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CONFERENCE ABSTRACTS

Abstracts of the Immature Beetles Meeting 2025

October 2–3, Prague, Czech Republic

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The Immature Beetles Meeting (IBM) is a traditional biennial event held in Prague, dedicated to the study of beetle larvae. The main topics of the meeting usually cover morphology, ecology, and development of beetle larvae, as well as their taxonomic and systematic implications. The jubilee 10th meeting took place at the Campus Hybernská of the Charles University in Prague on Thursday and Friday October 2–3. On Friday afternoon, several participants visited the insect collections of the National Museum of the Czech Republic in Praha – Horní Počernice. In total, 44 colleagues from 12 countries attended the meeting (see Fig. 1). As the personal get-together is one of the major reasons to organize the IBM, hybrid participation was not offered this year. Most attendees came from Europe, particularly from the Czech Republic, Poland, Germany, Italy, and the United Kingdom, but we were also pleased to welcome colleagues from Canada or Argentina.

A total of 13 oral contributions were presented, covering diverse topics related to beetle larvae, including morphology, larval biology, phylogeny, and systematics. The beetle families represented in the talks included Agyrtidae, Cerambycidae, Coccinellidae, Curculionidae, Elateridae, Leiodidae, Scarabaeidae, Staphylinidae, and Tenebrionidae, as well as the related sister order Strepsiptera. Compared with previous years, the 2025 IBM also featured some innovative and unconventional topics. Presentations ranged from a historical overview of IBM meetings, through records of scarabaeoid larval stridulation and observations of parasitic groups such as Strepsiptera and Asilidae, to biological studies of longhorn beetles and the extraordinary super glue discovered in ladybird beetles. Discussions throughout the meeting were lively and fruitful, and we hope to include similarly innovative and interdisciplinary content in future IBMs. Of course, no IBM would be complete without the traditional "beetle pub" gatherings, held on both evenings (see Fig. 2). These informal meetings over a glass of the famous Czech beer remain one of the most cherished traditions of the conference, allowing participants to exchange ideas in a relaxed and inspiring atmosphere. We were delighted that several Czech colleagues who could not attend the official sessions joined us for these evening gatherings.

The last two IBMs were strongly affected by the COVID-19 pandemic, which limited attendance and forced us to adopt suboptimal hybrid formats with fewer presentations. We are therefore particularly pleased that the meeting has now fully recovered, both in participation and spirit. We hope that the IBM tradition will continue to thrive, especially after the jubilee 10th meeting in 2025, further strengthening Prague's role as one of the key meeting points for the international community of beetle specialists. For more details about the last IBM, see our Facebook page: www.facebook.com/ImmatureBeetlesMeeting/

Acknowledgements

We are very grateful to all colleagues who supported the organization of the IBM 2025 and who attended the meeting. We also thank all participants who presented their presentations and took part in the discussions, as well as those who attended the informal beetle discussions in the evening larval pub. Michal Vinkler (Head of the Department of Zoology, Charles University) kindly supported our initiative to organize the meeting and provided the space where the meeting took place. The National Museum of the Czech Republic, the Czech Agrifood Research Center, and the Czech Entomological Society supported IBM 2025 as well. The meeting was organized as a part of the research activities of the organizers, partially supported by the grant SVV 260812/2025 (from the Charles University) to PŠ, by the Ministry of Culture of the Czech Republic (DKRVO

2024–2028/5.I.b, National Museum of the Czech Republic, 00023272) to DV, and by the Ministry of Agriculture of the Czech Republic, institutional support MZE-RO0425 to JS.

List of participants

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ORAL PRESENTATIONS

Immature Beetles Meeting Chronology: Twenty Years of Research and Discussion

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The immature stages of beetles (Coleoptera) remain poorly known, despite their importance for systematics, ecology, and applied research. To address this gap, the Immature Beetles Meeting (IBM) was established in Prague in 2007 and has since been held biennially. Over twenty years, IBM has attracted 206 participants from 30 countries and hosted 168 presentations, creating a unique platform dedicated to beetle larvae and pupae. Here, we summarize the history, structure, and outcomes of IBM, highlighting its role in fostering collaboration, advancing methods, and promoting the study of beetle immatures within the global research community.

Stridulations and greenhouse gas emissions of Scarabaeidae larvae – bringing climate change research and biodiversity monitoring together

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Root-feeding Scarabaeidae larvae are a major soil fauna group, and some species can pose a serious threat to agricultural and forest ecosystems. Lesser known is the fact that they have also the potential to substantially influence the spatial and temporal variability of soil greenhouse gas (GHG) sinks and sources. Our data show that Scarabaeidae larvae can be significant soil GHG sources and should not be neglected in soil GHG flux research. However, the overall effect of soil-inhabiting Scarabaeidae larvae on soil GHG fluxes remains poorly quantified since the majority of the available data comes from laboratory experiments, is often controversial, and has been limited to a few species. The latter is the result of our limited knowledge on larval ecology. We have developed an acoustic data analysis method based on larval stridulations and passive acoustic monitoring for gaining new insights into larval ecology and enabling for the first time non-invasive species-specific monitoring. This presentation will provide an overview of what we know thus far about carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emission from soil-inhabiting Scarabaeidae larvae and propose a concept of how soil monitoring could be the key to strengthen both our knowledge on greenhouse gas emissions and on the ecology of Scarabaeidae larvae, and bring climate change research and biodiversity monitoring together.

Morphology and ecology of invasive first instar larvae and their potential in taxonomy of Xenidae and Stylopidae (Coleopteroidea: Strepsiptera)

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The twisted-winged parasites (Strepsiptera) are an order of obligate endoparasitic insects with a cosmopolitan distribution. They exhibit numerous morphological, physiological, and behavioral adaptations to a parasitic lifestyle, with some apomorphies having no parallels in other organisms. Xenidae and Stylopidae are parasites of wasps and bees, both families are highly diversified and together account for approximately half of all described strepsipteran species. Their main apomorphy is the phoresis of first instar larvae. They are carried by fast flying aculeatan hosts to their nests where they infest the eggs or the larvae. Xenidae are mainly characterised by the unique morphology which exhibit adaptations that enhance their ability to attach to the smooth body surfaces of wasp hosts. This includes enlarged and round adhesive tarsal pads and filamentous cuticular outgrowths on the mouthparts, which strongly increase its wettability.

Stylopidae are exclusive parasites of bees. An important evolutionary change in the primary larvae is the loss of the jumping capacity, which is made dispensable by the phoretic behaviour. Elongated and rod-like tarsi of the fore- and middle legs are possibly better suited for anchoring in the dense vestiture of hairs of the host, and the spinulae on the caudal margin of the thoracic tergites and on abdominal sternites and tergites may be seen in the same functional context (Pohl & Beutel 2008). In some cases, the caudal setae can be extremely elongated (Straka et al. 2014). Therefore, larvae can be transported to the nests on the hosts along with pollen and nectar.

Given the differentiated chaetotaxy and the diversity of attachment structures, the study of first instar larva morphology is highly promising for the delimitation and description of new genera and species.

Acknowledgements. This project was supported by the Ministry of Culture of the Czech Republic (DKRVO 2024–2028/5.I.b, National Museum, 00023272; and P25/01IG-BE).

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Searching for boundaries of species delimitation in parasites: A case study of first instar larvae of the genus *Stylops* (Coleopteroidea: Strepsiptera, Stylopidae)

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The twisted-winged parasites (Strepsiptera) are an insect order known for their unusual biology and obligate parasitism, yet much about their taxonomy and evolutionary relationships remains unresolved. Among them, the genus *Stylops* Kirby, 1802, which parasitizes solitary mining bees in the genus *Andrena* Fabricius, 1775, poses particular challenges for species delimitation. The genus exhibits extreme morphological reduction, especially in females, and profound host-induced variation. While recent molecular studies have revealed extensive hidden diversity within *Stylops*, many of these genetically distinct lineages remain difficult to distinguish based on external morphology alone. This thesis investigates whether morphological traits of *Stylops* collected from geographically and taxonomically diverse *Andrena* hosts, particularly in the first instar larvae, can provide clearer criteria for distinguishing species. Using scanning electron microscopy (SEM), I examine structural features such as size of the head disc and position of the labium, size of sternites, setae and spines distribution and length in *Stylops* larval specimens associated with different *Andrena* hosts. These traits, often overlooked due to their minute scale, may hold taxonomically useful variation capable of reflecting species boundaries inferred from genetic work.

By focusing on the first instar stage, this study aims to evaluate the potential of larval morphology in supporting or refining current species hypotheses. The findings offer a complementary perspective to recent molecular approaches and contribute to the broader effort of resolving species limits in parasitic insect lineages where conventional characters are limited or unreliable.

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Rhizophagous larvae of Scarabaeidae species from the Pampas Region in Argentina

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The Scarabaeidae is a large family of Coleoptera comprising more than 35,000 species worldwide. Many species are scavengers that recycle dung, carrion, or decaying plant material. Others are plant-eaters, wreaking havoc on various crops and vegetation. In the Pampas Region in Argentina, nine species of rhizophagous larvae of Scarabaiedae have been identified. These nine species are grouped into three major subfamilies: Dynastinae, Rutelinae, and Melolonthinae. The Dynastinae include *Diloboderus abderus* Sturm, 1826 and *Bothynus striatellus* Fairmaire, 1878, both belonging to the tribe Oryctini. Also, *Archophileurus vervex* Burmeister, 1847, from the tribe Phileurini. Then, *Cyclocephala signaticollis* Burmeister, 1847, *Cyclocephala modesta* Burmeister, 1845, and *Cyclocephala putrida* Burmeister, 1847, belong to the tribe Cyclocephalini. For the Rutelinae, the species *Heterogeniates bonariensis* Ohaus, 1909, belongs to the tribe Geniatini, and *Anomala testaceipennis* Blanchard, 1850 belongs to the tribe Anomalini. Finally, within Melolonthinae, the species *Plectris bonariensis* Blanchard, 1851 is included in the tribe Macrodactylini. The life cycle of the species in the Dynastinae and Rutelinae subfamilies is annual. In Argentina, the adults emerge in the summer, from November to February. The larvae are scarabaeiform, characterized by the particular "C" shape of their body. All these species are an important agricultural nuisance and many efforts in trying to lower their damage is done. Some species like *C. signaticollis*, *A. vervex*, *P. bonariensis* and *H. bonariensis* have been recorded as hosts of singular ectoparasitoids like *Mallophora ruficauda* (Wiedemann, 1828), *M. bigoti* (Lynch Arribálzaga, 1883) and *M. atra* Macquart, 1834 (Diptera: Asilidae). In this contribution we will introduce the species from the Pampas Region to this international meeting, show advances on the description of the lifecycles, and discuss the ecological role of some of these species as hosts for the Asilidae dipteran parasitoids.

Larval morphology of Afrotropical tribe Oritocatopini (Coleoptera: Leiodidae)

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Tribe Oritocatopini is a small tribe of small carrion beetles, distributed with only three genera and 19 extant species in Afrotropical Region (Perreau 2000). An additional fossil monotypic genus, *Cretaciella sorianoae* Perreau, 2019, is recently described from Cretaceous amber in nowadays Spain (Perreau 2019). Only very brief and rather schematic description of larva of *Chappuisiotes lobeliae* (Jeannel, 1957) is available, based on probably third instar larvae collected by R. Jeannel on Mount Elgon, Kenya, in rotten trunks of *Lobelia* (Paulian 1937, 1941).

Larval morphology is described in detail for two genera. (1) *Afrocatops* Jeannel, 1964, where we are describing in detail all three larval instars of *A. joannae* Jeannel, 1964 (based on laboratory breeding of abundant material, adults collected in baited pitfall trap in Eastern Cape, Republic of South Africa [RSA]) and *A. natalensis* (Jeannel, 1936) (based on field collected larvae from Kwazulu-Natal, RSA, loaned from Field Museum, Chicago, USA). (2) Additionally, we redescribe third instar larva of *C. lobeliae*, based on the original material of R. Jeannel from Field Museum. Generally, mouthparts are very rich in various types of sensillae, much more than other known larvae of Leiodidae, with some unique ones. The larvae are very similar to *Dictydiella* Jeannel, 1936, South African primitive member of Leiodidae: Camiarinae: Agyrtodini (Kilian & Kleina 2011).

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Mysterious tergal structures in larvae of Leiodidae and Agyrtidae (Staphylinoidea) – new data

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The sister families Leiodidae and Agyrtidae are among the most interesting in the superfamily Staphylinoidea. They are considered primitive and exhibit high ecological and biogeographical diversity. Previous studies of larval morphology in Leiodidae (i.e. Gnaspini 1993; Wheeler 1985; Kilian 2007a, 2012; Kilian et al. 2022) showed the presence of small, paired structures in the dorsal cuticle of the thorax and abdomen. These structures were discussed at the 2007 Immature Beetles Meeting (Kilian 2007b). Preliminary research using transmission electron microscopy has revealed the epidermal and glandular nature of these structures in one species, *Sciodrepoides watsoni watsoni* (Spence, 1813). We also present scanning electron microscopic documentation of these glandular structures in the larvae of many other Leiodidae and Agyrtidae species.

This work was funded by the grant of University of Wrocław (IDUB. 1. 2024.).

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Fig. 1. Attendants of the Immature Beetles Meeting 2025 during the first day in the courtyard of the Hybernská campus (Charles University, Prague). Standing row (from left to right): A. Kilian, C.-M. Görres, L. Sekerka, K. Janovská, L. Petroni, P. Priori, H. Shaverdo, F. Blasetti, D. Benda, E. Mozzorecchia, L. Karpiński, P. Švácha, J. Rainey, T. Mráz, J. Colwell, J. Crespo, R. Angus, A. Damaška, M. Vais, L. P. Sandoval Salinas, J. Prokop, E. Rychlá, K. Mahlerová, M. Kamiński, G. Pačková, R. Kundrata, J. P. Nunes de Andrade Pereira, J. Růžička, H. Douglas, M. Perreau, J. Hájek and N. Perreau. Squatting row (from left to right): T. Lackner, P. Šípek, R. Gosik, B. Das, J. Skuhrovec and D. Jetelina.

Who's driving this bus? Exploring ovoviviparity in tenebrionid beetles

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Ovoviviparity – embryonic development within eggs retained in the female reproductive tract until hatching – has been documented in several beetle families (Carabidae, Cerambycidae, Chrysomelidae, Micromalthidae, Staphylinidae, Tenebrionidae; Hagan 1951, Tschinkel 1978, Liebherr & Kavanaugh 1985, Iwan 2000, Gabriš et al. 2016, Zilberman et al. 2019) yet remains exceedingly rare and phylogenetically restricted. Within darkling beetles (Tenebrionidae), nearly all confirmed cases occur in the tribe Platynotini, with Malagasy lineage exhibiting ovoviviparity as a seemingly fixed trait (Tschinkel 1978, Iwan 2000, Dutrillaux et al. 2010). Despite its striking distribution, the evolutionary drivers of this reproductive strategy among tenebrionids remain poorly understood, in part due to limited morphological and ecological data. Iwan (2000, 2010) proposed that ovoviviparity in Platynotini arose as an adaptation to arid habitats with strong diurnal temperature fluctuations, where reductions in oviposition structures and elongation of egg development facilitated egg retention and larviposition. Morphological correlates, such as shortened paraprocts and first coxal plates, appear consistent with this hypothesis, though exceptions – e.g., *Eurynotus capensis* (Fabricius, 1794), the sole oviparous Eurynotina species with elongate paraprocts – complicate the picture (Tschinkel 1978, Banaszkiewicz 2006). Recent phylogenetic work on Eurynotina has uncovered additional ovoviviparous taxa, expanding the scope of comparative analyses (Lumen & Kamiński 2023, 2024). Given the extraordinary diversity of female terminalia in Eurynotina (including variation in bursal sclerites and accessory pouches), this group presents a key opportunity to test morphological and ecological predictors of reproductive mode. Here we combine phylogenetic, morphological, and climatic data to reevaluate the evolution of ovoviviparity in Tenebrionidae, providing new insights into the ecological and anatomical correlates of this rare but repeated innovation.

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So similar yet so different – how close are Central Asian Dorcadionini (Coleoptera: Cerambycidae)?

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The flightless longhorned beetle (Coleoptera: Cerambycidae) genera *Dorcadion* Dalman, 1817 and *Eodorcadion* Breuning, 1947 belong to the extremely diverse and taxonomically complex tribe Dorcadionini Swainson, 1840. Although both genera (*Dorcadion* only partially) are distributed in the Central Asian region (mainly in Kazakhstan and Mongolia, respectively), which is characterised by an extreme continental climate, the life mode of their immature stages appear to be identical and these beetles occur in analogous habitats, the two genera exhibit completely different phenological patterns. The larvae of *Dorcadion* and *Eodorcadion* are called 'root-gnawers' as they feed on the underground parts of various types of grass (Poaceae), such as *Stipa* and *Achnatherum*. However, adults of *Dorcadion* in Kazakhstan are active mainly from the second half of April to the end of May, while those of *Eodorcadion* in Mongolia and eastern Kazakhstan typically occur from mid-July to the end of August, or even longer. Interestingly, while larval morphology shows almost no differences between these two genera, their contrasting emergence timelines suggest underlying ecological or evolutionary divergence. The reasons for this phenological variation remain unclear, prompting this study to investigate the factors driving these differences. Revealing the phylogeny of the Central Asian Dorcadionini and understanding their evolutionary relationship, among many other scientific benefits, may help to solve this puzzle. In this talk, we will attempt to decipher the cause of this variability.

Some remarks on the morphology of the immature stages of several species of the genus *Dorytomus* Germar (Curculionidae: Ellescini)

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The genus *Dorytomus* Germar, 1817 includes about 100 species found mainly in the Holarctic Region (Zherikhin & Egorov 1991, Caldara et al. 2014, Alonso-Zarazaga et al. 2023). This corresponds more or less with the current distribution of its only two host plant genera, *Populus* and *Salix* (O'Brien 1970).

The biology of this genus has been studied only in a limited number of species (Scherf 1964, Freude et al. 1983). *Dorytomus* weevils mainly inhabit floodplain communities and ecotones of wet meadows and forests (Hoffmann 1958, O'Brien 1970, Smreczyński 1972, Lhose 1983). Also, the morphology of immature stages is only rudimentarily known. Only a few papers, e.g., Scherf (1964), provided some information about immature stages of *Dorytomus* (*D. longimanus* (Forster, 1771) and *D. taeniatus* (Fabricius, 1781)). But, due to a lack of description of all body parts and details of chaetotaxy, the existing gap in those descriptions needs to be filled.

The systematics of the genus *Dorytomus* have undergone numerous revisions and still require a comprehensive overview. Originally, this genus was divided into numerous subgenera (Reitter 1916, Zumpt 1932, Iablokov-Khnzorian 1970, Smreczynski 1972, Hoffmann 1958, Alonso-Zarazaga & Lyal 1999) and was repeatedly disputed (O'Brien 1970, Dieckmann 1986, Lhose 1983). Therefore, many authors are in favor of eliminating most of the existing subgenera (Korotyaev 1996, Colonnelli 2003, Alonso-Zarazaga et al. 2023). Recently, based on morphological features of the adults, Legalov (2024) proposed a completely new division within the tribe Ellescini, assuming, among other things, the restoration of the genus *Olamus* Reitter, 1916.

The aim of our work is to provide complete descriptions of the larvae and pupae of the following species: *D. dejeani* Faust, 1883, *D. taeniatus*, *D. tortrix* (Linnaeus, 1761), *D. melanophthalmus* (Paykull, 1792), and the mature larva of *D. rufatus* (Bedel, 1888). The description of the developmental stages of *D. longimanus* (Gosik & Sprick 2025) was also used in the final analysis.

Thanks to studies carried out using SEM, most of the described species (except *D. longimanus*) were found to have barbed setae (probably not present in the pupae of other known weevils).

Despite the significant morphological similarity between immatures of described species, they can be divided into two distinct groups: the first group consisting of *D. dejeani*, *D. taeniatus*, *D. tortrix*, and *D. longimanus*, and the second group consisting of *D. melanophthalmus* and *D. rufatus*. Morphological differences between the two groups were visible both in the larval stage (mouthparts, antennae, and abdominal chaetotaxy) and in the pupal stage (chaetotaxy of the head and pronotum).

The division into mentioned morphological groups among the studied species corresponds to the new taxonomic division proposed by Legalov (2024), according to which *D. dejeani*, *D. taeniatus*, *D. tortrix*, and *D. longimanus* remain in the genus *Dorytomus,* whereas *D. melanophthalmus* and D. *rufatus* have been transferred to the genus *Olamus*. At the same time, the results of the preliminary genetic analysis based on COI seem to support the new taxonomic division proposed by Legalov (2024).

However, the division into subgenera within the genus *Dorytomus* proposed by Legalov (2024) was not confirmed by the results of morphological analysis of larvae and pupae.

Fig. 2. First “beetle pub” evening over a glass of the famous Czech beer with relaxed attendants.

Ladybird superglue: proteins attaching ladybird pupae to the substrate

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Insects produce a variety of adhesives for diverse functions such as locomotion, mating, and attachment of immobile developmental stages to substrates. An attachment of larval instars and pupae to the solid substrate before moulting (ecdysis) by a special excreted substance is known in some Coleoptera as well as Lepidoptera. We analyzed the aminoacid sequence of the material that attaches pupa of the harlequin ladybird, *Harmonia axyridis* (Pallas, 1773), to the substrate. We found at least two still uncharacterized proteins that are very different in aminoacid composition, yet similar in tertiary structure.

How should we organize diagnostic information about Elateridae larvae?

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Recent phylogenomic analyses by several research groups have provided new information about the evolution of Elateridae. But these articles focus mainly on the morphological evolution of adults. Meanwhile, existing morphological information is difficult interpret because classifications have changed. Major clients of taxonomic research are interested in the larval stages of click beetles, because these damage crops or prey on other pests. Preliminary hypotheses characterize major clades based on larval characteristics. This work also highlights the need for updated diagnostic tools for larval Elateridae.

Developmental biology of *Necrophila americana* (Linnaeus, 1758) (Coleoptera: Staphylinidae: Silphinae)

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Necrophila americana (Coleoptera: Staphylinidae: Silphinae: Silphini) is an obligate necrophagous beetle whose larvae develop exclusively on large carrion. It is distributed east of the Rocky Mountains in North America, with peak adult activity from May through July. Because of its strict association with decomposing remains, *N. americana* is a promising indicator species for forensic entomology and estimating post-mortem interval (PMI). However, to date, no study has quantified its developmental rate across different temperatures, limiting its forensic utility. Here, we present the first laboratory-derived developmental dataset for *N. americana*, obtained at five incubators set to constant temperature 18, 20, 22, 24, 26 and 28 °C). The conditions were continuously monitored with temperature and humidity data loggers, and the average temperature experienced by each individual was used for modelling. We report the lower developmental threshold (D_0) and accumulated degree-days (K) for each immature stage (egg, three larval instars, and pupa) as well as for total preimaginal development. Our results provide the thermobiological parameters necessary to incorporate *N. americana* into PMI estimations and offer possible insights into its potential range shifts under future climate scenarios.