Large Heath, especially management requirements, habitat preferences, ecology of the immature stages, population structure, parasitism and mobility, particularly of the northern sub-species *scotica*, (as most work to date has been on southern populations). **SNH, CCW, EN, BC, DANI, Univs**

Action 15 PRIORITY: HIGH

Conduct further surveys to determine the UK status and distribution of the Large Heath, and identify all large colonies and occurrence on protected areas, particularly in Scotland and Northern Ireland. **BC, SNH, EN, CCW, DANI.**

Action 16 PRIORITY: MEDIUM

Establish a monitoring programme throughout the Large Heath's range, either by standard transects or timed counts, and collate data annually to compare trends.

**BC, ITE,
SNH, EN,
CCW.**

Action 17 PRIORITY: HIGH

Monitor the effects of habitat management on Large Heath colonies.

**BC, ITE,
SNH, EN,
CCW.**

3.8 COMMUNICATIONS AND PUBLICITY

Action 18 PRIORITY: HIGH

Publicise this Action Plan and the measures needed to conserve the Large Heath.

All

Action 19 PRIORITY: HIGH

Liaise with Peatlands Campaign Consortium to promote the use of Large Heath in campaigns to protect its habitat.

BC

3.9 REVIEW

Action 20 PRIORITY: HIGH

Review this Action Plan every five years and update if necessary.

BC

Key to abbreviations

All = All organisations listed

BC = Butterfly Conservation

CCW = Countryside Council for Wales

DANI = Department of Agriculture Northern Ireland

DOE(NI) = Department of Environment (Northern Ireland)

EN = English Nature

FA = Forestry Authority

FE = Forestry Enterprise

ITE= Institute of Terrestrial Ecology

JNCC = Joint Nature Conservation Committee

LDNP = Lake District National Park Authority

MAFF = Ministry of Agricultural, Fisheries and Food

NT = National Trust

NTS = National Trust for Scotland

NNP = Northumberland National Park Authority

SNH = Scottish Natural Heritage

SOAEFD = Scottish Office Agriculture, Environment & Forestry Department

Us = Universities

WOAD = Welsh Office Agricultural Department

WTs = Wildlife Trusts

References

- Buckell, F. J.** (1895). *Coenonympha typhon* and its varieties. *Entomologist's Record and Journal of Variation*, **7**, 100-107.
- Cadbury J.** (1990). The status and management of butterflies on RSPB reserves. *RSPB Conservation review*, **4**, 40-46.
- Dennis R. L. H.** (1972). A biometrical study of a Welsh colony of the Large Heath butterfly, *Coenonympha tullia* (Müller) (Rhopalocera). *Entomologist*, **105**, 315-326.
- Dennis R. L. H., Porter, K. and Williams, W. R.** (1984). Ocellation in *Coenonympha tullia* (Müller) (Lep., Satyridae) I: Structures in correlation matrices. *Nota lepidoptera*, **7**, 39-52.
- Dennis R. L. H., Porter, K. and Williams, W. R.** (1986). Ocellation in *Coenonympha tullia* (Müller) (Lep., Satyridae) II: Population differentiation and clinal variation in the context of climatically induced antipredator defence strategies. *Entomologist's Gazette*, **37**, 133-172.
- Eales H. T.** (1995). A revision of the status of the Large Heath butterfly (*Coenonympha tullia*) in Northumberland. Unpublished report to Butterfly Conservation.
- Eales H. T.** (1996). A revision of the status of the Large Heath butterfly (*Coenonympha tullia*) in Northumberland. Unpublished report to Butterfly Conservation.
- Eales H. T.** (1997). Sites in England from which the Large Heath butterfly, *Coenonympha tullia*, Müller. has been recorded since it's discovery as a British species in 1795. Unpublished report.
- Ford, E. B.** (1945). *Butterflies*. The New Naturalists series. Collins, London.
- Ford, E. B.** (1949). Early stages in allopatric speciation. In: *Genetics, palaeontology and evolution*. Ed by Huxley, Hardy and Ford. Allen and Unwin, London.
- Ford, E. B.** (1954). Problems in the evolution of geographical races. In: *Evolution as a process*. Ed by Huxley, J.
- Haworth A. H.** (1803). *Lepidoptera Britannica*. London.
- Joy J.** (1991). The ecology and life history of the Large Heath butterfly (*Coenonympha tullia*) on the Shropshire/Clwyd Mosses. *British Ecological Society Bulletin*, **22**, 114-118.
- Joy J.** (1992). Observations on the Large Heath butterfly (*Coenonympha tullia*) in Shropshire and Clwyd in 1990 and 1991. Butterfly Conservation, Occasional paper 3, Dedham, Essex.
- Joy J.** (1995). The response of Large Heath butterfly larvae from Fenn's and Whixall mooses to flooding. *Butterfly and moth review*. Butterfly Conservation (West Midlands Branch)

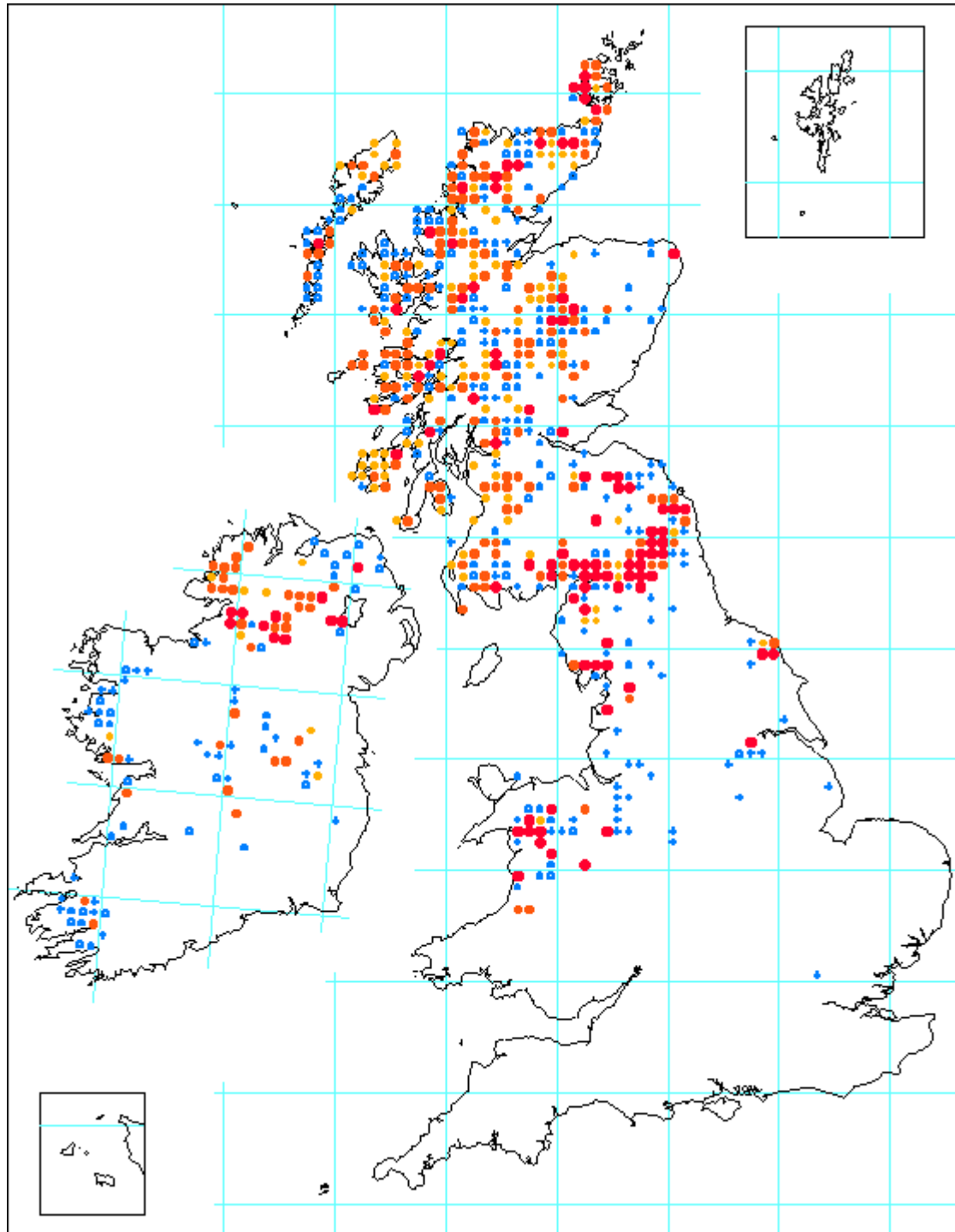
- Joy J. and Pullin A. S.** (1997). The effects of flooding on the survival and behaviour of overwintering Large Heath butterfly *Coenonympha tullia* larvae. *Biological Conservation*, **82**, 61-66.
- McLean I. F. G., Fowles A. P., Kerr A. J., Young M. R. and Yates T. J.** (1995). Butterflies on nature reserves in Britain. In: *Ecology and Conservation of Butterflies*. Ed by Pullin, A. S. Chapman and Hall, London.
- Melling T. M.** (1987). The ecology and population structure of a butterfly cline. PhD. University of Newcastle.
- Pollard E. and Yates T. J.** (1993). *Monitoring butterflies for ecology and conservation*. Chapman and Hall, London.
- Pollard E. and Greated-Davies J. N.** (1997). Butterfly Monitoring Scheme: Review and suggestions for the future. Unpublished report, ITE, Monks Wood, Huntingdon, Cambridgeshire.
- Porter, K.** (1980). A quantitative treatment of clinal variation in *Coenonympha tullia* (Müller) (Lep., Satyridae). *Entomologists monthly magazine*, **116**, 71-82.
- Oates M. R.** (1995). The role of the National Trust in the conservation of British butterflies. *Biological Journal of the Linnean Society*, **56**, 73-93.
- Rowland-Brown, H.** (1919). The distribution and variation of *Coenonympha tullia* in the UK. In: *Etudes de Lépidoptérologie comparée*, Volume **7**, Ed by Oberthür, C., 85-193.
- Roworth P, C.** (1997). The Large Heath butterfly in South Yorkshire and north Lincolnshire. Unpublished report to English Nature, Humber to Pennines Team, Wakefield.
- Spencer S.** (1996). A survey for the Large Heath butterfly in Montgomeryshire: Unpublished report to the Montgomeryshire Wildlife Trust.
- Steel C. and Parsons M.** (1989). Butterflies on County Trust reserves, draft Invertebrate Site Register Report. Unpublished report to Nature Conservancy Council, Peterborough.
- Thomas J. A. and Lewington R.** (1991). *The butterflies of Britain and Ireland*. Dorling Kindersley, London.
- Thomson G.** (1980). *The butterflies of Scotland*. Croom Helm, London.
- Tremewan, W. G.** (1990). Zygaenidae. In: *The moths and butterflies of Great Britain and Ireland*. Volume 2, Ed by Heath J and Maitland Emmet A. Harley Books, Colchester, 74-123.

Turner J. R. G. (1963). A quantitative study of a Welsh colony of the Large Heath butterfly, *Coenonympha tullia* Müller (Lepidoptera). *Proceedings of the Royal Entomological Society A*, **38**, 101-112.

Wain, M. (1997). A revision of the distribution of the Large Heath butterfly (*Coenonympha tullia*) in Cumbria with ecological observations. Unpublished report to EN, BC, FE & CWT.

Warren, M. S., Barnett, L. K. Gibbons, D. W. and Avery, M. I. (1997). Assessing national conservation priorities: an improved red list of British butterflies. *Biological Conservation*, **82**, 317-328.

Appendix 1 The approximate distribution of the Large Heath Butterflies for the New Millennium project (2001).
Copyright of Butterfly Conservation/Biological Records Centre.
(Dark full spot all records from 1995-1999; open circles all records between 1970-1982; cross all pre 1970 records).



Appendix 2 Regional surveys of the Large Heath

Eales H. T. (1995). A revision of the status of the Large Heath butterfly (*Coenonympha tullia*) in Northumberland. Unpublished report to Butterfly Conservation.

Eales H. T. (1996). A revision of the status of the Large Heath butterfly (*Coenonympha tullia*) in Northumberland. Unpublished report to Butterfly Conservation.

Roworth P, C. (1997). The Large Heath butterfly in South Yorkshire and north Lincolnshire. Unpublished report to English Nature, Humber to Pennines Team, Wakefield.

Spencer S. (1996). A survey for the Large Heath butterfly in Montgomeryshire: Unpublished report to the Montgomeryshire Wildlife Trust.

Wain, M. (1997). A revision of the distribution of the Large Heath butterfly (*Coenonympha tullia*) in Cumbria with ecological observations. Unpublished report to EN, BC, FE & CWT.

Wain, M. (1997). The distribution of the Large Heath butterfly (*Coenonympha tullia*) in Cumbria 1997, with a review of its historical records. Unpublished report to EN, BC, FE, NWW & CWT.

Wain, M. (1997). The distribution of the Large Heath butterfly (*Coenonympha tullia*) in Lancashire. Survey report 1997. Unpublished report.

Appendix 3 Conservation requirements of the Large Heath

The Large Heath inhabits lowland raised bogs (mosses), upland blanket bogs and damp, acid moorland. These are all, wet areas where the main larval food plant, Hare's Tail Cotton Sedge (*Eriophorum vaginatum*) occurs.

The specific management requirements of the Large Heath are little understood at present but most sites are open with little or no tree invasion. Some sites are abandoned cut over peat bogs with pockets of suitable habitat amidst birch but the long term suitability of these sites is unknown. Preferred larval food plants are usually clumps of tall tussocky Hare's Tail Cotton Sedge (*Eriophorum vaginatum*) with *Erica tetralix*, the main adult nectar source on most sites, nearby. These tussocks provide a refuge in the winter and are always present on sites with Large Heath. Overgrazing can potentially be a problem on some sites if this severely reduces the tussocky structure of the vegetation. Historically the best sites would have been too wet for grazing and it is the maintenance of wet bogs with a high (but not too high, as to threaten larval survival) water-table which will ensure the conservation of the Large Heath.

On acid moorland and blanket bog, the ideal grazing regime is not known but should preferably be light and extensive.