

Why is the Small Tortoiseshell declining?

Report for 2008/2009

Owen Lewis & Nia Hamer

University of Oxford, Department of Zoology

owen.lewis@zoo.ox.ac.uk

Introduction

In 2008, with the support of Butterfly Conservation, we launched a project to investigate whether a newly-colonised parasitoid fly might be to blame for recent declines in the Small Tortoiseshell butterfly. The parasitoid is a tachinid fly called *Sturmia bella* which was not recorded in Britain until 1998. It lays eggs on nettle leaves, which are unwittingly consumed by feeding caterpillars. The eggs hatch and develop within the caterpillars as they grow, ultimately killing the host. In Britain, there had been records of the parasitoids attacking both Small Tortoiseshell and Peacock, as well as some records of emergences from other nymphalids. However, little was known about the distribution of the parasitoid, the fraction of hosts killed by this species, and the relative susceptibility of Small Tortoiseshells and Peacocks. To investigate the spread of *Sturmia bella* and its on its hosts and on native parasitoids, we asked volunteers to collect batches of wild larvae of Small Tortoiseshell and Peacock butterflies during the summer of 2008, and to send us any emerging parasitoid pupae for identification. Volunteers were recruited through Butterfly Conservation, and notes posted in *British Wildlife* magazine, the newsletter of the Entomological Livestock Group, and other online sources. A project web site was established at <http://users.ox.ac.uk/~zool0376/Small-Tortoiseshell.htm> with protocols and data sheets.

Results

In total, 53 batches of Peacock and Small Tortoiseshell caterpillars were collected with sufficient data for analysis. We were also kindly supplied with data from the UK Butterfly Monitoring Scheme (UKBMS), run by Butterfly Conservation and the Centre for Ecology and Hydrology, which allow us to calculate the extent of decline for these species and any links to the presence of *Sturmia bella*. The data from 2008 are still being processed, but the preliminary results are described here. We will be continuing our survey in 2009 (see below) and are planning to publish our results formally once a second season of data has accumulated.

■ **Small Tortoiseshells have declined dramatically in recent years**

UKBMS transect data show that Small Tortoiseshells have declined in abundance by approximately 50% when comparing pre-1998 (before the arrival of *Sturmia bella*) and post-1998 (after the arrival of *Sturmia bella*) periods (**Figure 1**). The Peacock has declined significantly less (~2%) over the same period.

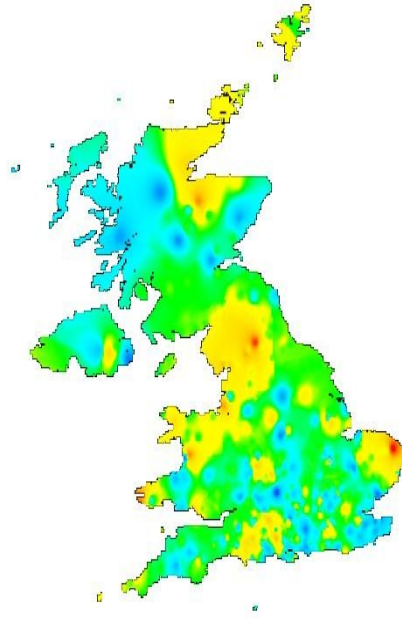


Figure 1. The pattern of decline (cool colours) and localised increases (warm colours) in abundance of Small Tortoiseshells across the UK, comparing data from before and after 1998.

■ ***Sturmia bella* now has a wide distribution in southern Britain**

Sturmia bella was found in 30% of the larval groups collected, including samples from as far north as Merseyside and Doncaster (**Figure 2**). We received very few samples from northern England and none at all from Scotland, so we are uncertain how far north *Sturmia bella* has reached. Collecting samples from the north is a priority for 2009.

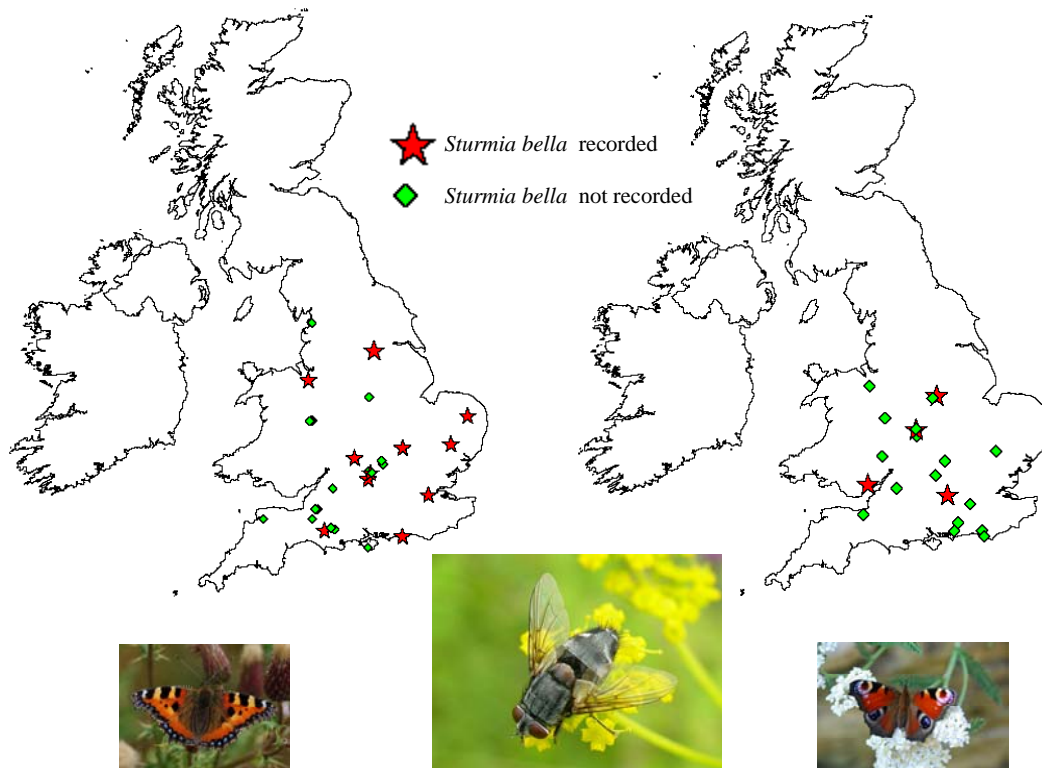


Figure 2. Locations of 1998 samples for Small Tortoiseshell (left) and peacock (right) where *Sturmia bella* was (red stars) or was not (green diamonds) recorded.

■ **Small Tortoiseshells have declined most dramatically in southern Britain**

The butterfly has declined most dramatically in latitudinal zones in southern Britain and the Midlands which have been colonised by *Sturmia bella*, where numbers have been reduced by 52%. However, Small Tortoiseshells have been declining in northern England and Scotland too (38% decline).

■ ***Sturmia bella* is now the major parasitoid for Small Tortoiseshells (but not Peacocks)**

Of 888 Small Tortoiseshell caterpillars collected from 40 sites, 18% were killed by *Sturmia bella*. Just 3% of the 697 Peacock caterpillars collected were affected. In Small Tortoiseshells, *Sturmia bella* affected more batches and killed more caterpillars than any other parasitoid species, and its effects were greater than all other tachinid flies combined

(Figure 3). At localities where *Sturmia bella* is present it kills 61% of caterpillars.

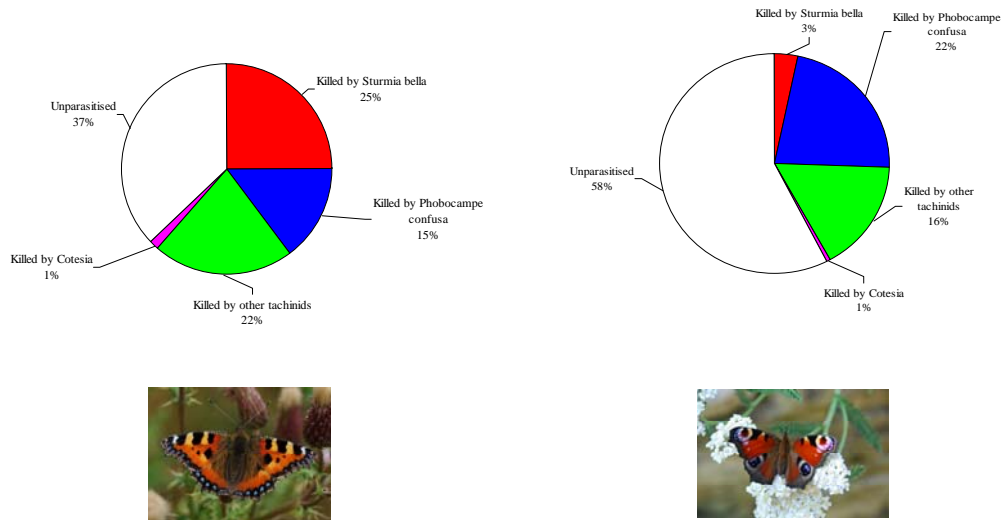


Figure 3. Proportions of larvae of Small Tortoiseshell (left) and Peacock (right) that were unparasitised (white), parasitised by *Sturmia bella* (red), other tachinids (green), *Phobocampe confusa* (blue) or *Cotesia* spp. (pink).

■ ***Sturmia bella* is mostly recorded from caterpillars collected in late summer**

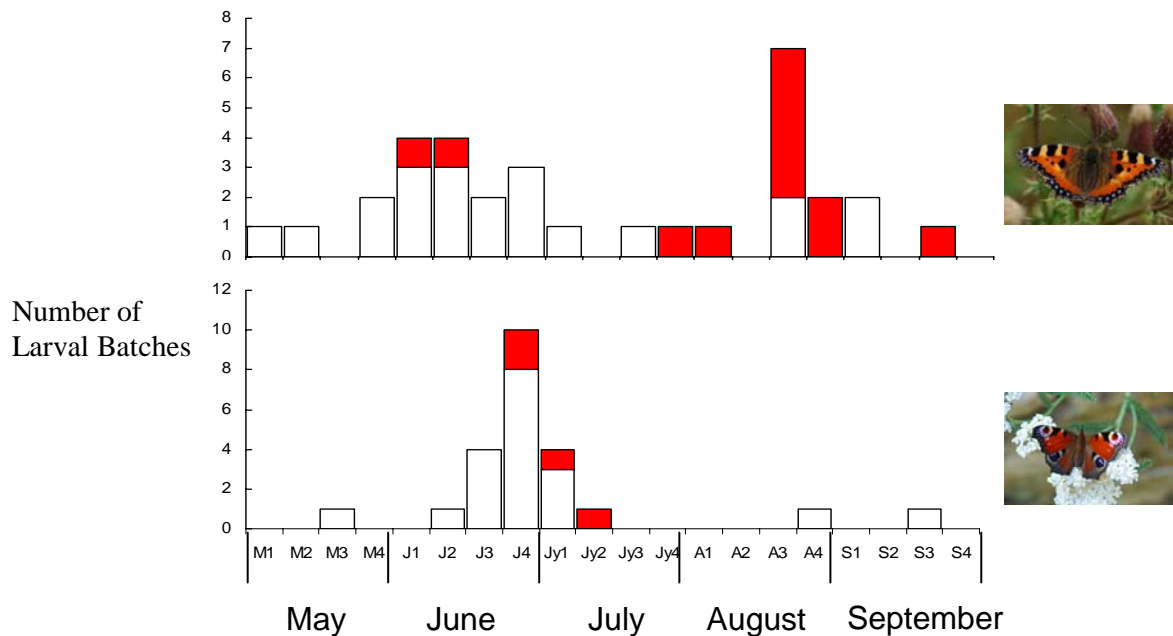


Figure 4. Numbers of larval batches of Small Tortoiseshell (above) and Peacock (below) that were parasitised by *Sturmia bella* (red) or not (white) in relation to collection date.

Peacocks are mostly single-brooded in the UK, while Small Tortoiseshells have two generations. The lower mortality of peacocks may be because their larvae are not present at the time when *Sturmia bella* is most active (**Figure 4**).

■ ***Sturmia bella* is an additional cause of mortality to the larval batches it parasitizes**

Batches of *Small Tortoiseshell* and Peacock larvae parasitized by *Sturmia bella* have significantly higher overall parasitism rates than batches unaffected by *Sturmia bella*. However, the success rates of native parasitoids are significantly reduced when *Sturmia bella* is present. This suggests that the new parasitoid has increased the overall burden of parasitism for Small Tortoiseshells, and may now be competing with the native parasitoids.

■ **The overwintering strategy of *Sturmia bella* in the UK is still unknown.**

Puparia of *Sturmia bella* from late summer caterpillars hatched in late September and October. Small Tortoiseshells and Peacocks overwinter as adults, but it is unknown for tachinid flies like *Sturmia bella* to overwinter as adults in the UK. We believe that *Sturmia bella* may have an unknown, alternate host to fill this apparent ‘gap’ in its life cycle.

■ **There is no evidence that local decline rates reflect the presence of *Sturmia bella***

Using UKBMS transect data the median rate of decline in small tortoiseshells on sites near confirmed localities for *Sturmia bella* (49%) is not statistically different from the median decline (50%) on sites where the parasitoid has not been recorded.

Synthesis

The evidence to suggest that *Sturmia bella* is the cause for the recent decline Small Tortoiseshells is as yet weak and mainly correlational. Additional data (particularly from northern Britain where *Sturmia bella* may not yet have colonised) will be needed to investigate causality. This is a priority for 2009. In separate research, we are also seeking to find out more about the biology and alternative hosts of *Sturmia bella*, and how it interacts with the native parasitoid community, and to test alternative explanations for host population fluctuations using the UKBMS data.

Acknowledgements

For all their help we are extremely grateful to Tom Brereton, David Roy, Martin Warren, Chris Raper, Mark Shaw, Matt Smith and of course our many volunteer caterpillar collectors. Photos of Small Tortoiseshell © Jim Asher, Peacock © Owen Lewis, *Sturmia bella* © Chris Raper.