Bugs **Matter**

THE 2024 REPORT

The Bugs Matter Citizen Science Survey

The National citizen science survey of ‘bug splats’ on vehicle number plates to monitor flying insect abundance.

Address for correspondence: info@bugsmatter.app

buglife

Kent Wildlife Trust

Find more information about the Bugs Matter project here:
kentwildlifetrust.org.uk/bugs-matter

Authors and Contributors

KEY AUTHOR:

Dr Lawrence Ball Kent Wildlife Trust

CONTRIBUTORS:

Andrew Whitehouse Buglife
Evan Bowen-Jones Kent Wildlife Trust
Mollie Amor Kent Wildlife Trust
Nikki Banfield Buglife
Paul Hadaway Kent Wildlife Trust
Paul Hetherington Buglife

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The 2024 Bugs Matter citizen science survey has found further reductions in the number of insects sampled on vehicle number plates in the UK.

The number of recorded flying insects fell by 62.5% between 2021 and 2024, although the rate of decline has slowed between 2023 and 2024. This decrease in insect splats over such a short time is concerning. It is likely due to the compounding effects of both a background rate of decline as well as a short-term cycle of decline, perhaps linked to the extreme climate in the UK in recent years. Continuing the Bugs Matter survey is essential to improve our understanding of insect declines and determine if this is a long-term trend.

To take part in 2025

Download the Bugs Matter app on your Android **Bugs Matter – Apps on Google Play** or Apple **Bugs Matter on the App Store** device.

Sign up and make every journey count!

In recent years, scientists, conservation organisations and the media have drawn attention to global declines in insect abundance, the consequences of which are potentially catastrophic. Invertebrates are critical to ecosystem functions and services, and without them, life on Earth would collapse. However, there has been insufficient data to make robust conclusions about trends in insect abundance, because standardised insect sampling approaches are not widely applied to all insect groups or at a national scale.

The Bugs Matter citizen science survey provides a standardised and large-scale approach to monitor the abundance of flying insects over time.

The sampling method is analogous to the 'windscreen phenomenon', a term given to the anecdotal observation that people tend to find fewer insect splats on the windscreens of their cars now, compared to in the past.

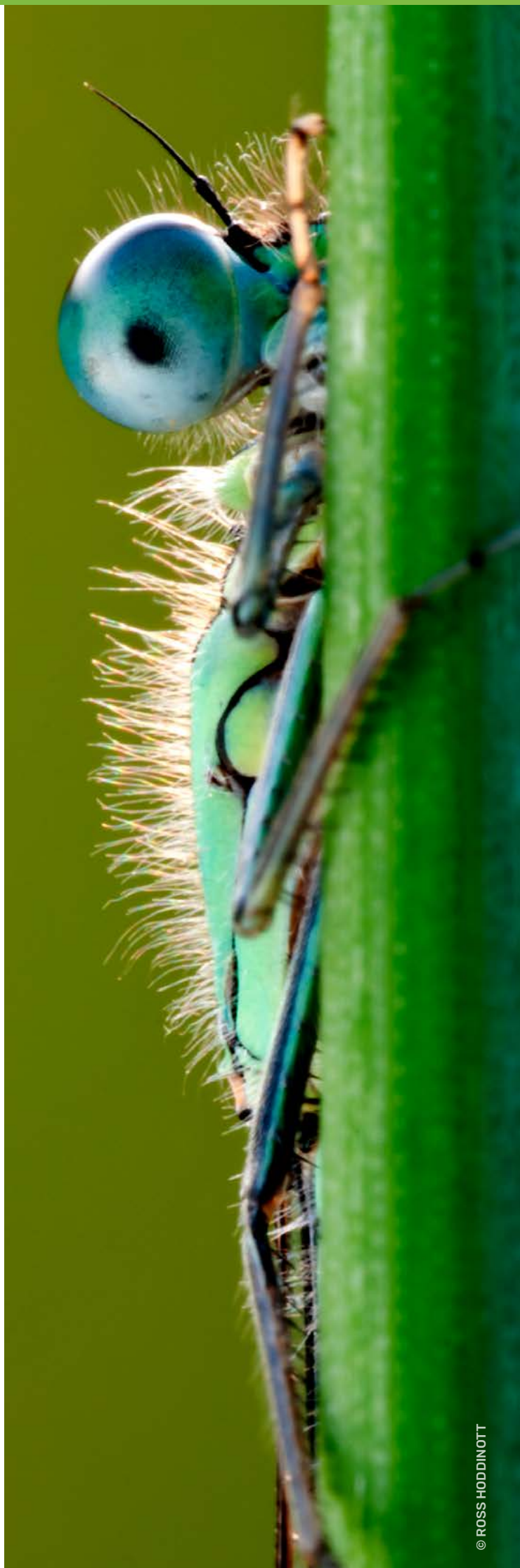
Prior to commencing a journey, citizen scientists clean the front number plate of their vehicle to remove any residual insects. The app requests a checkbox confirmation that the number plate has been cleaned.

Upon starting a journey, citizen scientists tap a button in the app to begin recording the journey route using the mobile device's GPS. This provides crucial data on the length, duration, location, and average speed of the journey. Insects are then sampled when they collide with the number plate throughout the duration of a journey.

Upon completing a journey, citizen scientists tap a button in the app to finish recording the journey route. They record the number of insect splats on the front number plate of their vehicle. The journey route, the number of insect splats, and a photograph of the number plate are submitted via the app.

Citizen scientists were asked to participate only on essential journeys and not to make journeys specifically to take part in the survey.

Promotional image showing screenshots from the Bugs Matter mobile app.



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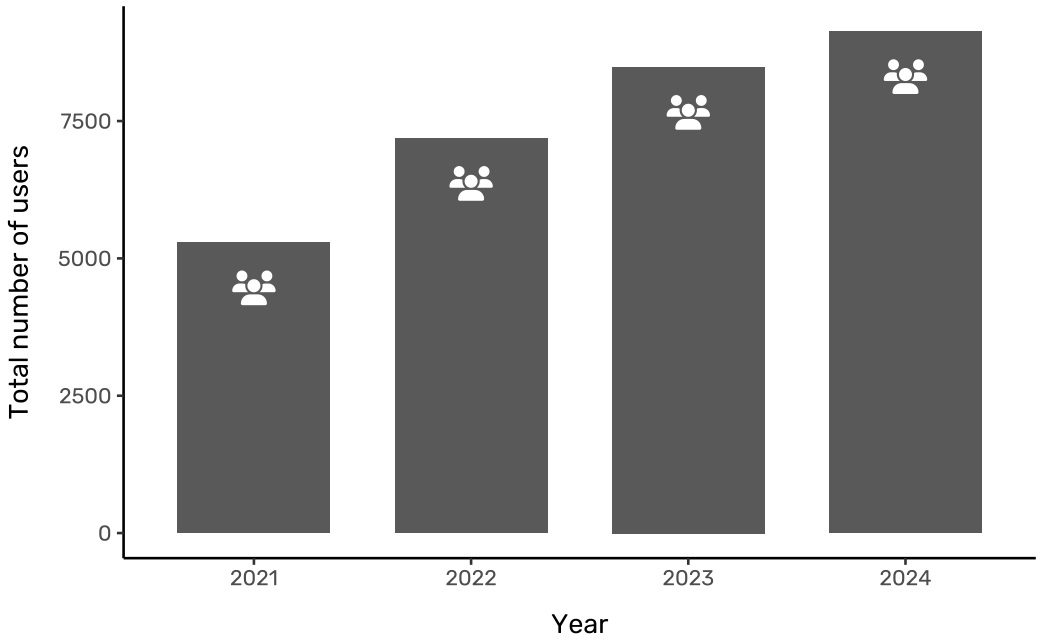
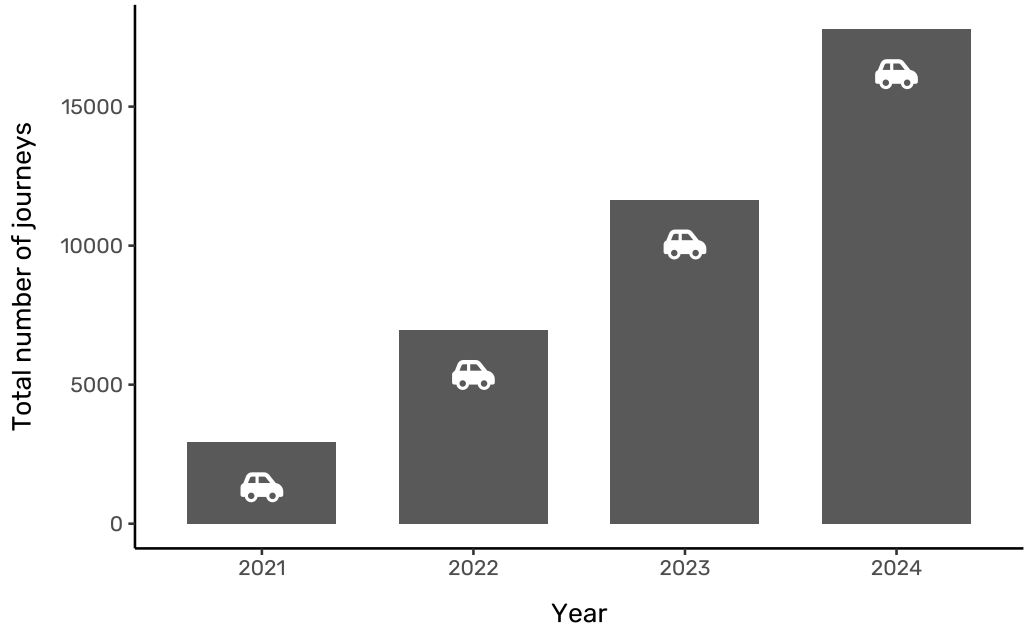
To date, 9575 citizen scientists have signed up to take part in the Bugs Matter survey. In 2024, 651 new users signed up.

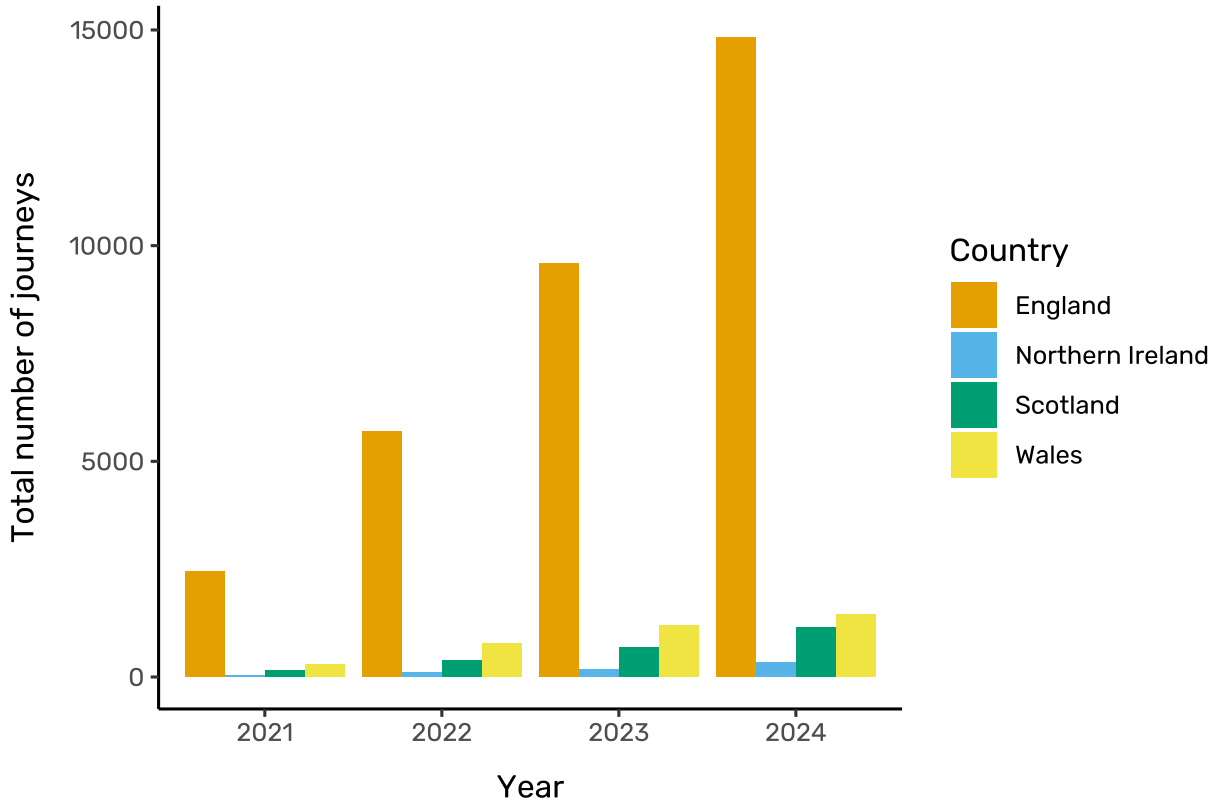


Cumulative count of users in each survey year in the UK.

Citizen scientists recorded a total of 8,828 journeys in 2024, bringing the total to 25,615 journeys (6,125 and 17,772 in the cleaned dataset), covering a whopping 761,750 kilometres (473,330 miles).



Cumulative count of journeys in each survey year in the UK.



Cumulative count of journeys in each country in each survey year

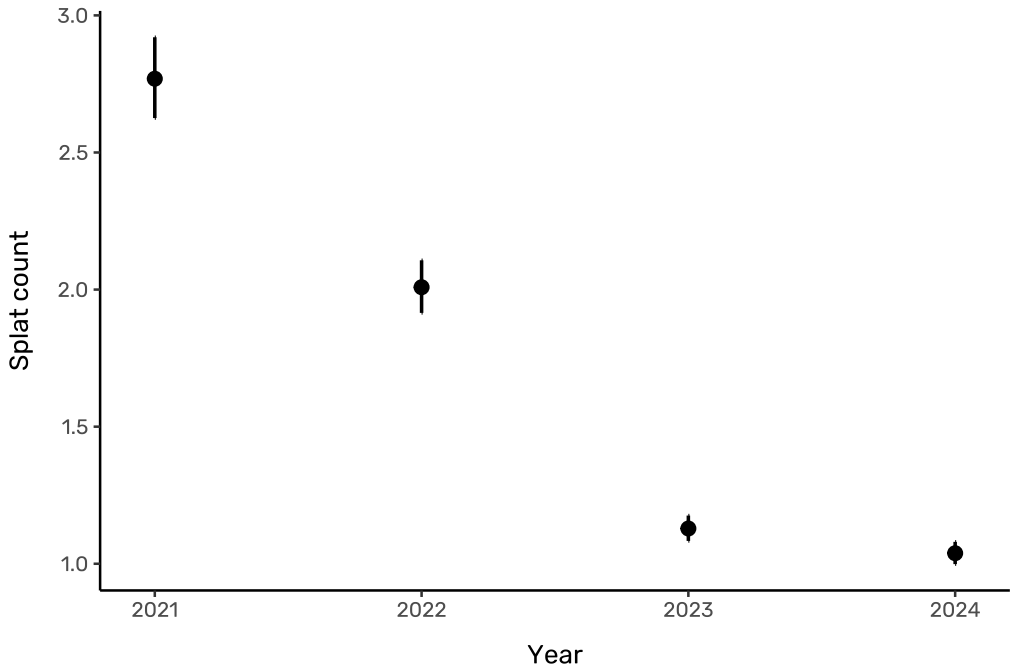
Prior to the analysis, steps were taken to clean the data and remove outliers. Overseas journeys or journeys which included ferry crossings were omitted. Journeys recorded outside the May-September survey period were omitted. Journeys with GPS errors were removed from the dataset. These errors were caused by a drop-out of background tracking due to GPS signal being lost by the device, and they appear as long straight lines between distant locations. Very short (<1 km) or fast journeys (average speed >97 kph), and journeys with over 500 insect splats were removed. Finally, all journeys during which rainfall occurred were omitted from the dataset due to the high chance that rainfall could dislodge insects from number plates.

A negative binomial statistical model was used to examine the relative effects of survey year, time of day of the journey, calendar date of the journey, average journey speed, journey distance, vehicle height, vehicle type, elevation, temperature, and local land cover, on splat count.

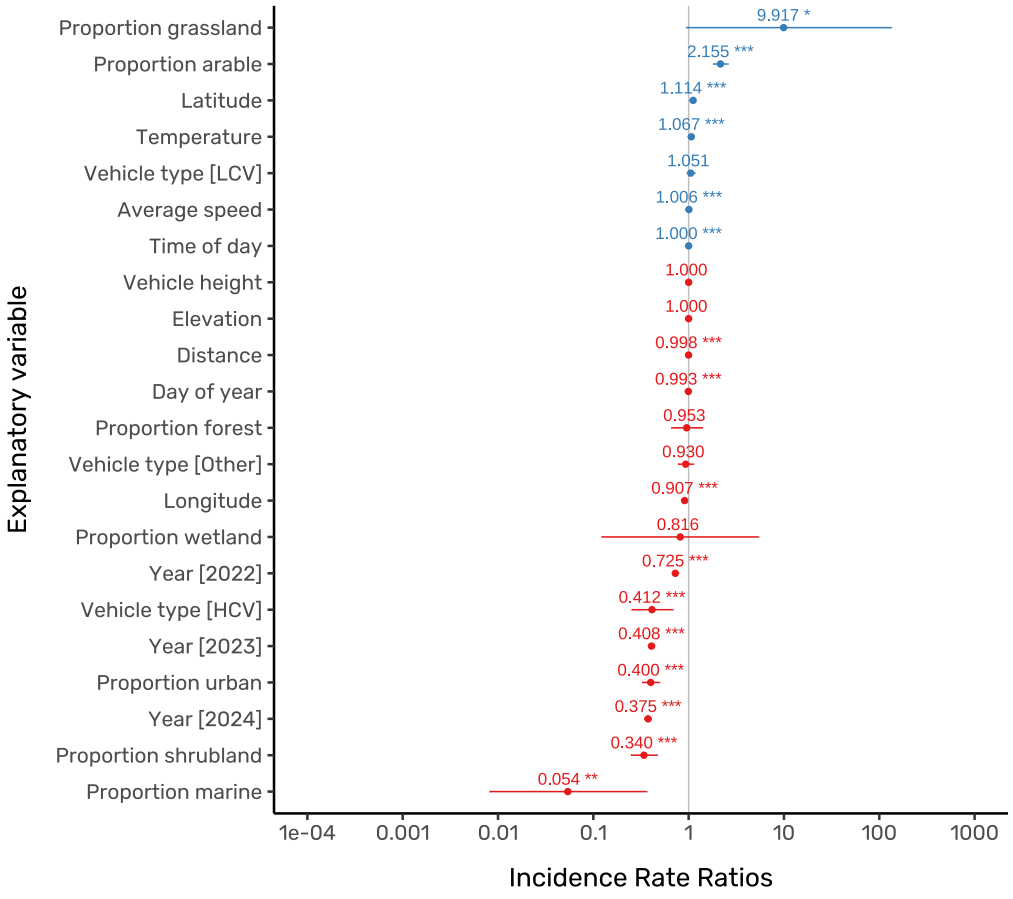
The results found that **the number of insect splats recorded in the UK fell by 62.5% (95% CI [60.0%, 64.9%]) between 2021 and 2024, a rate of -96.2% per decade.** However, the rate appears to have slowed, with an 8.0% decrease between 2023 and 2024 (compared to 27.5% in 2021-2022 and 43.8% in 2022-2023). Its most likely that we are seeing the compounding effects of both a background rate of decline as well as a short-term cycle of decline, perhaps linked to the extreme climate in the UK in recent years. The rate of decline has slowed, and it may even flatten or reverse in 2025.

In England, the number of insect splats fell by 62.0% (95% CI [59.2%, 64.6%]) between 2021 and 2024, in Scotland, by 65.2% (95% CI [54.8%, 73.3%]), in Wales by 64.2% (95% CI [54.5%, 71.9%]), and in Northern Ireland by 55.4% (95% CI [19.8%, 76.0%]) over the same time period.

The results found much higher insect splat rates in the countryside than in urban areas, highlighting the impact we have had on nature in our towns and cities - journeys in urban areas had, on average, 60% fewer bug splats. Splat rates were higher early in the season but also in warmer areas, with a 6.7% increase in bug splats for each 1°C increase in temperature - insects are more active at higher ambient air temperatures. Splat rates were slightly higher on faster journeys but slightly lower on longer journeys, and lorries splatted fewer bugs than cars. The number of bug splats increased with latitude (11.4%/degree) and decreased with longitude (9.3%/degree) – suggesting greater insect numbers in the North and West of the UK.



Predictions of splat count by the Negative Binomial statistical model across year values in the UK.



A forest plot showing the magnitude, direction and statistical significance (* p < 0.05, ** p < 0.01, *** p < 0.001) of the relationships between the variables in the Negative Binomial statistical model and the insect splat rate.

What do the results mean?

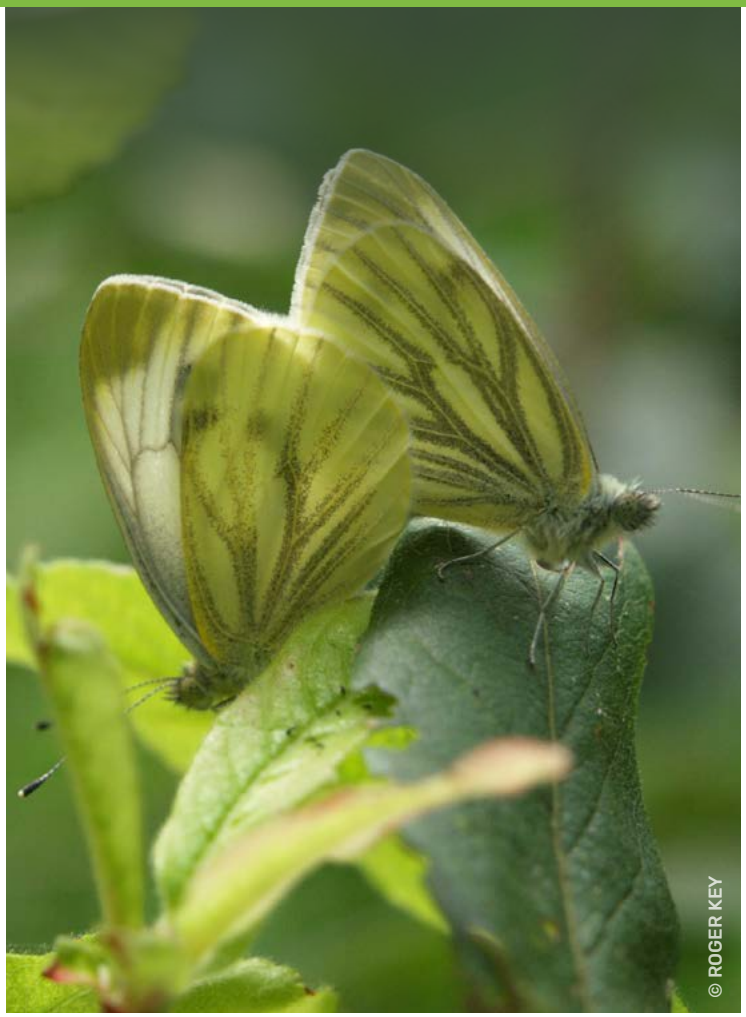
The results of the 2024 Bugs Matter survey are using, for the first time, the data collected only through the Bugs Matter mobile application. In previous years, the data has been compared with a 2004 baseline, which showed a 77.6% reduction in bug splats between 2004 and 2023, a rate of 43.1% per decade. Similar declining insect trends have been reported by many other scientific studies around the world. There are several drivers of insect declines, which act alone or in combination – these include habitat loss and fragmentation, pollution on land and in freshwaters, pesticide and herbicide use, light pollution, and climate change.

So what could be the cause of the rapid and steep decline between 2021-2024? It is possible we are observing the compounding effects of both a long-term background decline in insect numbers as well as a short-term cycle linked to the extreme weather experienced in the UK in 2022 and 2023. Indeed, the fact that 2024 has seen only a marginal drop on the previous year, could indicate the end of a short-term cycle, which would be confirmed by the same or a greater number of bug splats in 2025.

Insect population dynamics and activity are influenced by a range of natural factors that vary inter-annually and across spatial and temporal scales. These factors add noise to longer-term trends in insect abundance, but can be partly controlled for by measuring these factors and including such measurements in statistical models. For instance, the inclusion of mean temperature, land cover type, time of day of the journey, and calendar date of the journey helps to control for inter-annual and spatial differences in temperature, spatial variation in land, vegetation or habitat cover, seasonal variation in insect abundance or activity, and variation in insect abundance throughout the day respectively, all of which may naturally influence insect abundance and activity.

Whilst the aim of the Bugs Matter survey is to quantify long-term trends in insect abundance, the sampling approach can also be considered to measure the activity-density of insects. Thus, it is conceivable that insects are just as abundant between years but are less active. This may explain the results of this survey at shorter timescales, where insect numbers increase with temperature and time of day, not because there are more insects, but because the same number of insects are active in a different way. How the activity-density of insects interacts with roads is also unknown. Insect sampling was restricted to transects along the road network, and therefore the spatial coverage of the survey is inherently limited. It could be increased by including other modes of transport such as buses, coaches, trains, and light aircraft.

In addition to natural factors, properties of the insect sampling approach also add noise to longer-term trends in insect abundance, which again, can be partly controlled for. The vehicle type, vehicle speed, journey distance, and types of roads driven all create sampling bias. By measuring these variables and including them in the models, these effects can be controlled for to obtain more accurate estimates of change in the number of insects sampled between survey years. However, there are other important variables that are not yet included in the models. For example, environmental variables with demonstrated lethal and sub-lethal influence on insect population ecology such as pesticide use, pollution, and climate change could explain a further proportion of the unexplained variation in the data. Our model also lacks data on several other factors that influence insect abundance and activity, such as variation in habitat management, roadside verge management, disease and predation of insects, weather conditions including humidity or wind, and natural variation in insect lifecycles or flight periods.



The Bugs Matter survey is still relatively new. Insect populations and activity fluctuate from year to year for many reasons, so we must treat our results with some caution. However, as we continue to observe annual declines we can be more confident that we are observing a trend. The continued decline in the abundance of flying insects that has been recorded by Bugs Matter is a great concern, it indicates that populations of flying insects are disappearing at an alarming rate. Action must be taken at local, national, and international levels to restore nature at scale and support the recovery of our insect populations.

Kent Wildlife Trust and Buglife administer the Bugs Matter citizen science survey and are extremely grateful to those who have signed up to the app and participated in the survey so far. Bugs Matter has the potential to provide an efficient, standardised and scalable approach to monitor trends in insect abundance locally, regionally, and globally, provide insights on drivers of insect abundance, and indeed track the recovery of insect numbers if we can implement effective conservation policy and practice.

Support the survey

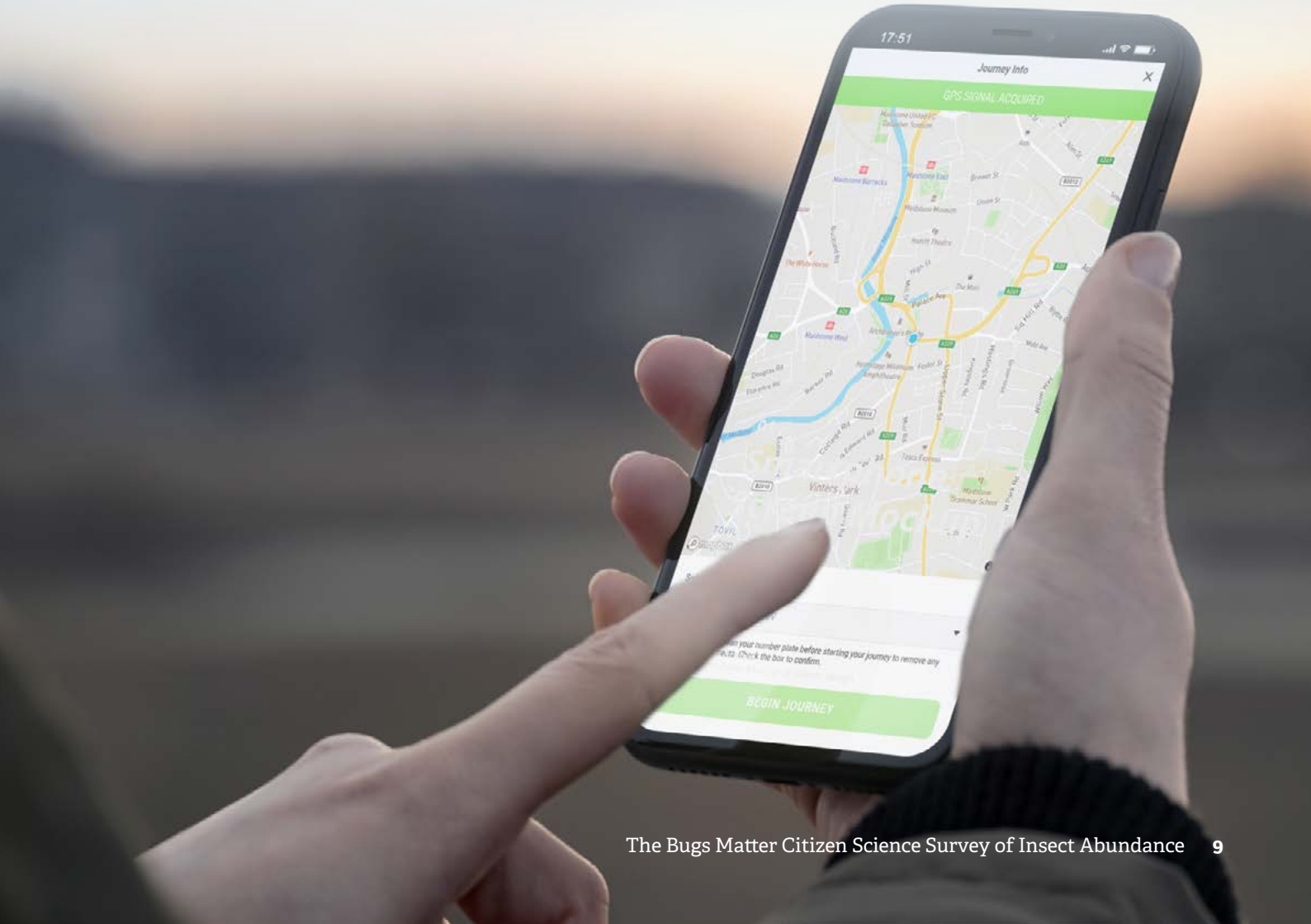
If you would like to support the Bugs Matter survey please visit:

Kent Wildlife Trust
kentwildlifetrust.org.uk/get-involved/our-projects/bugs-matter

Buglife
buglife.org.uk/get-involved/surveys/bugs-matter/

If you would like to partner with Bugs Matter,
please email corporate@kentwildlife.org.uk for further details.

You can also get in touch via info@bugsmatter.app
if you would like to support the project through
technological innovations, partnerships,
or if you have feedback on the survey.



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