Bumblebee Conservation Trust

BeeWalk

Annual Report 2017

Saving the sound of summer

bumblebeeconservation.org

Contents

Cover photo: male Early bumblebee (Bombus pratorum), photographed by Kate Ashbrook. This spring specialist had a below-average year in 2016.

BeeWalk Annual Report 2017

About BeeWalk

BeeWalk is a standardised bumblebee-monitoring scheme active across Great Britain since 2008, and this report covers the period 2008-16. The scheme protocol involves volunteer BeeWalkers walking the same fixed route (a transect) at least once a month between March and October (inclusive). This covers the full flight period of the bumblebees, including emergence from overwintering and workers tailing off. Volunteers record the abundance of each bumblebee species seen in a 4m x 4m x2m 'recording box' in order to standardise between habitats and observers.

Managed by Dr Richard Comont and Helen Dickinson of the Bumblebee Conservation Trust (BBCT). To contact the scheme organisers, please email beewalk@bumblebeeconservation.org.

Since the scheme began, it has received significant financial contributions from the Redwing Trust, Esmée Fairbairn Foundation, and the Garfield Weston Foundation.

Acknowledgements

We would like to thank the financial contribution by the Redwing Trust, Esmée Fairbairn Foundation, Garfield Weston Foundation and the many other organisations, charitable trusts and individuals who have supported the BeeWalk scheme in particular, and the Bumblebee Conservation Trust in general. In particular, the Biological Records Centre have provided website support, data storage and desk space free of charge.

We are indebted to the volunteers and organisations past and present who have contributed data to the scheme or have helped recruit or train others in connexion with it. Thanks must also go to all the individuals and organisations who allow or even actively promote access to their land for bumblebee recording.

Finally, we would like to thank the photographers who have allowed their excellent images to be used as part of this, our first BeeWalk Annual Report.

Citation

Comont, R. F. & Dickinson, H. 2017. BeeWalk Annual Report 2017. Bumblebee Conservation Trust, Stirling, Scotland UK.

This report can be downloaded from www.bumblebeeconservation.org

Further information can be found on the BeeWalk website, www.beewalk.org.uk.

News and research

373

BeeWalk continues to grow, with a record 373 sites walked in 2016

71

71 extra transects were walked during 2016, 24% more than in 2015

1,200

There are now over 1,200 registered users of the BeeWalk website

65,287

The number of records submitted to BeeWalk by the 5 January 2017

206,399

The number of individual bees recorded on BeeWalk so far

24

The number of bumblebee species recorded on BeeWalk transects so far

18

Access requests from government agencies and LERCs to use BeeWalk data on the NBN Gateway

BeeWalk highlights in numbers

BeeWalk's growing importance

Transect monitoring goes from strength to strength, with 373 transect sites walked during 2016. This is an increase of 71 sites compared to 2015 (24% increase), with 66 new BeeWalkers submitting data for the first time.

The 65,000 records submitted so far include important new areas for the Shrill carder bee *(Bombus sylvarum)* in Ebbw Vale, and the Broken-belted bumblebee *(B. soroeensis)* on Salisbury Plain. The latter is part of a collaboration between the Wiltshire Wildlife Trust (& the associated Wiltshire Local Environmental Records Centre, LERC) and the Defence Infrastructure Organisation to better monitor invertebrates on the Plain, which emphasises the use of BeeWalk transects for bumblebee monitoring.

BeeWalk Mentoring & transect renewal

During the 2017 field season we are trialling a new BeeWalk Mentor scheme. Four experienced BeeWalkers have volunteered to act as mentors to BeeWalkers in their local areas, covering Essex; South Suffolk, and East Hertfordshire; Cardiff and surrounding areas; and Northumberland. They will be able to offer help and support for existing and new BeeWalkers. They will be available to help with a range of aspects to do with surveying, including choosing a transect route, registering transects on the website, bumblebee identification, and entering data. They will be contactable via email this summer. If you're in those areas and would find mentoring helpful, or would be happy to become a BeeWalk mentor yourself, or just would be keen to get involved in any way, please email us at beewalk@bumblebeeconservation.org.

We have 155 transects which have been registered on the website but never had data submitted. We are currently getting in touch with the owners of these transects to establish if they can be offered out to other volunteers (or if there's a pile of data waiting to be entered!). Our aim is to increase the number of active transects on the website so if you feel you could take on another transect in your area, please see the map later in this report, which shows all available transects and get in touch.

Dates for your diary

23 March 2017: release date for Trust Science Manager, Richard Comont's new book, Spotlight Bumblebees (ISBN 1472933613). Not an ID book, this new addition to the Spotlight series showcases how to be a bumblebee: how they came to be, home life in a bumblebee nest, the tricks they use to forage effectively, and what we can do to help.

Summer 2017 will see the release of the Trust's first official book! The Conservation and Science team are currently working on a new bumblebee book, focussed largely on identification. BeeWalk data (alongside BWARS records) are being used to produce up-to-date distribution maps for all our species. Further details will be announced in due course on the Bumblebee Conservation Trust website.

Autumn 2017: The Trust will be holding its annual general meeting and member's day in York during October 2017. All Trust members are welcome to attend. Further details will be announced on the website later in the year at AGM & Members' Day.

BeeWalk trivia!

- Most transects walked by one BeeWalker = 26, walked by James Riall (covering almost 44km a month!)
- Most transects per vice-county:
  - Somerset = 36
  - Kent = 22
  - Wiltshire, Lancashire, Derbyshire = 15
- 800 transects have had data submitted since the start of the recording scheme
- 37 transects have been walked for at least five years
- 145 transects were walked in 2010, the first non-trial year - 2016 saw 373 transects walked, an increase of 257%
- In 2016, active transect lengths added up to over 620km - that's almost 5000km walked that year!

Photo credit: BBCT

Distance travelled

Our BeeWalk volunteers have been clocking up the miles surveying bees – three volunteers have all walked more than 100 kilometres, and James Riall has walked virtually the equivalent of Land's End to John o'Groats! Here's our top 20 by distance travelled.

Recorder name	Kilometres walked
Riall, James	941
Gammans, Nikki	151
Crosby, Mary	121
Withers, Nick	99.9
Feledziak, Nicholas	85.4
Rice, Tricia	66.2
Baird, Katty	65.7
Roberts, Stuart	65.2
McElroy, Clare	64.7
Jarvis, Tina	57.5
Dineley, Angela	56.8
Allen, Geoff	49.2
Lovelace, Melody	45.6
Driver, Thomas	42.6
Baldwin, D.	40.5
Smith, Peter	40.4
Winder, E.	35.9
Larkin, Paul	35.6
Connor, Jordan	33.2

Research and collaborations

BeeWalk was established with the twin aims of collecting abundance and distribution data on Britain's bumblebees, and using this data as widely as possible to analyse population trends and carry out other research as appropriate. The Trust carry out some of this research in-house, but we also collaborate widely with other researchers on shared projects. Additionally, we make the BeeWalk data freely available on the National Biodiversity Network (NBN) Gateway for others to use (as long as they acknowledge us as the source of the data).

The growing importance of BeeWalk as a data source is highlighted by the fact that the BeeWalk protocol is used by several organisations to monitor their sites in partnership with the Trust. This includes the Royal Society for the Protection of Birds (RSPB), the Derbyshire, Gwent and Beds, Cambs & Northants Wildlife Trusts, the Open University's Snakeshead Fritillary Monitoring Partnership, and various others. The Trust has also been asked to advise on projects and monitoring programmes run by the RSPB, Centre for Ecology & Hydrology (CEH), British Trust for Ornithology (BTO) and OPAL (the Polli:Nation project) and others.

We are also keen to work with students at all levels, and can help with project ideas and provide data. The Trust are currently collaborating with undergraduate, Masters and PhD students on a range of topics, with BeeWalk projects generally concerned either with elements of phenology (seasonal timings) and flower visitations.

Photo credit: Kate Ashbrook

Major ongoing collaborations

National Pollinator and Pollination Monitoring Scheme

One of the main take-home messages of the 2014 English National Pollinator Strategy (NPS) was the lack of available data on wild pollinators. To help fill this gap, Defra funded a group of organisations, led by CEH and including the Trust, the Bees Wasps and Ants Recording Scheme, BTO, Butterfly Conservation, the Hoverfly Recording Scheme, and the Universities of Reading and Leeds, who were appointed by the Department for Environment, Food and Rural Affairs (DEFRA) to establish and test the protocol for a Pollinator Monitoring Scheme.

The objectives of this project were:

1. To identify a robust sampling framework for national pollinator monitoring.
2. To develop and test new methods for monitoring pollinators and pollination services to crops as part of this framework (with a focus on bees and hoverflies).

A major output is the development of a National Pollinator and Pollination Monitoring Framework (NPPMF) to guide future monitoring and build on existing citizen science activity. Extensive field testing during 2014 and 2015 strongly supported the use of transects and volunteers for monitoring bumblebees. The full findings of the project were published during 2016 and the project report can be downloaded from the DEFRA website.

During 2016, Defra commissioned the same group of organisations (funded by Defra, Welsh Government, and JNCC) to carry out two years of data gathering acting on the recommendations of the report. The Trust are again part of the project, which began in January 2017 and will run to the end of 2018.

Photo credit: RHS

Caste-specific demography and phenology in bumblebees: modelling BeeWalk data

A collaboration between the Trust, Steven Freeman of the Biological Records Centre (BRC), within CEH, and Eleni Matechou of the University of Kent. Records coming into BeeWalk are, where possible, separated into caste (queen, male, worker), and a further category, 'unknown caste'. Being able to reliably split this unclassified group into castes will greatly increase the descriptive power of BeeWalk, as knowledge of the abundance of different castes is much more informative of the state of the colonies than the mere fact of a sighting of a species.

This project set out to investigate the feasibility, and best method, of splitting the 'unknown' caste into males/queens/workers, based on the abundance of those already identified to caste. An MSc thesis was produced during 2013-14 (Guangxin Feng, 2014, University of Oxford) which investigated the abundance and phenology of different castes of the Common carder bumblebee using mixture models (probabilistic models which represent the presence of subpopulations within an overall population – here, castes within the overall population of a single species).

The MSc project found that these mixture models were suitable for modelling the BeeWalk data, and had the advantage that they could also be used to calculate a range of further variables explaining bumblebees' colony dynamics and population size. Consequently we have continued the collaboration and extended it across a greater range of species *(B. pascuorum, B. lapidarius, B. hortorum, B. pratorum, & B. hypnorum)* and years (2011-2016). A paper outlining the modelling approach is in late-stage preparation and will be submitted to a scientific journal in spring 2017.

Mapping the spread of the Tree bumblebee

The Tree bumblebee *(Bombus hypnorum)* was found in Britain for the first time in 2001 at Landford, Wiltshire – the first bumblebee to establish after crossing the English Channel for almost 150 years. The Bees, Wasps and Ants Recording Society (BWARS) are monitoring the spread of the species on an annual basis, and the Trust provide BeeWalk data to assist with the mapping project. The current map can be viewed on the BWARS website.

Photo credit: Richard Comont

Research & policy publications 2008 - 16

Dicks, L.V., Baude, M., Roberts, S.P.M., Phillips, J., Green, M. and Carvell, C. (2015). How much flower-rich habitat is enough for wild pollinators? Answering a key policy question with incomplete knowledge. Ecological Entomology 40:22-35.

This research used BeeWalk phenology data within a project looking at developing agri-environment packages for wild pollinators as part of the Countryside Stewardship Scheme launched in 2015 in England.

Response for Nature reports (2015). Available online. These country-specific reports outlined suggestions from the conservation community to answer the question posed by the 2013 State of Nature report: what needs to be done to improve the state of nature in the UK?

WC1101 – Development and testing of monitoring to support the National Pollinator Strategy (2016). Defra. Available online. As outlined above, this report aimed to design possible structures for a future National Pollinator Monitoring Scheme.

Background & methods

Trends in bumblebee populations were compiled from a network of 373 sites in 2016 and 800 sites across all years.

Background to BeeWalk

The Bees, Wasps and Ants Recording Society (BWARS) has been collecting data on the distribution of hymenoptera data since 1978, providing a good understanding of the distribution of bumblebee species across the UK, but there has been a significant lack of data on bumblebee abundance. Abundance data, knowing the size of populations and how these change over time, is key to monitoring population trends for bumblebee species, identifying which species are most at risk and acting as an early warning system for significant declines.

The lack of abundance data, alongside the need to better understand what's happening to all our species, not just the rarest, led to the development of the BeeWalk project. BeeWalk collects bumblebee data from across the UK to gain an accurate understanding of current bumblebee populations and distributions. In particular, the scheme aims to:

- Collect long-term data on bumblebee distribution and abundance.
- Analyse data to identify population trends and drivers thereof.
- Use these and other findings to inform policy and conservation interventions by the Trust and others, including improved understanding of forage plants & identification of management impacts.
- Encourage the public understanding of bumblebees.

BeeWalk transects (fixed monitoring routes) are monitored by volunteers using a standardised methodology to ensure accurate and comparable data is gathered. Most transects are roughly 1-2 km in length and take in some flower rich habitat. Transects are walked a minimum of once a month between March and October (the main bumblebee flight period), ideally between 11am and 5pm on days with minimal wind or rain.

Bumblebees are identified to species and caste where possible (and recorded as 'indeterminate bumblebee' or 'unknown caste' where not) and the number of each entering the 'recording box' on each section of the transect is recorded. The recording box covers an area up to four metres in front of the recorder, two metres either side of them, and between ground level and two metres up. This is employed in order to standardise between habitats, which may have very different levels of visibility, as well as between recorders (different people will be able to identify bees from different distances, depending on experience) and species (more distinctive species can be identified from further away).

Recorders who are confident of their plant ID skills also have the option to record which flower species the bumblebees are visiting. This provides us with a better understanding of the forage preferences of bumblebee species nationwide and across a range of habitat types, which will allow us to better tailor our flower advice to gardeners and landowners.

Holding up-to-date national population data allows us to better target our conservation activities and ensure that the advice we provide, including to governmental organisations, results in policies which reflect the current needs of our bumblebees.

Photo credit: Judith Conroy, Blooms for Bees

BeeWalk from the beginning

The survey methodology for the BeeWalk scheme was based on existing transect-walking schemes such as the UK Butterfly Monitoring Scheme, with minor changes to reflect the facts that bumblebees are harder to identify than butterflies (so the recording box was made slightly smaller) and that bumblebees are less reliant on good weather to be flying (so the weather criteria were relaxed slightly).

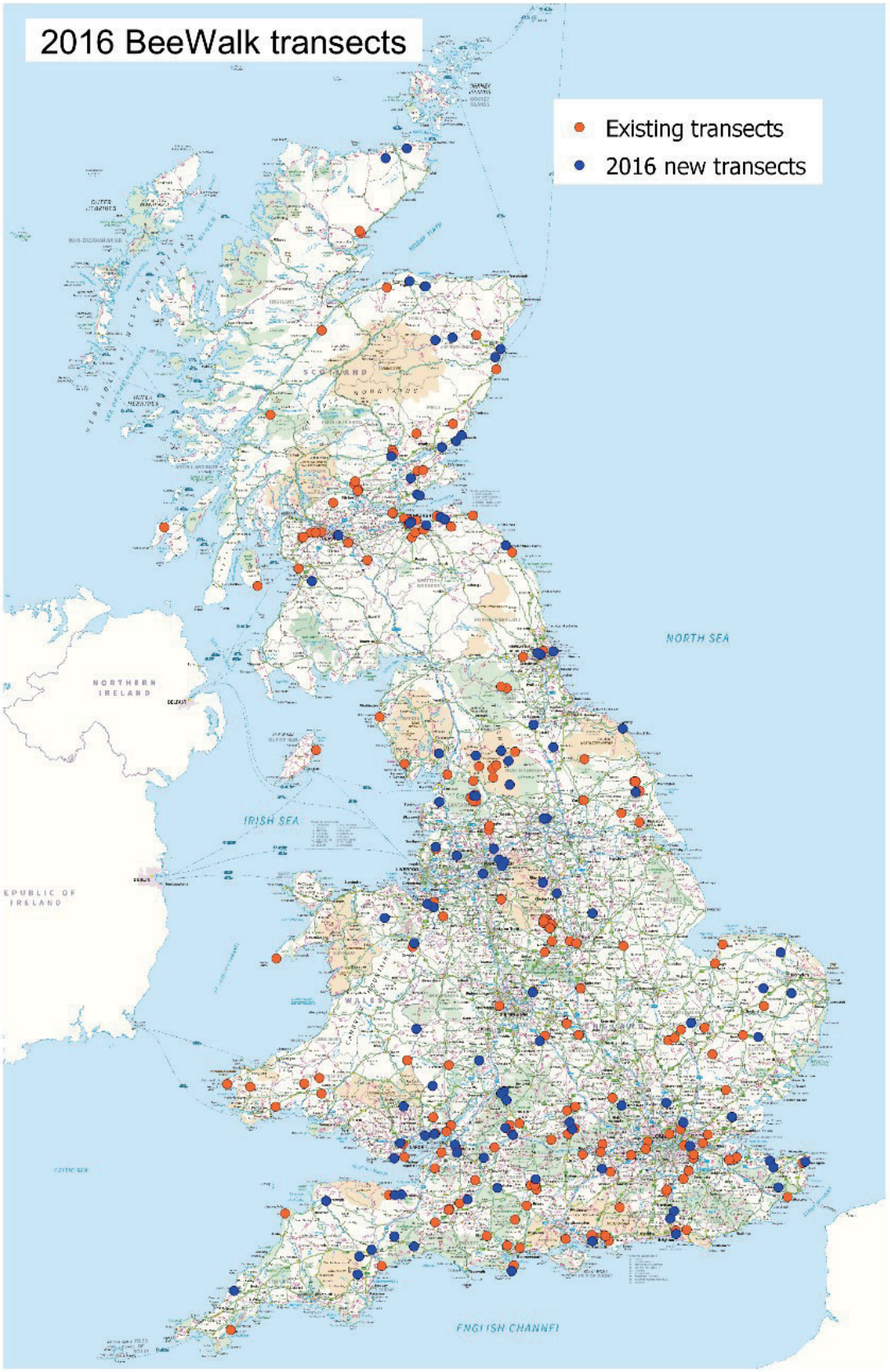
The project was trialled during 2008 and 2009, opened to Trust members in 2010, and launched as a scheme for the general public in 2011. In these early years the scheme was run as part of a University of Stirling PhD project, undertaken by Leanne Casey (supervised by Professor Dave Goulson) entitled *"Using citizen science to monitor bumblebee populations"*.

Following this research project, the scheme was run as an entirely Trust-run project from 2013 onwards, and continued to grow through funding by the Esmée Fairburn foundation between 2013 and 2015. Data were initially submitted using paper recording forms, which were then input into spreadsheets for analysis. This quickly became unworkable due the growing number of transects, and in 2011 electronic recording forms were introduced.

With a continued increase in data being submitted each recording season and the desire to continue to grow the scheme, even this began to exceed the time available and in early 2014 the BeeWalk website was created, hosted by the Biological Records Centre. This allowed transects to be registered online and records submitted directly, greatly reducing the staff time required to enter and sort data. In turn, this allowed time to be focused on data quality, analysis, volunteer training and support, and the continued growth of the scheme.

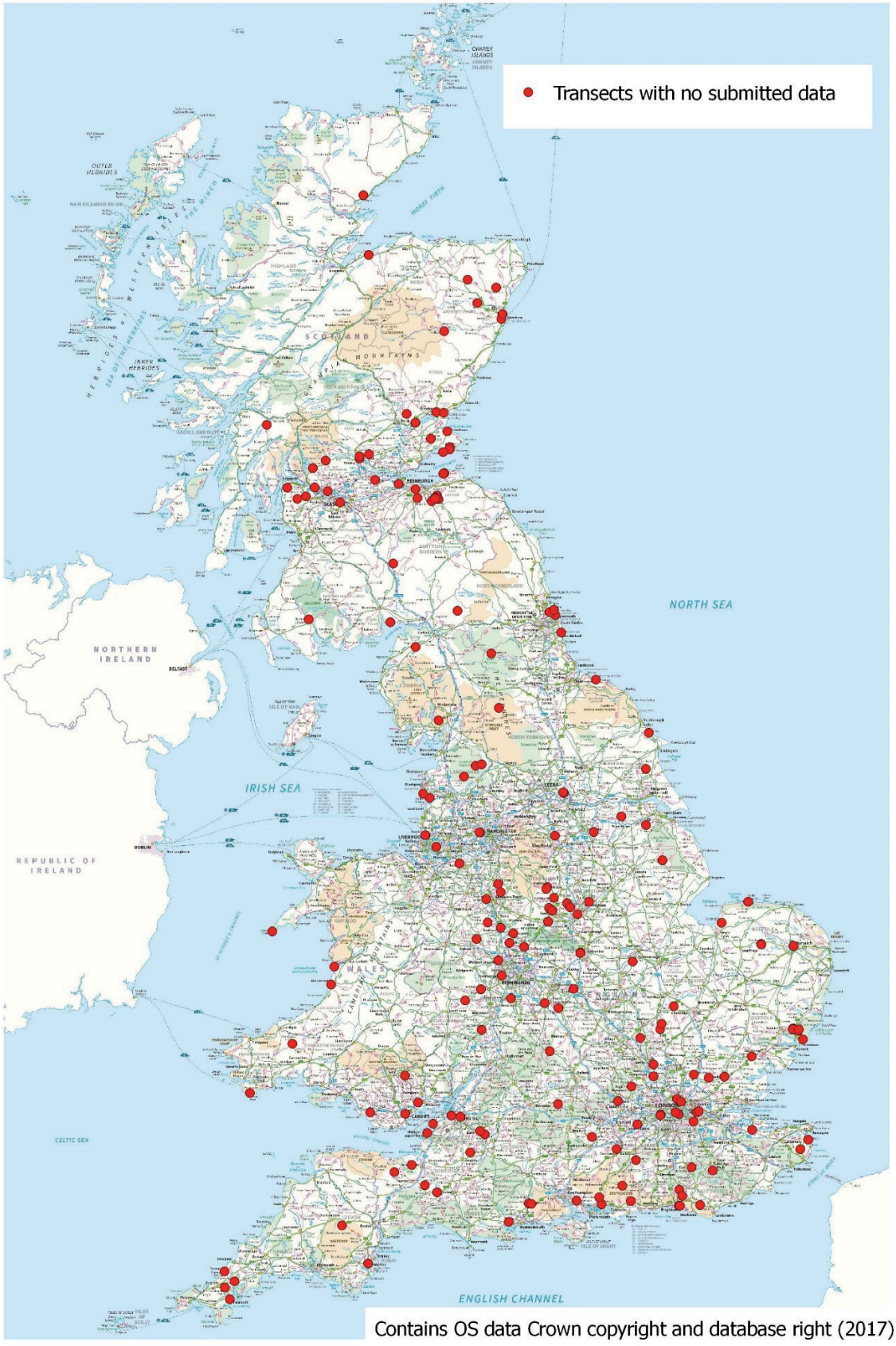
Consequently, the scheme gained a greater focus on accuracy, validation and verification from 2014 onwards in order to meet the high standards required for monitoring scheme data to be viewed as scientifically robust and reliable. After three scoping years and six in operation as a public recording scheme, the BeeWalk dataset now stands at 65,287 validated records of 24 bumblebee species.

2016 BeeWalk transects



BeeWalk transects established in 2008-15 (blue dots) and in 2016 (orange dots).

Transects with no submitted data



BeeWalk transects drawn on the website but still without submitted data

Data background

The scheme and associated data provide a unique resource and have greatly boosted the scientific credentials of the Bumblebee Conservation Trust, as shown by the increasing number of scientific collaborations the Trust are invited to be part of, and the increasing use of the BeeWalk methodology as a standard monitoring tool by other organisations such as the RSPB. However, the central goal of the BeeWalk programme is to be able to reliably evaluate the trends in British bumblebee populations. Transect counts provide an annual estimation of the abundance of a species. They do not provide an absolute measure of the total abundance, but a relative measure which requires statistical interpretation to evaluate changes over time. This is complicated by the fact that transect locations change over time, allied to the effects of short-term weather conditions, etc.

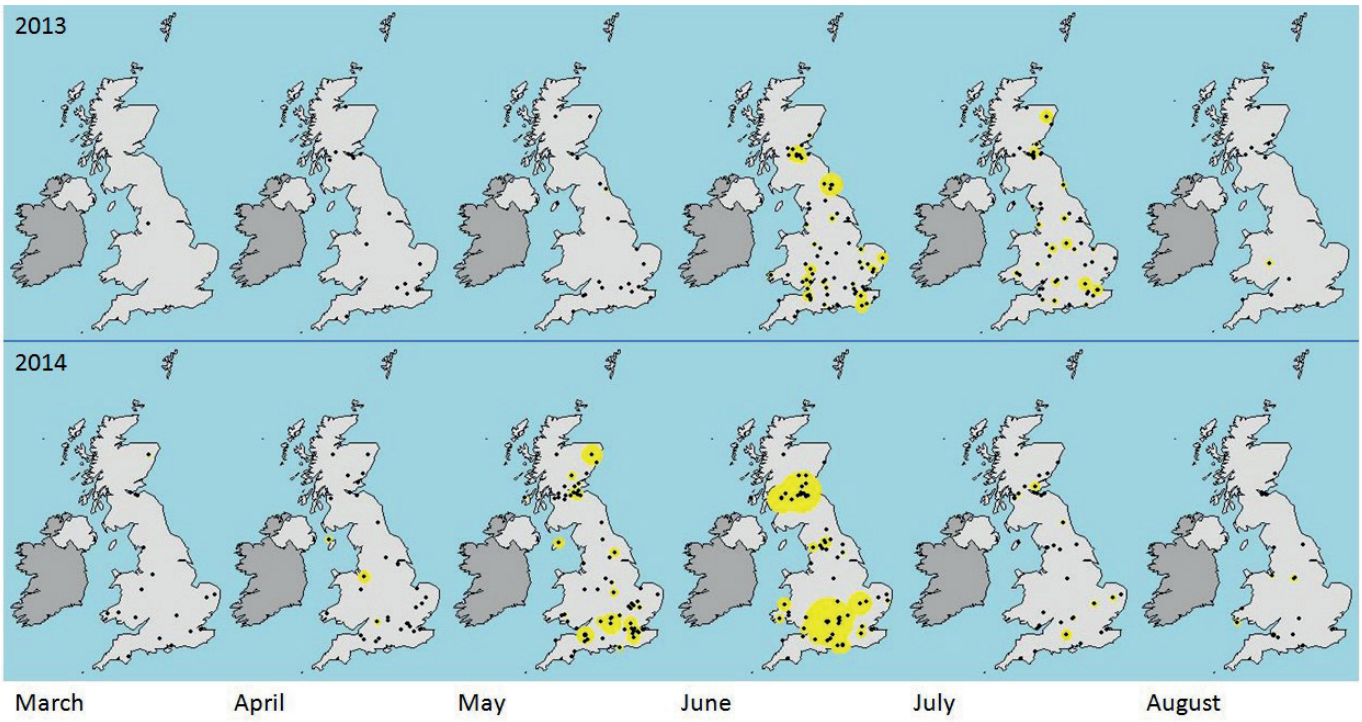
There are existing transect-based monitoring projects, such as the long-running UK Butterfly Monitoring Scheme led by the Centre for Ecology & Hydrology (CEH) and Butterfly Conservation. These schemes have long-established analysis protocols, but it is not possible to simply repeat their analyses to produce bumblebee population trends.

This is because of the different nature of butterfly and bumblebee spatial distribution across the landscape. In particular, bumblebees display central-point foraging behaviour, where insect density is high around floristic resources and in flight corridors between these resources and nests, but density is low outside these areas. These areas (particularly the corridors) will also change between years as nest sites change, for instance, meaning that transect counts can be subject to large-scale annual variations in apparent abundance purely as a result of altered proximity to these flight corridors and are not a constant proportion of the bumblebees seen across years. Although butterflies do aggregate within favoured areas, these tend to be large and diffuse (such as south-facing hillsides) and are not subject to such extreme annual fluctuations: indeed, their spatial distribution across a transect can (and is) essentially modelled as random. This allows a site-based modelling process whereby abundance fluctuations at each site are modelled in an annual ‘site index’, and changes in these site indices are aggregated to produce a national butterfly index.

Bumblebee spatial distributions do not meet the assumption of randomness required for this modelling process, and in particular the site-based annual variation for reasons other than abundance, which makes the creation of site indices unhelpful. Consequently, although there are some lessons and background which can be taken from surveys such as the UKBMS, bumblebee data must be analysed using a new methodology.

Photo credit: Kate Ashbrook

Trend calculation



Blobbomaps of the relative distribution and abundance of the Early bumblebee, Bombus pratorum, month by month in 2013 and 2014. Black dots mark the locations of transects where the species was recorded in each month, which the yellow circles are scaled according to the maximum abundance recorded on each transect per month. The earlier and greater peak abundance (probably related to weather conditions) is clearly demonstrated.

This began with simple map-based displays of the distribution of abundance, which demonstrated monthly and annual differences in peak abundance within and between species. As the BeeWalk scheme grew, direct calculation of population trends became more feasible. It is generally accepted that several years-worth of data are needed for reliable trend estimation in order to remove biases from annual random changes. This was thought to be particularly true of the BeeWalk data as the period included a number of climatically-exceptional years which are likely to have affected bumblebee numbers.

Many of the rarer bumblebee species were recorded so infrequently on BeeWalk transects that there was simply not enough data to work with. Data from the years 2008-9 were also removed as trial years. This left 14 species plus two aggregates (Bombus lucorum/terrestris) workers and total Bombus, which included all Bombus recorded including low-abundance species and those only identified to genus in the field) to be modelled across the period 2010-16.

Estimates of population trends across the 2010-16 period were calculated using a method similar to the analysis methodologies used by the UKBMS and the BTO's Breeding Bird Survey. First, the bumblebee counts submitted by BeeWalkers were added up to produce total counts of each caste of each species per month surveyed. The distance walked each month was also calculated as a measure of the area surveyed. The resulting monthly counts were then analysed using a log-linear model. This works out the monthly counts as a rate (count/distance), which allows for the fact that differing numbers of transects were walked each month, and the fact that each transect is a different length. The model estimated abundance trends across the 2010-2016 period.

These data were also used to demonstrate the abundance of each of the 16 species or species aggregates in 2016 against the 2010-15 mean monthly abundance per kilometre surveyed, in order to see whether 2016 was statistically a 'good', 'bad', or 'standard' year for each species.

Bumblebee population trends

Population trends were positive for four species and one aggregate species, and negative for ten species as well as for total bumblebees. It is encouraging that the only conservation priority species abundant enough to model, the Brown-banded carder *(Bombus humilis),* showed a mean annual increase. Less surprisingly, the Tree bumblebee (*Bombus hypnorum)* also increased year on year, as it continues to spread across the country.

One of the largest decreases was recorded by the Early bumblebee *(Bombus pratorum)*, despite a very abundant year in 2014. This is likely to result from a series of poor springs, and it is hoped that at least one of our student projects will help shed light on this.

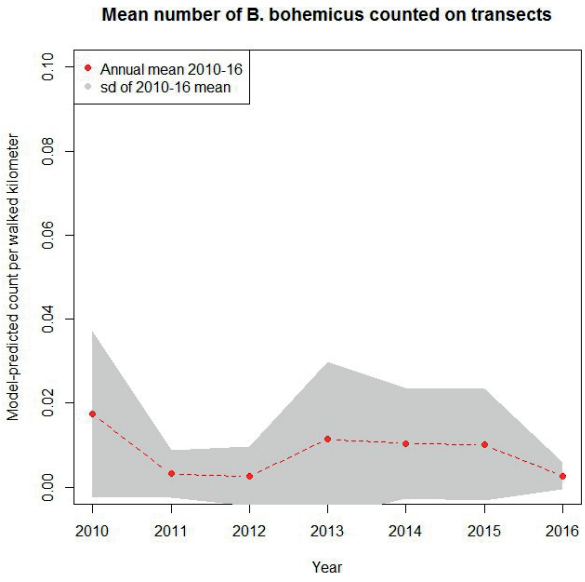
2010-2016 population trends for the 14 bumblebee species and 2 species aggregates with sufficient records in the BeeWalk dataset. Species showing population increases are on the left of the table, those showing decreases are on the right. Both groups are ordered from the top down, most to least change. Conservation priority species have been highlighted in blue and cuckoo species in red.

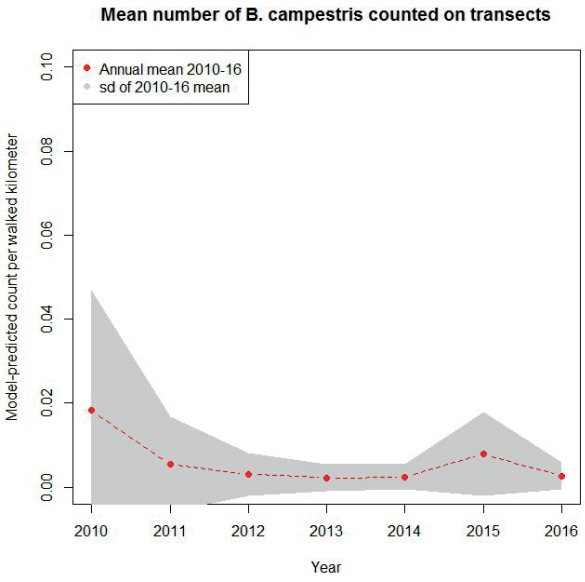
Species	Trend
B. lucorum/terrestris workers	0.2552131
B. hypnorum	0.09973465
B. vestalis	0.09422705
B. jonellus	0.06544606
B. humilis	0.05634655

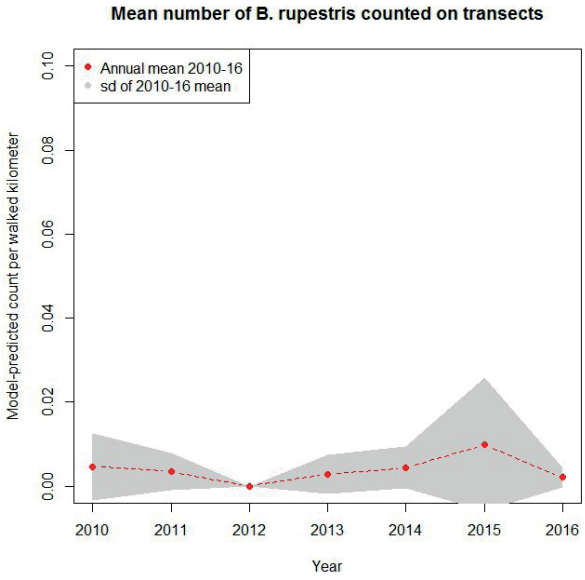
Species	Trend
B. lucorum	-0.1044738
B. sylvestris	-0.100832
B. terrestris	-0.08273232
B. pratorum	-0.06458254
B. rupestris	-0.04223255
B. hortorum	-0.03236329
B. campestris	-0.2730684
B. bohemicus	-0.1693556
B. lapidarius	-0.01333212
TOTAL bumblebees	-0.007407546
B. pascuorum	-0.00476433

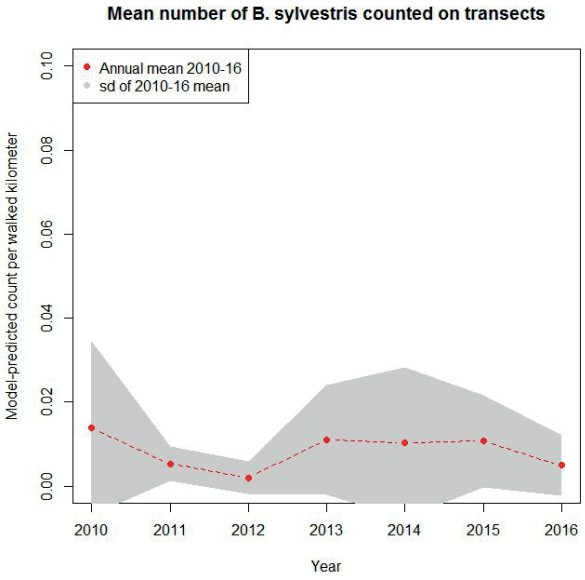
Photo credit: Richard Comont

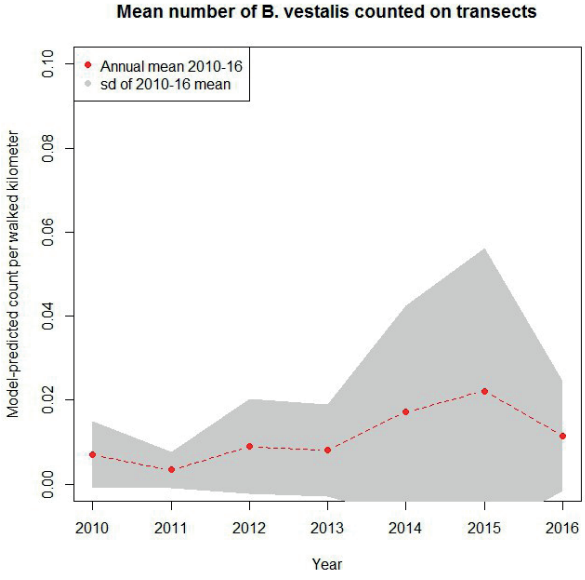
A Short-haired bumblebee, the most recent British species to go extinct in Britain.





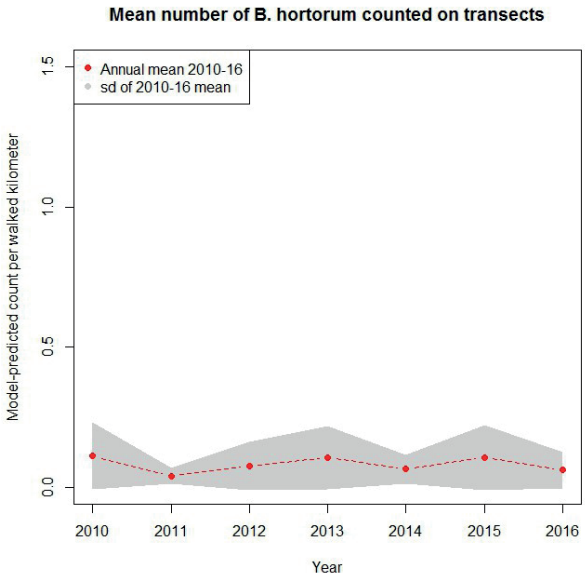


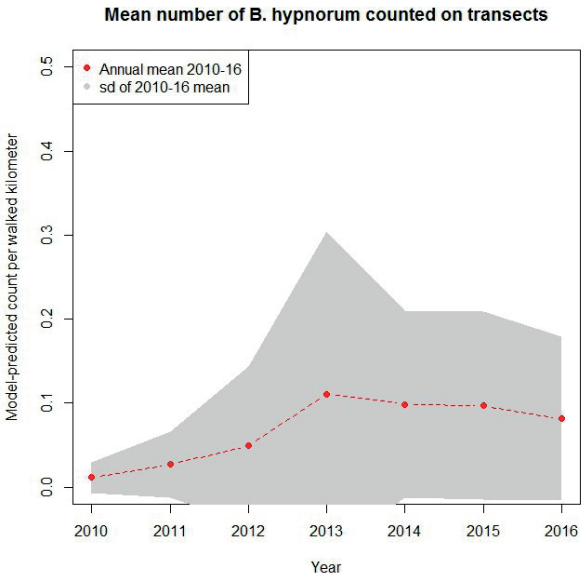


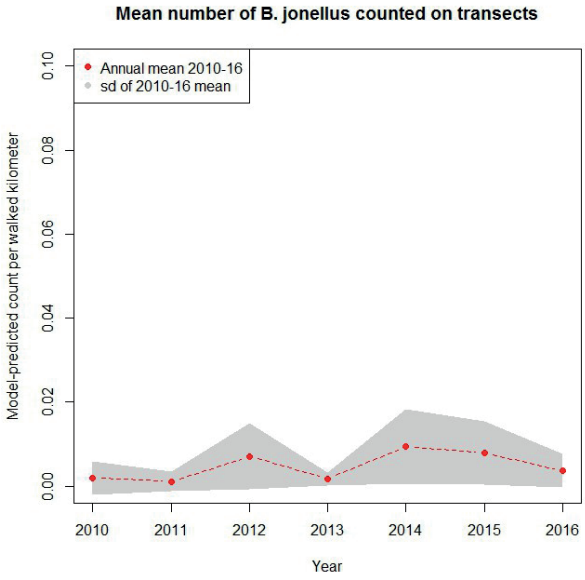


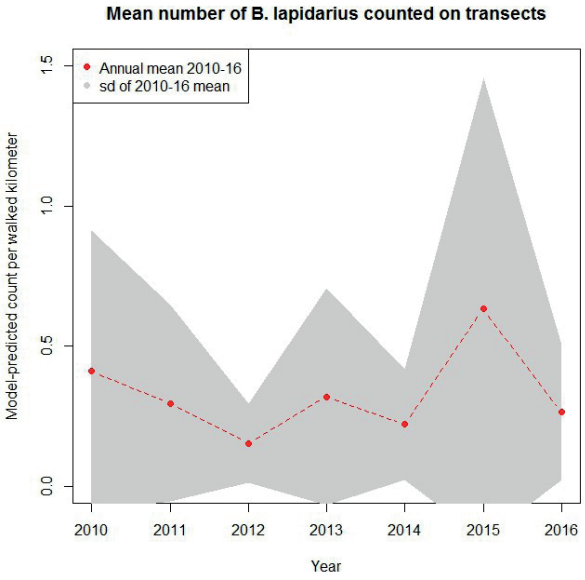
Abundance trends in British bumblebee species 2010-16, shown as the mean number of bumblebees of that species counted per kilometre walked each year (red line). The grey cloud is a measure of variability (standard deviation).

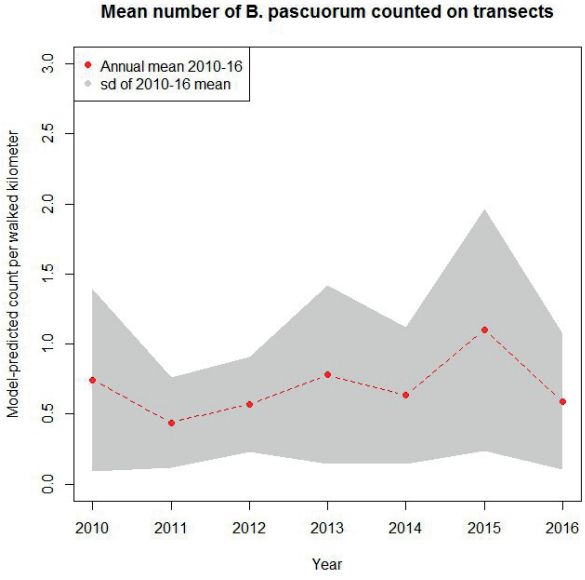
Bombus lucorum & Bombus terrestris often cannot be reliably split as workers, so records submitted as 'Bombus lucorum/ terrestris workers' are plotted in addition to both species. Total bumblebees includes all records.

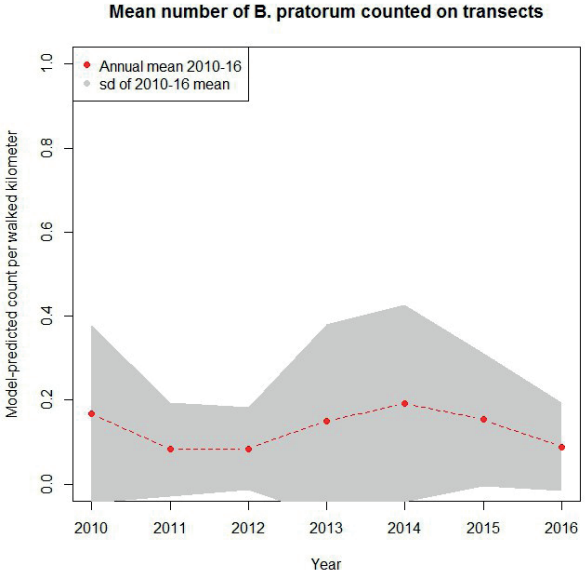

Mean number of B. hortorum counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.0
0.5
1.0
1.5
2010
2011
2012
2013
2014
2015
2016
Year

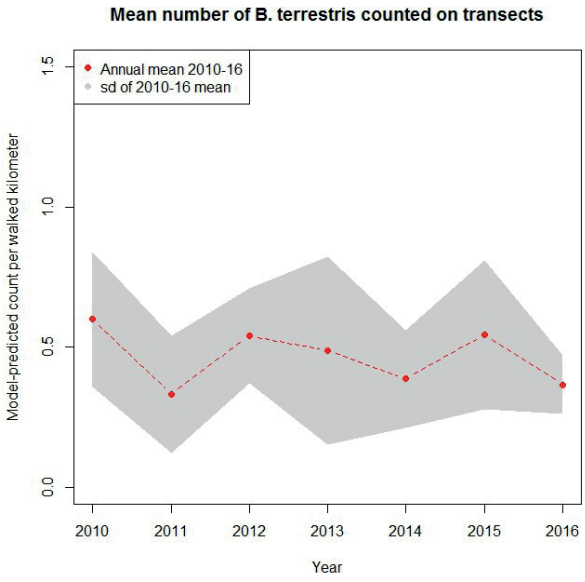

Mean number of B. hypnorum counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.0
0.1
0.2
0.3
0.4
0.5
2010
2011
2012
2013
2014
2015
2016
Year

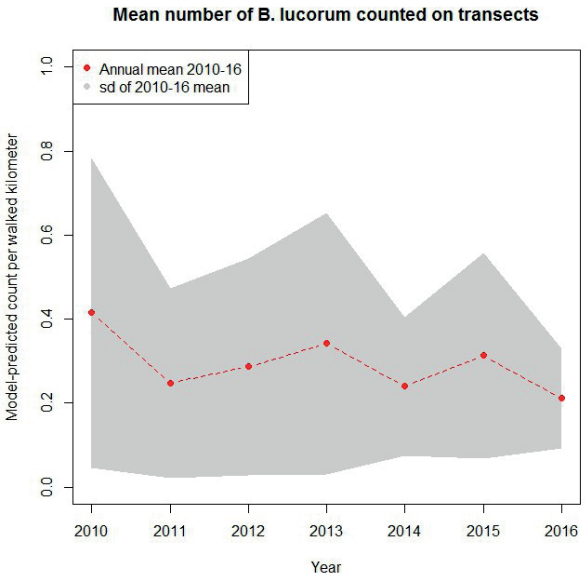

Mean number of B. jonellus counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.00
0.02
0.04
0.06
0.08
0.10
2010
2011
2012
2013
2014
2015
2016
Year

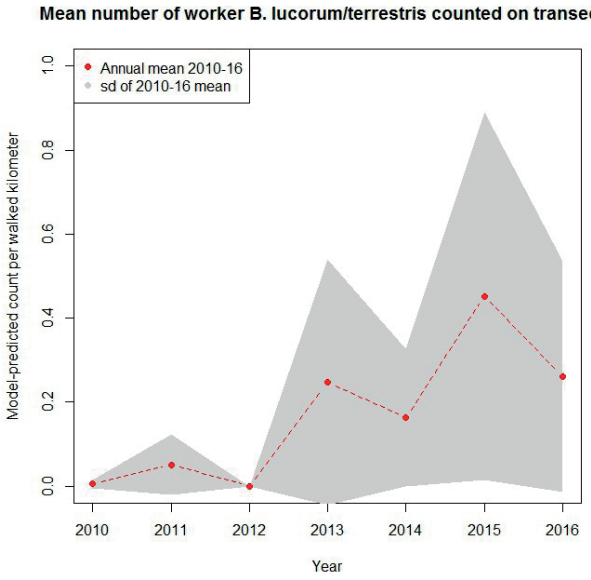

Mean number of B. lapidarius counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.0
0.5
1.0
1.5
2010
2011
2012
2013
2014
2015
2016
Year

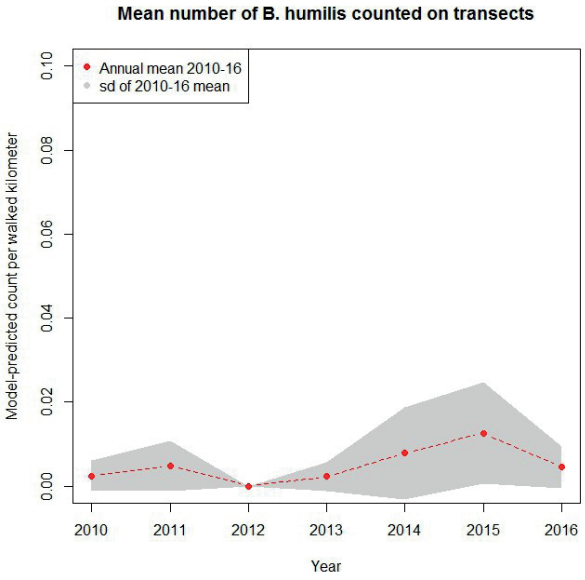

Mean number of B. pascuorum counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2010
2011
2012
2013
2014
2015
2016
Year

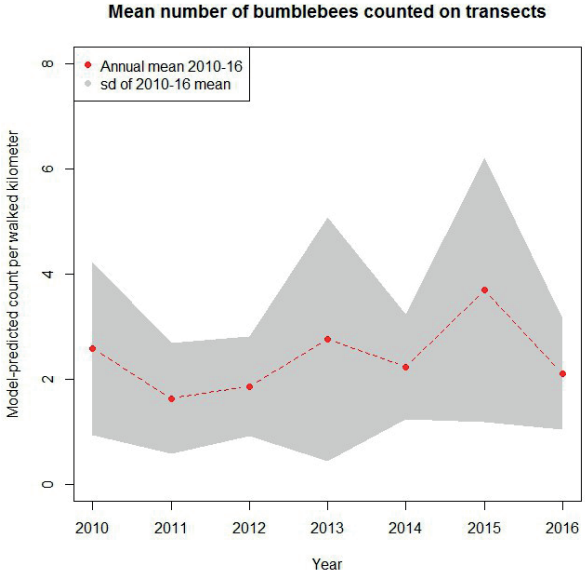

Mean number of B. pratorum counted on transects
Annual mean 2010-16
sd of 2010-16 mean
Model-predicted count per walked kilometer
0.0
0.2
0.4
0.6
0.8
1.0
2010
2011
2012
2013
2014
2015
2016
Year











Abundance trends in British bumblebee species 2010-16 (cont.), shown as the mean number of bumblebees of that species counted per kilometre walked each year (red line). The grey cloud is a measure of variability (standard deviation).

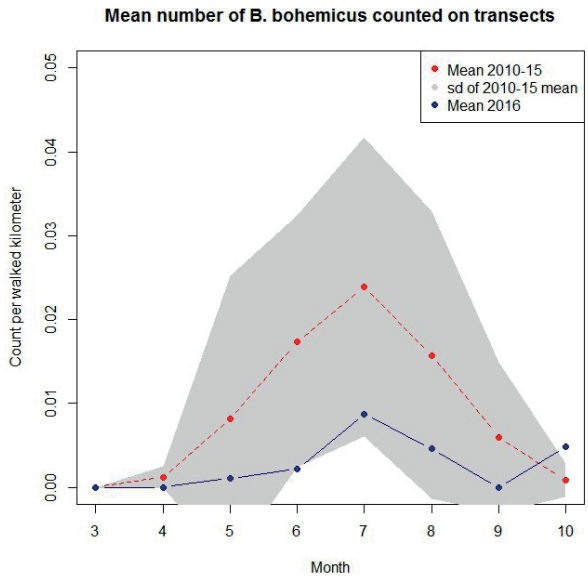
Bombus lucorum & Bombus terrestris often cannot be reliably split as workers, so records submitted as 'Bombus lucorum/ terrestris workers' are plotted in addition to both species. Total bumblebees includes all records.

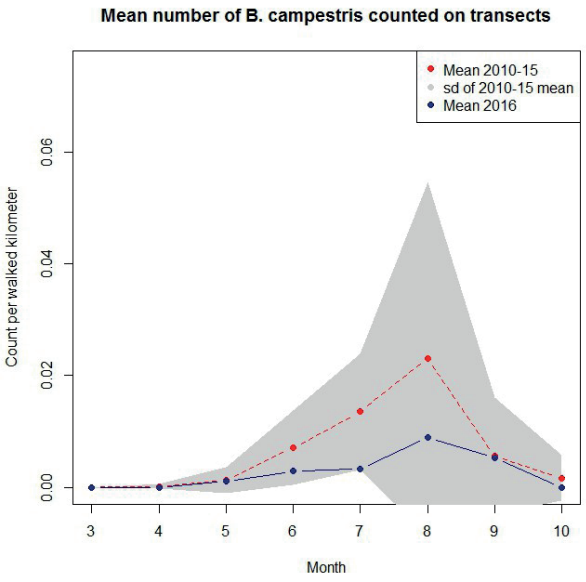
2016

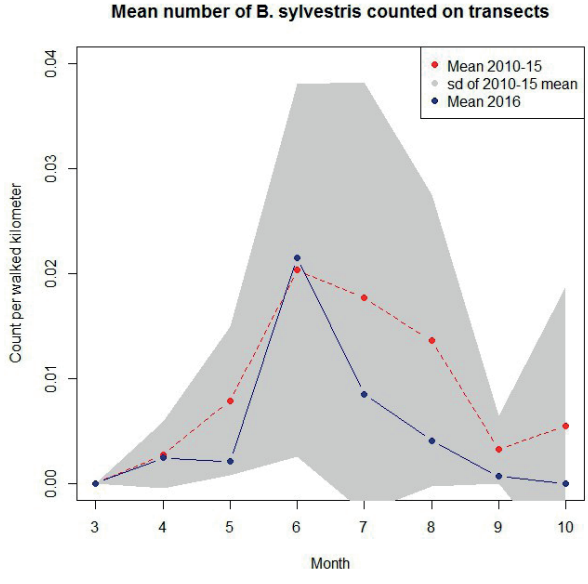
For most bumblebee species, the patchy spring saw a slow start to 2016 and, although things improved, it was a below-average year for most species, and for bumblebees in general. The Buff-tailed bumblebee *(Bombus terrestris)* in particular had a poor summer, with repeated counts significantly lower than would be expected. The species which did best in 2016 was the Tree bumblebee *(Bombus hypnorum)*, with most monthly counts slightly higher than average, and a significantly higher count in March 2016.

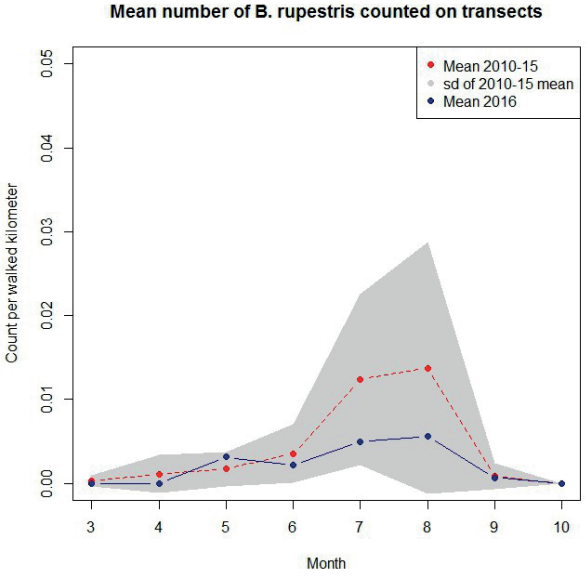
This species is rapidly becoming one of the earliest-emerging bumblebee and the high early count is likely to reflect this.

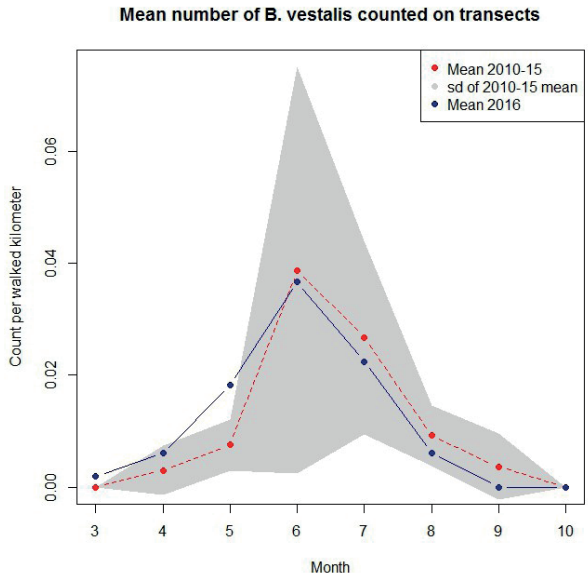
In these plots, the average count for each species between March and October (blue line) is plotted against the average monthly abundance for the six-year period 2010-15 (red line). The grey cloud indicates the variability of the 2010-15 average – where the blue (2016) line is outside this grey area the count is significantly different to what would be expected.

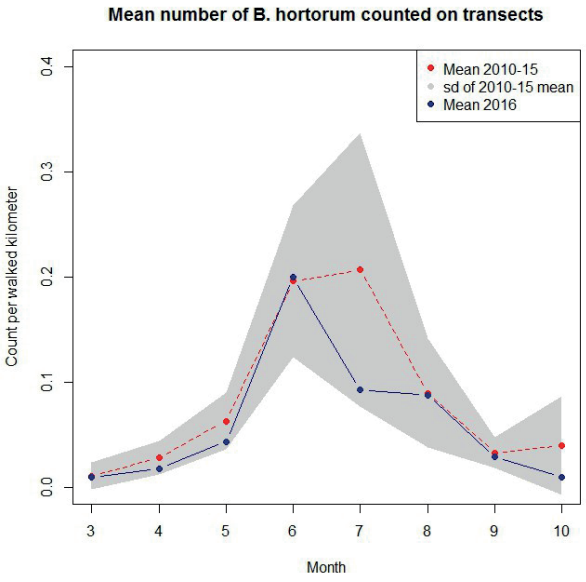


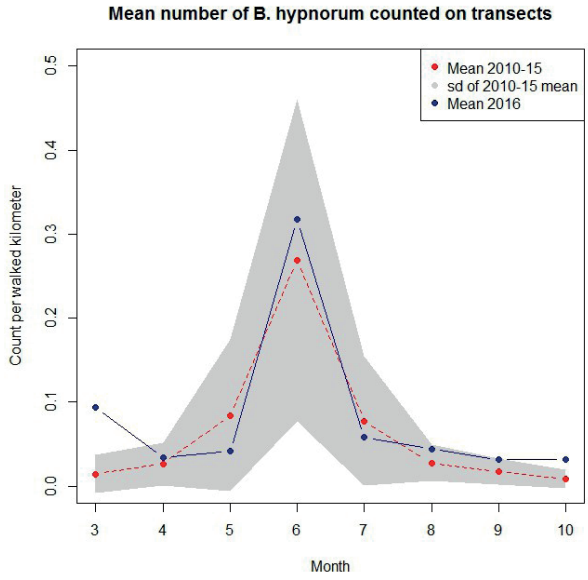


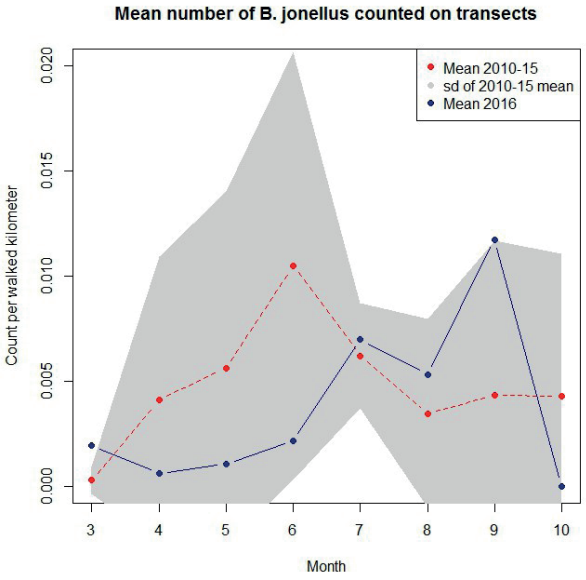


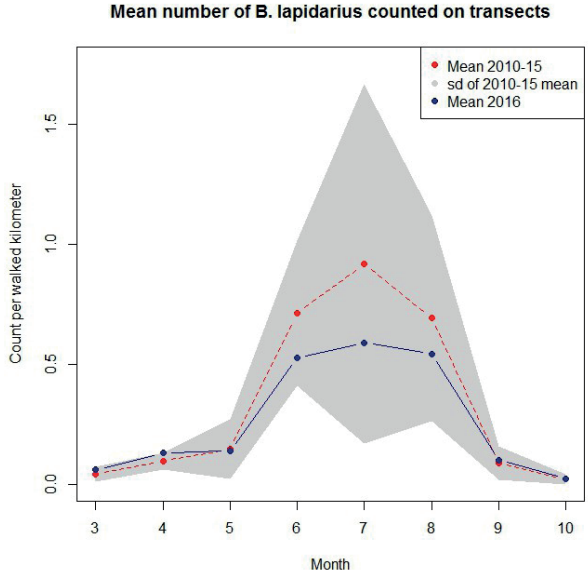


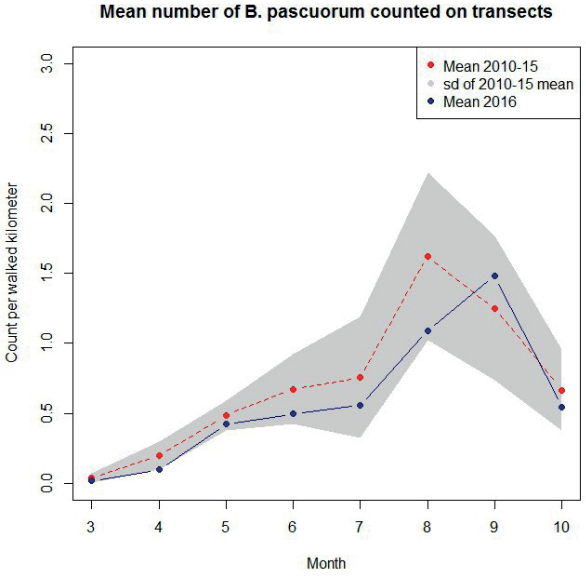

Mean number of B. vestalis counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.00
0.02
0.04
0.06
3
4
5
6
7
8
9
10
Month


Mean number of B. hortorum counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.0
0.1
0.2
0.3
0.4
3
4
5
6
7
8
9
10
Month

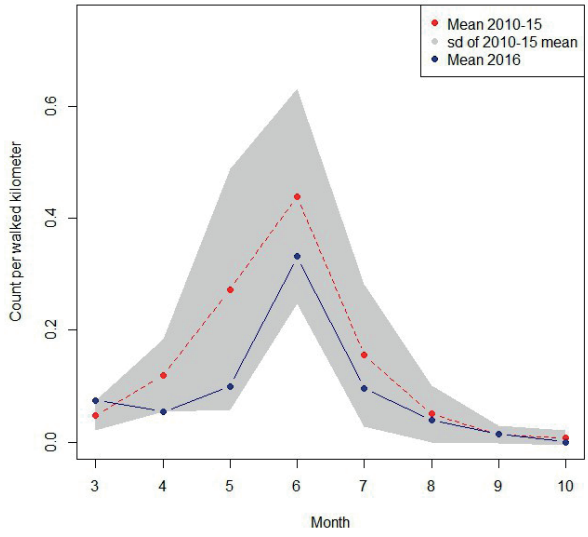

Mean number of B. hypnorum counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.0
0.1
0.2
0.3
0.4
0.5
3
4
5
6
7
8
9
10
Month


Mean number of B. jonellus counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.000
0.005
0.010
0.015
0.020
3
4
5
6
7
8
9
10
Month

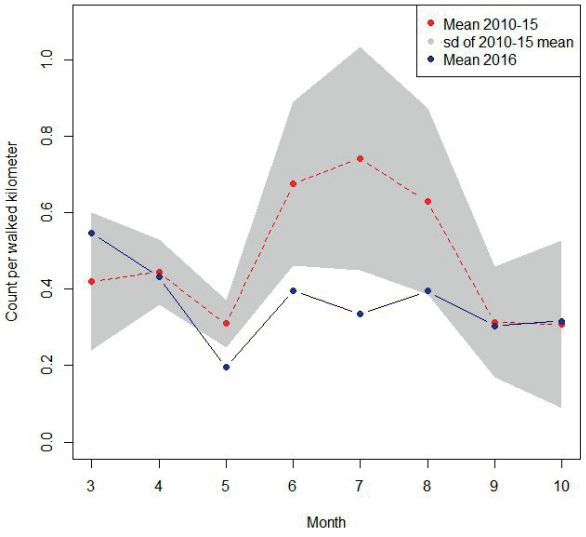

Mean number of B. lapidarius counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.0
0.5
1.0
1.5
3
4
5
6
7
8
9
10
Month


Mean number of B. pascuorum counted on transects
Mean 2010-15
sd of 2010-15 mean
Mean 2016
Count per walked kilometer
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3
4
5
6
7
8
9
10
Month

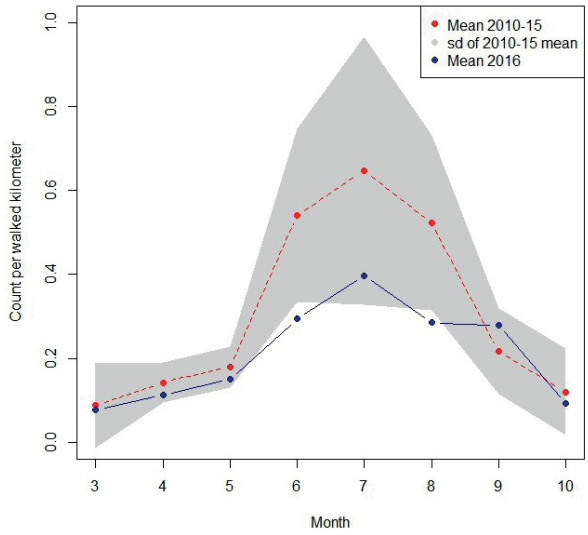
Mean number of B. pratorum counted on transects



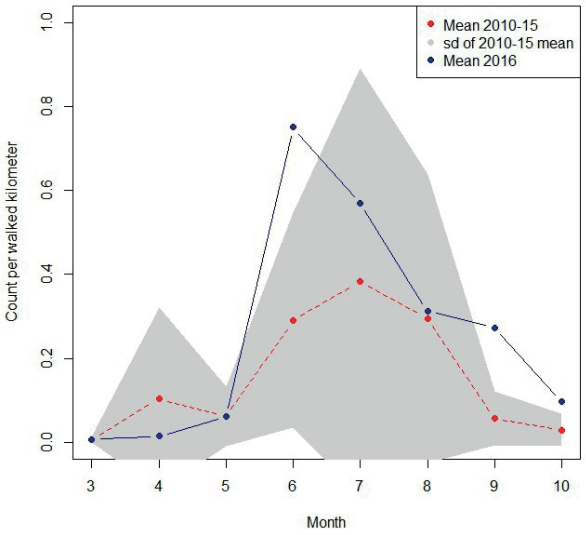
Mean number of B. terrestris counted on transects



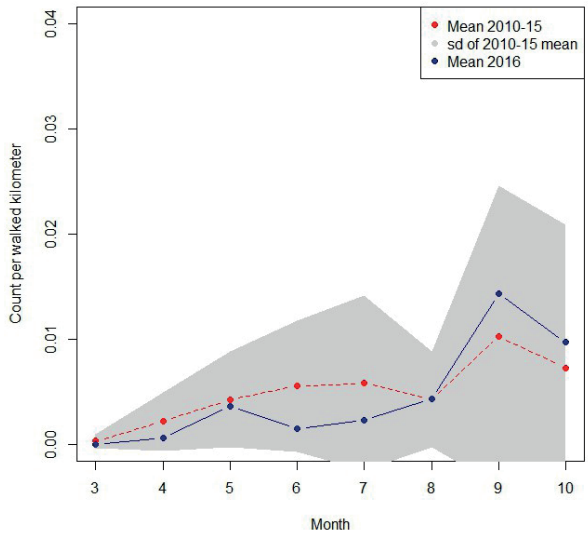
Mean number of B. lucorum counted on transects



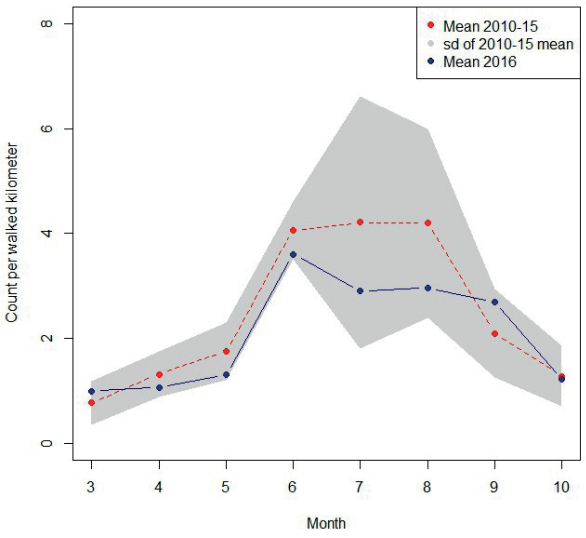
Mean number of B. lucorum/terrestris workers counted on transects



Mean number of B. humilis counted on transects



Mean number of bumblebees counted on transects



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It can be downloaded from www.bumblebeeconservation.org and further information can be found on the BeeWalk website, www.beewalk.org.uk.

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