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Lepidium didymum L., a new host plant for *Pieris mannii* (Mayer, 1851). Is this new host plant facilitating the species' rapid northwestern expansion?

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Abstract
The first confirmed use of *Lepidium didymum* (Brassicaceae) as a larval host plant of *Pieris mannii* (Mayer, 1851) is documented, based on oviposition and successful rearing in Belgium. The discovery of this new hostplant highlights the species' ecological plasticity and may be a contributing factor regarding the ongoing expansion of the species across urbanised areas of north-western Europe. The widespread presence of *L. didymum* in disturbed habitats may help sustain and extend future populations.

Key words
Pieris mannii — Papilionoidea — Pieridiae — *Lepidium didymum* — Brassicaceae — new host plant — range expansion — ecological plasticity — urban ecology — western Europe.

Introduction

Historically, *Pieris mannii* (Mayer, 1851) has been regarded as a habitat specialist, typically confined to xerothermic habitats, such as hot, rocky areas near sun-exposed limestone cliffs. It was highly localised in stable populations (Ziegler & Eitschberger 1999). The species occurs across a wide altitudinal range, from sea level up to 2000 m. *P. mannii* is polyvoltine producing multiple generation from March until October and is able to tolerate harsh winters.
The original range of *P. mannii* extended from North Africa (Morocco, where it is now more than likely extinct), throughout the Iberian Peninsula and Southern Europe, across Asia Minor, and eastward to Iran (Higgins & Riley 1970; Tshikolovets 2011).
The species *P. mannii* presents considerable nomenclatural challenges, with different issues. This article does not debate this issue, leaving it to others to argue this in a future publication.
Many named subspecies of P.mannii have been described, several of which arguably do not warrent this status, with only a few valid exceptions. The principal ones, as recognized by Ziegler & Eitschberger (1999) in their review article on the species, are:
- *mannii* (Mayer, 1851) from the Balkans. (url)
- *todaroana* Pincitore-Marott, 1879 from Sicily. (url)
- *rossii* Stefanelli, 1900 from Italy. (url)
- *andegava* Delahaye, 1910 from northwestern France. (url)
- *alpigena* Verity, 1911 from the southwestern Alps.
- *hethaea* Pfeiffer, 1931 from Asia Minor. (url)
- *haroldi* (Wyatt, 1952) from Morocco. (url)
- *reskovitsi* Gozmány, 1968 from the Bükk Mountains of Hungary. (url)
- *roberti* (Eitschberger & Steiniger, 1973) from southern Spain.

These subspecies are distinguished by subtle and overlapping morphological traits. Additionally, the markings can vary significantly between generations, further complicating identifications among the

subspecies. Excellent colour photographs of all subspecies are published by Ziegler & Eitschberger (1999).
Dapporto *et al.* (2022) reported significant intraspecific variation in the mitochondrial COI gene, featuring at least 10 mutations, exclusively in populations from southeastern Spain.
Blattner *et al.*, using RAD sequencing and whole-genome sequencing on a subset of samples (specifically historical and early-expansion individuals), identified several distinct lineages originating from historical populations in southeastern France, the western tip of Italy, coastal Slovenia, Valais, Ticino, and eastern Austria. However, such comparable genomic data sets are not available for the various subspecies of *P. mannii*, limiting direct comparisons across the entire species complex.
Several isolated northern populations were historically documented, including colonies in Lower Austria; the Bükk Mountains in Hungary (probably extinct); Slovakia (probably extinct); eastern France (Ain Valley near Lyon); the Lake Geneva region (until 1918), and Valais and southern Ticino in Switzerland (Ziegler 2009). One notable but rarely cited record is Delahaye's 1910 description of the subspecies *P. mannii andegava* from the Anjou region in western France (Maine-et-Loire department). By 2009, Ziegler noted this population was "considered to have disappeared or possibly become locally extinct." Given the active entomological community in France, this conclusion seems plausible.
Historically, *P. mannii* was thought to be highly sedentary, with strong site fidelity and no known instances of migration or range expansion.
In 2001, *P. mannii* was rediscovered after many years in the Ain département (France) (Bordon & Vernier 2003). In 2005, it was recorded near Geneva, almost a century since the last known observation, and in 2006 in the Jura region of Vaud, Switzerland (Ziegler 2009). Whether these populations were previously overlooked or represent the early stages of a range expansion remains uncertain. Notably, most of these observations were made in village gardens.
From 2008 onward, the spread of *P. mannii* rapidly increased. The species was recorded at many sites north of the Swiss Alps (Ziegler 2009) and had reached Baden-Württemberg in Germany (Herrmann 2008). By 2009, it had been observed in the Haut-Rhin department of France (Feldtrauer & Feldtrauer 2009), and by 2010 in both Schwaben (Bavaria, Germany) and Vorarlberg (Austria) (Kratochwill 2011). Documentation of the north-westward expansion of *P. mannii* is provided in Herrmann's study (2010) which mentions its range extension and naturalisation in South-western Germany.
In the years that followed, *P. mannii* continued to expand across Germany (Pähler 2016; Wiemers 2016; Wiemers *et al.* 2020), Austria (Gros 2018) and France (Essayan *et al*. 2012). It was first recorded in the Netherlands in 2015 (van Swaay *et al.* 2016), and a year later in eastern Belgium, initially in the province of Luxembourg and later in Limburg (Vantieghem 2018; Taymans 2018) and Luxemburg (Hensle *et al.* 2016). By 2020 the species had reached Poland (Bury 2023).
Within five years of the first sightings in Belgium, the species had reached West Flanders, with a record near the North Sea coast (Cuvelier & Vervaeke 2023a, Cuvelier & Vervaeke 2023b).
In 2025, the first author came across a Facebook post (url) reporting the first sightings of the species in the United Kingdom, although no photographs were provided. A search on observation.org on 20.viii.2025 revealed additional records, including photographs. However, most appear to have been identified using the ObsIdentify app, and none of the images are of sufficient quality or show the wings clearly enough to verify diagnostic characters. The Butterfly Conservation website dedicates a whole page on the observations, including a photograph of a female *Pieris mannii* taken on 02.viii.2025 in Suffolk.
To the best of our knowledge, this remains the only record supported by convincing evidence that *Pieris mannii* has reached eastern England.
According to the official Danish records, *Pieris mannii* has, at present, not been observed in Denmark (personal communication, Morten Schneider Mølgaard). However, its arrival is considered likely in the near future.
The expansion of *P. mannii*, first detected in southwestern Switzerland, has progressed both northeastward (Blattner *et al.* 2024) and northwestward (Cuvelier & Vervaeke 2023a, Cuvelier & Vervaeke 2023b) across Europe at an estimated rate of 50–100 km per year. Given the rapid expansion, climate change is unlikely to have been the primary driver.
Although the expansion appears to originate from natural dispersal, more than likely in eastern France, urbanization clearly facilitated the spread of the species (Ruffener *et al.* 2024), with *P. mannii* thriving in villages and cities but rarely found in truly rural or wild areas. This unusual habitat preference contrasts with native populations, which are mostly confined to semi-naturalised areas outside urbanised regions. The shift seems linked to the availability of larval host plants in anthropogenic habitats.
Lafranchis *et al*. (2015) provided a comprehensive account of the ecology of *P. mannii* in France, including its food plants. Clarke (2024) compiled confirmed records of larval feeding across the species' global distribution range, listing a broad array of Brassicaceae species as host plants, such as *Aethionema saxatile*, *Alyssoides utriculata*, *Aubrieta deltoidea*, *Aurinia saxatilis*, *Cardamine impatiens*, *Diplotaxis erucoides*, *Diplotaxis muralis*, *Diplotaxis tenuifolia*, *Hormathophylla spinosa*, *Iberis amara*, *Iberis linifolia*, *Iberis saxatilis*, *Iberis sempervirens*, *Iberis umbellata*, *Kernera saxatilis*, *Lepidium graminifolium*, *L. campestre*, *L. coronopus*, *Lobularia maritima*, and *Peltaria alliacea*.
Outside its native range in southern Europe, *I. sempervirens* is widely cultivated in gardens, and egg-laying by *P. mannii* has frequently been observed on it. In Rhineland-Palatinate (Germany), Geier (2016) found eggs in the wild on *I. sempervirens*, *D. tenuifolia* and *L. graminifolium*. Blattner *et al.* (2024) also report that *Diplotaxis tenuifolia*, widely cultivated as a leafy vegetable and abundant in urban wastelands, is an important larval host across Central Europe.
Additionally, Neu *et al.* (2021) documented *Alliaria petiolata*, *Brassica oleracea* and *Sinapis arvensis* as new larval host plants outside the species' historical range. These findings suggest *P. mannii* may be expanding its ecological niche by utilising a broader array of Brassicaceae in newly colonised areas.
The ecological opportunities created by human activity appear to be uniquely exploited by a specific population of *P. mannii*, as the expansion across Central Europe originated from a localised area within the species' historical range, corresponding to the subspecies *P. mannii alpigena*.





Fig. 1. *Pieris mannii* ♂, Gullegem (Belgium), 12.ix.2021 (© Jacques Vervaeke)
Fig. 2. *Pieris mannii* ♀, Gullegem (Belgium), 28.ix.2022 (© Jacques Vervaeke)

Among the genera utilised, *Lepidium* is of particular interest. A large, cosmopolitan genus within the Brassicaceae family, it includes around 265 known species worldwide, inhabiting diverse ecosystems from temperate to subtropical zones. In Europe, at least a dozen species are native or have naturalised, including *L. campestre*, *L. ruderale*, and *L. coronopus*, with others introduced through trade and horticulture. Of these, *L. campestre*, *L. coronopus*, and *L. graminifolium* have been recorded as larval host plants of *P. mannii*, particularly in southern Europe.
Lepidium didymum, an annual or short-lived perennial native to South America, has spread widely into disturbed habitats such as roadside verges, lawns, and waste grounds. In temperate regions, it can flower from early spring to late summer, and even into autumn if conditions are mild. In temperate maritime climates *L. didymum* overwinters as low-growing rosettes, especially in sheltered or urban areas and roadside verges.
Despite its abundance, no evidence from field observations or the literature existed prior to this study indicating that *P. mannii* uses *L. didymum* as a larval host.

Observations
On 12.vii.2023, the second author observed a female *Pieris mannii* ovipositing in his vegetable garden and photographed the event with his mobile phone (Fig. 3) and a number of eggs were found on the plants that were later identified as Lesser Swinecress (*Lepidium didymum*), a weed that thrives annually in the vegetable garden.
Due to an impending prolonged absence, no attempt was made to breed. The same behaviour was observed several other occasions over the following days. It remains unclear as to whether this involved the same female or several *Pieris mannii* females. Given the absence of *Iberis* species in the garden, the observed oviposition seemed atypical and may have resulted from the lack of suitable host plants.
In the garden of the third author, *P. mannii* has been regularly observed (Figs 1–2, 5), however, oviposition has never been recorded.
On 11.v.2025, the first author observed a female *Pieris mannii* exhibiting oviposition behaviour in his garden. At one point, he saw her actively laying eggs on a plant he was initially unable to identify. He continued to follow the female briefly and managed to take several photographs. Further investigation revealed that the plant was *L. didymum*, which, is relatively common in his garden.
Subsequent observations of egg-laying in the garden of the third author consistently involved *Iberis sempervirens*, of which five plants are growing.
Four eggs laid on *L. didymum* were collected and subsequently reared on the same plant species (Fig. 4; 6-13).
On 26.vi.2025, four adults successfully emerged: two males and two females.





Fig. 3. *Pieris mannii* ♀ laying eggs on *Lepidium didymum,* Ieper (Belgium), 12.vii.2023 (© Sylvain Cuvelier)
Fig. 4. *Pieris mannii* larva, Kemmel, 30.v.2025 (© Jori Degrande)
Fig. 5. *Pieris mannii* ♂, Gullegem (Belgium), 29.ix.2022 (© Jacques Vervaeke)





Fig. 6. Close-up of flower pods of *Lepidium didymum*, Kemmel (Belgium) (© Jori Degrande)
Fig. 7. *L. didymum* specimen in the vegetable garden, Kemmel (Belgium) (© Jori Degrande)
Fig. 8. *L. didymum* plant potted for rearing, starting from the egg stage of *P. mannii*, Kemmel (Belgium) 11.v.2025 (© Jori Degrande)





Fig. 9. Egg of *P. mannii* on *L. didymum*, Kemmel (Belgium) 14.v.2025 (© Stef Spruytte)
Fig. 10. Larva of *P. mannii* on *L. didymum*, Kemmel (Belgium) 30.v.2025 (© Jori Degrande)







Fig. 11. Larva of *P. mannii* on *L. didymum*, Kemmel (Belgium) 30.v.2025 (© Jori Degrande)
Fig. 12. Pupa of *P. mannii* reared on *L. didiymum*, Kemmel (Belgium) 18.vi.2025 (© Jori Degrande)
Fig. 13. *P. mannii* ♀, Kemmel (Belgium) 11.v.2025 (© Jori Degrande)

Results and discussion

The present findings provide new insight into the ecological drivers facilitating the rapid range expansion of *Pieris mannii* in north-western Europe. Historically confined to semi-natural, xerothermic habitats, the species is now firmly established in urbanised areas, across Flanders in Belgium. The key driver of this expansion appears to be the species' capacity to exploit a broadening range of larval host plants, many of which thrive in anthropogenic habitats.

Fig. 14–19, show the Belgian distribution (2000–present) of several larval host plants recently reported outside the historical range of *P. mannii*. The maps are based on records from the biodiversity platform, Waarnemingen.be. These maps, derived from citizen science data, should be interpreted cautiously. The number of observations recorded in urban environments is typically a lot higher than in areas of low population. and easily accessible locations, while ornamental garden plants, such as *Iberis sempervirens* are underreported. As such, the apparent scarcity of certain species in the data likely reflects recording bias rather than true ecological absence.

Consideration needs to be taken when interpreting these patterns, or when drawing conclusions about host plant suitability across *P. mannii*'s expanding range.

Nonetheless, even accounting for these limitations, it is evident that several larval host plants, are widely distributed across the urban environments of Flanders. These species may contribute substantially to the butterfly's ability to maintain successive generations across its expanded range. Likewise, although *I. sempervirens* is sparsely represented in the dataset, it has been repeatedly confirmed as a host plant in the field and should not be overlooked when evaluating larval resources in garden environments.

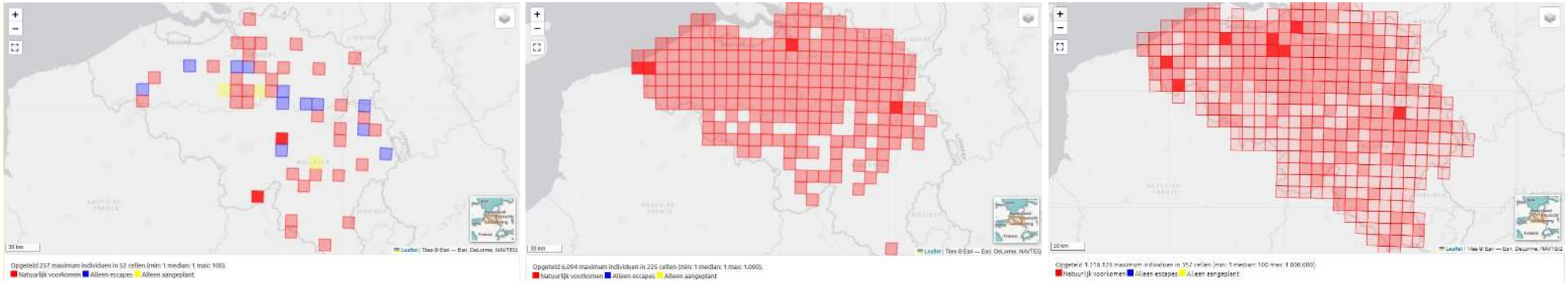


Fig. 14. Distribution of *Iberis sempervirens* in Belgium, 2000-2025 (source: Waarnemingen.be)
Fig. 15. Distribution of *Diplotaxis tenuifolia* in Belgium, 2000-2025 (source: Waarnemingen.be)
Fig. 16. Distribution of *Alliaria petiolata* in Belgium, 2000-2025 (source: Waarnemingen.be)

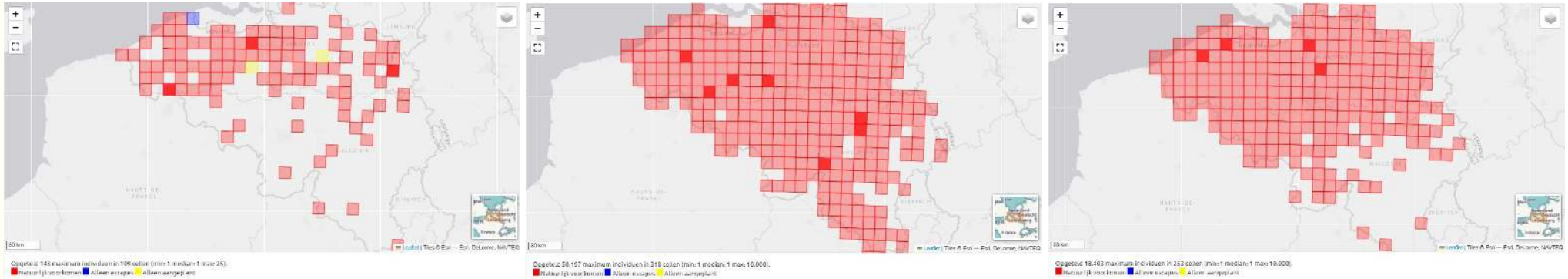


Fig. 17. Distribution of *Brassica oleracea* in Belgium, 2000-2025 (source: Waarnemingen.be)
Fig. 18. Distribution of *Sinapis arvensis* in Belgium, 2000-2025 (source: Waarnemingen.be)
Fig. 19. Distribution of *Lepidium didymum* in Belgium, 2000-2025 (source: Waarnemingen.be)

As with the host plants, the distribution map of *P. mannii* published by Cuvelier & Vervaeke (2023a) and Cuvelier & Vervaeke (2023b) shows a clear predominance of records from the Flemish region of Belgium. This pattern likely reflects a combination of genuine species presence and recorder effort, which tends to be higher in urbanised areas. Additionally, because the literature has placed particular emphasis on *I. sempervirens* as a key larval host in gardens, survey efforts often disproportionately target this species. As a result, observations of egg-laying on other potential host plants may be underreported, particularly across the butterfly's expanding range and through successive generations.

Here, we report multiple instances of oviposition on *Lepidium didymum* in the southern part of West Flanders (Belgium), accompanied by successful rearing of larvae to adulthood. These observations

provide the first confirmed evidence that *L. didymum* serves as a suitable larval host for *P. mannii* in this region.
Notably, the same plant is known as a larval food source for *Pieris napi* and *Pieris rapae*, as summarised by Clarke (2024).
L. didymum is widely distributed across northern France, Germany, Belgium, and the Netherlands, and has become a common element of urban and peri-urban environments. Given its abundance and demonstrated suitability, it may play a significant role in supporting the continued range expansion of *P. mannii* across much of north-western Europe. The plant's extended flowering period, winter rosette growth, and year-round availability in mild, urban microclimates make it particularly well suited to sustaining multiple annual generations.
The capacity of *P. mannii* to locate, accept, and complete its development on previously overlooked or undocumented host plants such as *L. didymum* reflects a notable degree of ecological plasticity. This is particularly striking in light of the species' historically narrow host associations within its native range. The current data on the distribution of this host plant should be interpreted with caution due to spatial and reporting biases. Nevertheless, they highlight the diversity and availability of potential larval resources in urban areas.
This combination of native and non-native, cultivated and naturalised Brassicaceae is likely to continue facilitating the species' expansion into new areas. Future research should systematically verify host plant use across different regions and throughout the full breeding season. Without such targeted studies, important ecological interactions may remain undetected.

Conclusions
This study provides the first confirmed records of *Pieris mannii* utilising *Lepidium didymum* as a larval host plant, based on direct field observations of oviposition along with a successful rearing to adulthood. The addition of *L. didymum*, a cosmopolitan ruderal species commonly found in urban and disturbed environments, adds to the known list of accepted hostplants of *P. mannii* and may play a significant role in facilitating its continued and rapid spread across urbanised areas of Europe.
These findings highlight the importance of ongoing, detailed fieldwork in capturing real-time ecological changes, particularly in species undergoing rapid range expansion. They also highlight the need to reassess host plant surveys across the species' expanding range, with greater attention given to other potential Crucifer species which may be the key to supporting populations in newly colonised areas.
As *P. mannii* continues to establish itself in new regions, a comprehensive understanding of its host plant usage is essential for understanding its future distribution and assessing potential ecological impacts. Further research should focus on whether similar host plant adaptations are emerging independently in other populations, or whether this is just an isolated occurrence in populations from the Southwestern Alps.

Author contribution
Jori Degrande: conceptualization, field work, analysis, visualisation, writing - original draft, writing – review and editing.
Sylvain Cuvelier: conceptualization, field work, analysis, visualisation, writing - original draft, writing – review and editing.
Jacques Vervaeke: conceptualization, writing – review and editing.

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