Large heath
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Large heath *Coenonympha tullia*

Climate Change Sensitivity:	HIGH	Ability to Manage:	MEDIUM
Non climatic threats:	HIGH	Vulnerability:	HIGH

Summary

The large heath has declined rapidly in England. Historically, this has been due to degradation of its habitat through agricultural improvement, including drainage and high intensity burning of moorland, and the loss of wetland through peat cutting, tree planting, or woodland succession. The species is at the southern limit of its range in the UK and climate change appears to be playing an increasing role in its overall decline.

Adaptation options focus on ensuring management promotes a diverse mix of mire vegetation containing bog mosses, hare's-tail cottongrass *Eriophorum vaginatum* and cross-leaved heath *Erica tetralix*. This may increasingly require greater control over the hydrology of sites to ensure optimal water levels. Assisted colonisation to establish populations in areas that are beyond the dispersal ability of the butterfly and where the climate will remain suitable can also be considered, especially on sites where the hydrology can be controlled.

Description

The large heath is a medium-sized, highly variable grey-brown butterfly (wingspan 35-40 mm) that never basks with its wings open. Males and females are similar, with the females being a slightly lighter colour. The eye spots on the underside of this species vary with latitude. Those in the north of Scotland (*ssp. scotia*) have almost no spots at all, with adults looking like a large small heath, while those in England (*ssp. davus*) have brightly coloured, distinctive spots. Intermediate forms occur in central and southern Scotland (*ssp. polydama*), although never occur south of the border, making identification of the English populations straightforward.

Ecology and distribution

The large heath is restricted to flat, boggy habitats in northern England, with a few isolated sites in the midlands and the south. Sites are usually below around 500 m in altitude, and have a base of sphagnum moss interspersed with dense tussocks of hare's-tail cottongrass. They also have abundant cross-leaved heath, the main nectar source, and other plant species characteristic of high quality mire. The optimum habitat appears to be sites with thicker peat (>0.5 m) and higher water tables (Dennis & Eales 1999).

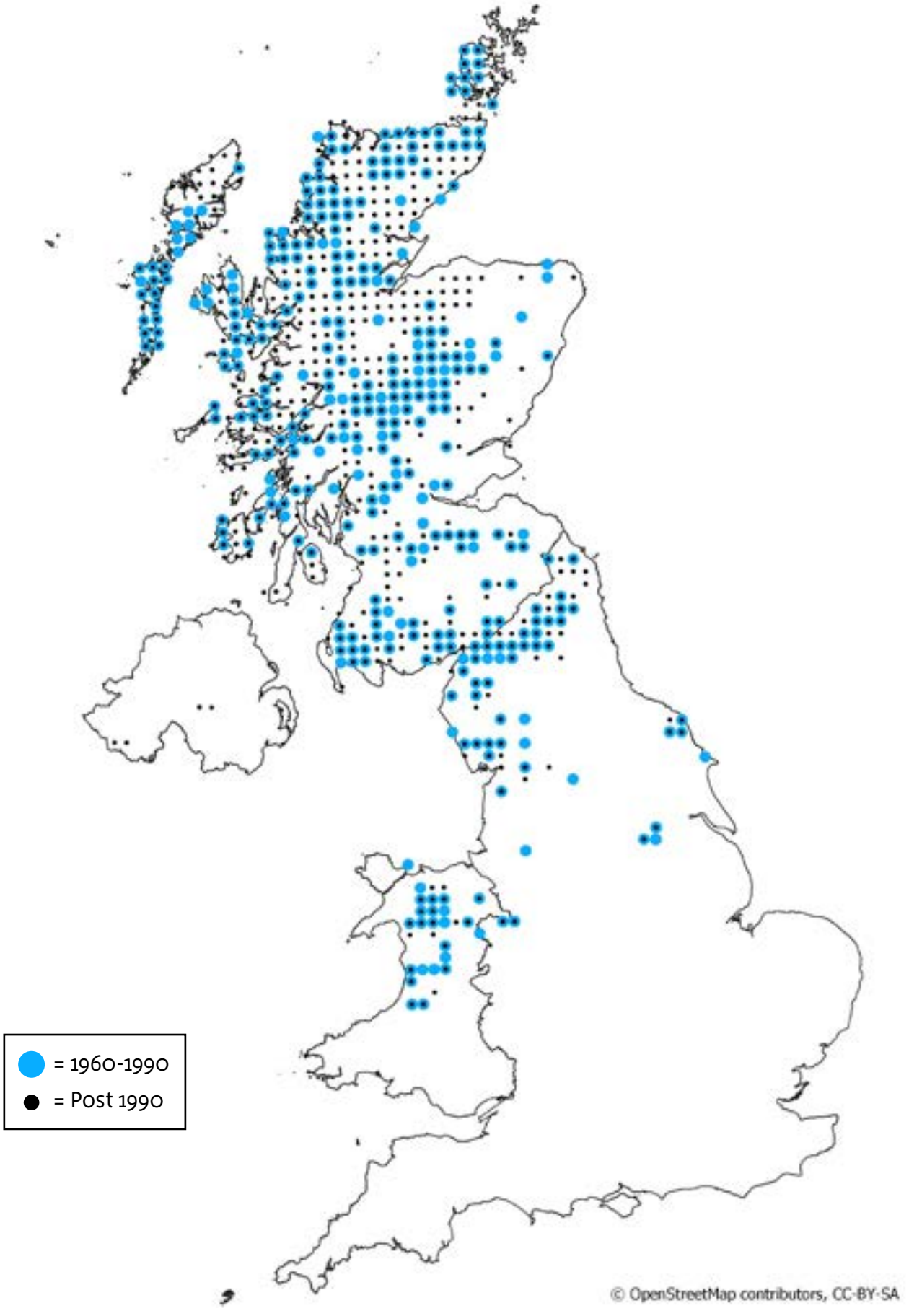
There is one generation a year, with adults flying between mid-June and early August, with a peak in mid-July. Eggs are laid singly, often on dead cotton grass. Sites dominated by tall heather are largely avoided by ovipositing females (Wainwright 2011). The larvae feed during the day from late July to late September (Joy 1991). The main host plant is hare's-tail cotton grass. Occasionally, however, they feed on jointed rush *Juncus articulates*, and in the North York Moors, common cottongrass *Eriophorum angustifolium*.

The larvae hibernate deep in the vegetation while still small, and emerge in March to continue feeding. Pupation occurs in April or May. A small proportion of each cohort have a two-year life cycle and remain as third instar larvae throughout their second summer (Bourn & Warren 1997; Melling 1990). This flexibility may help the species to cope with unpredictable weather during the adult flight period. Adults feed primarily on cross-leaved heath, but hawkweeds *Hieracium/ Hypochoeris* spp., heather *Calluna vulgaris/Erica* spp., tormentil *Potentilla erecta*, and white clover *Trifolium repens* are also used.

The butterfly has declined seriously in England, being lost from half the English counties in which it once was present (Eales & Dennis 1998). Although the rate of decline has slowed, nationwide field surveys suggest that 14% of historic English populations (with a pre-2000 record) are now extinct (A. Suggitt, pers.com.). Much of this decline can be attributed to direct habitat loss through agricultural improvement, drainage and peat cutting (Franco *et al* 2006). In addition to habitat loss, sites have also been degraded by drainage or high intensity burning (Grant *et al* 2012), resulting in the loss of the structure and nectar sources the butterfly requires. Nitrogen deposition is also been suggested as a driver for this change. Population decline has been halted or even reversed in locations where proactive intervention has been put in place.

Butterfly Conservation's presence records for large heath over 2 timeslices, 1960-1990 and post 1990, are shown on the map below (10km grid scale).

Presence of large heath records, 10km².
Source: Butterfly Conservation: Butterflies for the New Millennium.



Confidence in climate change impacts[28]

Distribution change: **MEDIUM CONFIDENCE** Mechanism: **LOW CONFIDENCE**

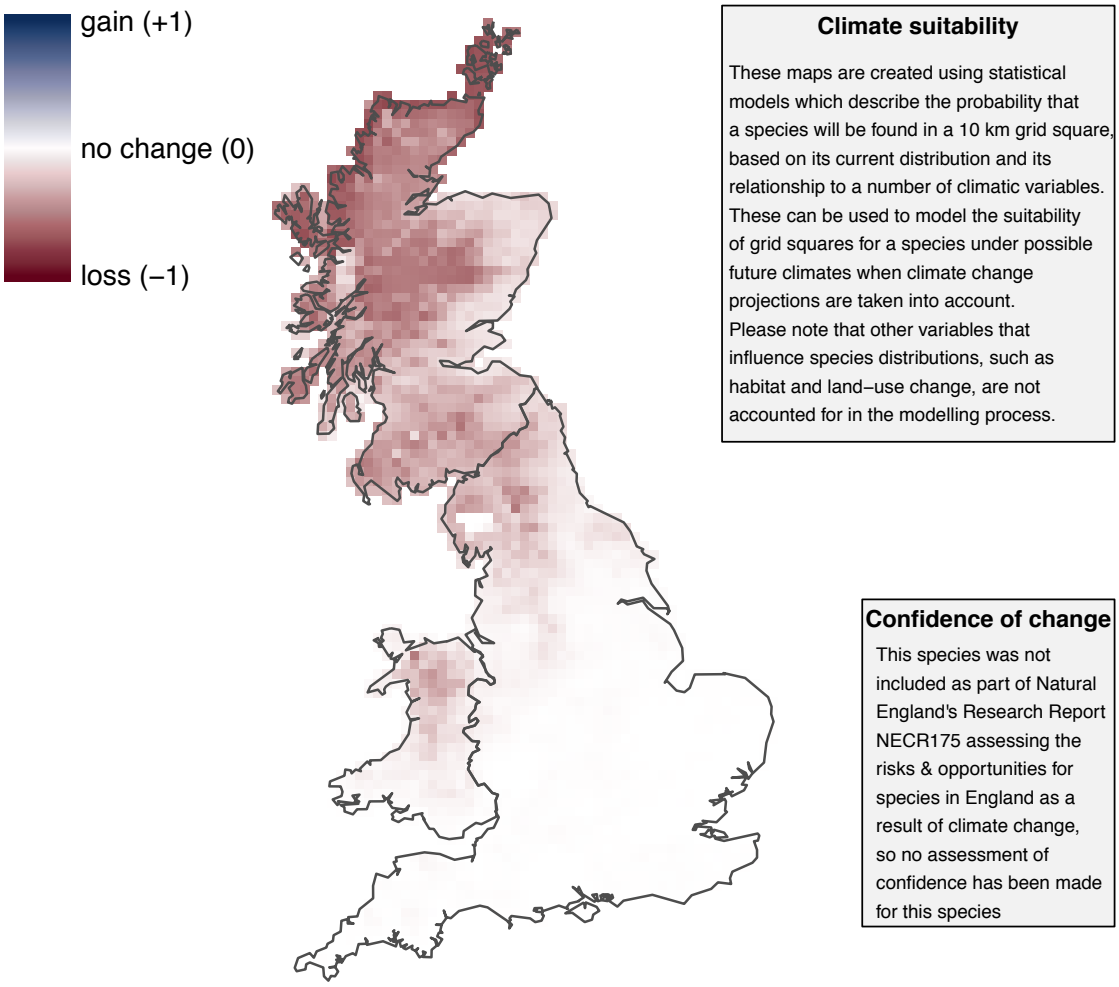
Modelling suggests that in England, the area climatically suitable for the large heath will decline (Berry *et al* 2002; Hill *et al* 2002, Pearce-Higgins *et al* 2015). The quality of the wetland habitat has been shown to be the most important factor affecting the presence of the large heath (Dennis & Eales 1999), and recent work suggests that climate change may directly and indirectly contribute to a degradation of wetland habitat (Weking, Hermann & Fartmann 2013).

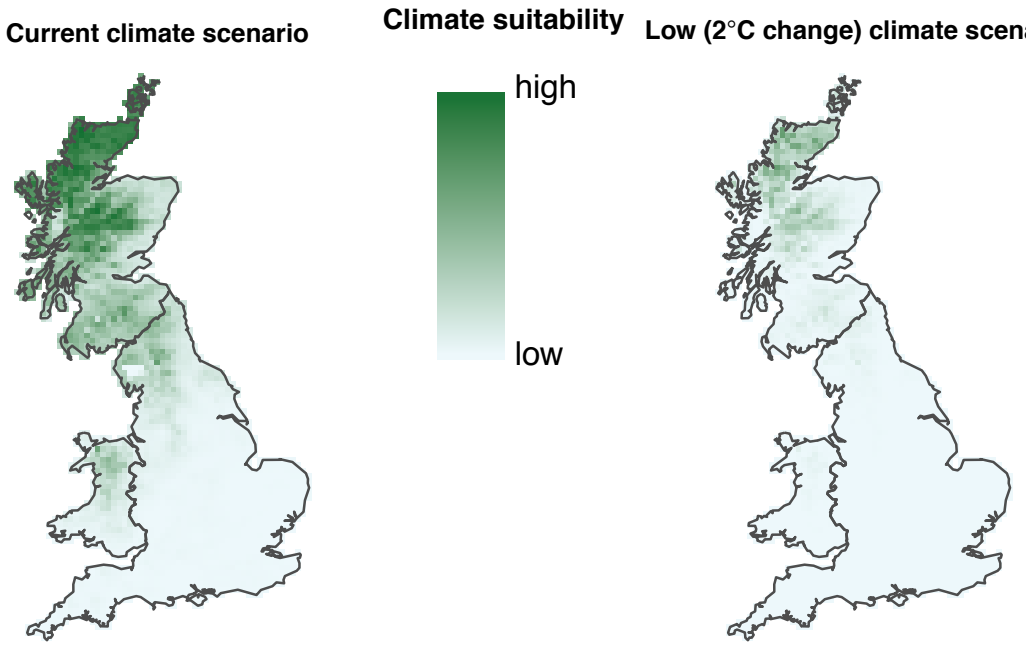
The larvae have been shown to be sensitive to raised water levels (Joy & Pullin 1997,1999), suggesting that on some sites prone to flooding the species would be sensitive to changes in the frequency of extreme rainfall events and overall rainfall patterns.

Other potential mechanisms by which climate change could impact on the large heath include competition from other species, losses or gains due to extreme events such as wildfire, and changes in patterns of oviposition.

28 An assessment of the strength of evidence that distributions are changing and the mechanisms causing change are understood. Refer to Part B, section 5 of the species section introduction for more information.

Projected change in potential distribution of large heath in the UK with a temperature rise of 2°C (Pearce-Higgins *et al* 2015).





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Further information on these projections can be found in the introduction to the species section (Part A, Section 3 and Part B Section 5). Note that this is a guide to where a species may be able to survive, it does not capture other issues such as habitat availability and fragmentation – see text above for further details. Contains public sector information licensed under the Open Government Licence v3.0. Please also see acknowledgement and copyright at the beginning of this manual.

Please read this case study alongside the relevant habitat sheets.

Adaptation options

Maintaining existing sites in optimum condition and restoring degraded wetland sites that previously supported the species will increase the resilience of populations to climate change. Greater control of site hydrology may be needed to reduce the impacts of climate change on the condition of wetlands, especially for those sites in the south and east of the country projected to have the greatest decline in summer rainfall.

- Manage existing sites to ensure a diverse mix of mire vegetation containing bog mosses, hare's-tail cottongrass and cross-leaved heath.
- Make plans to reduce the risks of and respond to extreme events such as wildfire.
- Restore the hydrology of degraded sites to promote mire and bog development, including by blocking articifical drainage.
- Ensure scrub is controlled to prevent additional pressure on the hydrology of sites.
- Restore sites in close proximity to existing populations, as the species has poor dispersal ability.
- Due to the larval sensitivity to flooding, if the species is present on sites where water level manipulation is used to promote restoration, ensure suitable hare's-tail cottongrass tussocks remain in drier areas, to provide refugial areas that will allow larvae to avoid drowning.
- Monitor known populations to determine the extent of any change, and if it is suspected that climate change is responsible for losses, undertake research to identify the mechanisms responsible. Measures should also be put in place to monitor the impact of adaptation actions.
- Identify additional sites outside the range of natural colonisation for potential artificial reintroduction. Success is likely to be highest in sites in the north of England where changes to patterns of rainfall are unlikely to have an adverse impact on the habitat, or where systems can be put in place to artificially maintain water levels.

Relevant Countryside Stewardship options

SP9 ***Threatened species supplement***

WT10 ***Management of lowland raised bog***

UP3 ***Management of moorland***

UP4 ***Management of moorland vegetation supplement***

Case Study

Heysham Moss large heath Project

Since 2012, Chester Zoo has worked with Lancashire Wildlife Trust (LWT) to restore the large heath to Heysham Moss, where it has not occurred for over 100 years. After acquiring the site in 2004, LWT undertook restoration work to ensure the habitat was suitable for the species. A rearing programme was initiated in 2013, with gravid female butterflies collected from Winnmarleigh Moss. Enclosures at the zoo were constructed to receive the butterflies for egg laying and rearing larvae to pupation. In 2014 and 2015, pupae have been transported to Heysham Moss, and adult butterflies were released when they emerged. A third and final rearing cycle is in progress.

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