



Public and media interest in bed bugs-Europe 2023

Peter Brimblecombe^{a,b,*}, Gabi Mueller^c, Pascal Querner^{d,e}

^a School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK

^b Department of Marine Environment and Engineering, National Sun Yat-Sen University, Kaohsiung 80424, Taiwan

^c City of Zurich, Department of Environment and Public Health, Urban Pest Advisory Service, Eggbühlstrasse 23, CH-8050 Zurich, Switzerland

^d Natural History Museum Vienna, Burgring 7, 1010 Vienna, Austria

^e Institute of Zoology, Department of Integrative Biology and Biodiversity Research, University of Natural Resources and Life Sciences, Vienna (Boku), Gregor-Mendel-Straße 33, 1180 Vienna, Austria

ARTICLE INFO

Keywords:

Cimex lectularius

Paris

Google trends

Infestation

Pest eradication

ABSTRACT

In late summer of 2023 bed bug (*Cimex lectularius*) infestations received much media attention especially from Paris Fashion Week (2023–09–25/2023–10–03). Concern in France has grown in recent years and the public may have been sensitised from the recent release of the report *Les punaises de lit: impacts, prévention et lutte* from the Agence Nationale de Sécurité Sanitaire. Additionally, families returning from summer travel for the start of the school year (2023–09–04) may have brought *Cimex* spp. with them. A belief, typically false, that they are associated with poor housekeeping and the commercial sensitivity of infestations makes quantitative data on the occurrence and frequency of the insects difficult to find. Often it was based on the number of consultations with physicians and enquiries about bed bugs. Our study has used Google search frequency (Google Trends) to assess the growth and spread of public interest. It found that concern over the Paris outbreak spread to neighbouring countries and was an inverse function of distance. Health issues are a popular topic in science journalism and articles with bad news, threat, continuity and geographic proximity helped generate considerable media activity such that the public perceptions of the problem were enhanced and suggests that government agencies need to collect well standardised data on bed bug occurrence. Google Trends proved a sensitive tool to follow the public concern over an insect that invokes considerable dread.

Introduction

Bed bugs (*Cimex* spp.) are a household pest that feed on human blood. *Cimex lectularius* Linnaeus, 1758, the common bed bug and *Cimex hemipterus* Fabricius, 1803, the tropical bed bug, have long been a problem for our society, with discussion of their effects from classical times in *The Clouds* of Aristophanes and Pliny's *Natural History*. The two species occur in Europe and both are closely associated with humans, they are present in homes (usually in the bedrooms), hotels, trains and other public areas, where the animals can feed on human blood. In residential environments, they are often associated with bedrooms occupying habitats close to beds. During daytime they often hide in cracks and spaces in or under the bed, floorboards or in the seams of soft furnishings. The feeding activity results in itchy wounds, skin reactions and lack of sleep. Bed bugs can be transported over long distances in aircraft and trains, often in suitcases or bags with clothes and other textiles. Travel has long been seen as important to their transmission, so

hotels are a frequent habitat and source of animals brought into homes. Additionally, they can be introduced with second hand furniture (McIntyre, 2000). Within an infested building, bed bugs can migrate from one room to another, but this distance is limited (Akhoundi et al., 2015; Booth et al., 2012; Wang et al., 2010), so they need to be carried through external environments. While conditions historically were cold for these insects in England and those in Northern Europe possibly limited their spread from eastern to western Europe (Naylor et al., 2018). However, the problem was already well-described by Southall (1730) and Victor Hugo's mother Sophie Françoise Trébuchet was troubled by them in Spain (Hugo, 1985).

Through the 20th century, while still a matter of public concern (Mertens and Peters, 1938) bed bugs became less troublesome with the improved effectiveness of pesticide sprays based on arsenic, mercury and pyrethrum, though more significantly dichloro-diphenyl-trichloroethane (DDT) from the 1940s. The organo-chloride pesticides changed the approach to control of bed bugs as a single treatment could be very

* Corresponding author.

E-mail address: p.brimblecombe@uea.ac.uk (P. Brimblecombe).

<https://doi.org/10.1016/j.cris.2024.100079>

Received 31 October 2023; Received in revised form 25 March 2024; Accepted 27 March 2024

Available online 2 April 2024

2666-5158/© 2024 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

effective (Romero, 2011). The developing resistance to DDT (Busvine, 1958) and emerging evidence of negative effects on ecosystems, the environment and human health meant that the pesticide fell from favour and many governments curtailed the use of DDT (Chapin and Wasserstrom, 1981). Although *Cimex* spp. developed a resistance to pesticides, infestations continued to decline in the late 20th century (Romero, 2011). However, since the 1990s there has been a resurgence (Delaunay, 2012; Fountain et al., 2014; Jourdain et al., 2016; Saenz et al., 2012) with travel increases and pesticide resistance often seen as a cause (Lewis et al., 2023). Additionally, the tropical bed bug (*Cimex hemipterus* Fabricius, 1803) though infrequent, has been noticed in temperate regions (Balvín et al., 2021; Chebbah et al., 2021; Gapon, 2016).

Despite a lack of evidence that bed bug infestations arise from poor house-keeping and a lack of cleanliness, there is social stigmatisation (Hollin and Giraud, 2022) and shame (Fung et al., 2021) associated with those who have the insect in their homes. However, the association of infestations with low income and socio-economic status (Fung et al., 2021; Ralph et al., 2012; Sutherland et al., 2020) are worrying factors for large cities. For the hotel industry a potential for economic loss (Seidel and Reinhardt, 2013) and large costs for treatment are a big concern when numbers rise. In many countries, bed bugs are not primarily seen as a public health problem, so they are not addressed with great urgency by health authorities. This means that cost of treatment is often borne by the owners of domestic dwellings (Fung et al., 2022; Jourdain et al., 2016) with no official reporting required from pest control companies undertaking treatments.

Surveys suggest also that many people cannot recognise bed bugs (Seidel and Reinhardt, 2013). This is similar to problems with identification of the Tiger mosquito (*Aedes albopictus* Skuse, 1894) in Zurich, which created much public and media interest and led to numerous misidentifications, yet few real Tiger mosquito (*Aedes albopictus*) have been caught (Brimblecombe et al., 2023). In metropolitan France, Jourdain et al. (2016) suggest a general increase of *Cimex* spp., with direct observations or faecal spots and stains as criteria thought sufficient as an indicator for infestations.

There is concern from the medical profession (Ibrahim et al., 2017), despite a lack of evidence that the insects spread disease (Doggett et al., 2012). However, recent studies identified histamine, a component of the bed bug aggregation pheromone, as a potential insect-borne allergen (Gordon et al., 2023; DeVries et al., 2018), and some studies found bed bugs to be hosts for *Trypanosoma cruzi* and *Bartonella quintana* (Hacker et al., 2023). Beyond these risks, the effect of bed bugs on mental health is undisputed (Goddard and de Shazo, 2012; Susser et al., 2012). In many countries (France, Switzerland etc.), the state health authorities have no legislative responsibility, so this falls to municipal bodies or individuals (Jourdain et al., 2016), although this may change in France (Anses, 2023). Regional approaches to control have been successful in some places e.g., New York (Hacker et al., 2023).

It is difficult to get information on the quantitative abundance of bed bugs in buildings. Pest control companies have useful records of treatments (Jones, 2021), although these may derive from public concern about insects other than bed bugs. However, many companies are reluctant to provide details of pesticide applications and their frequency (Brimblecombe et al., 2023). Some of the large pest control companies in the UK have shared a little information from their treatment records (King, 2023), but it can be skewed by their market share, which can change dramatically as they gain or lose big hotel contracts. Most companies are very protective of their data because they see it as commercially sensitive, and the hospitality industry is never very open about the scale of the problem (personal communication: Richard Naylor). There are some informal registries on the internet such as *BadBugs* in France (<https://badbugs.fr>) and the *Bedbug Registry* (<https://bedbugregistry.com/>).

Government and private agencies have sometimes tried to assemble data to assess the extent of the problem in terms of public enquiries, consultations with physicians and extermination activities. A long-term

record is available from Sweden (Fig. 1a) as an outcome of pest control activities (Štefka et al., 2022). In Switzerland (see Fig. 1b), the Urban Pest Advisory Service of the City of Zurich (UPAS) has records of enquiries back to the early 1990s (Brimblecombe et al., 2023). In Germany, a picture (Fig. 1c) of increase in extermination activity is available for 2007/2013 (SRD, 2014) and in France (Fig. 1d) there are surveys from 2017/2022 that reveal the share of the infestations spread across these years (Anses, 2023). In the UK, some local government websites reveal statistics and the *British Pest Control Association (BPCA) Reports* (BPCA, 2016) used the freedom of information regulations to find local authority activities and assemble six years of data for Britain (Fig. 1e).

In recent years a continuing trend of rising public concern has been apparent (Naylor et al., 2018). This has led to an increased focus from government agencies such as ANSES (Agence Nationale de Sécurité Sanitaire) in France (Anses, 2023). Bed bug numbers were already high before the COVID-19 pandemic following growth in recent years (Fig. 1a, b). During the pandemic, pervasive travel restrictions meant fewer hotel guests, so the hospitality industry spent less on pest control treatment. However, bed bugs survive only a few months in the absence of a host. Thus, in centrally heated buildings it is unlikely that any infestations would survive hotel closures of six months or greater linked to COVID-19. Travel has slowly recommenced, but the numbers of reports of them in some locations, such as Zurich and France continued a decline from the pandemic year, 2020 onwards (Fig. 1b,d).

In late September of 2023, *Cimex* spp. infestations became widely discussed as part of *The Great Big Bedbug Outbreak* (BBC, 2023). *Cimex* spp. were especially noticed during Paris Fashion Week (2023–09–25/10–03, dates in this paper follow ISO 8601), which triggered public and media interest that spread well beyond France in October. Worry over their transfer via the Eurostar high-speed rail service (Kelly, 2023) to London and ferries from Marseille to the North African coast (Cobbe, 2023) increased interest.

In this study, we analyse the public interest and examine media coverage in the late summer outbreak of 2023 and relate it to potential changes in the populations of *Cimex* spp. in countries of Western Europe. Our research considers the patterns of change over the previous decade and what might have triggered the intensity of interest that seemed to follow Paris fashion week of 2023. We were particularly interested in the extent to which the stories grew in the media and on the internet rather than seeing this as a major increase in the presence of *Cimex* spp. It also seemed that there might be gaps and a lack of standardisation in the collection of data on bed bugs by government agencies that might easily be exaggerated in journalistic output.

Method

Public interest in *Cimex* spp. was tracked using *Google Trends* (trends.google.com), which analyses the popularity of top search queries in Google Search across various regions and languages. *Google Trends* gives a normalised output such that the maximum number of searches in a given period is 100. This search volume has been used in medical science to assess the frequency of searches for a given topic e.g., Walker (2018) used *Google Trends* to determine the seasonal patterns in tick-borne encephalitis in Germany, but found that it was hard to establish a relationship between case numbers and searches. Here, we used the website to assess the relative volume of searches for a given search-term or topic. The search terms in different places are linguistically specific (e.g., Punaise de lit, Chinchés de cama, Bettwanze etc.), so often we used topic searches, which aggregated different terms under the topic “bed bug”.

The tool can be tuned to a country, but also administrative regions (*Régions*) and even finer scales such as communes, so it is possible to generate maps of the level of search activity across geographic regions. The search volume is available from 2004, although there have been some changes to geographical assignment (in 2011) and data collection

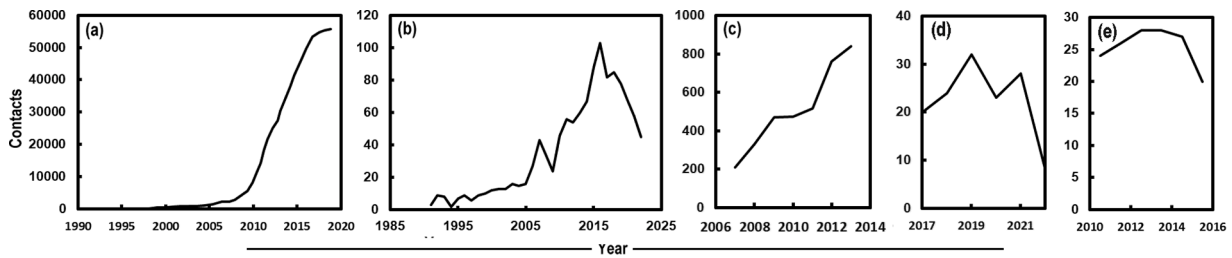


Fig. 1. The public contacts or queries about bed bugs with pest control groups each year in (a) Sweden (b) Zurich (c) Germany and (d) France as a percentage share in of the reported infestations in surveys across the years. (e) Inspections in the UK, where the units are contacts per 100 000 population.

was improved in 2016 and 2022, so care may be required in comparing searches across these time thresholds. There are concerns that requests made at different times can return different results (Behnen et al., 2020), so we repeated downloads on different days. Interest across different geographic subregions can be compared, again calculated on a scale from 0 to 100, but here the popularity of the search term or topic is normalised to the total search volume for the location.

A range of official sources of quantitative data related to treatments and consultations were available from France, Switzerland, Germany and the UK, but the collection methods varied widely, so were as trends rather than absolute values. Although they covered a range of years, they also lacked currency. Some assessments made by pest control companies were available for 2023–09 (September 2023), but tended to be semi-quantitative. Consultations and insect records are necessarily integer values, and often small, which makes nonparametric statistics an appropriate choice. The correlation between Google search volume and time was initially determined using the Kendall rank correlation coefficient, τ . This is similar to the Pearson correlation coefficient r , but as a non-parametric test it is less sensitive to outliers. Exponential fits to determine half-lives of public interest used the online curve and surface fitting routines (<http://findcurves.com>).

Results and discussion

Google searches for “bed bugs” might not necessarily match the frequency of occurrence of *Cimex* spp.. Fig. 2a shows the annual incidence of general practice bed bug consultations related to by region for the period 2019–04–01/2020–03–31 and suggests elevated rates of consultation in the east of France. However, this data could be biased as

it might be affected by areas where there are fewer doctors. Nevertheless, there is a satisfying correspondence between consultations and the normalised Google search activity for the topic “bed bug” across the same period (Fig. 2b). Elevated levels of activity in the east are again evident.

Temporal change

The general view that *Cimex* spp. have increased in recent years is supported by the growing number of Google searches for the topic “bed bug” made in France 2013/2022 (Fig. 3a). Naturally most of these searches would not typically use the English term bed bug or as the scientific name. The search term “punaise de lit” accounts for 60 % of the topic searches and shows good agreement (Kendal $\tau = 0.96, p < 0.0001$) between the terms which show similar seasonality and a positive trend with time with the topic term ($p < .0001$). The annual cycles in insect catch and indoor observations are typically driven by an expansion of activity in the warmer season (Brimblecombe and Querner, 2023), and in the case of bed bugs through heightened awareness and observations after summer travel (Brimblecombe et al., 2023). It shows a five-fold increase in web-based interest over the years, in line with Nicolas Roux de Bézieux’s (creator and manager of the platform Badbugs.fr) claim that what “we see here in France is a doubling every five years” (Schofield, 2023). It parallels the rising concern within French Agencies that examine the issue (e.g., Anses, 2023). It is also reflected in the media with headlines such as “Les punaises de lit se répandent partout en France depuis deux ans...” i.e. bed bugs have been spreading everywhere in France for two years (Maligorne, 2023). The trend in Google searches over time is not necessarily true for other countries of

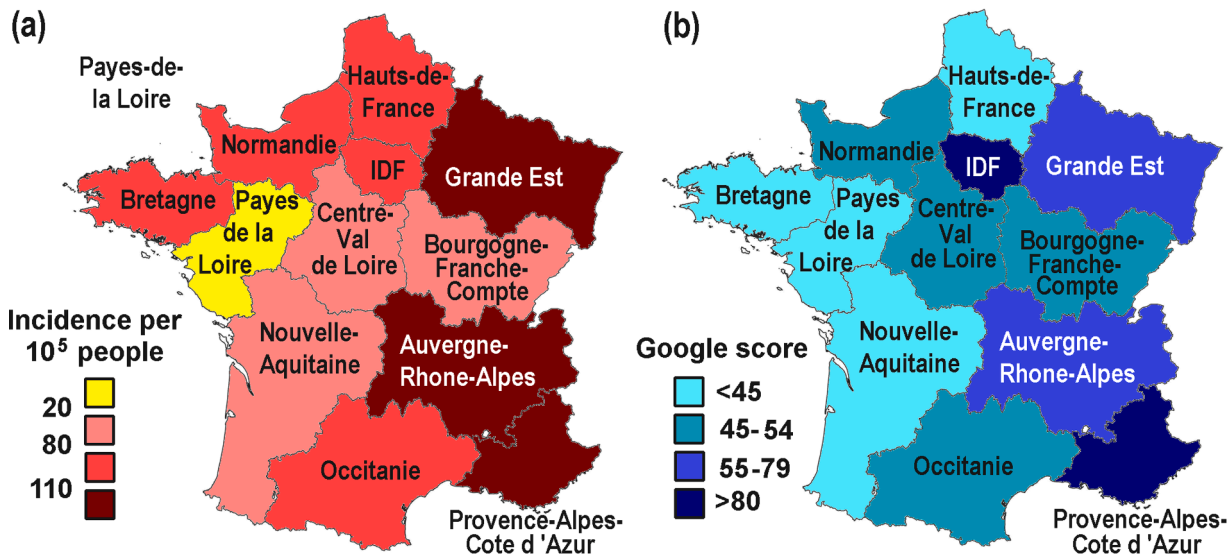


Fig. 2. (a) The annual incidence of general practice consultations related to bed bugs for the period 2019–04–01/2020–03–31 (Ministere de la Sante) and (b) normalised Google search for the same period in *Régions* of France (Administrative Regions).

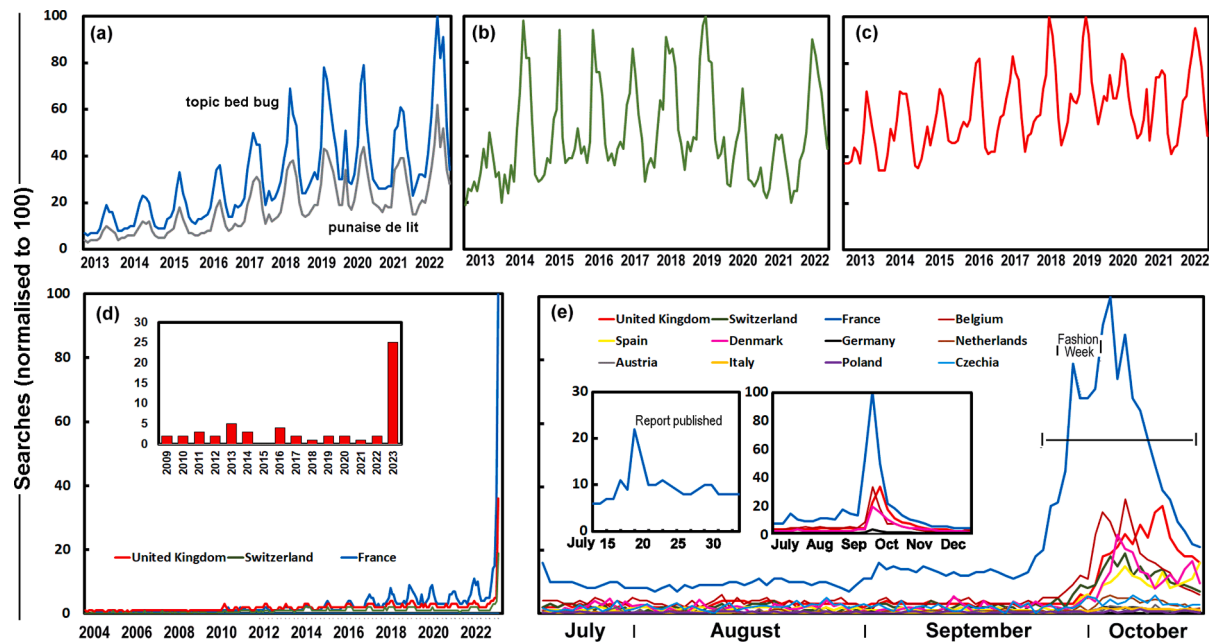


Fig. 3. Google searches for the topic “bed bug” 2013/2022 in (a) France, with the faint grey line denoting searches with the term “punaise de lit”, (b) Switzerland and (c) UK. (d) The long-term change in Google searches for the topic “bed bug” 2004–01/2023–10 for France, Switzerland and UK. Inset shows the number of programmes and news items about bed bugs on the BBC website 2008–01/2023–10. (e) Google searches for the topic “bed bug” 2023–07–27/10–16 for some European countries. The horizontal indicator marks the 20-day period 2023–09–26/10–15 used in Section 3.2 on intercity transfer. The left inset shows searches in France for the topic “bed bug” 2023–07–13/08–03. The right inset shows the topic searches for countries with larger bed bug search volume (Belgium, Denmark, France, Germany and the UK) over the extended period 2023–07/2023–12.

Europe. In the case of Switzerland (Fig. 3b) there is only a slight increase over time, which is not significant ($p \sim 0.091$), but this may be because public interest in Zurich faded after a set of campaigns that started in 2011 and were completed in 2016 (Brimblecombe et al., 2023). There was a further campaign in 2022, which may explain the slight increase in Google searches for that year. In the UK there is a weaker, though significant ($p < .0001$) positive trend with time.

Fig. 3d shows the recent very substantial spike in Google topic searches in France, Switzerland and the UK, where the increase in recent months totally dominates the record 2004–01/2023–10. The dominance of 2023 is also evident in the number of articles and programs on the BBC website shown in the inset.

The spike in 2023 is shown in greater detail over the 90 days (2023–07–27/10–16) for a larger number of countries in Fig. 3e. Media stories in France were prevalent in the summer (e.g., articles in *Le Monde*, 2023–07–15, 2023–07–19 and 2023–07–20). Particularly important was the publication of the report *Les punaises de lit: impacts, prévention et lutte* (Anses, 2023) on 2023–07–19, which led to some increase in internet searches as shown in the left inset to Fig. 3e. Schools reopened in France on 2023–09–04 and we see an increase in searches (Fig. 3e from the weekend that preceded this, which might be the product of families concerned they had brought *Cimex* spp. back in their luggage used for summer travel. However, the number of searches increased more dramatically in late September and early October, in line with intense media interest (e.g., Cobb, 2023; Kelly, 2023). Interest in the UK was delayed until October (red line in Fig. 3e), which was paralleled by 20 mentions on the BBC website that month. The right inset of Fig. 3e shows the topic searches for countries with larger bed bug search volume (Belgium, Denmark, France, Germany and the UK) over a more extended period (2023–07/2023–12) revealing a return to the normal search volume.

The public can be caught up in the media frenzy, so accuracy of identification may be poor or there is simply a casual interest in the topic and in the end many of the recent sightings have proven false. Nicolas Roux de Bézieux, says in three out of four calls he gets from concerned

homeowners, the problems turn out not to have been caused by bedbugs (Schofield, 2023). The intensity of interest has been examined by comparing the frequency of Google searches for bed bugs with the searches for eradication of the pest, which is likely to be undertaken by those who are concerned that they are experiencing an outbreak rather than just taking an interest in the emerging problem. This is a little difficult as there are far fewer searches for treatments and extermination than for bed bugs in general. In France we used the search terms “punaise de lit” and “traitement punaise de lit”, the latter occurring as less than 2 % of the frequency of the more general search term during the 30-days 09–15/09–14.

Fig. 4a shows the changes in searches for “punaise de lit” and “traitement punaise de lit” (both normalised to a maximum of 100) over the 60-day period 2023–08–26/10–25. It is evident that the searches for “traitement punaise de lit” decay from their maximum more rapidly ($r^2 = 0.75$; initial half-life ~ 1 day) compared with “punaise de lit” ($r^2 = 0.98$; half-life ~ 5 days). Thus, interest in treatments was small and did not persist very long. However, the modern internet news cycle is very short; for an individual internet article perhaps just hours (Castillo et al., 2014), but such persistent interest is relatively lengthy. The situation in the UK was more difficult to resolve, but the general interest in bed bugs persisted for around 5 days, although interest in extermination was lower and harder to resolve because of a noisy signal (Fig. 4b).

Intercity transfer

The potential for transmission of the *Cimex* spp. and stories about them among locations in Europe is likely to be driven by transport and communication networks. Here we adopt the notion of demographic gravitation to assess the potential for exchange of social discourse. Such classic gravitational approaches are used to treat transfer between geographic locations (Stewart, 1948) and in more recent times have been applied to rail and air traffic (Grosche et al., 2007). Assuming transfer is related to metropolitan areas of capital cities, which are a key location for such discourse e.g., Île-de-France shows the largest internet

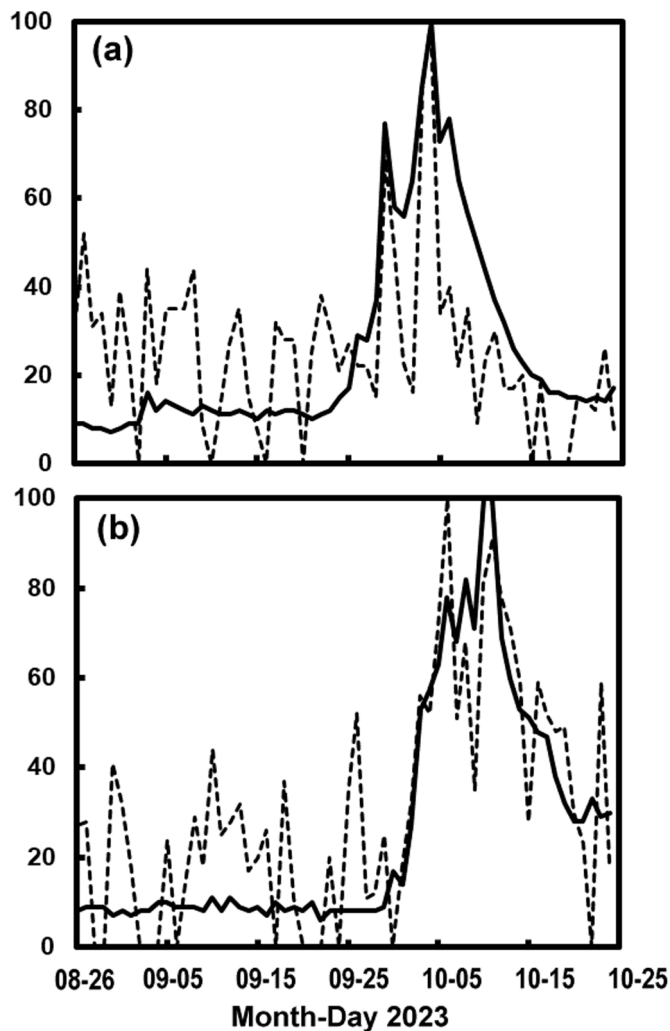


Fig. 4. (a) The average Google Trends score for the search term “punaise de lit” (solid line) and “traitement punaise de lit” (dotted line) in France for the 60-day period 2023–08–26/10–25. (b) The average Google Trends score for the search topic “bed bug” (solid line) and “bed bug extermination” (dotted line) in the UK for the same 60-day period.

interest in bed bugs of any region in France. We calculate the transmission to other cities (i) from the formula: $P_{\text{PARIS}}P_i/(d_{\text{PARIS},i})^2$ where P is the population of the metropolitan areas, and d the distance from Paris to the cities (by air). Fig. 5 shows the average Google Trends score for the topic “bed bugs” for the 20-day period 2023–09–26/10–15 which corresponds with a period of public interest. These have been ordered in terms of the gravitational potential for transmission. Closer and populous cities show a greater potential for the transfer of discourse about the bed bug infestation in Paris; the trend is significant ($p \sim .016$) with the Kendall rank correlation coefficient $\tau = 0.67$.

Understandably searches for bed bugs after the concern in Paris arose first in France. Although the increase started a day or two before the Paris Fashion Week (2023–09–25/10–03). Searches in France peaked 2023–10–04 and more regionally in Île-de-France on 2023–10–03. Belgium peaked 2023–10–03 Switzerland 2023–10–06 and the UK this was not until 2023–10–11, almost as though the transfer took time to cross the English Channel or the language barrier.

Recent need for treatment

The sections above offer a reasonably convincing view of the intense public interest and media attention in September and October of 2023,

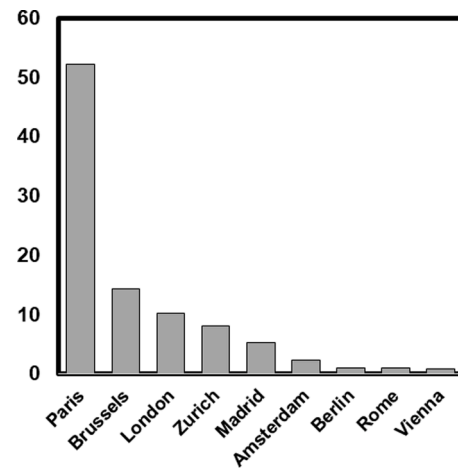


Fig. 5. The average Google Trends score for the topic “bed bugs” for the 20-day period 2023–09–26/2023–10–15 arranged in order of the strength of demographic gravitation.

but suggest that concern over eradication was lower and perhaps more fleeting. There was a risk that this situation had simply been overblown in news reports (Bachelor, 2023). However, the social perceptions can be compared with the activities of pest control companies, whose expertise means that they are able to properly identify the *Cimex* spp. and make a realistic assessment of the presence of an infestation. In the UK, Rentokil pest control company revealed a 65 % increase year-on-year in bed bug infestations, comparing the second quarter of 2022 with that of 2023 (King, 2023). This suggests that the increase in the UK treatments predated the concerns in Paris. Imaging of bugs in Paris and London by Spotta Ltd, which can identify the insects remotely, suggested to them that increased travel after COVID-19 made 2023 a year when they were abundant (Shaw, 2024). In Luton, a town 50 km north-west of London, a smaller increase was noted. Local authorities received 86 calls relating to *Cimex* spp. For the year 2022–10/2023–09, compared to 81 in the previous year (2021–10/2022–09). There were 15 calls in September 2023 compared to 12 in September 2022 (Fullbrook, 2023). In October, Leicestershire AZK Pest Control, saw their weekly call-out triple (Patel, 2023). Rentokil in Belgium suggested that bed bug cases were up by 30 % this summer as compared with 2022, and they were being found more widely in private homes as well as in hotels, nursing homes and prisons (Vivian, 2023). In Germany, there has been a 93 % increase in effort at control from 2019 through to the beginning of October 2023. In a single week (2023–10–09/10–15), there were three cases among travellers returning from France (personal communication: Marco Müller), while such occurrences were noticeable, they are hardly statistically significant and seem to hint at longer term change post COVID-19, rather than the late summer crisis.

Media influence

There was much concern that the presence of bed bugs in Paris late summer of 2023 was exaggerated: “Freaked-out fashionistas in town then started documenting their concerns on social media,” which led to a growing panic among both Parisians and travellers. French Health Minister Aurélien Rousseau pleaded with the public to remain calm, saying there was “no reason for general panic” (Bachelor, 2023) and that “France has not been invaded by bedbugs” (Bachelor, 2023)

The media stories about bed bugs had many elements that make good news. As newspaper journalist Hetherington (1985) wrote: “... anything which threatens people’s peace, prosperity and well-being is news and likely to make headlines”. There is an enormous body of research on what makes particular topics newsworthy (Harcup and O’Neill, 2017). In science journalism health issues rank high as a “best selling topic”.

However, a usability factor is also important in medical and technical stories; they are particularly popular if they offer advice for daily life. Articles about bed bugs often achieved a level of familiarity and usefulness by giving advice to travellers or suggesting the responses possible to those who found the unwarranted guests. A sense of threat, risk or negative consequences (i.e., bad news) also make a story newsworthy (Badenschier and Wormer, 2011), and in France there was worry that reported infestations might affect the Paris Olympic Games planned for 2024 (Schofield, 2023). Recently there have been suggestions the bed bug story was a deliberate misinformation campaign that resulted from a pro-Ukrainian position widely adopted in Europe (Conzett, 2024; Davis, 2023).

Follow-up of stories about subjects already in the news is another important driver of newsworthiness (Harcup and O'Neill, 2017). Such continuity allows news to gain momentum. The earlier articles published about the release of the Anses Report (2023) in France, provided information and context that made the emerging story of Parisian infestations more accessible to readers. Geographical proximity is a further driver of news value (Badenschier and Wormer, 2011), so it was particularly significant to see that interest rose in adjacent countries with convenient communication with France notably England, with its Eurostar connection, but also Morocco and Algeria with ferry links to Marseille, and a familiarity with the French language. Google searches on the topic bed bug peaked in both the North African countries around 2023–10–03 at levels of interest almost identical to that of France.

A number of observers realised that the magnitude of the infestations in Paris were potentially exaggerated, but a media frenzy ensured the story spread to other countries. Transport Minister Clément Beaune said on Wednesday (2023–10–04) that of nearly 50 reported sightings of bed bugs on metro and SNCF trains, not one had been verified (Schofield, 2023). Misidentification of insects by the public is common and especially prevalent when news stories and awareness campaigns heighten concern (Brimblecombe et al., 2023); at times people even mistake seeds for bed bugs. Improved detection and accurate identification is possible with a range of new methods (Akhoundi et al., 2023; Crawley and Borden, 2021; Naylor et al., 2020) that may help in future.

While pest control companies (e.g., in the UK and Germany) in recent years report an increase in eradication effort, this is a long-term change that has little of the drama seen in the public concern in Paris and beyond. The media hype spread the story internationally, even to far-away locations where *Cimex* spp. are a familiar problem, such that in Hong Kong and Singapore a strong internet interest peaked in the first week of October. Although some records from France and Switzerland would hint that public reporting of *Cimex* spp. have declined over recent years (Fig. 1), it should not diminish the reality of the issue; in France 10 % of households feel that they have experienced a bed bug problem 2017/2022 (Anses, 2023).

Conclusion

This study indicates the value of Google Trends in tracking public interest in *Cimex* spp.. The spatial distribution of consultations about bed bugs in France shows similarities with the distribution of Google searches, suggesting searches as a relevant metric for assessing public concern about bed bugs. The temporal profiles of the searches reveal evidence of interest in the publication of a key reports and the return from holidays. However, the biggest impact arose after *Cimex* spp. were found during Paris Fashion Week. Here widening interest from the international media drove strong concern about these bugs so feared by the public; an interest that seems to have grown more rapidly than the insect populations. The internet may be an especially valued source of information as it has an anonymity, so it provides a confidential source in the case of insects that might be negatively viewed by one's friends and associates.

In recent decades, even though control is not centralised in many countries, government agencies have been increasingly concerned about

infestations in crowded housing and other centres of potential risk, such as cinemas, hospitals and barracks. Major cities often reflect wide ranges of economic prosperity, with both rich and poor areas. Crowded accommodation can provide places of standing populations of *Cimex* spp. and public transport facilitate transmission across the urban landscape.

Despite a sense of media hype, *Cimex* spp. remain a significant problem, which has been hard to track, because of the difficulty of collecting data when pest control companies and the hospitality industry can be reluctant to give statistics on the extent of the problem. Bed bugs are very much an issue for urban governance, with control so often at a local rather than national level. However, government agencies need to address the issue and improve the collection of data on bed bug presence and treatments. In the absence of good and standardised data a factual vacuum allows media exploitation that may promote a sense of crisis.

CRedit authorship contribution statement

Peter Brimblecombe: Conceptualization, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **Gabi Mueller:** Writing – review & editing. **Pascal Querner:** Funding acquisition, Writing – review & editing.

Declaration of competing interest

The authors have no competing interests.

Data availability

The data used available at <https://zenodo.org/records/10845986>.

Funding

This work was supported by the Austrian Academy of Sciences; grant number: Heritage_2020- 043_Modeling-Museum.

Acknowledgements

Thanks to Marco Müller, managing director of GROLI Schädling-bekämpfung GmbH and Richard Naylor, Director Entomologist, Research and Development, Cimex Store Ltd for providing data and guidance.

References

- Akhoundi, M., Kengne, P., Cannet, A., Brengues, C., Berenger, J.M., Izri, A., Marty, P., Simard, F., Fontenille, D., Delaunay, P., 2015. Spatial genetic structure and restricted gene flow in bed bugs (*Cimex lectularius*) populations in France. *Infect. Genet. Evol.* 34, 236–243.
- Akhoundi, M., Chebbah, D., Elissa, N., Brun, S., Jan, J., Lacaze, I., Izri, A., 2023. Volatile organic compounds: a promising tool for bed bug detection. *Int. J. Environ. Res. Public Health* 20, 5214.
- Anses, 2023. Avis 17entokil aux punaises de lit: impacts, 17entokil17n et 17ent (saisine n° 2021- SA-0147) Anses, Maisons-Alfort, Paris.
- Bachelor, B., 2023. What You Need to Know About Europe's Bed Bug Panic. CNN Travel October 14 2023. <https://www.cnn.com/travel/what-you-need-to-know-about-europes-bedbug-panic-wellness/index.html>.
- Badenschier, F., Wormer, H., 2011. Issue selection in science journalism: towards a special theory of news values for science news? *The Sciences' Media Connection—Public Communication and Its Repercussions*. Springer Netherlands, Dordrecht, pp. 59–85.
- Balvín, O., Sasínková, M., Martinů, J., Nazarizadeh, M., Bubová, T., Booth, W., Vargo, E. L., Stefka, J., 2021. Early evidence of establishment of the tropical bedbug (*Cimex hemipterus*) in Central Europe. *Med. Vet. Entomol.* 35, 462–467.
- BBC, 2023. Stories of Our Times, The Great Big Bedbug Outbreak: Real or Hype? <https://www.bbc.co.uk/sounds/play/p0gm6vvy>.
- Behnen, P., Kessler, R., Kruse, F., Gómez, J.M., Schoenmakers, J., Zerr, S., 2020. Experimental evaluation of scale, and patterns of systematic inconsistencies in google trends data. In: ECML PKDD 2020 Workshops: Workshops of the European Conference on Machine Learning and Knowledge Discovery in Databases (ECML PKDD 2020): SoGood 2020, PDFL 2020, MLCS 2020, NFMCP 2020, DINA 2020,

- EDML 2020, XKDD 2020 and INRA 2020. Springer International Publishing, Ghent, Belgium, pp. 374–384. September 14–18, 2020, Proceedings.
- Booth, W., Saenz, V.L., Santangelo, R.G., Wang, C., Schal, C., Vargo, E.L., 2012. Molecular markers reveal infestation dynamics of the bed bug (*Hemiptera: cimicidae*) within apartment buildings. *J. Med. Entomol.* 49 (3), 535–546.
- Brimblecombe, P., Querner, P., 2023. Changing insect catch in Viennese museums during COVID-19. *Heritage* 6, 2809–2821.
- Brimblecombe, P., Müller, G., Schmidt, M., Tischhauser, W., Landau, I., Querner, P., 2023. Urban pest abundance and public enquiries in Zurich 1991–2022. *Insects* 14, 798.
- Busvine, 1958. Insecticide-resistance in bed-bugs. *Bull. World Health Organ.* 19 (6), 1041.
- Castillo, C., El-Haddad, M., Pfeffer, J., Stempeck, M., 2014. Characterizing the life cycle of online news stories using social media reactions. In: Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing, pp. 211–223.
- Chapin, G., Wasserstrom, R., 1981. Agricultural production and malaria resurgence in Central America and India. *Nature* 293, 181–185.
- Chebbah, D., Elissa, N., Sereno, D., Hamarsheh, O., Marteau, A., Jan, J., Izri, A., Akhouni, M., 2021. Bed bugs (*Hemiptera: Cimicidae*) population diversity and first record of *Cimex hemipterus* in Paris. *Insects* 12, 578.
- Cobbe, E., 2023. Paris is Crawling with Bedbugs. They're evEn Riding the Trains and a Ferry. <https://www.cbsnews.com/news/paris-bedbugs-france-infestation-hotels-homes-even-trains/> (Last Accessed 28 October 2023).
- Conzett, N., 2024. Erinnerst du Dich an die PARISER Bettwanzenplage? Rate Mal, Wer Dahintersteckt. *Watson CH* (14.03.2024). <https://www.watson.ch/international/fr-ankei/742521289-bettwanzen-in-paris-steckt-propaganda-aus-russland-dahinter> (Last Accessed 20 March 2024).
- Crawley, S.E., Borden, J.H., 2021. Detection and monitoring of bed bugs (*Hemiptera: cimicidae*): review of the underlying science, existing products and future prospects. *Pest Manag. Sci.* 77, 5334–5346.
- Davis, B., 2023. Bedbug panic 'could have been spread by Russia' French intelligence suggests. *Independent*. <https://www.independent.co.uk/news/world/europe/bedbugs-paris-france-russia-outbreak-b2434487.html> (Last Accessed 20 March 2024).
- Delaunay, P., 2012. Human travel and travelling bedbugs. *J. Travel. Med.* 19, 373–379.
- DeVries, Z.C., Santangelo, R.G., Barbarin, A.M., Schal, C., 2018. Histamine as an emergent indoor contaminant: accumulation and persistence in bed bug infested homes. *PLoS ONE* 13 (2), e0192462. <https://doi.org/10.1371/journal.pone.0192462>.
- Doggett, S.L., Dwyer, D.E., Penas, P.F., Russell, R.C., 2012. Bed bugs: clinical relevance and control options. *Clin. Microbiol. Rev.* 25, 164–192.
- Fountain, T., Duvaux, L., Horsburgh, G., Reinhardt, K., Butlin, R.K., 2014. Human-facilitated metapopulation dynamics in an emerging pest species, *Cimex lectularius*. *Mol. Ecol.* 23, 1071–1084.
- Fullbrook, D., 2023. Bedbugs: Luton Council deals with 86 bedbug incidents in a year <https://www.bbc.com/news/uk-england-beds-bucks-herts-67055275> Last accessed 2023-10-28.
- Fung, E.H.C., Wong, H., Chiu, S.W., Hui, J.H.L., Lam, H.M., Chung, R.Y.N., Wong, S.Y.S., Chan, S.M., 2021. Risk factors associated with bedbug (*Cimex* spp.) infestations among Hong Kong households: a cross-sectional study. *J. Hous. Built Environ.* 1–19.
- Gapon, D.A., 2016. First records of the tropical bed bug *Cimex hemipterus* (*Heteroptera: Cimicidae*) from Russia. *Zoosyst. Rossica* 25, 239–242.
- Goddard, J., de Shazzo, R., 2012. Psychological effects of bed bug attacks (*Cimex lectularius* L.). *Am. J. Med.* 125, 101–103.
- Gordon, J.M., Santangelo, R.G., González-Morales, M.A., Menechella, M., Schal, C., DeVries, Z.C., 2023. Spatial distribution of histamine in bed bug-infested homes. *Sci. Total Environ.* 880.
- Grosche, T., Rothlauf, F., Heinzl, A., 2007. Gravity models for airline passenger volume estimation. *J. Air. Transp. Manage* 13, 175–183.
- Hacker, K.P., Greenlee, A.J., Hill, A.L., Schneider, D., Levy, M.Z., 2023. Spatiotemporal trends in bed bug metrics: New York City. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0268798>.
- Harcup, T., O'Neill, D., 2017. What is News? News Values Revisited (Again). *Journal. Stud.* 18, 1470–1488.
- Hetherington, A., 1985. News, Newspapers and Television. Macmillan, London, p. 40.
- Hollin, G.J., Giraud, E.H., 2022. Estranged companions: bed bugs, biologies, and effective histories. *Environ. Plann. D* 40, 80–98.
- Hugo, A., 1985. Victor Hugo Raconte Par Adele Higo. Plon, Paris.
- Ibrahim, O., Syed, U.M., Tomecki, K.J., 2017. Bedbugs: helping your patient through an infestation. *Cleve. Clin. J. Med.* 84, 207–211.
- Jones, S.C., 2021. Magnitude and Spread of Bed Bugs (*Cimex lectularius*) throughout Ohio (USA) Revealed by Surveys of Pest Management Industry. *Insects* 12 (2), 133.
- Jourdain, F., Delaunay, P., Béranger, J.M., Perrin, Y., Robert, V., 2016. The common bed bug (*Cimex lectularius*) in metropolitan France. Survey on the attitudes and practices of private-and public-sector professionals. *Parasite* 23.
- Kelly, J.W., 2023. Bedbugs: Eurostar Introduces Preventative Measures Amid Paris Infestation. <https://www.bbc.com/news/uk-england-london-67007392> (last Accessed 28 October 2023).
- King, S., 2023. Rentokil warns of potential surge in bed bug infestations as the summer holidays begin. *Pest Magazine*, 18 July 2023. <https://www.pestmagazine.co.uk/news/entokil-warns-of-potential-surge-in-bed-bug-infestations-as-the-summer-holidays-begin.html>.
- Lewis, C.D., Levine, B.A., Schal, C., Vargo, E.L., Booth, W., 2023. Decade long upsurge in mutations associated with pyrethroid resistance in bed bug populations in the USA. *J. Pest. Sci.* 96, 415–423.
- Maligorne, C., 2023. Les punaises de lit se répandent partout en France depuis deux ans, voici la raison, L'édition du soir (13 septembre 2023) <https://www.ouest-france.fr/leditiondusoir/2023-09-13/les-punaises-de-lit-se-repandent-partout-en-france-depuis-deux-ans-voici-la-raison-4b654a61-7a94-4a5f-9957-bb52ed633af4>.
- McIntyre, N.E., 2000. Ecology of urban arthropods: a review and a call to action. *Ann. Entomol. Soc. Am.* 93, 825–835.
- Mertens, H., Peters, G., 1938. Die Wanze Unterwegs. Berlin Hygiene Verlag Deleiter.
- Naylor, R., Balvín, O., Delaunay, P., Akhouni, M., 2018. The bed bug resurgence in Europe and Russia. *Adv. Biol. Manag. Modern Bed Bugs* 59–68.
- Naylor, R., Jones, P., Naylor, A., Sampson, C., 2020. Remote monitoring for bed bugs. *Int. Pest Control* 62, 324–327.
- Patel, A., 2023. Bed Bugs are a 'Bigger Problem Than Anticipated' says Leicestershire Pest Expert, Leicestershire Live. <https://www.msn.com/en-gb/lifestyle/home-and-garden/bed-bugs-are-a-bigger-problem-than-anticipated-says-leicestershire-pest-expert/ar-AA1j1Dpt> (last Accessed 30 October 2023).
- Ralph, N., Jones, H.E., Thorpe, L.E., 2012. Self-reported bed bug infestation among New York City residents: prevalence and risk factors. *J. Environ. Health* 76, 38–45.
- Romero, A., 2011. Moving from the old to the new: insecticide research on bed bugs since the resurgence. *Insects* 2, 210–217.
- Saenz, V.L., Booth, W., Schal, C., Vargo, E.L., 2012. Genetic analysis of bed bug populations reveals small propagule size within individual infestations but high genetic diversity across infestations from the eastern United States. *J. Med. Entomol.* 49 (4), 865–875.
- Shaw, D., 2024. The business of bed bugs. *Business Daily BBC*. [https://www.bbc.co.uk/sounds/play/w3ct4n08?xtor=ES-211-\[68813_PANUK_DIV_04_SND_EditorialVitaminDBedbugsRevisited_RET_DEF\]-20240125-](https://www.bbc.co.uk/sounds/play/w3ct4n08?xtor=ES-211-[68813_PANUK_DIV_04_SND_EditorialVitaminDBedbugsRevisited_RET_DEF]-20240125-).
- Schofield, H., 2023. France Bedbug Panic: Officials Respond as Paris school infested. <https://www.bbc.com/news/world-europe-67027138> (last Accessed 20 October 2023).
- Seidel, C., Reinhardt, K., 2013. Bugging forecast: unknown, disliked, occasionally intimate. Bed bugs in Germany meet unprepared people. *PLoS ONE* 8, e51083. <https://doi.org/10.1371/journal.pone.0051083>.
- Southall, J., 1730. A Treatise of Bugs. John Roberts Oxford.
- SRD, 2014. Anzahl Der Einsätze von Kammerjägern zur Bekämpfung von Bettwanzen in Berlin in Den Jahren Von 2007 Bis 2013. Statista Research Department, 11.02.2014. <https://de.statista.com/statistik/daten/studie/287919/umfrage/einsaetze-von-kammerjaegern-zur-bekaempfung-von-bettwanzen-in-berlin-seit-2007/>.
- Štefka, J., Votýpka, J., Lukeš, J., Balvín, O., 2022. *Cimex lectularius* and *Cimex hemipterus* (bed bugs). *Trends Parasitol.* 38, 919–920.
- Stewart, J.Q., 1948. Demographic gravitation: evidence and applications. *Sociometry* 11 (1/2), 31–58.
- Susser, S.R., Perron, S., Fournier, M., Jacques, L., Denis, G., Tessier, F., Roberge, P., 2012. Mental health effects from urban bed bug infestation (*Cimex lectularius* L.): a cross-sectional study. *BMJ Open* 2, e000838.
- Sutherland, C., Greenlee, A.J., Schneider, D., 2020. Socioeconomic drivers of urban pest prevalence. In: Graham, L. (Ed.), *People and Nature*.
- Vivian, I., 2023. Bedbug hysteria: cases up by 30% in Belgium as SNCB remains 'vigilant', *The Brussels Times*, 11 October 2023 <https://www.brusselstimes.com/belgium/732337/bedbug-hysteria-cases-up-by-30-in-belgium-as-sncb-remains-vigilant> (last Accessed 28 October 2023).
- Walker, M.D., 2018. Can Google be used to study parasitic disease? Internet searching on tick-borne encephalitis in Germany. *J. Vector. Borne Dis.* 55, 327–329.
- Wang, C., Saltzman, K., Chin, E., Bennett, G.W., Gibb, T., 2010. Characteristics of *Cimex lectularius* (*Hemiptera: cimicidae*), infestation and dispersal in a high-rise apartment building. *J. Econ. Entomol.* 103, 172–177.