



CREaTE

Canterbury Research and Theses Environment

Canterbury Christ Church University's repository of research outputs

<http://create.canterbury.ac.uk>

Please cite this publication as follows:

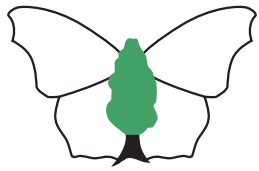
Burman, J. (2014) Monitoring moths using sex pheromones. Moths Count Newsletter 2014. p. 6.

Link to official URL (if available):

This version is made available in accordance with publishers' policies. All material made available by CReaTE is protected by intellectual property law, including copyright law. Any use made of the contents should comply with the relevant law.

Contact: create.library@canterbury.ac.uk





**Butterfly
Conservation**

Saving butterflies, moths and our environment



Moths Count Newsletter 2014

Seven years of success!

The National Moth Recording Scheme (NMRS) is going from strength to strength; over the past year we have received a minimum of 1.4 million new moth records. We have been sent data refreshes from 87 vice-counties; they include records up to 2011 and in some cases 2012 and 2013 records. The Moths Count team are extremely grateful to the network of County Moth Recorders for their continued support of the NMRS.

There are now 17,054,891 moth records in the NMRS. However, we still have a substantial number of the refreshed datasets to import, so the total number of records is likely to increase significantly. Many thanks to everyone who contributes to the NMRS by sending their records to the network of County Moth Recorders, record collators & Local Record Centres, who then undertake the vital work of collating, verifying and submitting records to the NMRS.

The Large Yellow Underwing is the most recorded species in the NMRS accounting for 2.4% of all observations, followed by Heart and Dart and Dark Arches which both account for 1.5% of records.

We have recently upgraded the NMRS server and moved the NMRS database onto it. This investment in new hardware is part of Butterfly Conservation's commitment to the long-term sustainability of the NMRS. This upgrade work has inevitably delayed the importation of datasets sent to us over the winter months. However, we are pleased to report that the system has undergone rigorous testing and data import has recommenced recently.

We have had some useful discussions in the last few weeks with the National Biodiversity Network with a view to improving the distribution maps available on the Moths Count website. We are hoping to have individual species distribution maps at 2km in addition to 10km resolution, and species lists for 2km and 10km grid squares but are currently limited by a technological incompatibility.



Cinnabar (R. Scopes)

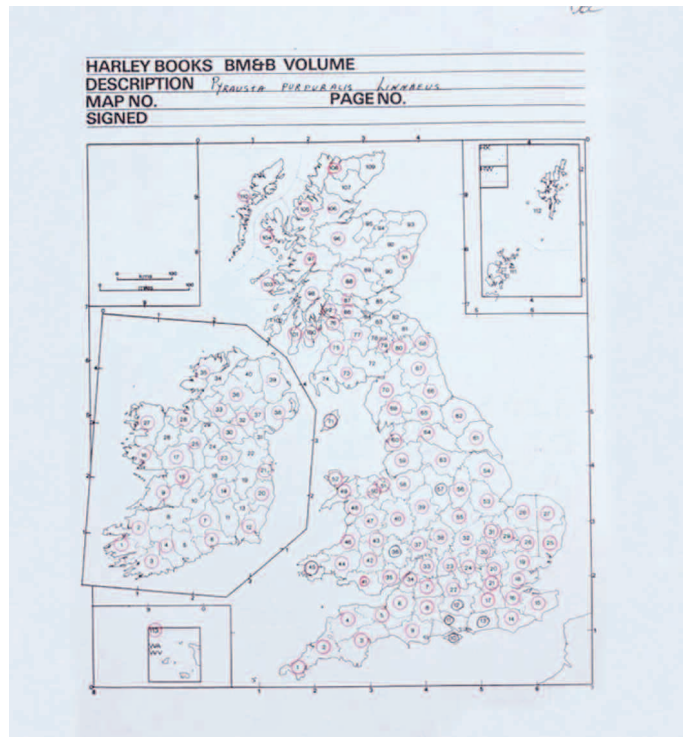
At the start of the year, we announced the plans for the *Macro-moth Atlas for Britain and Ireland*, which we aim to publish in 2018. We have always intended to produce an atlas, but the timing was dependent upon the progress of the NMRS. We will be including all records in the NMRS up to the end of 2016 and collaborating with MothsIreland. A significant amount of recording needs to be done between now and the end of 2016 to ensure reasonable coverage and accurate species distributions.

It is very encouraging to see that the moth recording community has already taken up the gauntlet and is actively targeting under-recorded areas during this field season (see article on page 6). At the end of this year there will be two further seasons to improve coverage of the NMRS, not to mention the winter months when historical records can be harvested from notebooks, museum collections and the like.

If you want to help reduce the number of 'white-holes' and add records to under-recorded squares please contact the relevant County Moth Recorder in the first instance to find out where these areas are. In due course we will be producing a list of under-recorded 10km squares based on the NMRS database. However, this might not be 100% accurate as there may be records that we have not yet received from the County Moth Recorder network.

Many people have enquired about the NMRS and the new *Checklist of the Lepidoptera of the British Isles* by David Agassiz, Stella Beavan and Bob Heckford, which was published at the end of 2013. Butterfly Conservation and the National Moth Recording Scheme will be adopting this, but there's no need for panic. For now, it is fine to continue to record the way you have been and we will be happy to receive datasets and moth records using the 'old' names and numbering system until the new ones become familiar. There will undoubtedly be months or even years of transition from the old to the new checklist as the field guides and species dictionaries used in recording software and websites are updated.

Another significant development occurred early this year. Thanks to a grant from the Department for Environment Food and Rural Affairs just before Christmas, we were able to scan the hand-annotated micro-moth maps and record cards originally compiled by A. Maitland Emmet and more recently by Dr John Langmaid and Dr Mark Young. These are available on the Moths Count website (www.mothscount.org) along with digitised vice-county level maps for 756 species. We are extremely grateful to John Langmaid and Mark Young for making the original paper maps available and to Dave Green for taking on the digitisation. Currently the digitised maps include data up to 31st December 2012, but we plan to update these annually and seek further funding to digitise the remaining 862 species record cards.



Above: Hand annotated paper map for *Pyrausta purpuralis*.

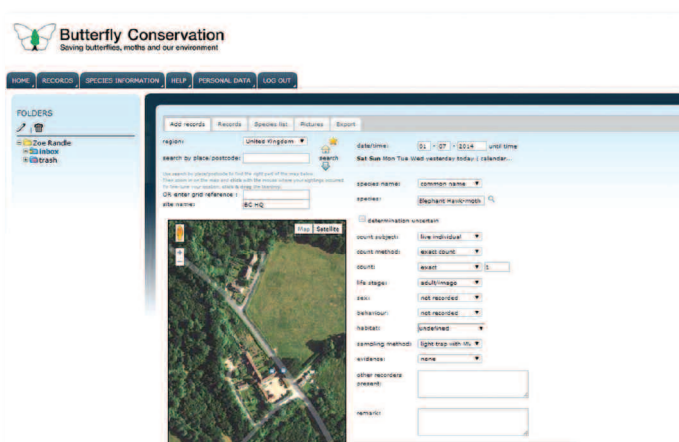
Right: Digitised distribution map for *Pyrausta purpuralis*.



After several years of development in conjunction with our partners De Vlinderstichting (Dutch Butterfly Conservation) we are pleased to announce that the NMRS Online Recording system is now live (www.mothrecording.org).

This system provides a comprehensive yet straightforward tool for recorders to enter, store and manage their own moth records. There are a few aspects to be finalised, but we felt that it was important to get the system up and running for recorders to use without further delay. County Moth Recorders spend a lot of time entering records received in various non-electronic formats and encouraging recorders to computerise their sightings will reduce the work load. All records entered into the online system will be forwarded to County Moth Recorders for verification and for inclusion in county datasets prior to entering the NMRS database.

Therefore, as previously, no records (including those entered into the online system) will enter the official NMRS database without having been collated and checked by the relevant County Recorder. Recorders can enter full details of their sightings on this system, including exact or vague counts, recording methods, life stage, behaviour etc. Sites can be entered by searching on place name or postcode and then marking the location on an onscreen map or satellite image or as grid references, if these are known. Records will automatically be assigned to vice-counties, enabling forwarding to the appropriate County Moth Recorder. There are also built in verification checks based on the known flight period and geographical range of each species.



Other interesting features include species information pages, photographs, flight charts and distribution maps. The maps will enable recorders to see their records in context with those of other online recorders and the 'official' distribution of each species from the main NMRS database, and can be changed from national to county level. Over time, additional analysis features will be added, further improving the system for recorders who want to interpret their own records. We hope that this new system will be of great benefit to moth recorders.

We have also started to analyse the NMRS database. A very simple analysis was undertaken comparing the occupancy of the five most widespread moth species as a proportion of the total number of 10km squares with moth records in each year between 1990 and 2012 in the NMRS database (Figure 1). The most widespread moth in 2012 was Large Yellow Underwing, occupying 56% of 10km squares with moth records that year across the UK, Channel Islands and Isle of Man. The four other most widespread species were Silver Y (54%), Brimstone Moth (52%), Dark Arches (52%) and Green Carpet (50%) of 10km squares. Each of the species shows a substantial increase in distribution over the period, even after allowing for the varying number of 10km squares recorded each year. If a species were stable in its range, you would expect the line on Figure 1 to be flat. Are these genuine increases? Interestingly, the percentage of recorded 10km squares has also increased over time due to the increasing popularity of moth recording and hence recording effort (Figure 2). The drop in recent years is presumably due to incomplete data submission.

The similarity between Figures 1 and 2 suggests that robust conclusions cannot be drawn from the data using simple analyses that do not take in to account complex biases such as recorder effort, duration of trapping or the lack of standardised sampling methodology. However, species that have shown extreme population increases, as per *The State of Britain's Larger Moths 2013* report, such as Least Carpet do show increased occupancy at 10km resolution (Figure 3). At the other end of the spectrum, V-moth which has a reported 99% decline in abundance also shows a steep decline in percentage of occupied 10km squares (Figure 3).

The first full analysis of the NMRS data utilising methods that try to account for recording effort bias in such datasets was published earlier this year in the *Journal of Applied Ecology* and is summarised on page 8.

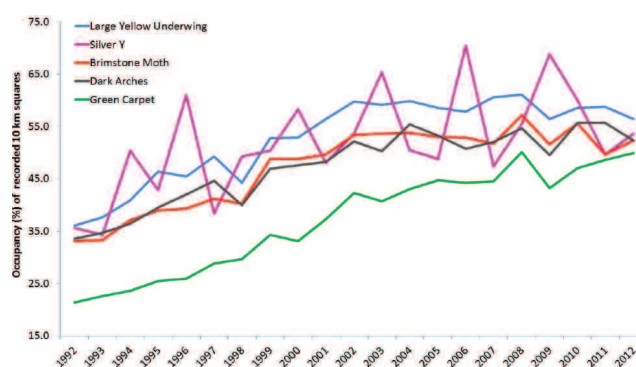


Figure 1: Percentage occupancy (of recorded 10km squares) at 10km resolution of the five most widespread moths in the NMRS database between 1990 and 2012.

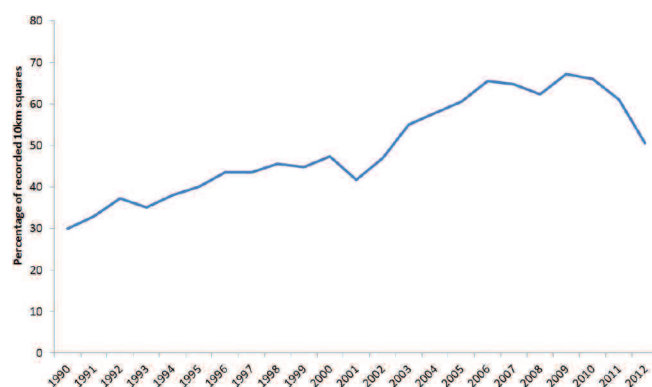


Figure 2: Percentage of recorded 10km squares in the NMRS database between 1990 and 2012.

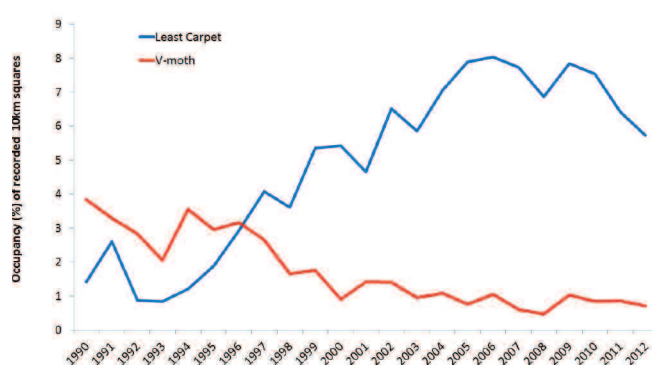


Figure 3: Percentage occupancy (of recorded 10km squares) at 10km resolution of Least Carpet and V-moth in the NMRS database between 1990 and 2012.

The state of Dutch larger moths

As in Britain more than 95% of Lepidoptera in the Netherlands are not butterflies but moths. The Dutch fauna comprises about 2,200 indigenous moth species, of which more than 800 are larger moths. Most of the larger moth species also occur in Britain, with only around 100 species that are not found in Britain. These are mostly species of dry habitats on sandy soils, such as the beautiful Tau Emperor, *Aglia tau* and the very rare *Lemonia dumi*. Conversely, there are also about 100 species that occur in Britain but not in the Netherlands. This, for example, applies to Fisher's Estuarine Moth, Plain Clay and Anomalous.



Tau Emperor (A. H. Baas)

In 2013, the Dutch Butterfly Conservation (DBC) and Working Group Lepidoptera Faunistics of EIS-Netherlands published a preliminary Red List of larger moth species in a book entitled *Moths Enlightened*. The List is compiled according to the criteria of the Dutch Ministry of Economic Affairs, not according to those of the IUCN. A species' status is based on a combination of both the trend and rarity in abundance as well as the trend and rarity in distribution during a 30 year period from 1982 to 2012. The data used for the calculations are mainly gathered by a fantastic group of over 1,500 indispensable volunteer recorders.

The data include mainly casual records that are not collected in a standardised way. Consequently, it is very important to take recording intensity or frequency into account in the calculations. A Moth Monitoring Scheme with a standardised way of recording has only just started this year in the Netherlands. All records of Dutch moths are compiled in the database 'Noctua' that consists of more than 4 million records.

Eighty species were excluded from the analyses as they were either regular migrants (e.g. Silver Y), sporadically observed (e.g. Brindled Ochre) or recent colonists (e.g. Clancy's Rustic). The conclusions of the remaining 761 resident species provide an alarming picture: 61% are more or less threatened and 9% are considered extinct.



In total, 63 species are 'critically endangered' (e.g. Dark Brocade), 102 species are 'endangered', 135 species are 'vulnerable', 96 species are 'near threatened' and (only) 295 species are of 'least concern'.

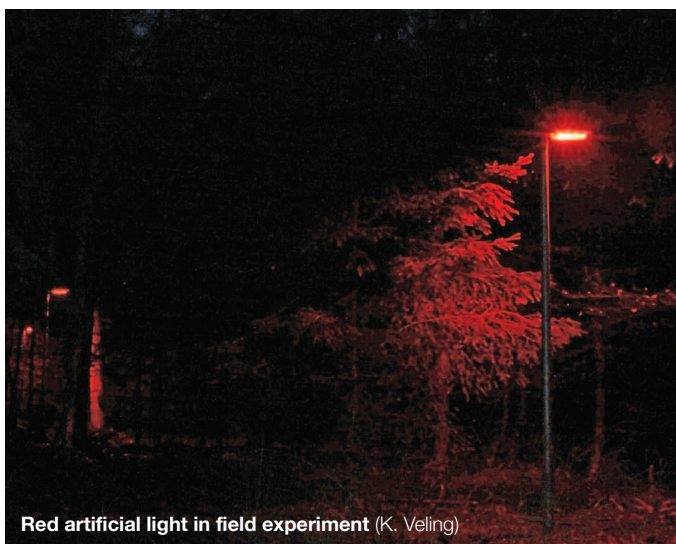
Eleven species went 'extinct in the 19th century' and 39 species in the 20th century. Twenty species are considered 'extinct in the 21st century' but this conclusion should be taken with care. A species is only taken into account in the calculations when it has been recorded in at least 10 different years in the Netherlands. The status 'extinct' does not mean that a species has not been observed in the last 10 years. There are several species that consequently received the status 'extinct in the 21st century' but that have been recorded at least once since 2000, such as, for example, Muslin Footman.

The majority of species show similar trends in the Netherlands and Britain. The most severely decreasing species in Britain, such as V-moth and Garden Dart, are also decreasing in the Netherlands. There are few exceptions where species show opposite trends in both regions, such as Varied Coronet. One increasing species that recently colonised south-east England is the notorious Oak Processionary Moth which mostly occurs in oaks along road verges. In the Netherlands, this moth is still expanding despite intensive efforts to control it by biological, chemical, mechanical and thermal methods. Flower-rich road verges with plenty of natural enemies may provide a simple and environmentally friendly solution.

It is obvious that more research is needed to understand the causes and consequences of species trends. The general decline of moths is likely to affect other organisms as moths are an important food source for many other animals and act as pollinators for many plants. The main causes of decline are generally considered to be urbanization and intensive land use, resulting in the loss and fragmentation of suitable habitat, climate change, chemical pollution and light pollution.

The use of artificial light has increased dramatically in the last few decades and may not only disturb foraging and mating behaviour of moths, but also their development.

In the Netherlands, DBC, other NGOs, Wageningen University and Research Centre and the Netherlands Institute of Ecology are currently involved in large-scale field research on the long-term effects of different colours of artificial light (red, green and white) on plants and animals (see image below).



Red artificial light in field experiment (K. Velling)

This research is funded by the Netherlands Organization for Scientific Research, Philips Lighting and the Dutch Oil Company. The long-term effects of artificial light are measured on natural populations of not only moths but also birds, bats, small rodents, toads and plants in a variety of nature areas. The first results of this field research will follow soon.

In conclusion, the alarming, general decline of larger moths in The Netherlands mirrors the situation in Britain. To halt this decline, a collective effort from recorders to researchers, nature conservation agencies, landowners and policy makers is needed. It is obvious that moths should get a more prominent role in national and European nature conservation policies!

Dr Ties Huigens Dutch Butterfly Conservation

Further reading (in Dutch with English summary):

Ellis, et al. 2013. *Moths enlightened: dynamic, important, threatened.*



Moth Recorders' Meeting (Oropendola Productions)

2014 National Moth Recorders' Meeting

The 4th National Moth Recorders' Meeting was held in January this year at the Birmingham and Midland Institute. The turnout was fantastic as usual, with almost 200 people attending. These meetings provide an opportunity to network; catch up with friends as well as find out about moth projects across the UK and indeed Europe. We would like to thank everyone who came to the event (moth recorders and speakers alike) who contributed to another successful meeting.

Fifth National Moth Recorders' Meeting

Please make a note in your diaries for next year's National Moth Recorders' Meeting, which will be held once again at the Birmingham and Midland Institute, central Birmingham on **Saturday 31st January 2015**. Further details will be revealed in due course.

Moth Night 2014

This year's Moth Night ran from 3rd to 5th July, with the theme of woodland moths. To date, over 20,000 records of over 900 species have been entered through the Moth Night online recording system, representing at least 60,000 individual moths. These numbers are sure to increase as the deadline for entering records is still some way off.

Please submit your records for Moth Night 2014 via **www.mothnight.info** by 30th November 2014. A full report of Moth Night 2014 will be available in Atropos next year.

In 2015 Moth Night will take place in the autumn; the dates are 10th to 12th September 2015.

Monitoring moths using sex pheromones

Researchers in the PheroBio Project (including collaborators from the Swedish Agricultural University, Linköping University, Gävle University and Canterbury Christ Church University) are currently testing blends of synthetic insect sex pheromones (odours used by females to attract males), in order to catch and monitor rare and declining insect populations. We are particularly interested in the moths of Western Europe, including members of the Sesiidae (clearwings), Zygaenidae (burnets) and Tineidae amongst others.

Using a powerful pheromone attractant is highly accurate in determining the occupancy of a species, and importantly we can use lures in conjunction with 'funnel traps', which allow the insects to be caught without causing them any harm. After trapping, moths can be released back into their natural environment, providing a cost-effective and low disturbance means of insect surveying.



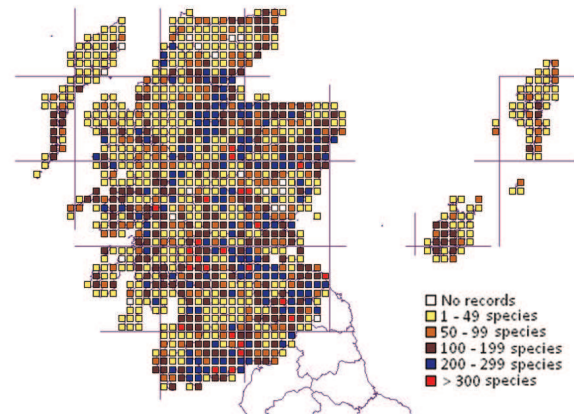
Above: Proven field attraction of the Six-belted Clearwing (shown on left) and Six-spot Burnet (shown on right) to rubber bungs baited with pheromone compounds (images courtesy of Prof. Nils Ryrholm).

In conservation biology, insects deserve special attention from a biodiversity perspective, being the largest and most diverse group of organisms, which play vital roles in ecosystems and human welfare. Insects also exhibit rapid responses to fluctuating conditions, and are therefore excellent indicators of changes within the landscape, providing real-time information about the health of the local environment. With EU directives currently set on 'halting biodiversity loss by 2020' the emphasis and importance of monitoring insects is greater than ever. >>

Scottish targeting for the moth atlas

Since the inception of Moths Count a key objective has been to produce a national macro-moth atlas. The provisional atlas published in 2010 was a revelation and the distillation of much hard work by many observers and county recorders. We now have until the end of 2016 to ensure that we can get as much representative coverage as we can for the atlas. In Scotland, the challenge is particularly great because the areas involved are large, and often remote, with relatively few observers.

The atlas will be based on recording areas of 10km squares. There are relatively few 10km squares in Scotland with no records at all - just 15. However, there are nearly 200 with fewer than ten species and over 400 with fewer than 50. A simple analysis of records in south-east Scotland suggests that a total of 50 species might require four or five trapping visits, at sites with reasonably good habitat, through the summer months when moths are about in their greatest numbers. This is a good target, but realistically we're not going to get that coverage across the 400 plus 10km squares. Further refinement of the targeting may need to be considered. Looking at the map opposite there are clearly patches of the white and yellow squares indicating fewer than 50 species. Targeting one or two squares in each of these 'patches' is, perhaps, the most effective way to gain the most representative atlas mapping. For example, Jo Davis is working hard to plug some of the yellow patches in Lanarkshire, and Paul Brooks similarly in Angus.



I have a set of volunteer new moth-ers in East Lothian with loaned moth traps in their gardens. I have also just been on holiday to the Isle of Harris for a week in a holiday cottage. Now the 10km square that the cottage was in had 32 macro moth species already recorded which isn't that many, but is a lot more than most other squares in Harris. During my stay I added 13 species to that square (almost turning it brown on the map!). I also put traps out in three other squares with 1, 1 and 2 species each and they now have 13, 19 and 19 respectively. Daytime recording isn't so quite so productive but I did add new species to three squares including taking one square's total from zero to one – a Satyr Pug. Catching a new species for me by way of three Poplar Lutestring moths was an added bonus.

So, there is a lot more opportunity and a reasonable amount of time before the atlas recording period closes. If you can do something to make the atlas provide a more representative view of moth distribution then I would encourage you to do so.

Mark Cubitt County Moth Recorder
VC 82 & VC 84, East Lothian & West Lothian

>> This is particularly true of moths and butterflies, which serve as valuable bio-indicators for a range of important habitats. Abundance of burnet moth species, for example, has been shown to correlate with species richness of other Lepidoptera in natural grasslands (Franzén & Ranius 2004, Franzén & Nilsson 2008). The burnet moths are also declining in the UK, and in many other parts of Europe; a pattern which is thought to be due to habitat fragmentation and reduction in habitat size (Wenzel *et al.* 2006). We are consequently developing pheromones for the endangered New Forest Burnet moth and Slender Scotch Burnet in order to provide a potent tool for the monitoring and conservation of these vulnerable insects.

Other groups of moths are also useful for assessing the health of deciduous forest, namely Sesiid moths such as the Yellow-Legged Clearwing and Tineid moths such as *Nemapogon wolffiella*. We have been working with a variety of Sesiid and Tineid pheromones and monitoring the distribution of these species with unprecedented accuracy in southern Sweden.

Many of these species are increasingly vulnerable across Britain and Western Europe, and thus we are interested in developing new methods of attracting these insects to monitor where they are found, and what is leading to their decline. In the future, we hope the development of insect pheromones will become an essential tool in insect conservation and management, and we will continue to develop pheromones for priority species alongside Butterfly Conservation. Work is already underway to identify attractants for Dark Bordered Beauty and the Small Dark Yellow Underwing in the next few years, amongst many other exciting prospects.

If you have any comments or queries on the project please email Dr Joe Burman joseph.burman@canterbury.ac.uk

Dr Joe Burman Canterbury Christ Church University

Further Reading

Franzén & Nilsson. 2008. *Ecography*, 31, 698–708.
 Franzén & Ranius. 2004. *Entomologica Fennica*, 15, 91–101.
 Thomas & Clarke. 2004. *Science* 305, 1563–1564.
 Wenzel *et al.* 2006. *Biological Conservation*, 128, 542–552.

Munching Caterpillars

Funded by the Heritage Lottery Fund and many other partners, The Munching Caterpillars Project (www.munchingcaterpillars.org) has been busy visiting schools and events across Dorset and Somerset. The education programme aims to inspire children and families about butterflies, moths and their caterpillars through fun, interactive activities. To date 35 schools have been visited, 105 workshops have been run and 35 events such as country shows, fetes and festivals, have been attended. At least 4,000 children aged between 7 and 11 have been engaged in the project so far.

Our workshops focus on using live insects to engage with children and adults alike and provide them with the chance to get up close to creatures they may never have the opportunity to see. Caterpillars and moths in particular are perfect for education. Not only because they tend to stay still in the daytime and are relatively easy to catch, but also because the diversity across species is so vast. Even just having a few moth and caterpillar examples can encourage discussions across a wide range of topics such as camouflage, adaptation, predator avoidance, life cycles, and defence mechanisms. During our workshops we use a range of specimens to demonstrate key learning objectives. Eggs, caterpillars, shed skins of caterpillars, and pupae are used to create a much more hands on connection to the fascinating life cycle of moths and butterflies. Where possible moth traps are set in the ground of the school or event. This provides a more personal and exciting experience as the moths are local to the area. It also gives us the chance to record moths in an area that may not have been surveyed before.



Munching Caterpillars School Visit (R. Lucas)

Even just the sight of a round black box with a tea towel over the top sparks an air of excitement in the classroom. Moth favourites such as the Buff-tip and Peppered Moth are the kings and queens of adaptation and great camouflage; whilst Cinnabars and Eyed Hawk-moths demonstrate impressive warning colouration and a defence against predators. Moth names are great too. Some say it like it is for example the Heart & Dart and Chocolate-tip, some are 'cool' like the Lobster Moth and the Elephant Hawk-moth, and then there are the amusing ones: Uncertain and Spectacle always gain a giggle.

Our aim by the end of these sessions is to have all hands up when we ask our final question: 'Who likes moths?' If we can achieve this then we may have created a fascination with these insects that we can only hope will last a lifetime.

Megan Lowe
 Munching Caterpillars Project Officer,
 Butterfly Conservation

NMRS yields first results

The first major analysis of data from the National Moth Recording Scheme (NMRS) has revealed an overall decline among Britain's larger moths.

More than 10 million moth sightings from 1970 to 2010 were used to assess changes in moth distributions. The study, carried out by Butterfly Conservation, the Centre for Ecology & Hydrology and University of York was published in the *Journal of Applied Ecology* in July and is the first to examine long-term trends for all of Britain's resident larger moths. Trends for 673 species were calculated, adjusting for the huge variations in recording effort over time. Some 60% of species showed a statistically significant change over the 40-year period, with two-thirds more species declining significantly (260 species) than increasing (160 species).

The findings are consistent with analyses of moth population trends in Britain from the separate Rothamsted Insect Survey database, and with evidence of moth declines from other European countries such as the Netherlands and Finland.

The variation within the NMRS results provides clues to the likely factors driving the changes. Declines among widespread moths, for example, were most severe in the southern half of Britain which has seen greater agricultural intensification and urban spread over the last four decades. In contrast, these same widespread species showed no overall decline in northern Britain, where land use changes have generally been less pronounced.

A further indication of the negative impacts of intensive land use came with the finding that moths associated with low nitrogen environments (based on the preferences of the hostplants on which the moth caterpillars feed), such as Cistus Forester and Oblique Striped, declined in relation to those that inhabit more fertile habitats, such as the Snout and Mocha. Nitrogen enrichment of the environment (eutrophication) is a problem particularly associated with intensive farming.



Cistus Forester (M. Parsons)



Pine Hawk-moth (R. Scopes)

In contrast, climate change could be a much more important driving force for moth species that are restricted to warm or cold parts of Britain. Moths restricted to northern Britain, such as Northern Dart and Small Dark Yellow Underwing, tend to have declined over the 40-year study. Land use changes have been less severe in northern Britain, suggesting that the warming climate might be causing problems for this group of moths that are adapted to cool climates.

But climate change may also be having some positive effects. Many moths at the northern limit of their range in southern Britain, such as Jersey Tiger, Pine Hawk-moth and Black Arches, increased over time, most likely in response to warming temperatures.

Of course, these conclusions are simplistic: in reality each species is influenced by a wide range of factors interacting in different ways. For example, some rapidly increasing species such as Orange Footman and Spruce Carpet may be responding to increased hostplant availability rather than to climate change.

One of the interesting aspects of the study is that it covers all resident species, not just the widespread and common, nocturnal species for which Rothamsted Insect Survey trends are already available. For example, there are no hawk-moth trends in the Rothamsted studies, but the NMRS analysis suggests that this group is doing well, with Elephant, Small Elephant, Lime and Poplar Hawk-moths all increasing.

The NMRS data, contributed by thousands of moth recorders, are being put to other uses. A different analysis of trends was used in the *State of Nature* report last year and in a recent review of global biodiversity change published in the journal *Science*. The NMRS will provide a fantastic resource for researchers and conservationists into the future.

Richard Fox Surveys Manager, Butterfly Conservation

Further reading

Burns *et al.* 2013. *State of Nature* report. The State of Nature partnership
Dirzo *et al.* 2014. *Science* **345**: 401-406
Fox *et al.* 2014. *Journal of Applied Ecology* **51**: 949-957

Bonkers for conkers

“Our conker trees are under threat from an alien insect, and you can discover whether pest controllers could help save them.” So began the Conker Tree Science project back in 2010. The ‘alien insect’ was, of course, the Horse Chestnut Leaf Miner (*Cameraria ohridella*): a tiny moth, no bigger than a grain of rice, and rather beautiful bronzy-chestnut in colour with white stripes. It has been present in Britain since 2002 when it arrived in London and now has been found almost everywhere north to Newcastle.

We (Darren Evans and I) set up the Conker Tree Science project because we wanted to give people the opportunity to discover more about the interconnectedness of the natural world – and what better way than for people to be involved in real research? We gave people two missions: to find out whether the length of time that the Leaf Miner has been present affects the damage for Horse Chestnut leaves, and its predation by ‘natural pest controllers’.

This was real science, and we couldn’t have got the answers without the involvement of people from across the country.

To discover the rate of pest control, people simply put mined leaves in a bag at the beginning of July, left it two weeks and counted the emerging insects. “I never knew moths could be so small,” one school child told me. Some of the emerging insects were ‘pest controllers’, which are native parasitoids that have begun to predate *C. ohridella*. Children (and adults!) were fascinated to discover that they lay their eggs inside the *C. ohridella* larvae mining inside the leaf, eat the larvae from the inside and burst out, killing them in the process. For the very keenest of participants we produced a key to identify the parasitoids to species (published in *British Wildlife* vol. 22, pp. 305-313, and also available via www.conkertreescience.org.uk)

The Conker Tree Science project was really successful – about 9,000 people (including 2,000 school children) got involved through publicity on television and radio. Throughout the project we learned lots from participants, including the affection many people have for ‘their’ Horse Chestnut trees, but also that some feel very strongly that we should not interfere with this newly-colonising species attacking a non-native tree. Where do we draw the line when valuing nature?

So what about the missions? We discovered that it takes about two years from *C. ohridella* first arriving in a place to it causing maximum levels of damage to Horse Chestnut tree leaves, and parasitoids are at low levels but increasing with the length of time that *C. ohridella* has been present (so there is a small chance they might increase sufficiently to provide more effective control of the moth’s populations).



Horse Chestnut Leaf Miner (D. Kilbey)

The results have been published in a scientific journal for anyone to read – so this was real science, but it was a project which also opened many people’s eyes to micro-moths, their parasitoids and the interdependence of species with each other.

The Conker Tree Science project finished in 2013, but the website (www.conkertreescience.org.uk) is still open for people to record sightings of leaf damage by *Cameraria* and has the methods to run your own missions. We are especially interested in records north of Lancaster to Newcastle to track the leaf-miner’s spread northwards.

Michael Pocock Centre for Ecology & Hydrology

Further reading:

Pocock & Evans. 2014. PLoS ONE 9(1): e86226.
doi:10.1371/journal.pone.0086226

Mothy Mutterings

Mothy Mutterings is a new monthly update dedicated to Butterfly Conservation’s work on moths and to more general moth-related information from around the UK. It is available from the Moths Count website (www.mothscount.org).

Are you missing out on E-moth?

E-moth is an electronic newsletter from the Moths Count project. If you would like to receive it please contact Butterfly Conservation **01929 400209** or info@butterfly-conservation.org with your email address.

Moth Mobility

In comparison to day-flying insects such as butterflies, the mobility of most nocturnal moth species is poorly known. However, moth mobility is an important area of study since it may help us understand why some species are declining, and such knowledge is key to mitigating such declines. It is vital to find out how far moths travel in fragmented landscapes and what influences and affects moth dispersal ability. Discovering the answers to these questions will enable conservationists and land managers to improve the quality of and linkage between habitats in order to benefit moths and help reverse their worrying declines.

Until recently very little research had been undertaken to investigate moth mobility. In the early 1990s a study was undertaken in a network of small islands off the south-west of Finland by Marko Nieminen and colleagues. Using mark-release-recapture (MRR) methods they found that most noctuid moths were capable of moving between the islands, whereas no individuals of the families Geometridae or Arctiidae were observed to do so. Moth body size was a key factor in moth migration: slow-flying, thin-bodied moths did not move among islands whereas robust, fast-flying species moved among islands frequently.

Habitat patch size was important in influencing migration rates: emigration from small habitat patches was greater than from large habitat patches. Female moths moved among islands as much as males. However, the maximum distance travelled by females was shorter than by males of the same species. For example, one male Ingrailed Clay travelled 1.6km, four times further than a female of the same species. MRR invariably underestimates real distances as the longest movements are less likely to be recorded than smaller ones, so these results are very dependent on the scale of the MRR.

More recently, further research has been published which provides a greater insight into the movements of moths across landscapes. MRR experiments in intensive arable farmland in Oxfordshire in 2007 and 2008 by Dr Thomas Merckx and colleagues from Oxford University revealed that several widespread species travelled substantial distances. For instance, Large Nutmeg, Heart & Dart and Scalloped Oak travelled average distances of 384m, 505m and 558m, respectively, with some individuals of each species moving over 1km.

Of these species the Scalloped Oak travelled the furthest distance (1.14km). The maximum distance Buff-tip and Drinker travelled was over half a kilometre compared to eight other species – Setaceous Hebrew Character, Brown-line Bright-eye, Light Emerald, Small Emerald, Scorched Carpet, Small Waved Umber, Fern, and Pretty Chalk Carpet – which travelled maximum distances of less than 500m.



Scalloped Oak (R. Levertori)

The moth species in the study were grouped according to their larval feeding preference into grass/herb feeders and shrub/tree feeders. On average, the grass/herb feeders were 30% more mobile than the shrub/tree feeders. However, the situation is not that straightforward. In another recent study, carried out with many more species and in forest fragments at a landscape scale, Dr Eleanor Slade and colleagues found that adult feeding rather than larval foodplant preference was a greater predictor of moth mobility, whilst moths with larvae that feed on shrubs and/or trees were on average more mobile than those whose larvae were grass/herb feeders. For example, Scorched Wing (adult feeding with shrub/tree feeding larvae) had a predicted weekly movement rate of 363m compared to White Ermine (non-feeding adults and grass/herb feeding larvae) which was predicted to move only 92m in a week.

It is thought that nectar-dependent adult moths need to be more mobile in order to visit flowers, and that the adults of shrub/tree feeding larvae may be more mobile than those with grass/herb feeding larvae because shrubs and trees are generally more dispersed in landscapes than grasses and herbs. One individual in Eleanor's study was recaptured outside of the study area; it was a Broad-bordered Yellow Underwing which had travelled 13.7km in two months! Wingspan and wing shape were also found to be important factors in moth mobility, particularly for species that were forest specialists. For example, Lobster Moth (a forest specialist) was predicted to move an average distance of 1.7km in a week whereas Poplar Hawk-moth (not a forest specialist) was predicted to move only half a kilometre.

Another study, carried out by Betzholtz and Franzen, looked at species traits in noctuid moths in relation to mobility. They found that species are highly mobile, with flights of 8-16 km regularly undertaken. They did not find a relationship between mobility and body size or habitat preference. However, they did find that widely distributed host-plant generalists and species with adult activity period during late summer were more mobile than host plant specialists with more restricted distributions and species active at other times of the year.

Moth dispersal ability is also the subject of a PhD being carried out by Hayley Jones at Rothamsted Research in collaboration with the University of York. In simulated dusk to dawn conditions moth flight distance and speed has been investigated using tethered flight mills. A flight mill consists of a lightweight arm suspended between two magnets. This magnet suspension provides an axis with very little resistance, so even relatively weak fliers can turn the mill successfully. The arm is very lightweight but suitably rigid due to a unique construction method* (Patent pending; Lim *et al.* 2013). The moth is attached to one end of the arm and flies in a circular trajectory with a circumference of 50cm. A disk with a banded pattern is attached to the axis so that it turns with the arm, and a light detector detects the movement of the bands to record the distance flown and the flight speed.

Over an eight-hour period the average distance flown by Copper Underwing was 12.8km, Large Yellow Underwing 11.3km and Dark Arches 8.9km. Males of the species flew the furthest total distance: Copper Underwing 30.9km; Large Yellow Underwing 24.9km and Dark Arches 18.5km. The species that flew the fastest were Dark Arches 3.3m/s (7.4 miles per hour (mph)), Copper Underwing 2.8m/s (6.3 mph) and Large Yellow Underwing 2.7m/s (6 mph).



The results from these various studies demonstrate that some moths are highly mobile, but that dispersal ability is dependent upon many interacting factors including physical morphology (e.g. body size, wingspan, wing shape), life history traits (e.g. larval and adult feeding preference), physiology and habitat features (size, type, fragmentation). It is early days, but these new insights into moth mobility are starting to provide some insight for scientists, land managers and conservationists on how best to mitigate the effects of habitat fragmentation and climate change – two of the greatest challenges facing our moths.

Zoë Randle Surveys Officer, Butterfly Conservation

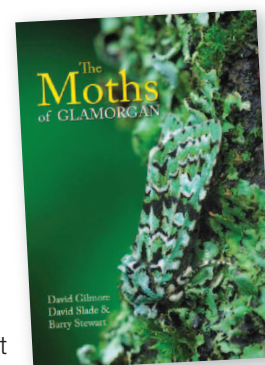
* Lim, K.S., Wolf, M., Jones, H. & Black, I. 2013. Flight mill. GB1314415.9

Further Reading

Betzholtz & Franzen. 2011. *Ecological Entomology* **36**: 369-376
 Merckx *et al.* 2009. *Agriculture, Ecosystems and Environment* **129**: 302-309
 Merckx *et al.* 2010. *Agriculture, Ecosystems and Environment* **138**: 147-151
 Nieminen 1996. *Oecologia* **108**: 643-651
 Nieminen *et al.* 1999. *Ecography* **22**: 697-707
 Slade *et al.* 2013. *Ecology* **94**: 7 1519-1530

The Moths of Glamorgan

When working on a book like the Moths of Glamorgan (published earlier this year), one of the first things you have to do is decide when your cut-off date for records is going to be. Our first cut-off was 31st December 2004, and just 18 days into 2005, I found the first Welsh colony of *Bankesia conspurcatella* in central Cardiff. This small, but pretty little micro was only known from a handful of sites in England at the time and it would have been a shame to have left it out of the book. So in many respects it was fortunate then that the writing stage for the book took longer than expected, and that the cut off for records was extended.



Indeed, by the time we were ready to go to press we had added in five more years of records and a great deal of rewriting had to take place. In the first draft of the text, Small Dusty Wave for example was down as 'only recorded from Cardiff, and showing no signs of expansion'. Adding in the extra data gave it a completely different slant, as it started being picked up to the south and west of Cardiff in 2005, and in 2007 reached Porthcawl, 30km away!

There are other examples of species that would not have even made it into the book had it not been for the extension. It seems remarkable to think that a species as common and widespread as Horse Chestnut Leaf Miner (*Cameraria ohridella*) was first recorded in 2006, and would therefore have been omitted.

One of the most important aspects of this book though is to put in print our reasons for excluding species from the county list. Our research into a record of Plumed Prominent that kept being recited in literature led us to the original source, and from that we were able to see that the moth was caught in June – impressive for a moth that is usually only seen in late autumn!

So a book like this is essentially drawing a line in the sand: "This is what we knew at the time of writing". It is now up to the recording community to build on this, find species we may have missed, and look at how species are faring in our changing environment. All I can say is that I'm glad the line has finally been drawn!

The Moths of Glamorgan by David Gilmore, David Slade & Barry Stewart is currently only available from selected outlets in South Wales, directly from the authors or from Atropos books.

<http://gmrg-vc41moths.blogspot.co.uk/p/the-moths-of-glamorgan.html>

David Slade County Moth Recorder VC 41, Glamorgan

Special Offer: family membership for the price of single membership!

As a thank you for supporting our Moths Count project we would like to offer your family the chance to join Butterfly Conservation for a year at the price of a single membership.

As a family member you will receive all the standard membership benefits including:

- A welcome pack bursting with useful information, a car sticker and collectible postcards,
- *Butterfly* magazine three times a year packed full of fascinating features and stunning photography
- Our exclusive gardening book written by Kate Bradbury
- Membership of your local Butterfly Conservation Branch including regional newsletters and invitations to local walks, talks and events
- Opportunities to take part in monitoring and recording schemes

Plus you will receive:

- *Junior* magazine, with lots of fun activities for children
- A *Let's Look for Butterflies* sticker book
- A Butterflies of Britain poster
- A set of colouring pencils

Membership helps us to continue the important work we do to save threatened moths and their habitats. By taking advantage of this offer you are not only helping us to protect these amazing creatures but also to show future generations just how important they are.

Join today at www.butterfly-conservation.org/join or call **01929 406015** and use the code **FAMILYMC**

Offer valid for new members only, signing up by direct debit before 31.12.14.

Not interested in membership?

Why not take a look at our range of moth and butterfly gifts at www.butterfly-conservation.org/shop. 100% of the profits go to Butterfly Conservation to fund the important work we do saving butterflies, moths and our environment.

MOTHS COUNT



Moths Count Contacts

General enquiries

info@butterfly-conservation.org 01929 400209

Richard Fox

Project Manager

rfox@butterfly-conservation.org 01626 368385

Les Hill

Database Manager

lhill@butterfly-conservation.org 020 3759 6103

Zoë Randle

Surveys Officer

zrandle@butterfly-conservation.org 01929 406006

Acknowledgements

The ongoing Moths Count project is supported financially by Natural England, Natural Resources Wales, Forest Services, Forestry Commission England, Northern Ireland Environment Agency, Royal Entomological Society, Scottish Natural Heritage and many other individuals and partners.



Moths Count Butterfly Conservation Manor Yard East Lulworth Wareham Dorset BH20 5QP
t 01929 400209 www.mothscount.org e info@butterfly-conservation.org

Butterfly Conservation, Company limited by guarantee, registered in England (2206468) Registered Office: Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP.
Charity registered in England and Wales (254937) and in Scotland (SCO39268).

MC18 Designed and produced by nectarcreative.com 01942 681648. Printed on 100% recycled stock using vegetable based inks.