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Rapid Communication

First evidence of establishment of the palm borer moth *Paysandisia archon* (Burmeister, 1879) in southern Switzerland

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Abstract

We report the first evidence of establishment of the palm borer moth *Paysandisia archon* (Burmeister, 1879; Lepidoptera: Castniidae) in southern Switzerland. Originally from South America, *P. archon* has been increasingly spotted in southern Europe in recent years, where it poses a substantial threat to palms as its larvae bore into their meristem, feeding on the inner tissues, weakening the plants, and, in most cases, leading to their demise. We conducted non-systematic surveys and compiled reports of sightings of *P. archon* and its attributed damages, which were then all stored in an online database. Sightings and damage caused by *P. archon* have been confirmed across multiple locations in southern Switzerland, with major infestations reported on the northern shore of the Lago Maggiore and affecting various palm species. While *P. archon* poses a major threat to cultivated palm specimens that are iconic for the (sub)urban landscape of southern Switzerland, it may also help control the undesired spread of the invasive Chinese windmill palm *Trachycarpus fortunei* in the peri-urban forests.

Key words: *Trachycarpus fortunei*, invasive species, Castniidae, biological invasions, urban green, insects, pests

Introduction

In the Anthropocene, translocations of species to regions outside their native ranges are strongly increasing (Thomas 2020), with some introduced species having detrimental effects on the invaded ecosystems (Blackburn et al. 2014). According to the enemy release hypothesis, non-native species benefit from the absence of natural enemies during the initial stage of the establishment phase (Keane and Crawley 2002). However, increasing evidence suggests that over time this advantage may diminish due to the adaptation of native pathogens and pests and the introduction and accumulation of non-native ones (Crous et al. 2017; Blossey et al. 2021; Medzihorský et al. 2023), making the prediction of the ecological outcome in the invaded (novel) ecosystems even more uncertain (Kerr et al. 2024).

A widely cultivated and naturalized plant family that has accumulated various non-native pests outside its native range is the palm family (Arecaceae) (EFSA 2014; Soroker and Colazza 2017; Fehr et al. 2020). An example of a strongly increasing non-native palm pest in Mediterranean Europe is the palm borer moth *Paysandisia archon* (Burmeister, 1879; Lepidoptera: Castniidae) (Muñoz-Adalia and Colinas 2020). Originating from South America, *P. archon* has been increasingly spotted in Mediterranean Europe in recent years, where it poses a significant threat to palms as its larvae bore into the heart of palms, feeding on the inner tissues, weakening the plants, and potentially leading to their demise (Muñoz-Adalia and Colinas 2020; Mori et al. 2023). Various cultivated ornamental palm species are being attacked, as well as populations of the European fan palm (*Chamaerops humilis* L., 1753), which is native to the Mediterranean region where it plays a vital ecological role (Muñoz-Gallego et al. 2022).

In 2023, the establishment of *P. archon* has been documented for the first time in southern Switzerland, where it is infesting cultivated and naturalized non-native palms, among them the invasive Chinese windmill palm *Trachycarpus fortunei* ((Hook.) H. Wendl., 1861). Before 2023, only three isolated records of *P. archon* were documented in Switzerland—two in plant nurseries—followed by successful eradications with no further spread (Colombi et al. 2012; Rezbanyai-Resel 2013; EPPO 2020). Even though Switzerland does not host native palm species, the currently observed establishment of *P. archon* is gaining strong attention due to its potential impact on cultivated—and meanwhile remarkable—ornamental palms in gardens and parks and on the invasive Chinese windmill palm (*T. fortunei*), which is currently spreading in the peri-urban forests (Conedera et al. 2018; Fehr et al. 2020, 2024). While the palm borer moth could have a positive effect by controlling the spread of the Chinese windmill palm in forests, its effects on non-invasive palm species are undesirable, given the iconic role of ornamental palms in the (sub)urban landscape of southern Switzerland (Vogelaar and Hale 2014; Tonellotto et al. 2022).

Here, we present the first records of establishment of *P. archon* in southern Switzerland, the observed attributed damages on the different palm host species and discuss the future implications of the presence of the moth on the naturalized populations of *T. fortunei* and on cultivated palms within the whole cross-border Insubric region between Switzerland and northern Italy.

Materials and methods

After receiving reports of several sightings of *P. archon* individuals in August 2023, we conducted non-systematic surveys in areas close to these initial observations searching for individuals of *P. archon* and species-specific damage signs on palms. Typical damage caused by *P. archon* includes entry holes and sawdust-like material within leaf axils in the upper part of the stem

Table 1. Confirmed records of the palm borer moth (*Paysandisia archon*) in Switzerland based on observations of the insect or on attributed damage on the host palm individuals.

Locality	Insect record		Damage record			Environment	Observation date	X/ Y coordinats (CH1903 / LV03)
	Metam. stage	n	Host palm species	n	Damage type			
Brissago (TI)	adult moth	4	–	–	–	Garden/park	2023-08-11	698003 / 107725
Brissago (TI)	–		*Brahea armata*	1	foliage damage	Garden/park	2023-09-06	698062 / 107554
Brissago (TI)	–		*Chamaerops humilis*	1	foliage damage	Garden/park	2023-09-06	698058 / 107562
Brissago (TI)	pupal casing	1	*Phoenix canariensis*	1	holes and tunnels	Garden/park	2023-09-06	697987 / 108233
Brissago (TI)	–		*Trachycarpus fortunei*	1	foliage damage	Garden/park	2023-05-31	698006 / 107675
Brissago (TI)	–		*Trachycarpus fortunei*	12	foliage damage	Garden/park	2023-09-06	698006 / 107675
Ronco s./ Ascona (TI)	adult moth	1	–	–	–	Garden/park	2023-07-29	699547 / 111018
Porto Ronco (TI)	adult moth	1	–	–	–	Garden/park	2023-07-30	699012 / 109984
Gudo (TI)	–		*Trachycarpus fortunei*	1	foliage damage	Forest (naturalized palm)	2021-08-08	717093 / 114672
San Antonino (TI)	larva	10	*Chamaerops humilis*[1]	11	sawdust and foliage damage	Plant nursery	2023-10-13	718125 / 113661
San Antonino (TI)	–		*Trachycarpus fortunei*	10	foliage damage	Plant nursery	2023-10-13	718101 / 113637
Lugano (TI)	–		*Trachycarpus fortunei*	2	foliage damage	Garden/park	2023-09-22	716871 / 95268

[1] Cultivated in pots

on one side and/or regularly holed palm leaf segments indicating larval activity within the palm heart (Kontodimas et al. 2017). We additionally created an online database to compile the reported sightings, including further reports from private people and environmental authorities, we received in the meanwhile. For each record, we documented details including, e.g., type of observation (e.g., adult moth, larvae, pupa, pupal casing, and/or characteristic damage to the host species), exact location, host palm species, and date of observation.

Results

Sightings of *P. archon* specimens and/or damages attributed to *P. archon* have been confirmed in Brissago, Porto Ronco, Ronco s./Ascona, San Antonino, Gudo, and Lugano (Table 1; Figure 1). In total, five observations of adult moths were recorded across the three localities Brissago, Porto Ronco, and Ronco s./Ascona (Figure 2A). However, damage attributed to the palm borer moth was more extensively documented, particularly in Brissago, where various palm species showed signs of infestation. Here, beside 12 infested individuals of *T. fortunei* (Figure 2B), three other palm species (*Brahea armata* S. Watson, 1876, *Chamaerops humilis*, and *Phoenix canariensis* H. Wildpret, 1882) exhibited foliage damage. In the same planting in Brissago, two other host palm species originating within the native distribution of *P. archon* (i.e., *Butia odorata* (Barb. Rodr.) Noblick, 2011 and *Trithrinax campestris* Burmeist. 1879) did not show any signs of infestation.

In a plant nursery in San Antonino, 11 individuals of potted *C. humilis* were infested by larvae of *P. archon* and displayed foliage damage and saw dust on the stem. At the same nursery, we also recorded foliage damage caused

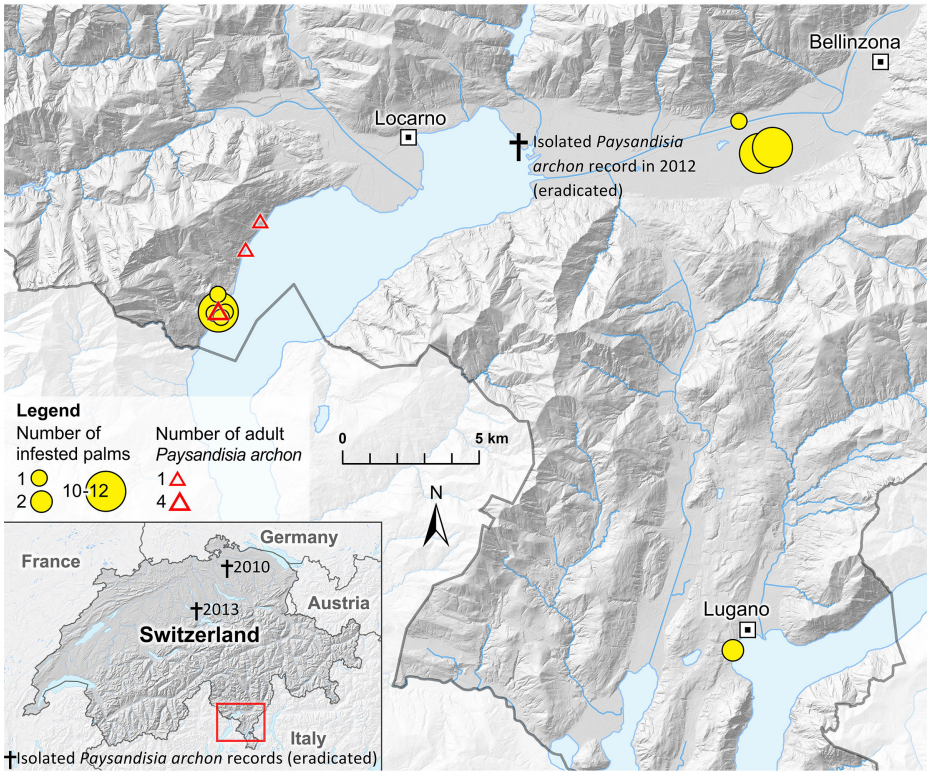


Figure 1. Map showing locations of the records of *Paysandisia archon* since 2021 in southern Switzerland. Red triangles represent records of observed adult individuals of *Paysandisia archon*. Yellow dots represent records of damages on palms attributed to *Paysandisia archon*. The size of the triangles and dots represent the number of observed adult moths and damaged palms, respectively. Black crosses represent isolated and eradicated occurrence records of *P. archon* (also including records from north of the Alps) before 2023 (see also Supplementary material Table S1).

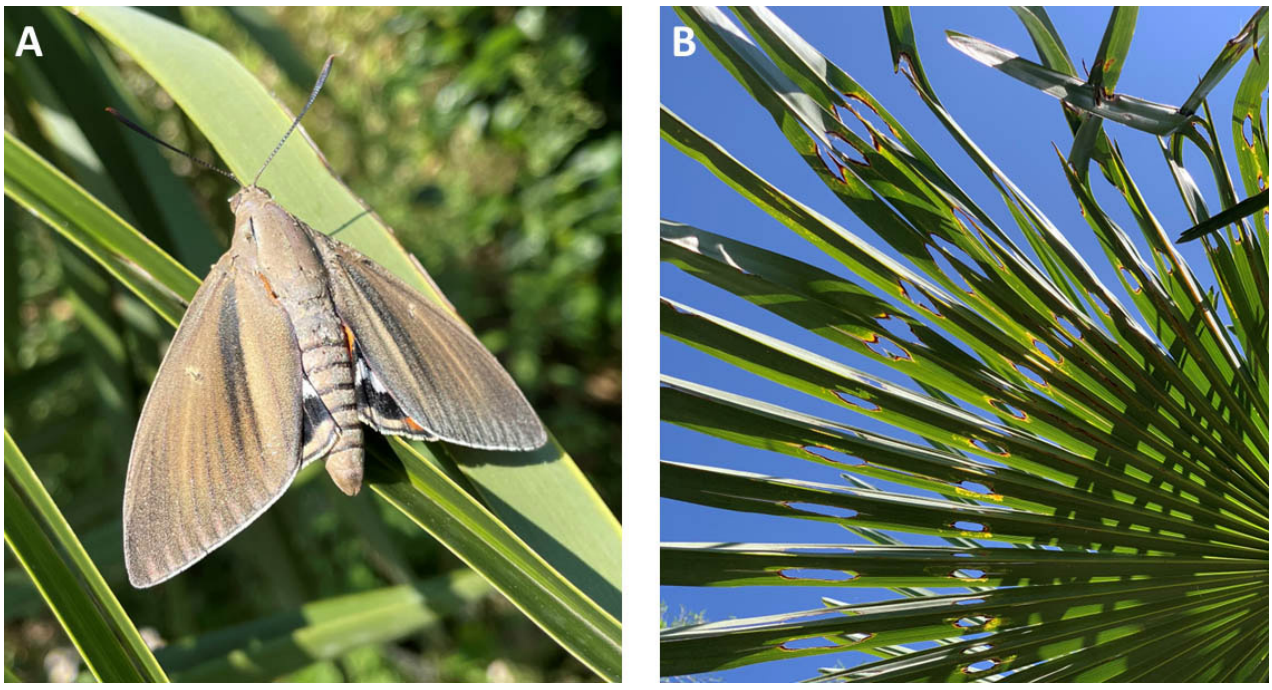


Figure 2. (A) Adult palm borer moth *Paysandisia archon* in Brissago (photo by Luca Pagano) and (B) Chinese windmill palm *Trachycarpus fortunei* leaf showing regularly holed leaf segments, a typical characteristic of an infestation by *P. archon* (photo by Vincent Fehr).

by *P. archon* on ten individuals of *T. fortunei* cultivated in the ground. All recorded infested palms in 2023 refer to cultivated individuals in gardens or parks. Based on a photograph dated 2021 of a small damaged naturalized palm in the forest understory (municipality of Gudo), we could however assume an even earlier arrival of the moth and its potential of attacking naturalized palms as well.

Discussion

Our findings indicate an established presence of the palm borer moth *Paysandisia archon* affecting several cultivated and one naturalized invasive palm species in southern Switzerland. As *P. archon* is already present around lake Garda infesting cultivated palm species (Mori et al. 2023), it was expected that it will sooner or later arrive in an area of a high density of cultivated and naturalized *T. fortunei* palms such as southern Switzerland (Fehr et al. 2024). The already high local infestation rate in Brissago suggests that the moth was most likely already present within the region, remaining however undetected for several years. In line with this, we assume that additional, yet undiscovered populations exist in southern Switzerland. A likely pathway of the introduction of *P. archon* was the continuous import of ornamental palms in the region, including infested ones (Muñoz-Adalia and Colinas 2020), as indicated by the highly infested potted *Chamaerops humilis* individuals in a nursery in San Antonino. A natural dispersion (flying moths) from neighbouring Italy seems on contrary less probable, as the flight activity of the moths is generally limited to short distances (Liégeois et al. 2016).

Before 2023, only three isolated occurrences of *P. archon* were documented in Switzerland – two in plant nurseries in 2010 and 2012 and one in 2013 in a garden (Supplementary material Table S1; Colombi et al. 2012; Rezbanyai-Resel 2013; EPPO 2020). Until 2020, *Paysandisia archon* was classified in Switzerland as a particularly dangerous quarantine organisms under the National Plant Health Legislation (PSV, 916.20, Teil A, Art. 21.1, 2019/09/01). As a result, any detected *Paysandisia archon* individuals and infested palms were immediately eradicated, leading to no further detections during subsequent random surveys in the following years (EPPO 2020). Since January 1st, 2020, however, *Paysandisia archon* is no longer classified as a particularly dangerous quarantine organism under the National Plant Health Legislation (PGesV-WBF-UVEK, SR 916.201, Annex 1, 2020/01/01), possibly resulting in less stringent eradication measures eventually allowing its establishment.

Nearly all palm species presently cultivated in southern Switzerland are potential hosts of the palm borer moth (EFSA 2014), however, substantial differences in *Paysandisia archon*'s preferences for different host palm species have been observed (Mori et al. 2023). Evidence from other regions suggest possible strong damages on and losses of cultivated palm specimens

in gardens and public parks in the future. For example, some over 100-year-old individuals of *Jubaea chilensis*, *Brahea armata*, and *Butia odorata* (Fehr and Burga 2016) of remarkable monumental value are at immediate risk.

As palms are considered as iconic elements of the (sub)urban landscape in southern Switzerland (Tonellotto et al. 2022), they hold strong sociocultural value and consequently are also of high economic value for the tourism and the landscaping industry. Consequently, it is crucial to implement effective measures to protect these palms from *P. archon.*

Conversely, *P. archon* is also expected to have a desirable effect as it is likely to control the invasive Chinese windmill palm *T. fortunei* (Fehr et al. 2024). *T. fortunei* escaped from cultivation into the peri-urban forests, where it is locally building dense populations in the forest understory and posing a potential threat to alluvial forest ecosystems (Fehr et al. 2024) and potentially increasing the intensity of forest fires on the peri-urban forested slopes, where many ignitions occur (Fehr et al. 2024). *Trachycarpus fortunei* is one of the most suitable hosts of *P. archon* and the mortality rate after infestation is very high (Isidoro et al. 2017; Muñoz-Adalia and Colinas 2020). For example, in the French region Languedoc-Roussillon, *P. archon* reduced the number of *T. fortunei* by 80 to 90% within 10 years (EFSA 2014). Considering this and that *P. archon* is already present in several areas in southern Switzerland together with the very high density of *T. fortunei* in gardens and parks (Tonellotto et al. 2022), we expect a continuous expansion of *P. archon* within southern Switzerland strongly reducing the number of *T. fortunei* individuals in cultivation and of naturalized individuals in the forest understory, as was already shown for naturalized palm stands in other regions of the world after the arrival of palm pests such as *Rhynchophorus* spp. (Milosavljević et al. 2019; Fehr et al. 2020).

In northern Switzerland, a possible establishment of *P. archon* will depend on both climatic and human factors, i.e., introduction events of *P. archon* individuals (which has already occurred at least twice in the past; see Table S1), the availability of sufficient cultivated host palms, and mild winter climatic conditions (Mori et al. 2023). The highest palm densities in northern Switzerland are found in microclimatically favorable areas near lakes or in large cities (V. Fehr *personal observation*). We anticipate that *P. archon* larvae are likely to survive the winters in these areas, as they have been observed to establish in regions with comparable winter temperatures, such as the French Rhône Valley (see the iNaturalist occurrence records reported in Figure S1). Although palm density is substantially lower in northern Switzerland compared to the south, the most commonly cultivated *T. fortunei* is a highly preferred host plant for *P. archon*. We thus do not exclude possible local establishments of *P. archon* in northern Switzerland in the future.

Given that complete eradication of *P. archon* in southern Switzerland is not feasible, the current goal should focus on slowing the spread of *P. archon* by removing and properly disposing infested palm trees. Special attention

should be given to the proper disposal of infected palm material. It is crucial to avoid transporting it over medium and long distances and to ensure it is not disposed of in inappropriate waste dumps. This approach aims to safeguard non-invasive ornamental palm species, while the authorization of sustainable techniques and products for controlling *P. archon* should be anticipated by the national and regional authorities. At present, some promising techniques and products are commercially available in the European Union, none of these are however currently approved in Switzerland (BLV 2024). The future management strategy to mitigate the impact of this pest should consider the diverse stakeholder interests (e.g., environmental authorities, tourism, and landscaping industries). Initiatives should include a public awareness campaign to inform the community about the control of *P. archon* and to promote cooperation with neighbouring regions, as well as experts in entomology and pest management. Future research efforts should focus on monitoring the spread dynamics of *P. archon*, evaluating the sensitivity of different palm species to this pest.

Authors' contribution

VF: research conceptualization, sample design and methodology, investigation and data collection, data analysis and interpretation, writing – original draft; GBP: research conceptualization, sample design and methodology, investigation and data collection, data analysis and interpretation, funding provision, writing – review and editing: MC: research conceptualization, sample design and methodology, writing – review and editing; AM: sample design and methodology, sample design and methodology, writing – review and editing.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Isolated occurrence records of the palm borer moth (*Paysandisia archon*) in Switzerland (also including records from north of the Alps) before 2023.

Figure S1. Occurrence records of *Paysandisia archon* (red pins) in the French Rhône Valley on iNaturalist [accessed 28 of August 2024].

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