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## Operation Clothes Moth: Where Preventive Conservation and Public Engagement Meet

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### ABSTRACT

Clothes moths catch data from historic properties confirms numbers are on the increase in England. Citizen science research was conducted using *Tineola bisselliella* pheromone traps handed out from English Heritage properties from April to September 2017. One hundred and ninety-two participants recorded moth counts from residential properties in 42 counties in England. Using an average number of moths per trap, geographical spread indicates higher numbers in warmer southern counties of England. Pale-backed clothes moths *Monopis crocicapitella* were caught in significant numbers suggesting a new insect pest risk for historic house collections. Threshold numbers for clothes moths that could indicate an active infestation are proposed. Residential flats appear to be more vulnerable to clothes moth activity possibly related to the shared walls or spaces. The research was launched using a public relations campaign called 'Operation Clothes Moth' which generated major media activity across the internet, radio, television, newspapers and magazines. Public awareness of insect pest management, preventive conservation and the work of conservators and conservation scientists was significantly increased.

### ARTICLE HISTORY

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Insect pest management; citizen science research; webbing clothes moth *Tineola bisselliella*; pale-backed clothes moth *Monopis crocicapitella*; media campaign

### Insect pest management at English Heritage

Integrated pest management (IPM) has been established at English Heritage (EH) since 1997. It has been fundamental to preventing damage, improving collections care, building maintenance and recently raising the public profile of preventive conservation. Insect pest catch data compiled each year suggest that the common or webbing clothes moth (WCM) *Tineola bisselliella* numbers are rising. A public relations (PR) campaign about the risk of clothes moth to historic collections was conceived. This paper summarises IPM at EH focusing on clothes moths. It then outlines the 'Operation Clothes Moth' PR campaign and its impact on public awareness of IPM and preventive conservation as well as reviewing the findings from the citizen science research.

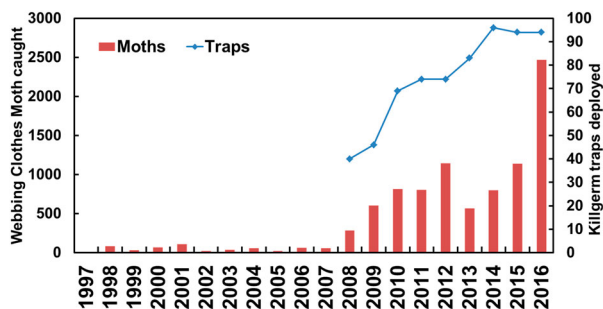
English Heritage is a charity responsible for the care of over 400 sites and half a million objects across England. Collections are housed in 113 historic houses, museums and stores. IPM at EH involves insect pest monitoring using over 3000 sticky blunder and clothes moth pheromone traps across 40 properties with a further 31 sites undergoing visual checks. Traps are checked on a seasonal quarterly basis by conservators, collections care assistants and site staff, who have been trained in insect pest identification (ID). Insect pest ID and records are quality controlled by the collections pest control manager. Results are collated into annual site reports which highlight risks and required actions including conservation cleaning,

building maintenance and localised insecticidal treatment, heat treatment or freezing. The IPM programme is effective and sustainable because it is managed by a dedicated collections pest control manager.

Insect pest data are used to identify long-term risks to EH collections. Over recent years, *T. bisselliella* numbers caught in blunder and pheromone traps have increased from 1142 in 2012 to 2469 in 2016 (Figure 1). From 2008 traps with *T. bisselliella* pheromone lure boards in 'Demi Diamond' holders manufactured by Killgerm Chemicals have been used. The annual 'total numbers caught' data indicate a significant rise in *T. bisselliella* numbers, 216% over 5 years. Using 'average numbers caught per trap' and accounting for infestations at specific properties indicate a rise of 143% over the last 3 years. The rising numbers of clothes moths, particularly *T. bisselliella*, has also been reported in the UK media and by Pinniger (2013).

Pale-backed clothes moths (PBCM) *M. crocicapitella* appear also to be on the rise with small but increasing numbers being caught on *T. bisselliella* pheromone traps (Figure 2). Multiple specimens caught on traps across England have been confirmed as *Monopis crocicapitella* by Tony Irwin, an entomologist specialising in moths. This is a potential new insect pest for historic houses and museums.

*T. bisselliella* with its voracious appetite and ability to complete multiple lifecycles in a year (in warmer temperatures) (Cox and Pinniger 2007) is emerging as the



**Figure 1.** English Heritage total annual WCM catch and number of *T. bisselliella* pheromone lure boards manufactured by Killgerm Chemicals. These were introduced in 2008 and as far as the authors are aware the formulation has remained unchanged over the following period. Image: Dee Lauder.

greatest risk to organic materials in EH collections particularly those made from wool, silk, fur, feathers and skin. It is predicted that with a future change in climate there will be an increased pest population (Brimblecombe and Lankester 2012).

### Citizen science research project and PR campaign

The rise in clothes moths in EH properties provided an opportunity to raise public awareness of IPM and preventive conservation. A PR campaign was proposed whereby members of the public were asked to help map the spread of *T. bisselliella* and *M. crocicapitella* across England by collecting a free EH branded clothes moths trap (Figure 3) (impregnated with the female sex pheromone of *T. bisselliella*) from all 113 staffed sites from April 2017. After 3 months of exposure in the home, results could then be recorded on the EH website by the end of September 2017.

A clothes moths hunt concept was presented to the PR team by Amber Xavier-Rowe in October 2016. The concept became the 2017 PR property spring opening campaign and was supported by PR,



**Figure 2.** *Tineola bisselliella* and *Monopis crocicapitella* clothes moths, caught on a Killgerm Chemicals *T. bisselliella* lure. Photo: David Pinniger.



**Figure 3.** English Heritage 'Operation Clothes Moth' branded trap. Image: Rebecca Bennett.

marketing, digital and historic property teams at EH. The campaign messages were honed and developed using content provided by the collections conservation team.

'Operation Clothes Moth', became the name of the campaign. Its purpose was to increase awareness of the EH brand, highlight new season opening of our properties and the conservation expertise behind caring for historic collections. The secondary purpose was to test the effectiveness of using citizen science research to answer the question whether clothes moths are on the rise in England and to explore the reasons. The authors were also personally interested in raising the public awareness of conservators and conservation scientists.


The campaign generated major press interest across all media when launched on 6 April 2017, starting with a feature on BBC Radio 4 Today programme, followed by 18 BBC regional radio interviews, a BBC radio world service interview, 5 BBC 1 television (TV) news and ITV Anglia TV news bulletins. The busy launch day culminated in a live interview on BBC Global World News TV, the BBC's international arm with an estimated weekly audience of 85 million (Figure 4). The campaign also featured on the front page of the BBC News webpage, which receives in excess of 100 million page views each week.

The printed news media were also interested. The *Daily Mail* (7 April 2017) devoted a full page including a cartoon. Articles also appeared in the *Daily Telegraph* (6 April) including an editorial comment, the *Sunday Telegraph* (9 April) with the heading 'In the flight path of Mothmageddon' and *The Times* (6 April). Features also appeared in *Women's Weekly* (24 April) and *The Spectator* (6 May). The accuracy and quality of the reporting were high, although spelling out to reporters the difference between curators and conservators helped. The PR campaign with reach across all media in the UK proved to be one of the most successful launched by EH.

Web pages were also created to support the PR campaign and research. A film and trap instruction







Figure 4. Amber Xavier-Rowe interviewed live by Philippa Thomas on BBC Global World News television.



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## OPERATION CLOTHES MOTH

It can be an uphill battle protecting our historic artefacts from clothes moths, but all the data we gather from your traps will help. Our conservation scientists will use the information you give us below to understand how clothes moths spread.


We Need You!

Mandatory fields are marked with \*

Country *	<input type="text" value="Please select"/>
Post Code *	<input style="width: 100px;" type="text"/> <input style="width: 100px;" type="text"/>
Type of property *	<input type="text" value="Please select"/>
Age of property *	<input type="text" value="Please select"/>
When did you turn your heating off *	<input type="text" value="Please select"/>
What temperature do you usually set your heating thermostat *	<input type="text" value="Please select"/>
Did you spot any damage *	<input type="text" value="Please select"/>
Room trap was located *	<input type="text" value="Please select"/>
Total number of moths in trap up to end of *	<input type="text" value="Please select"/>

Webbing clothes moth  
*Tineola bisselliella* \*


Enter number found 0, 1 etc



Hover to zoom

Pale backed clothes moth  
*Monopis crocipitella* \*

Enter number found 0, 1 etc



Hover to zoom

Email \*

**Contact Preferences**

Your support is helping to keep the story of England alive at over 400 historic sites across the country. We'd love to keep in touch with you about things to see and do, exclusive offers, our latest work, appeals and how your support makes a difference. We will never share your details with anyone else to use for their purposes. You can change your mind at any time. Please let us know how you would like to hear from us:

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Figure 5. Operation cloth moth web page record form. Image: English Heritage.



clip featured on the landing page. Further information about clothes moths and how to prevent damage also featured. An input form was designed linked to a live 'heat' map of England. There were also links to the collections conservation advisory pages. Traffic to the conservation web pages where the 'Operation Clothes Moth' pages were located rose from 2011 in March 2017 to 17,399 in April after the launch.

Towards the end of September, a social media reminder in the form of three tweets and one Facebook post were posted. The tweets said 'Did you pick up a free moth trap this summer? Help our conservation team and record your findings.' Response whilst modest for EH was good for a specialist topic with the Facebook post reaching 39,685.

The level of national and regional press interest could have only been supported through active involvement of the whole collections conservation team and entomologist David Pinniger. Fronting such a high-profile campaign was both frightening and exhilarating and provided the best media training possible for the collections conservation team. The press release and key messages benefited from professional PR expertise.

### Citizen science catch results

As far as the authors are aware, this is the first example of citizen science research applied to preventive conservation. Citizen science has been defined by the Oxford English Dictionary as 'The collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists.'

In total 5000 traps were distributed to the 113 staffed sites, approximately 4500 were given to visitors and 213

moth counts were recorded, a 4.7% return rate. There is no direct comparison of what is a good return. Asking participants to wait 3 months before recording results combined with the assumption that those that failed to catch any decided not to participate possibly influenced the rate of return. A comparison from the nature conservation is the high-profile Big Butterfly Count, which has been running for 6 years in the UK and reports 60,400 participants but not specifically how many returns ([www.bigbutterflycount.org](http://www.bigbutterflycount.org)).

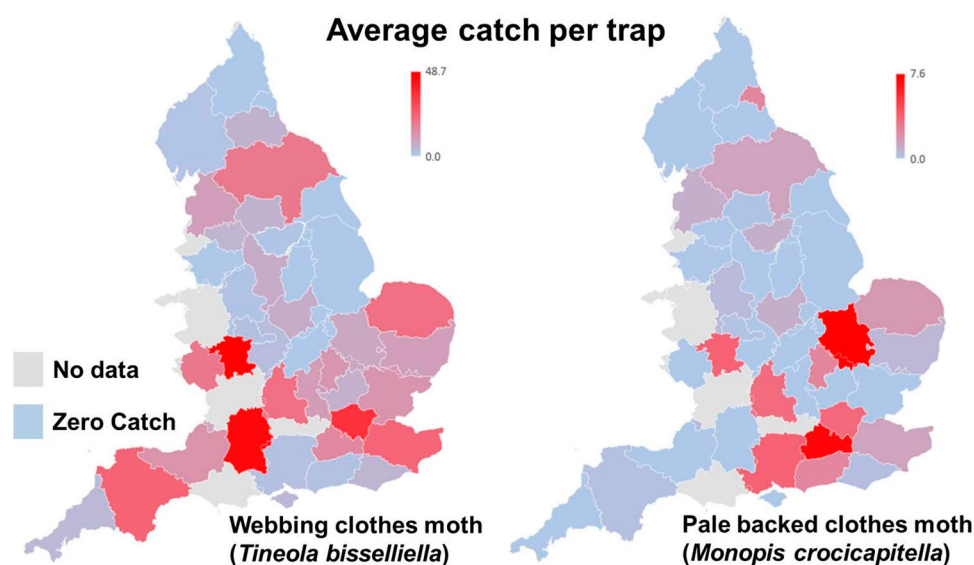
'Operation Clothes Moth' participants were asked to record information on an online form (Figure 5). This form had restricted options aiding the data analysis. Recorded information included post code, property type and trap location, amongst others. The data were then exported into Excel. Results were divided into four topics and some conclusions both clear and tentative could be made.

### Clothes moths numbers

The total number of *T. bisselliella* caught by participants was 3607. On average, 17 were found on each trap. In total, 69 of the 213 traps reported catching pale-backed clothes moths *M. crocicapitella*, with a total of 460. This catch result for *M. crocicapitella* is much higher than expected when comparing totals from EH properties where 15 were caught across the country in 2016 from 94 traps, itself significantly more than in previous years. It would suggest that *M. crocicapitella* could pose a threat in future years to historic house collections.

### Geographical location

The reported catch of *T. bisselliella* is higher in the southeast of England (average 23 per trap) (Figure 6).



**Figure 6.** Operation clothes moth data divided into English counties to show the geographical distribution. The average clothes moth catch per trap is plotted, with WCM on the left, pale-backed clothes moths on the right, with individual scales. Image: Paul Lankester.

This then appears to radiate outwards, with the southwest and west midlands the next highest (17 and 16 per trap). The east follows (12 per trap) with the northeast, northwest and east Midlands much lower (6, 5 and 3 per trap). Statistically, using the Mann–Whitney *U* test, the southeast is significantly different (99%) from the north east and significantly different from the east (90%). However, the southwest is not statistically significantly different from the southeast (90%). This could be due to the small number of returns from the southwest. In Figure 6, there are regions with a greater concentration of *T. bisselliella* than others. These data can be easily influenced by just one participant, for example, Norfolk had only five returns, with 0, 3, 4, 17 and 92 total moths trapped. The one result of 92 disproportionately increased the average. Another problem was the lack of returns for some regions. Therefore regions have been assessed so that outlier data and counties with no returns have less of an overall influence.

*M. crocicapitella* moths are concentrated in south-east England with 86% of total catch and an average catch per trap of three. The east also had an average catch per trap of three which is significantly higher than in other regions (Figure 6).

It should be noted, however, that there is a potential bias in the data as participants who thought that they had a problem with moths at home could have been motivated to collect a trap. However 26% returned results of no reported catch, and 49% returned a catch of four or less clothes moths.

The data gathered from citizens has improved our understanding of the threat of clothes moths. At EH we only regularly place pheromone lure traps at 26 sites in 11 counties, whereas participants have returned data from 192 properties in 42 counties.

### Housing type and age

Six of the top seven reported catches were all located in flats, and only three flats reported a zero clothes moth catch (Table 1).

One hypothesis for this could be the number of shared walls, floors or ceilings (hereafter called shared spaces) with other properties that are outside of the control of the owner (Table 2).

The age of the property also provides data that appear to agree with the hypothesis that more voids lead to more problems. Generally, older houses will have more dead spaces compared to modern types of construction. Participants could select from two options on the form, pre-1950 or post-1950. The average clothes moths catch per trap from a pre-1950 property was 26 compared to 14 for a post 1950 property; this is a statistically significant difference (99%).

As *T. bisselliella* infestations do not occur naturally outdoors in the UK and northern Europe (Plarre

**Table 1.** The zero catch rate for each property type.

Property type	Zero catch count	Total catch count	% Zero catch of category total
Bungalow	6	15	40
Detached	25	67	37
Flat	3	35	9
Other	1	2	50
Semi	13	50	26
Terrace	7	41	17

**Table 2.** Average clothes moths catch per trap for each property type, and the number of shared spaces each property has with neighbours.

Property type	Clothes moth average catch per trap	Shared spaces
Bungalow	1.7	0
Detached	13.2	0
Semi	13.7	1
Terrace	20.6	2
Flat	46.2	5

2014), it follows that infestations must be carried between houses on carpets, clothes and other possessions. Adjoining spaces give the moths an opportunity to spread without having to leave an enclosed environment.

### Damage threshold levels

Participants were also asked to record damage – ‘Did you spot any damage (Yes or No)’ (Figure 5). The number of participants that reported seeing the damage was approximately 40%. This could be damage from any species of clothes moth. The average *T. bisselliella* catch per trap, where damage was noted, at 31 was statistically significantly different (99%) to when damage was not noticed at seven per trap. This potentially identifies a threshold value for an infestation whereby more than 31 *T. bisselliella* moths suggests an established infestation. Seven or less does not. Threshold catch numbers could help to indicate an acceptable level unlikely to cause damage. This could be a question to ask of EH data in the future in terms of what is an acceptable level of *T. bisselliella* on a trap before serious damage is likely, combined with professional judgement relating to the property and type of materials on display.

### Conclusion

A review of EH *Tineola bisselliella* catch numbers has confirmed that they are on the rise and are becoming the insect pest of most concern. Damage is being limited through a systematic IPM programme which has been established since 1997. Using these findings to raise the public profile of EH, IPM and preventive conservation through a citizen science experiment resulted in considerable interest across all types of press media in the UK and beyond. The resulting

public catch data whilst limited has improved overall understanding of clothes moths in the UK including confirmation that properties in southern England are at greater risk and that *M. crocicapitella* are becoming established in domestic homes. The citizen science data has also provided evidence for a threshold level of over seven clothes moths caught on a trap, indicating a high risk of damage occurring. This information can help EH staff to target and plan IPM actions more effectively across the 40 properties monitored. We are also interested in comparing the distribution of EH and public catch data to see if 'hot spots' can be identified to further help maximise our IPM programme. The general quality of the public data was high which suggests that a citizen science approach may be a viable method to help answer preventive conservation research questions whilst raising public awareness and support.

### Acknowledgements

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### Disclosure statement

No potential conflict of interest was reported by the authors.

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