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## **Morecambe Bay Barred Tooth-striped Moth Survey 2019**



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**Butterfly Conservation**

# Background Information

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The Barred Tooth-striped moth (*Trichopteryx polycommata*) is listed as a species of principal importance on Section 41 of the NERC Act (2006), and was formerly listed as a UK Biodiversity Action Plan Priority Species. Formerly recorded widely across the UK, it currently has several strongholds including sites in north Lancashire and south Cumbria (see map 1). Across the UK the larvae feed on both wild privet and ash, but the exact habitat preferences in the North of England are not fully understood.

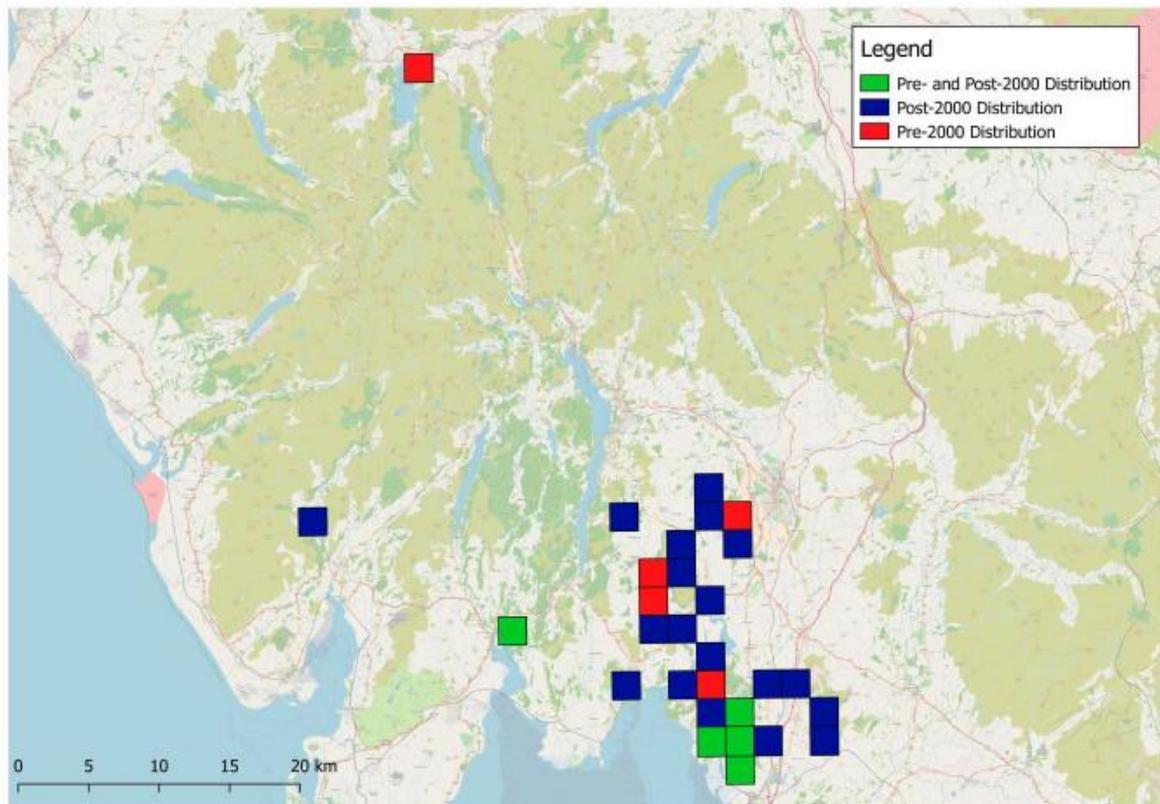


The ash woodlands that the moth frequents around Morecambe Bay are an important component of the mosaic of habitats that form the Morecambe Bay Limestones character area. The National Character Area (NCA) profile states that, “Morecambe Bay Limestones NCA is a lowland landscape arcing round the head of Morecambe Bay consisting of conspicuous limestone hills with prominent scars, cliffs, screes and exposed limestone pavements separated by areas of low-lying undulating farmland” (Natural England 2014 NCA Profile: 20 Morecambe Bay Limestones NE518). These priority woodland habitats are a target for higher tier Countryside Stewardship schemes and management advice for this Section 41 priority species is urgently required to enhance and maintain the moth as it faces threats from chalara dieback of ash and pressure from climate change.

## Known Distribution

Surveying for the Barred Tooth-striped moth (BTS) can be challenging due to difficult limestone terrain around Morecambe Bay, the moth’s varied response to light trapping and the difficulties in establishing the flight period of a species that appears to respond to late winter/ early spring weather systems.

Up to 2017, we had 543 historical records of the moth in Cumbria and North Lancashire, some recent and several much older (e.g. the Derwent Water record is from 1954). The moth’s distribution has traditionally been recorded in tetrads, which are 2 x 2 km squares (Map 1).



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Map 1: Tetrads (2x2km squares) with Barred Tooth-striped records in Cumbria and North Lancashire up to 2016.

In 2016 Ashen Oleander, a PhD student at Canterbury Christ Church University, began work on a pheromone lure for the BTS. The lure was successfully trialled at sites in North Lancashire and South Cumbria in 2017, making this a useful tool for surveying this species. Prior to the 2017 survey, we had records of BTS in 24 tetrads in North Lancashire and South Cumbria (2000 to 2016). During the 2017 survey we recorded the moth in 24 tetrads - largely due to the pheromone lure trials - with 9 of these being new tetrad records.

In 2018 and 2019, the pheromones were used to conduct a wider distribution survey in Lancashire, Cumbria and Yorkshire, as well as undertake a preliminary mark-release-recapture study (MRR) to calculate population estimates and assess habitat preferences.

## Acknowledgements

This 2019 Morecambe Bay Barred Tooth-striped survey was made possible by of the co-operation of the members of the Morecambe Bay Facilitation Fund. We would like to thank all the volunteers, organisations and landowners involved for their dedication and enthusiasm to this Citizen Science project.

This project was also supported by a grant from Tanyptera Trust, whom fund a project based out of World Museum Liverpool, promoting invertebrate conservation and recording across the Lancashire and Cheshire region.

Thanks also to Ashen Oleander and staff at Canterbury Christ Church University, Kent, for sharing their expertise and pheromone lures to use in this this study.

# 2019 Survey

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## Survey Aims

- Use pheromones developed by Canterbury University to expand the current known distribution of BTS in Lancashire, Cumbria and Yorkshire.
- Use pheromones and mark-release-recapture on known sites to assess population sizes, flight period, habitat preferences and movement across and between habitats.
- Undertake larval searches on ash and wild privet to increase the understanding of habitat preferences and association with wild privet/ash in Northern England.

We used pheromone widgets produced by Canterbury University and pheromone traps supplied from a Tanyptera Trust grant, to survey existing and new sites with areas of ash or wild privet. The pheromone widgets fit into the roof of the trap, the male moths are attracted to the pheromone and then drop into the lower chamber and are contained here until released the following morning.



Pheromone trap

Sites were selected and surveyed by landholders and volunteers in North Lancashire, Cumbria and Yorkshire. Landowners from the Morecambe Bay Facilitation Group, volunteers from known butterfly and moth groups, and partner organisations were enrolled and trained.

## 1. Wider Distribution Surveys

### Methods

In order to better understand the distribution of the species and identify the best populations, and thus the best habitat quality, sites across the Morecambe Bay area and into Yorkshire were identified for survey. Sites were selected, partly because of past distribution records, but also their potential habitat quality or sometimes simply due to ease of access. Pheromone traps were distributed to volunteers and the surveys were conducted over a 6 week period.

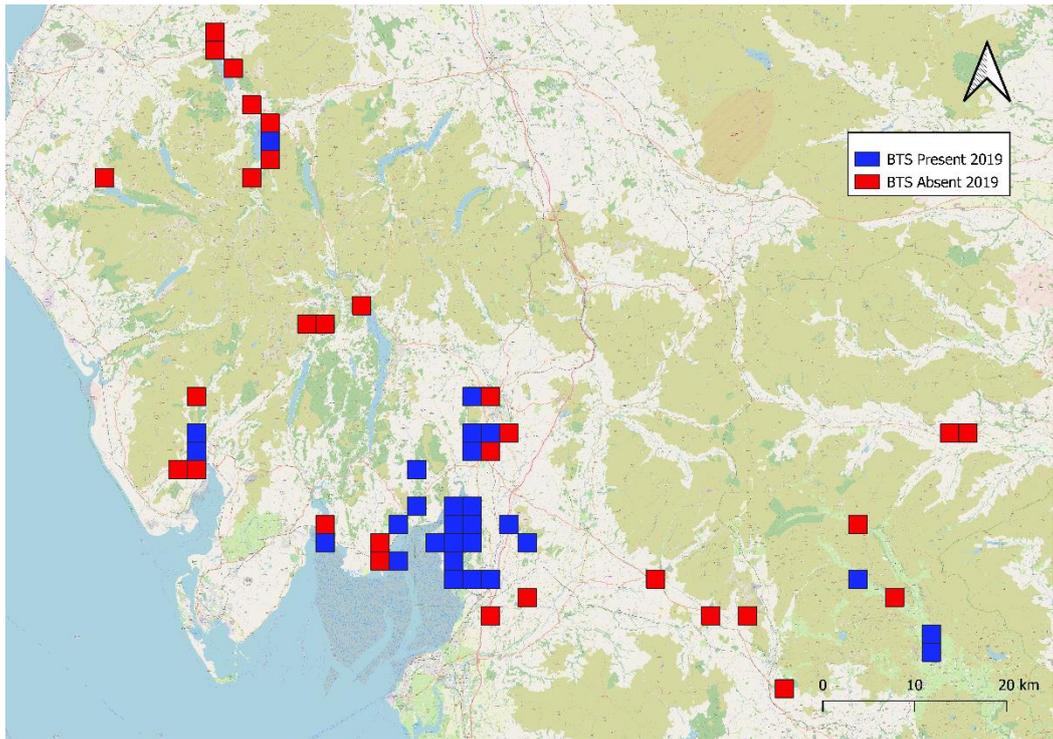
Traps were hung around 1 metre above the ground and left out for a maximum of one night per week in each location, to reduce the disruption to the breeding population. The traps were checked the following morning and the moths released into nearby vegetation. Pheromone widgets were kept in fridges or freezers between monitoring events.

Daytime search and light trapping records were also received from local moth recorders.

Training events were held for volunteer and landowners on 10/4/19 and 11/4/19 to conduct daytime searches for the adults and demonstrate the pheromone traps to volunteers.

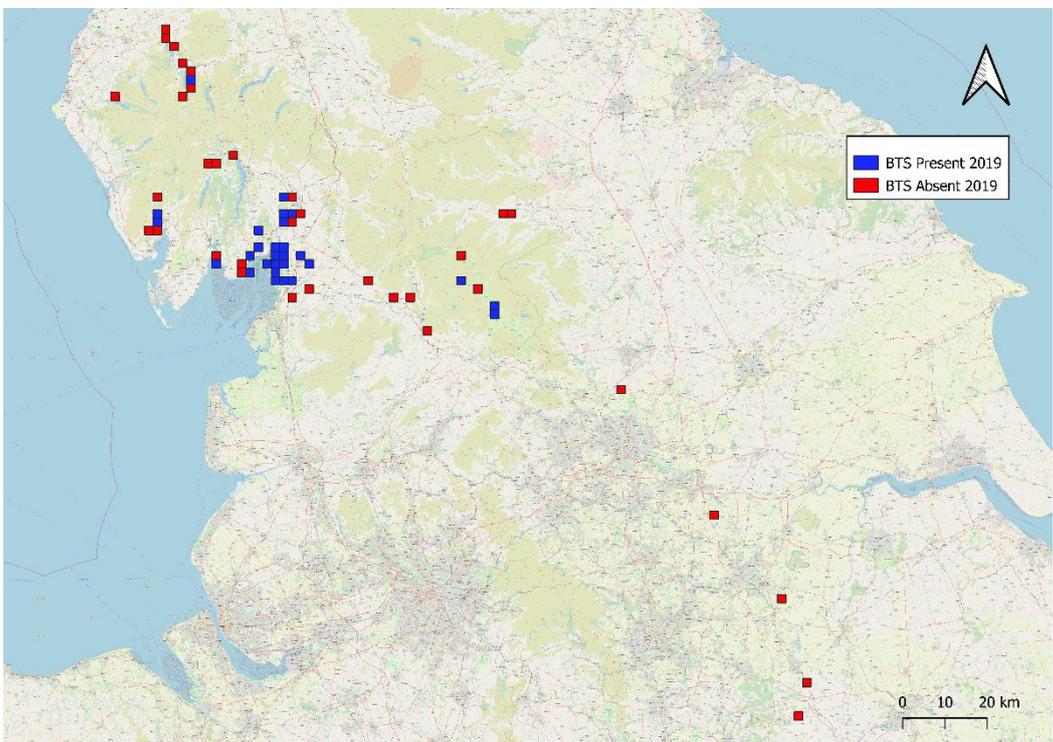
### Results

During the 2019 survey, a total of 461 adult BTS were recorded from 88 pheromone/light trapping and daytime search events (Maps 3 and 4). Moths were recorded in 28 tetrads, 9 of which were new records. Whilst the known extent was expanded further west and north in Cumbria, no new sites were identified south of the Arnside and Silverdale AONB, despite potentially suitable areas of ash limestone woodland being identified. Surveys in North Yorkshire identified one new site and confirmed breeding at a new site from 2018.



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Map 3: Distribution of positive and negative BTS survey tetrads in 2019 survey. Includes records from pheromone trapping, light trapping and daytime searches.



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Map 4: Distribution of positive and negative BTS survey tetrads in 2019 survey. Includes records from pheromone trapping, light trapping and daytime searches.

## 2. Mark-release-recapture Surveys

### Methods

In 2019, a Mark Release Recapture (MRR) survey was undertaken which involved two consecutive nights trapping events per week for a total of 4 weeks from the first week of April. The pheromones were only used for two nights per week to allow the male moths to have chance to breed. Three sites in North Lancashire and one in Cumbria, all with ash-oak-hazel limestone woodland and with previous records of BTS, were selected and surveyed by trained volunteers. The sites were RSPB Challan Hall Allotment, NE Gait Barrows, NT Sharp's Lot and Fell End Nature Reserve. Three traps were hung around 1 metre above the ground and placed in a straight line on the edge of ash woodland as below:-

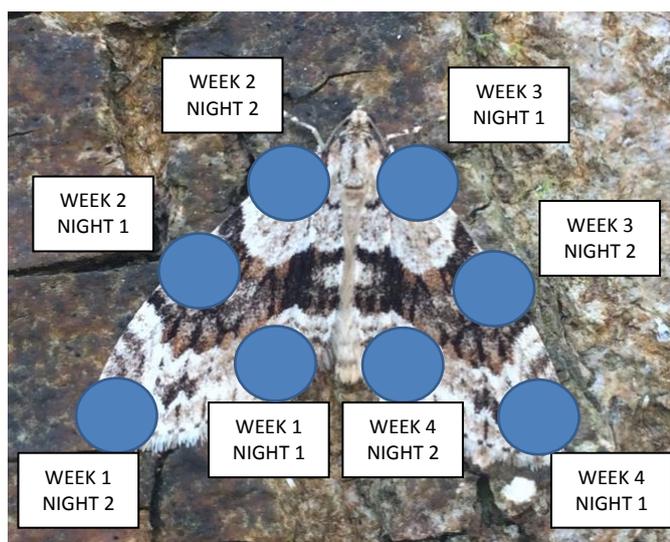
- Trap 1 – 50m out from the woodland edge into an open area
- Trap 2 – on the woodland edge
- Trap 3 – 50m into the woodland from the edge

The traps were checked the following morning and as many moths as possible were marked by placing a dot on the wing with a Sharpie pen. The scheme below was used to mark the wings depending on the night and week of the survey. A different colour pen was also used depending on the trap in which the moth was caught that night:-

- Trap 1 – **black pen**
- Trap 2 – **green pen**
- Trap 3 – **blue pen**

The moths were then released into nearby vegetation, close to the trap location of where they were caught. The traps remained in the same position for each night surveyed.

As the survey took place over the course of a month, the population was assumed to be an open population (i.e. births and deaths occurred during the survey period). Therefore, the Jolly-Saber method for estimating population size was used.



## Results

The MRR surveys were conducted between 31/3/19 - 25/4/19 across four sites. A total of 342 moths were caught during the MRR pheromone survey, with 331 moths successfully marked (96.8%). There were a total of 28 recaptures involving 27 individuals (Table 1).

|                     | <b>Total number of Moths Caught</b> | <b>Total Number of Recaptures</b> |
|---------------------|-------------------------------------|-----------------------------------|
| <b>Fell End</b>     | 157                                 | 15                                |
| <b>Sharp's Lot</b>  | 80                                  | 11                                |
| <b>Gait Barrows</b> | 83                                  | 2                                 |
| <b>Challan Hall</b> | 22                                  | 0                                 |
| <b>Total</b>        | 342                                 | 28                                |

Table 1: Total number of BTS caught and recaptured during the 2019 survey.

Of the 28 recaptures, 26 moths (96%) were recaptured only once, with one individual being recaptured twice. The average number of days between recapture was 4 days (range 1-15); therefore the oldest moth recaptured was at least 15 days old. The maximum distance travelled was 100m, from an open area into mature woodland.

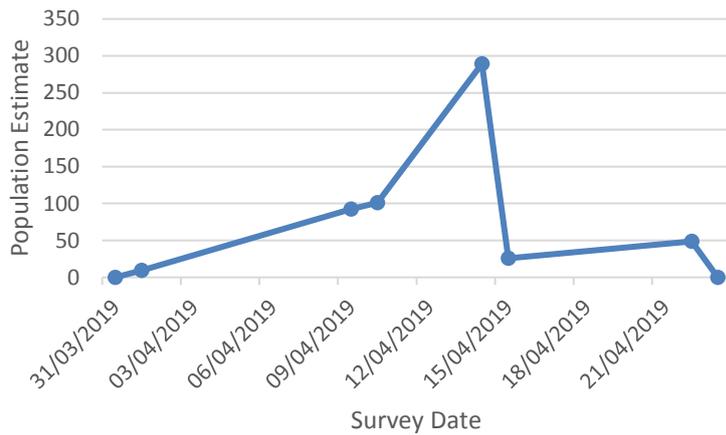
14 recaptures (50%) occurred in the same trap that the moth had previously been caught in (5 in the open, 5 on the woodland edge, 4 within the woodland. Table 2). The moths that were recaptured are summarised in Table 2. Of the recaptured moths initially marked in both woodland habitats i.e. at woodland edge or in woodland, (N=20), 18 individuals stayed in woodland habitat (90%) and only moved into open habitat (10%).

|                |                      | Trap Recaptured in |                      |                 |
|----------------|----------------------|--------------------|----------------------|-----------------|
|                |                      | <b>Open</b>        | <b>Woodland Edge</b> | <b>Woodland</b> |
| Trap Marked in | <b>Open</b>          | 5                  | 2                    | 1               |
|                | <b>Woodland Edge</b> | 2                  | 5                    | 6               |
|                | <b>Woodland</b>      | 0                  | 2                    | 5               |

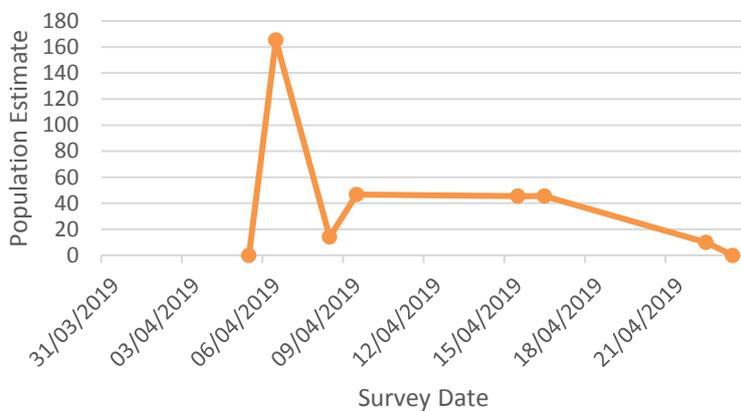
Table 2: Total number of moths recaptured in each trap location during 2019 MRR survey.

## Population estimates

The Jolly-Saber method was used to estimate population and peak flight period. A peak population estimate of 438 at Fell End, following 157 captures and 15 recaptures. The population estimate at Sharp's Lot was 240. However, at Gait Barrows and Challan Hall there were too few recaptures to undertake this analysis.



Graph 3: Jolly-Saber population estimate at Fell End Nature Reserve across the survey period.



Graph 4: Jolly-Saber population estimate at Sharp's Lot across the survey period.

Further analysis of the MRR data to further assess the relationship between habitat usage across the survey period is still to be undertaken in liaison with lecturers from Lancaster University.

### 3. Larval Searches 2019

#### Methods

Sites were selected where good numbers of adult moths have previously been recorded. The woodland edge was searched for wild privet or young ash with any evidence of caterpillar feeding damage or frass, which are easier to find than the larvae. When feeding damage or frass was found, a timed count was completed. Vegetation in a 1m circle around the damage/frass was searched for caterpillars for a total of 5 minutes. If a BTS larva was found data was recorded including the foodplant, height from the ground to the larva, distance from the woodland edge, degree of shade and position of the larva on the foodplant. A further three 5 minute timed counts were then completed by walking 2m, 4m then 6m into the woodland. The search along the woodland edge then continued, repeating the above steps if further evidence of larvae were found.

Training days were conducted on 22/5/19 and 24/5/19 to train local volunteers on the larval survey methodology.

## Results

Surveys at three ash-oak-hazel limestone woodland sites in Lancashire recorded a total of 12 BTS larvae. Larvae were found from 21/5/19 to 27/5/19, with no larvae found after this date despite searches being undertaken until 10/6/19. Sites searched include Gait Barrows, Underlaid Wood, Challan Hall, Scout Scar, Warton Crag and Whitbarrow. All BTS larvae at these sites were found on ash, however no significant stands of wild privet were present in any of the woodlands searched. The larvae were initially difficult to find, but this became easier as the year went on and we gained more experience in identifying good habitat and spotting the signs of feeding damage and frass.



BTS larva on ash

Larvae were found on average 81cm above the ground (range 45-250cm), with 10 of 12 larvae (83%) found on the upper third of the chosen foodplant. ash on which larvae were found were on average 121cm tall (range 20-300cm). The mean distance of the foodplant from the woodland edge was 2.1m (range 0-10m). 7 larvae were found in dappled shade (58%), 1 in full shade (8%) and 4 in open canopy (33%).

## Yorkshire

Searches were also undertaken at one site in North Yorkshire. Interestingly, of the 16 larvae that were found on 12/6/19, 14 were found on ash and 2 on wild privet. wild privet was considered frequent in the woodland. All searches on wild privet, both this year and by local recorders in previous years, have failed to find larvae on wild privet in the North West.

# Discussion

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The BTS pheromone lure is now an invaluable tool for surveying and monitoring populations of this rare and threatened moth. 2981 BTS records from 60 volunteers have been submitted during the three years of this survey project. In comparison, a total of 543 records from Lancashire and Cumbria were submitted from the early 1800s to 2016.

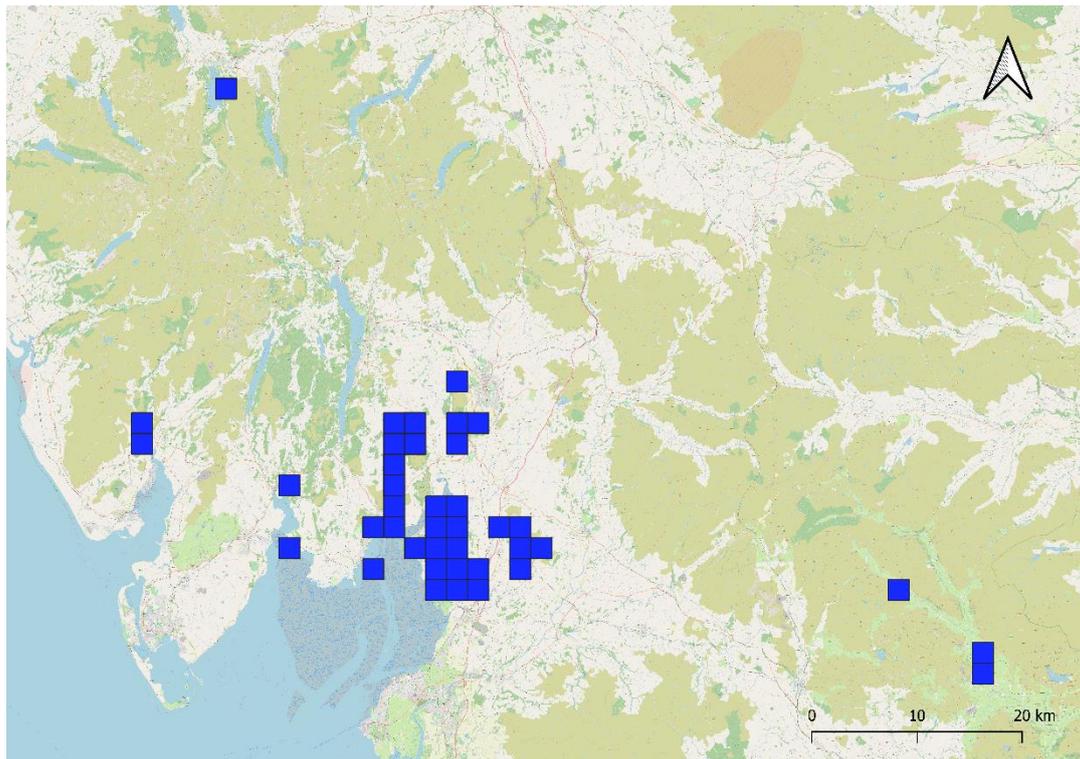
## Distribution

With this tool the known distribution of Barred Tooth-striped moth has been significantly increased. By the end of 2019 the moth has been recorded in 40 tetrads in total, 22 of which are new, with a definite stronghold in the ash limestone woodlands of Morecambe Bay (Map 5).

However, some unusual outlying records gives us a suspicion that this is still not the complete picture. The northern population at Crag Wood, Derwent Water (rediscovered in 2019), survives in upland ash woodland often on steep sided slopes well away from a limestone associated habitat of Morecambe Bay and the Yorkshire Dales. Also the two tetrads above Millom to the west are interesting in that they too share the steep slopes aspect. These two tetrad records are fairly close to each other, within one connected woodland, which has frequent ash. Neighboring woods were surveyed unsuccessfully to find any wider distribution; however this was done at the end of the flight season.

These records offer opportunities for further survey work in 2020.

We extended our pheromone surveys into the limestone ash woodlands of the Yorkshire Dales and we are pleased to be adding new Yorkshire records to the map. There must be extensive areas of woodland here to survey and extend the known moth distribution.



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Map 5: Tetrads with BTS records submitted to our project from 2017-2019.

#### Foodplant and breeding habitat quality

It is known that the moth uses wild privet in the South of England and Wales, whilst some larvae were found on wild privet in the Yorkshire Dales, they do appear to use ash in North West England. The areas around Morecambe Bay have little wild privet and we have found no evidence of larvae where it does exist. Our pheromone trapping of the adults suggests that mature stands of ash might not be enough to produce suitable breeding habitat, with several ash woodlands producing no moth records. Instead it appears that a mixture of mature woodland with regenerating ash with a woodland edge is important. In our MRR study 80% of individuals that were marked in woodland habitats (edge or mature woodland) were recaptured in woodland, with only 2 moths moving from the woodland habitat to an open area. This again correlates with locations of daytime records of adults resting on mature ash tree trunks, and with larvae that were found on small ash up to 3m tall. However, it is technically difficult to search the ash canopy any higher and this would be an interesting area of further research. There also seems to be a negative correlation to a thick ground flora, where Dog's mercury, Ramsons or Wood Broom thickly carpet the floor, moth numbers are often reduced, or zero.

Given the imminent threat from chalara ash dieback where small diameter and regenerating trees are most vulnerable to the disease, more research is urgently required to better understand the life of this moth species and what, if any, measures could be used to try to safeguard it.

#### Moth movement

MRR appears to show that male moths may have little inclination to move and 50% were recaptured in the same trap location they were marked at. Prior research has shown these pheromones to be very attractive to the males, yet our MRR suggests that the moths do not travel over open ground towards the pheromone trap (only 2 of 27 moths). However, only 7.9% of marked moths were recaptured and, with the low recapture rate it is still unclear whether these moths moved long distances.

### Populations

Estimates of total populations from the MRR may be high because of the low number of recaptures. Searches for the larva would suggest that larva occur singly and they are well dispersed. Even with some experience later in the year, larvae were difficult to find. However there is no doubt that given the right conditions the moth does very well; 105 is the record for moths in one pheromone trap from one nights sampling (pers. comm Justine Patton). Therefore the lack of adult recaptures in the MRR survey, with a method that is proven to be highly effective, is surprising. Perhaps there is a very low survival/high predation rate of adults following the trapping or perhaps there is a negative influence of the pheromone trap, e.g. males are not attracted more than once to the pheromone.

### Flight period

We assume that the moth, like other moth species, responds negatively to cold nights and to rainy weather, as the flight period had been affected by both events in recent years making the moth difficult to monitor. However, the moth has been recorded on nights as cool as 0°C, with the highest numbers recorded on nights above 4°C. Also, from our few sampling surveys using MRR it appears that the peak flight period occurs in the second week of April and is then mostly over after another week.

## Further Work

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- Further distribution survey work could be undertaken, especially around those north Cumbria records, western sites around Millom and the Duddon Estuary, south into Lancashire and east in the area around the Yorkshire Dales.
- Further work using MRR surveys will provide us with data, perhaps in conjunction with lecturers from Lancaster University, to indicate habitat usage and preferences.
- A better understanding of female oviposition preferences and larval life cycles is an important area for future research given the imminent threat from chalara ash dieback on our ash woodlands.
- Some of these areas for research have been proposed as Masters project at Lancaster University. The availability of the pheromone gives us an excellent tool to help study this moth before chalara dieback of ash seriously affects it.