EUROPEAN JOURNAL OF ENTOMOLOGY
ISSN (online): 1802-8829
http://www.eje.cz
Eur. J. Entomol. **123**: 217–232, 2026
doi: 10.14411/eje.2026.022
ORIGINAL ARTICLE

Worldwide distribution and invasion status of *Vespa velutina* (Hymenoptera: Vespidae), the yellow-legged hornet, in 2025

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Key words. Biological invasion, invasive species, new occurrences, pollinators, predator, southern hemisphere

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Abstract. The yellow-legged hornet, *Vespa velutina* var. *nigrithorax*, is an invasive generalist predator that preys heavily on honeybees and other pollinators. Native to eastern China, northern Vietnam, and foothills of the Himalaya, it has invaded and now inhabits most of South Korea and western Europe. Here we summarize discoveries of *V. velutina* documented for the first time during 2025 in New Zealand (the first confirmed records from the southern hemisphere), Algeria (the first records from Africa), Northern Ireland, Denmark, and several European islands (Sardinia, the Azores, and the Isles of Scilly). We also review recent changes in the distribution of *V. velutina* elsewhere in Europe and North America. These range expansions highlight the high reproductive rate of the species; the extensive dispersal of young queens, both naturally and via shipments of goods by sea and over land; the ability to establish new populations despite low genetic variability; and the potential of *V. velutina* to harm pollinators and pollination systems.

INTRODUCTION

Vespa velutina var. *nigrithorax* du Buysson, 1905 (Hymenoptera: Vespidae) (hereafter referred to by the species name *V. velutina* Lepeletier, 1836), commonly known as the yellow-legged hornet, has attracted growing scientific attention due to its capacity for dispersal and establishment in new regions where it exerts substantial environmental and socioeconomic impacts. Native to eastern China, northern Vietnam, and a region in the foothills of the Himalayas (Perrard et al., 2014), this variety of the species is a generalist predator of arthropods with high ecological plasticity, traits that have enabled it to adapt successfully to various environments far beyond its native range (Otis et al., 2023). Since 2004, its range has expanded dramatically, rapidly extending to most continents and becoming a widespread invasive species of global significance. Its populations generate major ecological and socioeconomic concerns, particularly due to its impact on honey bees and other insects and the costs of mitigation or control in regions it has invaded (Lioy et al., 2022). The expanding distribution of this species is an ongoing process as it colonizes an increasing number of territories, thereby requiring continuous monitoring and emphasizing the need for a globally coordinated response.

Vespa velutina causes extensive damage and disruption to honey bees via both direct predation and behavioural modification, specifically foraging paralysis (Monceau et al., 2014; Requier et al., 2019; Rojas-Nossa et al., 2022b). The species also preys on a wide range of other insect taxa (Rome et al., 2021; Verdasca et al., 2022), thereby altering pollination networks at both local and landscape scales (Rojas-Nossa et al., 2020, 2023; O'Shea-Wheller et al., 2023). These documented effects underscore its role as a major invasive predator and competitor with profound ecological repercussions. Moreover, its economic consequences are substantial. For example, losses of honeybee colonies caused by *V. velutina* have been estimated to cost €30.8 million per year in France alone (Requier et al., 2023). In Spain, within ten years of its first detection it had become the eighth most costly invasive species (management costs in 2020: US $5.33 million; Angulo et al., 2021). The species also negatively affects specialty crops by damaging ripe fruits such as wine grapes (Lueje et al., 2024; Nave et al., 2024). Although current knowledge of broader ecological effects remains limited, emerging evidence suggests the hornets may transmit insect pathogens between species (Gabín-García et al., 2021). Further consequences of *V. velutina* invasions on local ecosystems, such as bottom-up or top-down trophic cascades, remain largely unexplored, highlighting the need for integrative ecological studies to better assess the long-term impacts of this species across its invasive range.

The first well-evidenced instance of the species becoming established as an invasive population was in the Republic of Korea (South Korea), soon after it was first recorded there in 2003 (Kim et al., 2006). It rapidly spread throughout the country and has become the most abundant hornet (*Vespa*) species there (Choi et al., 2012; Park et al., 2025). From South Korea, it colonized the nearby Japanese island of Tsushima (Takeuchi et al., 2017), followed shortly thereafter on Kyushu (Minoshima et al., 2015).

In Europe, after being detected in 2004 in southwestern France, it quickly became apparent that *V. velutina* had already established a rapidly expanding breeding population (Villemant et al., 2006). Genetic analyses suggested that the invasion in France was likely initiated by a single queen mated by four males (Arca et al., 2015), highlighting the high potential for new exotic populations of this species to become established beyond its known distribution (Otis et al., 2023). Over the following years, *V. velutina* has spread widely across much of western Europe (Rome, 2026).

The aim of this review is to provide a comprehensive summary of the current distribution of *V. velutina* by synthesizing recent discoveries. The increasing incidence of the species in multiple regions underscores the necessity of international collaboration to track its expansion, assess associated ecological and economic risks, and design effective control strategies. In doing so, this paper seeks to raise awareness among researchers, policymakers and stakeholders about the critical importance of proactive and coordinated responses to mitigate the negative effects of *Vespa velutina* on beekeeping, pollination services, and biodiversity.

MATERIAL AND METHODS

Here we summarize new and recent records of *V. velutina,* reported through 31 December 2025, of *V. velutina* from countries outside of its native range in Asia. The authors contributed details, sometimes identified by their initials, that they gained from their personal field experience or knowledge of its current status within the geographic region in which they work. Individuals in several countries were not included either because they declined our invitation to share authorship (Denmark, the Netherlands, and New Zealand), the discoveries of hornets were few and information about them was available in websites (Northern Ireland, Republic of Ireland), or information from the surrounding country (i.e., France) made reporting unnecessary (i.e., Monaco).

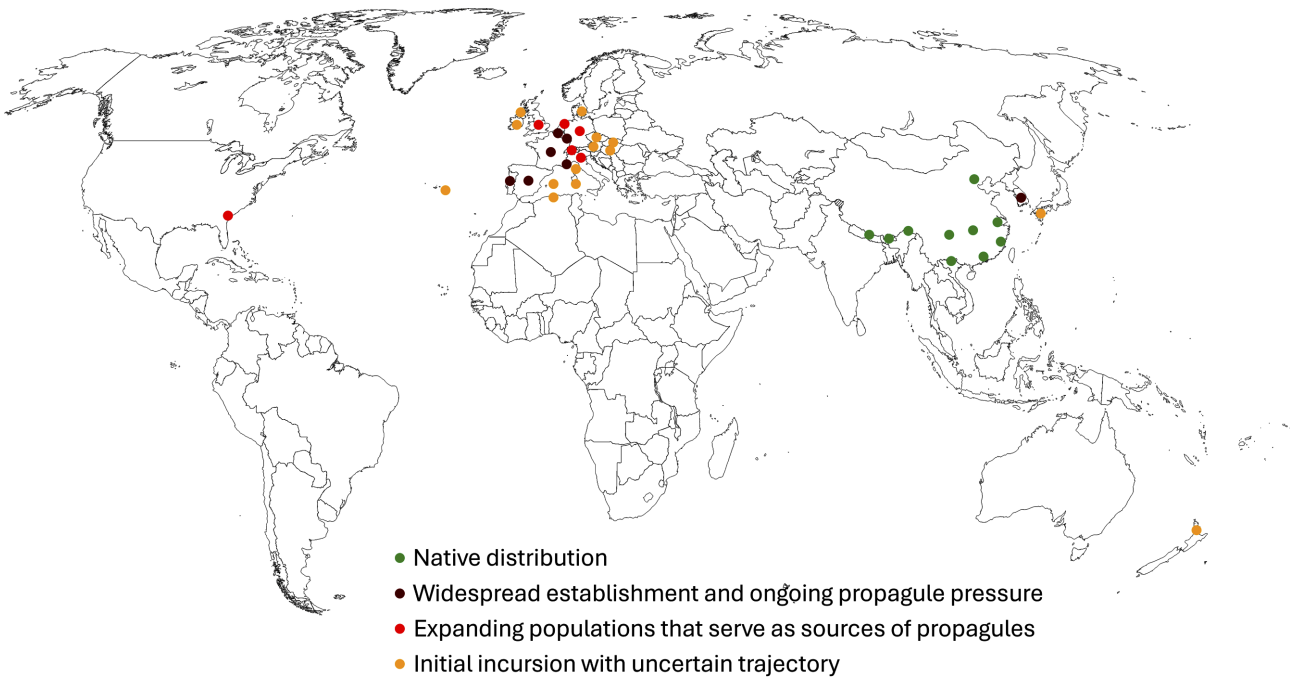

Fig. 1. Distribution of *Vespa velutina* var. *nigrithorax*. Data for its native range in Asia from Villemant et al. (2011). Refer to text for details on invasive data.

For those areas and countries not covered by the authors, we obtained additional information about recent invasions through Web of Science and targeted internet searches, using the keywords "*Vespa velutina*" or "Asian hornet" coupled with the name of a country or island. (References retrieved that related to the "Asian hornet" *Vespa mandarinia* Smith were ignored.) Wherever possible, websites have been archived to retain the version available on the dates they were accessed. Additionally, we searched two community science platforms, iNaturalist (www.inaturalist.org) and Observation (www.observation.org), for reports of hornets from regions peripheral to documented invaded areas. In a few instances we communicated directly with contributors to those platforms to verify details of reports.

We frame current patterns of invasion into the following three categories by classifying regions with recorded presence according to invasion stage, population dynamics, and propagule pressure (Simberloff, 2009; Essl et al., 2015).

Initial incursion with uncertain trajectory

Countries/regions in the earliest stage of invasion, characterized by few records and high uncertainty regarding whether the species will persist, disappear, or expand. This category aligns with the concept of lag phases in early invasions, where outcomes are highly stochastic and depend on both propagule pressure and environmental context.

Expanding populations that serve as sources of propagules

Countries/regions where populations are actively expanding and could also serve as sources of propagules (reproductive females, i.e. gynes) that colonize new areas. This stage corresponds to the post-establishment expansion phase described in the unified invasion framework, in which established populations increase their range rapidly.

Widespread establishment and ongoing propagule pressure

Countries/regions where the species has become established and populations are relatively stable, yet continue to generate propagules capable of sustaining local populations as well as dispersing further. This category reflects the concept of sustained propagule pressure which is a key driver of persistence and dispersal.

RESULTS

By the end of 2025, *Vespa velutina* had been recorded in 23 countries and on four continents outside of its native range in Asia (Table 1; Fig. 1). Below, we summarize re-

Table 1. Countries in which *Vespa velutina* var. *nigrithorax* has been detected outside of its native range in Asia, listed in chronological order by the year of first detection and alphabetically within the year.

Country	Year	Reference
Republic of Korea	2003	Kim et al., 2006
France	2004	Villemant et al., 2006
Spain	2010	Castro & Pagola-Carte, 2010
Belgium	2011	Bruneau, 2011
Portugal	2011	Grosso-Silva & Maia, 2012
Japan	2012	Sakai & Takahashi, 2014
Italy	2014	Demichelis et al., 2014
Germany	2014	Witt, 2015
Monaco	2015	Q. Rome, pers. comm.
Great Britain	2016	Budge et al., 2017
Netherlands	2017	Smit et al., 2017
Switzerland	2017	SCNAT, 2017
Luxembourg	2020	Ries et al., 2021
Republic of Ireland	2021	Dillane et al., 2022
Czech Republic	2023	Walter et al., 2024
Hungary	2023	Márta & Vas, 2023
United States of America	2023	Hoebeke et al., 2024
Austria	2024	Schorkopf et al., 2024
Slovakia	2024	Purkart et al., 2025
Algeria	2025	Semmar, 2025
Denmark	2025	Current paper
New Zealand	2025	Current paper
Northern Ireland	2025	Current paper

Fig. 2. Left: *V. velutina* photographed in the Botanical Garden Hamma, Algiers, on 17 August 2025, by Kevin Snair (iNaturalist, 2025a). Right: Embryo nests (incipient nests) collected on the north shore of Auckland, New Zealand, on 14 and 24 November, 2025. Photo courtesy of Guaraci Dias.

cent reports (2023 through 2025) of the species in various countries and major islands, excluding those where it has been established throughout the country for several years (e.g. Belgium, mainland France, Monaco, and South Korea (Park et al., 2026; Rome, 2026).

Countries with initial incursions and uncertain trajectory of *Vespa velutina*

Algeria

First records in 2025. Author KS photographed an individual *V. velutina* in the Botanical Garden Hamma, Algiers, on 17 August 2025 (Fig. 2 left; iNaturalist, 2026a). A second hornet was photographed a month later only 4 km west of the first (iNaturalist, 2026b; Semmar, 2025). These represent the first confirmed recent detections of *V. velutina* on the African continent. Pierre Doué collected a single female *V. velutina velutina*, the subspecies endemic to Java and Bali, in Egypt in 1855 (Chagnoux, 2026); there have been no subsequent observations there. The late summer dates suggest that at least one nest existed within Algiers. We are unaware of other observations and cannot comment on whether the species has established there.

Austria

A single queen hornet was collected in Salzburg on 9 April 2024 (Schorkopf et al., 2024). No additional individuals of the species had been reported in Austria by the end of 2025 (Linde Morawetz, pers. comm.).

Czechia

A photograph taken by a member of the public in the northern part of Plzen city, western Bohemia, on 5 October 2023, proved to be the first record of *V. velutina* from the Czech Republic. Several other individual hornets at this site were caught and tracked back to a nest which was then destroyed (Walter et al., 2024). In the same general region, five overwintering queens were intercepted on a truck from France in February, 2024. The species was also reported during October 2023 in the vicinity of Drahelcice, central Bohemia; however, no additional individuals were caught there subsequently. Finally, a small secondary nest was located and then destroyed in July 2024 near Opava, northeastern Czechia.

Invasive species in the Czech Republic are monitored by the Nature Conservation Agency that also coordinated the preparation of an eradication plan for *V. velutina* (Skuhrovec & Pergl, 2023) and administers "Invazní druhy" (Invasive species) (Nature Conservation Agency of the Czech Republic, 2026), a platform for reporting invasive species. The eradication plan outlines the procedures for monitoring and mapping of this species. Moreover, scientists and amateurs alike may use the application "Nahlaš sršeň" (Report a Hornet) (Zaoral, 2025) or the platform NAJDI.JE (Czech Agrifood Research Center, 2026).

Denmark

First record in 2025. A single individual that landed in a glass of beer near the town of Kertinge, in the northeast of the island of Fyn, on 4 September 2025, was the first record from Denmark (Per Kryger, pers. comm.). Given the climate in Denmark and the date of observation, we reason that a worker hornet sighted at that time of year likely was associated with a nearby nest, but there were no additional sightings to confirm this speculation.

Hungary

In August 2023, foraging *V. velutina* were observed at apiaries in Kimle, northwestern Hungary, close to the Austrian and Slovak borders (Kolics et al., 2025a). The nest was eradicated following successful radio-telemetric localization. Genetic analyses (COI gene sequencing) confirmed that the specimens belonged to the invasive population of western Europe (Kolics et al., 2025a). As no further sightings were recorded in either 2024 or 2025, there is no evidence of an established population in Hungary.

New Zealand

First records in 2025. In July, 2025, two male *V. velutina* were detected in the Auckland suburbs of Grafton and

Albany, approximately 17 km apart and on opposite sides of Waitemata Harbour (Inglis, 2025a). This represents the first detection of *V. velutina* var. *nigrithorax* in the southern hemisphere. These males were the only evidence of the presence of the species until mid-October, when a queen constructing an embryo nest (i.e., incipient nest) was discovered in the suburb of Glenfield (Inglis, 2025a). Between mid-October and the 22 December, 2025, 38 queen hornets were collected in a relatively small region surrounding the communities of Glenfield and Birkdale on Auckland's North Shore (Fig. 2, right). Of those, 25 were associated with nesting activities (Inglis, 2025b). The more than 200 post-diapause queens and colonies that were detected prior to the end of the nesting season (Biosecurity New Zealand, 2025) is concerning but may reflect in part the intensive detection effort. Genetic evidence suggests that the incursion in New Zealand resulted from a single inseminated queen (Scott Sinclair and Guaraci Dias, pers. comm.). A significant operation is in progress at the time of writing to eradicate *V. velutina* from the country.

Northern Ireland

First record in 2025. A resident of an eastern suburb of Belfast captured a *V. velutina* on 10 October 2025. After additional sightings of hornets nearby, a nest was located and destroyed (Anonymous, 2025a). This discovery was confirmed by Invasive Species Northern Ireland (ISNI, 2025).

Republic of Ireland

A dying hornet, likely a gyne, was discovered in Dublin in April, 2021 (Dillane et al., 2022). Its mtDNA lineage was the same as that documented throughout Europe (Dillane et al., 2022). There were no additional reports near Dublin until a single specimen was photographed there in July, 2025 (Invasives.ie, 2025). Shortly thereafter, beginning on 31 July, 36 *V. velutina* workers were sighted over a period of five weeks in the vicinity of Cork, following which two nests were located and destroyed. There were no additional records in the Republic of Ireland after 24 September (Invasives.ie, 2025).

Slovakia

Vespa velutina was first detected in Slovakia while feeding on fallen apples in Palárikovo, Nové Zámky District, on 28 September 2024 (Purkart et al., 2025). Others were detected in the following days, after which hornets fitted with radio transmitters were tracked to the approximate nest location (Kolics et al., 2025b). A thermal-imaging drone aided in locating a nest which was subsequently eradicated (Purkart et al., 2025). A segment of the COI mtDNA gene that was sequenced was identical to sequences from other European populations of *V. velutina* (Kolics et al., 2025b). Additionally, a single male was discovered in Dolný Ohaj on 15 October 2024, 14.5 km east of Palárikovo (Purkart et al., 2025). These observations represent the easternmost localities of this invasive hornet in Europe to date. More recently, on 17 March 2025, a mated gyne was discovered in the municipality of Pravenec, Trenčín Region, during the unpacking of goods transported from Karlsruhe, Germany. Finally, on 10 December 2025, a mated gyne was discovered in the industrial park of Lozorno, only 8 km east of the border with Austria, in a shipment of goods transported from Hungary.

Potential occurrences of the species in Slovakia can be reported through several channels, including the mobile application "Zastav sršňa" (Stop the Hornet) which was used to submit the first and the most recent confirmed records.

Countries with expanding populations that serve as sources of propagules

Germany

By the end of 2023, *V. velutina* had become prevalent in the western states of Baden-Württemberg, Hessen, North Rhine-Westphalia, Rhineland-Palatinate and Saarland (Requier et al., 2025). In 2024 and 2025, a pronounced eastward expansion and more widespread establishment of the species in additional states became evident (Bienenkunde, 2026). This development has been documented through state-level reporting platforms in several of Germany's 16 federal states, as well as through intensified public awareness activities. Notably, isolated records were reported in northern Germany (e.g. Hamburg; Husemann et al., 2020) and eastern Germany (e.g. Berlin) in 2023, followed by reports in several additional states in 2025 (Bienenkunde, 2026). Initially, German officials were legally obligated to eradicate all detected nests. However, this requirement was lifted in spring of 2025, when *V. velutina* was reclassified as an established invasive species. Since then, a nationwide management plan has provided a framework for federal and state authorities to implement measures based on cost-benefit assessments (Anonymous, 2025b).

Great Britain

Vespa velutina continued its establishment in Great Britain in 2025, with 544 credible sightings reported and 162 nests located and destroyed that year alone (Bee Base, 2025). A nest was discovered and destroyed in Runcorn (Cheshire) on 3 September 2025. Two months later, on 1 November, an individual was photographed in Crosby, Merseyside, approximately 30 km NW of Runcorn (Hedges, 2025). These are the first observations of the species in North West England. Together with the discovery and destruction of a nest in Langton, North Yorkshire, on 8 September 2025, these observations are approaching the predicted limits of climatic suitability for *V. velutina* in Great Britain (Keeling et al., 2017). Early analyses indicated that colonizing hornets derived from the European population (Budge et al., 2017). Due to the high number and widespread distribution of observations in England during 2025, spring trapping of gynes was suspended there (Bee Base, 2026).

The ability of this species to colonize relatively remote sites was demonstrated by the discovery of a foraging hornet in the town of Tresco, Isles of Scilly, on 21 September 2025, approximately 40 km WSW of the southwestern

tip of England. Its nest was quickly located and destroyed (Tresco Island, 2025).

Italy (including Sardinia)

Vespa velutina was detected on the island of Sardinia for the first time on 23 July 2025. An individual hornet hawking bees at a hive in the town of Ilbono (Province of Nuoro, east central Sardinia), was reported by a beekeeper to a community science website (Stop Vespa Velutina, 2025a). After its identity was confirmed by MP, additional hornets were detected in two nearby apiaries. Through telemetry techniques, a nest was found on 4 August in the adjoining town of Lanusei (Stop Vespa Velutina, 2025a), approximately 15 km west of the port of Tortoli.

The species continues to expand its range in continental Italy. For example, it has been documented along the west coast as far south as Sgrilla, Province of Grosseto (Stop Vespa Velutina, 2025b) and in the northeastern provinces of Rovigo (in 2016), Venice (in 2021), and Padua (in 2023), region of Veneto (Rome, 2026). Hornets from a nest discovered 10 km east of the city of Bologna in December, 2023, were studied by Cilia et al. (2024). Of particular note, an individual hornet was photographed in September, 2024, in the city of Lecce on the Salentine Peninsula, extreme southeastern Italy, followed by a record of a nest ~20 km away in Sternatia on 31 December, 2025 (Stop Vespa Velutina, 2025b). Genetic analyses placed Italian specimens within a cluster that included samples from other European locations, confirming they are derived from the population established initially in southwestern France (Granato et al., 2019).

Japan

Vespa velutina was first detected in 2012, on northern Tsushima Island (Sakai & Takahashi, 2014), only 50 km from Busan, South Korea, where the species had already become common (Choi et al., 2012). Shortly thereafter, a survey determined that the species had become naturalized on Tsushima (Ueno, 2014). Subsequently, several queens and nests were detected and killed in no less than six locations on Kyushu Island, as well as a colony and overwintered gyne on Iki Island and one nest in Hofu at the southwestern end of Honshu, the largest island of Japan (Okuyama & Takahashi, 2018; Takahashi, pers. comm., 7 Sept. 2025; TU, unpubl. observ.). Genetic analyses suggest that the hornets that have colonized Japan derived from South Korea (Takeuchi et al., 2017). In all instances except on Tsushima, the establishment of the species seems to have been prevented by the coordinated efforts of government agencies, scientists, pest control operators, and beekeepers.

Netherlands

The first nest of *V. velutina* in the Netherlands was detected in 2017 in the province of Zeeland, southwestern Netherlands (Smit et al., 2017). Subsequently, the population expanded northward at an estimated rate of 58 km/yr, with more than 500 nests reported in 2023 (Zeegers & Buesink, 2024). Zeegers & Buesink (2024) estimated the population growth rate to be approximately 7X/yr (range: 5-10X/yr). Relatively few observations have been reported north of Amsterdam (Observation, 2026) and the species remains uncommon in the three northern provinces. However, modelling has predicted that suitable habitat occurs throughout the Netherlands (Hassall et al., 2025) and the species is expected to soon be common throughout the country. In response to the large and growing population of *V. velutina*, eradication has been deemed to be no longer possible. Currently the management of colonies is to be proportionate to their environmental impact, risk to humans, and the relative costs to benefits of removal (Zeegers & Buesink, 2024)

Switzerland

The first *V. velutina* in Switzerland, a single queen in April 2017, was sighted in the canton of Jura in the northwest of the country (SCNAT, 2017). In 2019, the first small nest was found in the western canton of Vaud, followed by confirmation of successful establishment in Switzerland in 2020 when two secondary nests were found in Geneva and the canton of Jura (Cherix et al., 2021). The rainy and cool spring of 2021 was unfavourable for *V. velutina:* only one primary nest and three small secondary nests were located, all in Geneva (Cherix et al., 2022). Subsequently, the hornet population expanded rapidly to the north and east. The numbers of nests reported grew from 11 in 2022 to 222 in 2023, 785 in 2024, and 3030 in 2025 (Cherix et al., 2023, 2024; Seehausen et al., 2025, 2026). Currently, the species occurs north of the Alps, with only a single individual observed in the southern canton of Ticino, in 2020 (Info Fauna, 2026).

The invasion of *V. velutina* is closely monitored, and annual updates of the invasion status are reported in Swiss beekeeping journals. In 2023, a national monitoring platform was introduced (Frelonasiatique, 2026), where sightings can be reported with supporting photos or videos. Reports that are verified by experts are forwarded to cantonal authorities. The observations are then published in real-time on a map accessible through that monitoring platform as well as on a map of "info fauna," a data and information centre for fauna in Switzerland (Info Fauna, 2026).

United States of America

The first detection of *V. velutina* in the Americas was of a forager collected at bee hives by a novice beekeeper in Savannah, Georgia, in early August 2023. By the end of the calendar year, Georgia Department of Agriculture personnel had located, via catch and release of hawking workers, five nests in a relatively small region; all five were destroyed prior to the production of reproductives (Hoebeke et al., 2025). However, additional undetected nests were present, as indicated by numerous male hornets trapped across the greater Savannah region in December, 2023. The capture of 20 post-diapause queens in lethal traps in spring of 2024 confirmed that undiscovered nests had successfully reproduced in 2023. Over the subsequent two years, the numbers of post-diapause hornet queens trapped and nests destroyed in Georgia and South Carolina have

continued to increase. Specifically, during 2025, more than 525 queens were trapped in spring. Moreover, 152 nests were destroyed across the two states: 62 in Georgia (Clemson Regulatory Services, 2025) and 90 in South Carolina (Yellow-legged Ledger, 2025). The approximate area of the region where hornets and nests had been found by the end of 2025 exceeded 8 000 km^2 [estimated from maps provided in the Hornet Herald (for SC) and Yellow-Legged Ledger (for GA)]. A nest discovered in McConnells, York County, SC, approximately 340 km north of Savannah, on 9 December, 2025 (Clemson Regulatory Services, 2025), presumably was the result of a human-mediated accidental transport of a diapausing queen. Periodic updates on the *V. velutina* situation are provided in the Clemson Regulatory Services (2025) and Yellow-Legged Ledger (2025).

Early genetic analysis to characterise the mitotype of the invasive population pointed to an Asian rather than a European origin (Hoebeke et al., 2025). Subsequent genetic sequencing has corroborated a non-European origin (LJB, BAT, and Brock Harpur, unpubl. data), although the limited resolution of the population genetics within the native range of the species in Asia has thus far prevented more precise inference of the US population's origin. Both genetic sequencing and more classical SSR/microsatellite approaches suggest very little genetic variation and high inbreeding across the invading population (LJB, BAT, and Brock Harpur, unpubl. data). Evidence so far is consistent with the working hypothesis that the nests detected in 2023 were the offspring of a single nest established in 2022 that was headed by a doubly-mated gyne imported accidentally from Asia.

Widespread establishment and ongoing propagule pressure

France (including Corsica)

On the island of Corsica, foraging *V. velutina* were observed in an apiary in Bastelicaccia, Region of Ajaccio, on 29 August 2024. Several individuals were radio-tracked to a nest that was subsequently destroyed (Anonymous, 2024). Following the discovery of a second nest in Ajaccio in July 2025 and several additional hornets in September, local authorities established sentinel hives in Ajaccio to aid in detection of additional nests (L'environment de la Corse, 2025). At least one nest could not be located.

Vespa velutina has now colonized nearly all of continental France (Rome, 2026), with only colder mountainous regions remaining hornet-free. There have been no notable recent changes in its distribution there.

Luxembourg

Following its initial detection in 2020 (Ries et al., 2021), *V. velutina* is now considered established and widespread throughout Luxembourg. In particular, urbanised regions of Luxembourg-City and the Minett area in the south of the country are heavily invaded. Occasional records also exist for the Oesling region in the north, which is 300–400 m higher in elevation and more forested than the rest of the country. In 2025 alone, the Nature and Forest Agency Luxembourg (ANF) recorded 476 sightings and destroyed 220 nests (Marc Waxweiler, pers. comm.). Some beekeepers have reported severe reductions in colony populations that are thought to have been caused by *V. velutina*. The species is regularly detected in vineyards and orchards. A national emergency plan is in place to protect residents, biodiversity and honey production, as well as to coordinate ongoing surveillance and eradication activities (MECB, 2026).

Portugal

Vespa velutina is now commonly reported in those regions of Portugal that have a temperate climate. In contrast, it remains largely absent from relatively high elevation regions in the east and in the drier Mediterranean climatic region in the southeast (Verdasca et al., 2021). It is regularly encountered in western Portugal as far south as Setubal, and more sporadically further south (STOPvespa, 2025), and has had an average dispersal rate of 40 km per year (Carvalho et al., 2020). The lower Alentejo and Algarve regions were believed to be free of the species until 2025, when several individual hornets and nests were reported, including a nest near the southern coast in Lagos (STOPvespa, 2025; Rome, 2026). Invasion genetics indicate that the Portuguese population has significantly lower genetic diversity than the French population from which it was derived, possibly by jump dispersal from France (Quaresma et al., 2022).

Notably, a nest was reported 1500 km west of continental Portugal on São Miguel Island, the Azores archipelago, on 27 January 2025 (Governo dos Açores, 2025). It has not been reported in the Madeira archipelago.

Spain (including the Balearic Islands)

The species now is common across the northern provinces as well as most of Tarragona Province (southwest of Barcelona) (Lioy et al., 2022; Ramos-Chernenko, 2024; Rome, 2026). In contrast, in the Mediterranean area of southern Spain, *V. velutina* is not considered to be established but it has been detected there during the past four years. In Andalucía, the southernmost region of Spain, a nest was discovered and destroyed in Los Barrios (Cádiz Province) in 2022 (Ramos-Chernenko, 2024; Robla et al., 2026). An individual hornet was photographed near Punta Umbría (Huelva Province) in early March, 2024 (Robla et al., 2026). Additionally, the species has been recorded in Málaga Province: several individuals were observed and one photographed in Alhaurín de la Torre in July 2025 (Sáez Maldonado, 2025), with one nest detected by determining the paths and time taken by hornets to return to their nest after feeding on protein baits (Rojas-Nossa et al., 2022a; Álvaro García, pers. comm.). Individuals were also reported near Estepona, Málaga, on 10 October 2025 (Observation, 2026). Some models predict a few suitable areas for *V. velutina* in southern Spain, suggesting that the species may become more common there in the future (Bessa et al., 2016). General information from the Spanish administration on the distribution of the hornet can be consulted in MITECO (2026).

On the island of Mallorca, in the Balearic Islands, *V. velutina* was first detected in October 2015 in the Serra de Tramuntana (northwestern portion of the island). Between 2015 and 2017, 30 secondary nests were detected and eliminated, and a single occupied embryo nest was removed in 2018. Following two consecutive years without detections, the species was declared eradicated in 2020 (Leza et al., 2021). However, an isolated secondary nest was detected in 2021. Genetic analyses showed that samples from 2015–2018 were closely related to Italian populations, whereas 2021 samples were more similar to those from the Iberian Peninsula, particularly Catalonia, suggesting at least two independent introductions (Herrera et al., 2024). Following a further two-year absence, the species reappeared in the southwestern part of the island, with 20 nests detected in 2024 and 21 in 2025. These most recent records likely represent a third introduction; genetic analyses of hornets from these recent nests are ongoing.

Additional inconclusive records

Colombia

A photograph of pinned specimens posted to iNaturalist (2025c), reported to be from Valparaiso, Departamento de Antioquia, was not likely taken in that location. Entomologists from the Universidad Nacional de Colombia, local agricultural officials, and beekeepers investigated the region surrounding Valparaiso but were unable to verify the presence of the hornet (Gilberto Morales, pers. comm.). The iNaturalist record is no longer accessible on the website.

Norway

A photograph of *V. velutina* taken in Sandeford, on 2 November 2025, was posted anonymously to the biodiversity platform Observation. No details related to the hornet were submitted and the location corresponded to the parking lot of the ferry terminal. There were no additional reports from regional beekeepers and the record, deemed to be unverified, was removed from the platform (Linn Fenna Groeneveld, pers. comm.).

Senegal

A photograph of a *V. velutina* was purportedly taken in Dakar, Senegal, on 2 November, 2025 (iNaturalist, 2026d). Such an exceptional record requires verification by the photographer. Until that occurs, it must be treated as questionable.

Addendum

Several notable additions to the distribution of *Vespa velutina* were reported in 2026 while the manuscript for this article was being revised.

Spain (Canary Islands)

Following a report by a resident of Las Palmas de Gran Canaria, a nest containing 93 hornets was located in an urban area ≤3 km from the port of Las Palmas and removed in May, 2026 (Rodriguez, 2026). That discovery triggered the installation of traps in urban parks near the nest location and at the port by the Early Warning Network for Invasive Exotic Species of the Government of the Canary Islands (RedEXOS). Additional hornet sightings reported by residents resulted in the discovery of a nest in the same location as the first. That nest, believed to have been built by hornets that survived the removal of the nest in May, was removed on 5 June (Lavozdelanzarote, 2026).

Great Britain (Wales)

An abandoned nest located in Wrexham in January represents the first confirmed *V. velutina* nest in Wales (Wales, 2026).

Honduras

A photograph of a *V. velutina* was reported to have been taken on 24 Feb., 2026, at 1170 m elevation in an inland valley in Honduras near the Nicaraguan border (iNaturalist 2026e). This record, if verified, would represent the first record of *V. velutina* from Central America.

Ukraine

Two *V. velutina* hornets were trapped in Chervonohradska (Sheptytskyi), Lviv Oblast, western Ukraine, on 14 Apr., 2026 (Observation, 2026). These represent the easternmost localities of the species in Europe.

DISCUSSION

The many recent colonizations and range expansions by *V. velutina*, summarized here, underscore the extraordinary invasion potential of this species. Since its initial spread beyond its native range, first into South Korea by 2003, then into France by 2004 (Table 1), this invasive hornet has demonstrated a remarkable capacity for long-distance dispersal. Further, *V. velutina* has successfully established populations with minimal propagule numbers, in several cases by a single gyne, has overcome severe genetic bottlenecks and inbreeding (Hagan & Gloag, 2021), and has achieved rapid population growth across a wide range of geographic, climatic and ecological contexts.

Vespa velutina was reported from several countries and islands for the first time during 2025. Among them, New Zealand is particularly noteworthy, as it represents both the first record from Australasia and the first confirmed invasive occurrence south of the Equator. Also significant are the photographs taken in Algiers, Algeria, which represent the first documented reports of *V. velutina* var. *nigrithorax* from the African continent (iNaturalist, 2026a, b; Semmar, 2025). Other geographic regions that experienced their first hornet incursions during 2025 were Denmark, Northern Ireland, Sardinia, and the Azores. With confirmed records by the end of 2025 spanning 23 countries on four continents outside its native range, *V. velutina* represents one of the most successful invasive vespids documented to date (Beggs et al., 2011).

As a general trend, following an initial period of limited establishment in a suitable region during the first few years following colonization, the number of *V. velutina* colonies increases exponentially, accompanied by a swift geographic spread across the surrounding area (Choi et al., 2012; Franklin et al., 2017; Keeling et al., 2017; Rojas-

Nossa et al., 2022b; Zeegers & Buesink, 2024; Seehausan et al., 2026). This acceleration reflects the favorable environments encountered, the ability of gynes to disperse relatively long distances, both naturally and with the aid of humans, and a high reproductive rate that allows for sustained propagule pressure on surrounding regions (Lioy et al., 2022).

The current invasion status of *V. velutina* varies among countries, depending in large part on climatic conditions and how long the species has been present. The following sections illustrate how its population dynamics and geographic expansion correspond to invasion stages of initial incursion, expansion, and establishment, in line with general invasion theory (Blackburn et al., 2011).

Initial incursion with uncertain trajectory

In New Zealand, two male hornets discovered in Auckland at the beginning of the austral winter (i.e., early July, 2025) were a sign that one or more colonies of *V. velutina* were present. That proved true as numerous post-diapause gynes, many with embryo nests, were reported in a relatively small area on the north shore of Auckland during November and December of 2025. Taken together, these observations suggest that colonization of New Zealand likely occurred in 2024. Modelling suggests that the climate in New Zealand is moderately suitable for establishment (Villemant et al., 2011). Control efforts are underway, but with the difficulty of detecting all nests (Arca et al., 2015; Lioy et al., 2019), eradication will be difficult to achieve.

Observations of *V. velutina* in North Africa represent another particularly consequential development in the global invasion trajectory of this species. This incursion underscores the likely role of cargo shipments in long-range saltatory dispersal of hornets, and in particular the intense volume of maritime cargo traffic in the Mediterranean Basin (Union for the Mediterranean, 2021) that serves as a conduit for biological invasions. The recent discoveries of *V. orientalis* Linnaeus and *V. crabro* Linnaeus in Morocco (Driauach et al., 2026) and *V. bicolor* Fabricius and *V. orientalis* in southern Spain (Robla et al., 2026) highlight that risk. The large, well-established populations of *V. velutina* over much of western Europe serve as persistent sources of mated gynes that facilitate repeated introductions across the region, a dynamic that has been clearly illustrated by recurrent invasion events in the Balearic Islands (Herrera et al., 2024; this paper). Species distribution models of Villemant et al. (2011) and Abou-Shaara & Al-Khalaf (2022) identified a zone along the southern coast of the Mediterranean Sea, from Morocco to Tunisia, in which the climate may be suitable for the survival of *V. velutina.* In contrast, the distribution model of Barbet-Massin et al. (2013) predicted a low probability of establishment in that zone. The Algerian records can be viewed as an early warning of future hornet introductions to North Africa.

The recent reports of *V. velutina* in Ireland, Corsica and Sardinia are concerning. Some modelling suggests the species has a high probability of establishment on all three of these islands (Villemant et al., 2011; Abou-Shaara & Al-Khalaf, 2022; Hassall et al., 2025; Nie et al., 2025).

In Japan, *V. velutina* is now widespread on Tsushima Island and seems to be established on Kyushu Island. There has only been one sighting on Honshu, the largest of the Japanese Islands. However, due to its close proximity to Kyushu and the predicted suitability of climate for *V. velutina* (Villemant et al., 2011), it seems likely that the range of this hornet soon will expand further in Japan.

In Central Europe, *V. velutina* has been detected sporadically in Slovakia, Czechia, Hungary, Austria, eastern Germany, and western Ukraine. There is no evidence yet of established populations across that region, a situation that contrasts sharply with large portions of western Europe where the species quickly became established. Environmental conditions in Central Europe (in particular, relatively low precipitation and low mean temperature) contribute to low suitability for establishment of *V. velutina* (Villemant et al., 2011; Hassall et al., 2025; Nie et al., 2025). Rapid location and elimination of the nests may have prevented further local spread in these countries, as was reported to have contributed to the eradication of *V. mandarinia* Smith in northwestern North America (Taylor et al., 2024) and *V. velutina* in Mallorca (Leza et al., 2021), but that cannot be confirmed. Despite limited detections of *V. velutina* in these countries, monitoring remains valuable as it provides insights into the dispersal potential of the species as well as the effectiveness of strategies to locate and eliminate colonies.

The establishment of *V. velutina* in these diverse regions will be influenced by the ecological framework upon which its colonies depend, including the availability of prey, carbohydrate resources, and climate. That the species has navigated these constraints and become established in no less than seven ecoregions in Europe, two in Asia and one in North America (Olson et al., 2001) speaks to the need for research into its ecological plasticity as it continues to expand into novel environments.

Expanding populations that serve as sources of propagules

The invasion trajectories observed in Switzerland, the Netherlands, Great Britain, and Germany reveal a striking consistency in the dynamics of *V. velutina* expansion once populations become established in favorable environments. For example, nest numbers in Switzerland increased by orders of magnitude within only a few years of confirmed establishment (Cherix et al., 2023, 2024; Seehausen et al., 2025, 2026). Similarly, in the Netherlands, it achieved annual population growth of 5–10× per year, driven initially by numerous gynes dispersing from Belgium (Zeegers & Buesink, 2024). The rapid growth of the population coupled with sustained northward expansion led to formal reassessment in the Netherlands of EU control requirements due to its established status (Zeegers & Buesink, 2024). *Vespa velutina* has also spread rapidly in Western Germany, with the number of nests increasing two- to threefold per year, leading to its reclassification as an established invasive species in spring of 2025. In Italy,

there are many reports of *V. velutina* now in the Northwest following its establishment in Liguria and Tuscany. It is gradually expanding its range eastward and southward, with two reports from the southern end of the Italian Peninsula. Similar population patterns were observed in France, Belgium, and northern Spain and Portugal (e.g., Franklin et al., 2017; Carvalho et al., 2020; Diéguez-Antón et al., 2022). Collectively, the rapid population growth in these countries suggests that where the climate is favorable, the combination of limited detectability of nests, production of large numbers of gynes, and high dispersal capacity of mated gynes results in limited opportunity for control. Furthermore, these same factors contribute to high propagule pressure on nearby regions that have relatively smaller populations as well as on more distant uninfested regions, as discussed below.

The emerging situation in the United States reinforces this interpretation and highlights the global implications of continued spread. Despite rapid response efforts following initial detection of *V. velutina* in the state of Georgia (Hoebeke et al., 2025), evidence of missed nests and the rapidly growing population indicate that containment was compromised (Hoebeke et al., 2025; Clemson Regulatory Services, 2025; Yellow-Legged Ledger, 2025). The discovery of a distant, probably human-mediated introduction in northern South Carolina further demonstrates how long-distance dispersal can reduce the effectiveness of eradication efforts and accelerate expansion of the hornet's range (Verdasca et al., 2021).

Collectively, these patterns underscore how quickly *V. velutina* can transition from initial colonization to widespread establishment. While this may not seem remarkable for an invasive arthropod, we consider it noteworthy because *V. velutina* colonies have only one generation per year and, given the sessile nature of the constructed hornet nest, meaningful dispersal only occurs during a short period in spring (in line with other annual nest-building Hymenoptera). This contrasts with most other widespread invasive species that exhibit multiple generations and several periods of dispersal per year (Zhao et al., 2023). It is of considerable concern that invasive hornets, with their relatively long generation intervals, are able to so rapidly expand in both population size and geographic area despite rapidly-mounted surveillance and eradication efforts. Collectively, our poor global success rate in controlling *V. velutina* and other hornets (Otis et al., 2023) may be cause to reevaluate national response plans to detections of invasive social wasps.

Widespread establishment and ongoing propagule pressure

Vespa velutina completed its colonization of most of continental France (excluding high elevation regions with colder climates), Belgium and South Korea several years ago, and therefore no further changes in its distribution are anticipated there. Within six years of being detected in Luxembourg, it is now established throughout the entire country. On the Iberian Peninsula, *V. velutina* is now firmly established in approximately two thirds of Portugal and across northern and northeastern regions of Spain, the regions where the climate has been predicted to be highly suitable for the species (Verdasca et al., 2021; Villemant et al., 2011). It has continued to extend its distribution southward in Portugal and Spain where it has now been confirmed near the southern coast in areas where climatic suitability is relatively low but not negligible (Bessa et al., 2016; Ramos-Chernenko, 2024; Sáez Maldonado, 2025; Robla et al., 2026).

In regions where *V. velutina* is widely established, the several hundred gynes produced annually by each mature colony exert extensive propagule pressure on surrounding regions. Through self-mediated dispersal in spring, post-diapause gynes extend the distribution and contribute to increasing population density within their flight distance, estimated to be ~58 km/yr in the Netherlands (Zeegers & Buesink (2024), ~78 km/yr in France (Robinet et al., 2017a), and ~40 km/yr in Portugal (Carvalho et al., 2020). These are exceptionally high rates of spread for an invasive insect (Beggs et al., 2011). In contrast, gynes that accidentally stow away in shipments of commercial goods can be transported almost anywhere (Beggs et al., 2011). Trucks and trains are inferred to have enhanced hornet dispersal in Portugal (Verdasca et al., 2021) and France (Robinet et al., 2017a) and are documented to have transported gynes to Central European countries (summarized in this paper). In regions where natural range expansion begins to slow, such as in eastern Germany, eastern and southern Italy, southern Portugal, and southern Spain, jump dispersal continues to generate new local introductions. Jump dispersal via maritime shipments (Robinet et al., 2017b) is almost certainly the way in which *V. velutina* reached New Zealand, Algeria, Sardinia, Corsica, the Azores, and the United States. Regionally adapted management strategies to contain incipient infestations must consider the ongoing probability of stochastic arrivals of hornet gynes from various sources (Verdasca et al., 2021).

The situation in the Balearic Islands highlights the influence of ongoing propagule pressure from the well established populations in continental Europe. Extensive efforts to control *V. velutina* on Mallorca were followed by periods with no detections suggestive of eradication, yet the species has reappeared twice, with genetic evidence pointing to separate introductions from different locations (Leza et al., 2021; Herrera et al., 2025).

Additional considerations

Genetic analyses continue to reveal that *V. velutina* is capable of establishing viable populations following extreme founder events. Populations in western Europe, the USA, and New Zealand have all been inferred to originate from just one inseminated gyne, resulting in high levels of inbreeding and low genetic diversity (Arca et al., 2015; Budge et al., 2017; this paper). Multiple mating by the immigrant gyne may have contributed to the success of *V. velutina* in France (Otis et al., 2023) and the USA (LJB, BAT, and Brock Harpur, unpubl. data). In contrast, preliminary data suggest that the population in New Zealand was founded by one singly-mated gyne (Scott Sinclair and

Guaraci Dias, pers. comm.). These findings emphasize that genetic bottlenecks do not necessarily prevent invasion success in this species (Arca et al., 2015). Secondary introductions will likely increase genetic variability and facilitate local adaptation of already established populations (Hagan & Gloag, 2021).

The incursion of *V. velutina* into the southern hemisphere in New Zealand raises physiological and ecological questions. Seasonal inversion relative to an origin in the northern hemisphere poses a fundamental challenge for hornet gynes attempting to survive diapause and establish new nests. Gynes store large amounts of fat prior to diapause (Rome et al., 2015), most of which has been metabolized by the time they become active in spring (Cohen et al., 2022). They should not be physiologically capable of extending their diapause by several months (Hahn & Denlinger, 2007). Perhaps a hornet gyne that entered diapause in the northern hemisphere was transported quickly to New Zealand where it became active sufficiently early in the austral summer to rear reproductives before the end of the growing season. The relatively moderate climate in Auckland likely facilitated the colony's ability to reproduce successfully. In this context, the number of queens and nests detected in New Zealand since the species was first detected in July, 2025, is consistent with an introduction preceding that year, likely in 2024. *Vespa orientalis* is the only other hornet species that has made the transition to the southern hemisphere, in Chile (Ríos et al., 2020).

Photographic records submitted to community-science websites such as iNaturalist.org and Observation.org are increasingly being used in scientific publications (Skvarla & Fisher, 2023). Naturalists throughout the world contribute huge numbers of observations that expand our knowledge of distributions of fauna and flora. For example, the first reports of *V. velutina* var *nigrithorax* from Africa and Ukraine were posted to iNaturalist and Observation, respectively. Erroneous records are occasionally posted (i.e., *V. velutina* in Norway and Colombia, and possibly Senegal and Honduras), but in the case of large, easily identified species such as *V. velutina*, they are infrequent and quickly corrected. We found that for *V. velutina,* a species that is being intensively monitored, government supported websites to which anyone can submit observations (e.g. those in Germany, Switzerland, Great Britain, Luxembourg, and Portugal) provide the most thorough coverage of distributions. Photographs taken by local residents and posted to websites set up for reporting *V. velutina* represented the first records for Slovakia and Czechia. It has been argued that public reporting is essential for effective hornet control (Warren et al., 2025). Integration of these various reporting sites would yield a better, more current distribution of *Vespa velutina.*

CONCLUDING REMARKS

The global invasion history of *V. velutina* elevates this species to a model system for invasion biology. It demonstrates how both self-and human-mediated dispersal, combined with the ability to overcome severe genetic bottlenecks, delayed detection, a generalist diet, and ecological plasticity, collectively produce rapid, often irreversible expansion across diverse environments – typically outpacing the window of opportunity in which effective management remains feasible. Because the window of time for eradication of newly introduced populations is extremely narrow, proactive monitoring and development of management plans should be in place in advance of the arrival of the species.

The numerous recent incursions beyond the documented range of *V. velutina* are evidence of the extensive propagule pressure from both established alien and native Asian populations. In Europe, "bridgehead" populations situated some distance from where the species is established, seed new propagules themselves, driving successive introductions and accelerating the invasion (Bertelsmeier & Keller, 2018). This process is evident recently in Great Britain, eastern Germany, the USA, and southern portions of Italy, Spain, and Portugal. Most of the new infestations we have reviewed align with the climatic suitability predictions of Villemant et al. (2011), Abou-Shaara & Al-Khalaf (2022), and Hassall et al. (2025), confirming that regions with warm temperate climates and moderate annual precipitation are at particular risk. Accordingly, heightened awareness and vigilance are warranted in additional regions predicted to be climatically suitable, especially near ports where human-mediated transport is most likely to facilitate introductions (Wardhaugh & Pawson, 2024). The species distribution model of Villemant et al. (2011) predicted vulnerable areas to include east central Argentina, Uruguay and southeastern Brasil; central Chile; the Pacific Northwest of North America; southeastern and southwestern Australia; and South Africa. However, the age of that model, the explosive expansion of invasive populations, and global warming warrant updating the ecological forecasts of which regions are likely permissive to invasion. The general public, through their contributions to biodiversity platforms, and beekeepers, by reporting hornets hunting bees at hives, will continue to play a fundamental role in the detection of *V. velutina* as it continues to expand its range (Warren et al., 2025).

Importantly, the continued expansion of the *V. velutina* population has direct and far-reaching implications for pollinators and pollination services that are already under multiple pressures (Potts et al., 2010). *Vespa velutina* is a generalist predator that preys on a wide diversity of prey, including honey bees, other bees, flies, wasps, spiders, lepidopterans, and grasshoppers (Rome et al., 2011, 2021; Verdasca et al., 2022; Stainton et al., 2023; Herrera et al., 2025). However, because honey bee colonies contain thousands of potential prey in a fixed location, they are frequently targeted when hornet colonies become large, resulting in honeybees comprising a high proportion of the ca. 11 kg of prey captured over the season by a *V. velutina* colony (Rome et al., 2021). Foraging hornets can weaken honey bee colonies, suppress foraging activity, and increase colony mortality (Requier et al., 2019). Additionally, their predation on the community of foraging polli-

nators can disrupt pollination networks (Rojas-Nossa & Calviño, 2023; O'Shea-Wheller et al., 2023; Rojas-Nossa et al., 2020). As *V. velutina* spreads into new regions, its cumulative impacts on managed and wild pollinators will intensify. These effects may be especially pronounced in regions where pollinator populations are already stressed by habitat loss, pathogens, and climate change and where the density of *V. velutina* colonies is high.

The recent geographic records presented here reinforce the urgent need for coordinated international surveillance, proactive management strategies, and immediate responses following detection of exotic hornets. Early detection and eradication were temporarily successful on a few islands (e.g., England, Mallorca), but continuing dispersal of gynes from continental Europe jeopardized their long-term success. Eradication efforts have been implemented in response to discoveries of *V. velutina* colonies on other European islands (Ireland, Sardinia, Corsica, and the Isles of Scilly), as well as in New Zealand and the USA. It is too soon to evaluate the success of those efforts except in the USA, where the population now seems to be established. The accelerating pace of new incursions suggests that prevention and biosecurity remain critical challenges. Given the demonstrated ability of *V. velutina* to establish populations from single queens and its significant impacts on pollinators, continued expansion of this invasive hornet poses a growing threat to ecosystem functioning, agricultural crops (particularly grapes), and biodiversity worldwide.

AUTHOR CONTRIBUTIONS. Conception of research: G.W. Otis and S.V. Rojas-Nossa. Primary writing: G.W. Otis and S.V. Rojas-Nossa. Creation of Fig. 1: L. Seehausen. All authors contributed to writing, edited the manuscript, and approved the manuscript prior to submission of both the original draft and the revised version.

CONFLICT INTEREST STATEMENT. The authors declare no conflicts of interest.

ACKNOWLEDGEMENTS. We received extensive assistance while preparing this manuscript. In New Zealand, S. Sinclair and G. Dias, N.Z. Ministry of Primary Industries, shared information and gave permission to reproduce the photo of nests. L. Bartlett benefitted greatly from the expertise and efforts of M. Evans, D. Williams, C. Adams and team at the Georgia Department of Agriculture, and B. Cavin and the Clemson Apiary Inspection team, South Carolina. L. Castro and F. Prunier provided additional information for Spain. Á. García, L.F. Groeneveld, P. Kryger, G. Morales, L. Morawitz, J. Takahashi, and T. Zeegers kindly shared information through personal communications. A. Nave was supported by National Funds of FCT, the Portuguese Foundation for Science and Technology, under the projects UID/04033/2025: Centre for the Research and Technology of Agro-Environmental and Biological Sciences and LA/P/0126/2020 (https://doi.org/10.54499/LA/P/0126/2020). M.L. Seehausen was supported by CABI, an international intergovernmental not-for-profit organization, which gratefully acknowledges the support received from its member countries, donors, sponsors and partners. L. Bartlett acknowledges support from Pollinator Health: Research and Application no. 2023-08451 from the U.S. Department of Agriculture's National Institute of Food and Agriculture, and from the Georgia Beekeepers Association. M. Leza received support from grant PID2023-149487OA-I00 funded by MICIU/AEI/10.13039/501100011033 and by ERDF/EU, and acknowledges the support of the Ministry of Agriculture, Fisheries and Natural Environment of the Balearic Islands through a scientific collaboration agreement with the University of the Balearic Islands on the control of invasive hornets in the Balearic Islands. B. Taylor was supported by a Human Frontier Science Program fellowship, code LT 0056/ 2022-L. Monitoring and control of *V. velutina* in Mediterranean regions of France (i.e., Corsica) and Italy (i.e., Sardinia) were supported by ALIEM VIGIL and the Genapis.it3 project funded by the European Union (Regulation (EU) 2021/2115) and the MEDIBEES project (PRIMA program). The nonprofit organization Ekofond SPP developed the publicly available mobile application "Zastav sršňa" (Stop the Hornet), used for reporting of *V. velutina* in Slovakia.

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Received March 20, 2026; revised and accepted July 29, 2026
Published online August 18, 2026