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Social wasps in Spain: the who and where

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Abstract

Objective: The objective of this study was to list the social vespids occurring in Spain, determine their presence in each region, and correlate the data with the vespids responsible for allergic reactions and their progression over time.

Methods: Insects distribution data were collected in two phases: from the southern half of Spain (2008-2012), and from the northern half of Spain (2016-2019). Data for the vespids were collected from the prescriptions of Hymenoptera venom immunotherapy (HVIT) at six Spanish hospitals in the years 2009 and 2019.

Results: *Polistes dominula* and *Vespula germanica* were the most widely distributed species. *Vespa velutina* was found to be present in a large part of northern Spain. During the 10 year period, the prescriptions of vespids VIT increased by 42.63%. The north of Spain saw a 3.61 fold greater predominance of prescriptions for *Vespula* (to some extent influenced by *Vespa velutina* allergy) whereas in central and southern Spain, there was a 3.97 fold greater predominance of prescriptions for *Polistes*.

Conclusions: It is the first study that compares the vespids distribution maps with VIT prescription. A noteworthy finding is the wide presence of *Polistes dominula* and *Vespula germanica* in

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Spain and the appearance of *Vespa velutina* allergy in the northern part of the country. Data of HVIT prescriptions reflect inter-regional variability with the predominance of *Vespula* (due to *Vespula* and *Vespa*) in the north and that of *Polistes* in the center and south of Spain.

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Introduction

Vespid wasps belong to a hymenopteran family (Vespidae) with a practically worldwide distribution. The family contains six subfamilies, of which three include mostly solitary species and the other three only social or inquiline species; two of the social groups, Polistinae and Vespinae, occur in Spain. Social wasps build nests that they defend against potential predators with their sting, which most likely causes allergic reactions in local population. Understanding the distribution of wasps would be very useful for allergologists to correctly diagnose and treat the reactions caused by them.

The Spanish fauna of social vespids is made up of 24 species (10 of the genus *Polistes*, 6 of *Dolichovespula*, 4 each of *Vespa* and *Vespula*). This includes euryoic species, found in a wide range of ecosystems and at widely differing altitudes (*P. dominula*, *P. gallicus*, *P. austroccidentalis*, *P. nimpha*, *D. sylvestris*, *Vespula germanica*, *Vespula vulgaris*, and *Vespa crabro*). Some mountain-dwelling species, which are more or less widespread in the north and south of Spain, only appear at a few high-altitude enclaves (*P. biglumis*, *P. atrimandibularis*, and *D. omissa*) whereas several mountain species are absent from the south (*P. semenowi*, *D. adulterina* and *D. norwegica*), and some species are restricted to a few habitats (wooden or humid areas in the case of *Vespa velutina*, *V. austriaca*, *D. media*, and *V. rufa*; and marshy areas in the case of *P. bischoffi*).

Some species have been introduced exogenously (*P. major*, *Vespa bicolor*, *Vespa orientalis*, and *Vespa velutina*), each having established themselves to varying degrees. Finally, some social parasitic species, such as *P. atrimandibularis*, *P. austroccidentalis*, *P. semenowi*, *D. adulterina*, *D. omissa*, and *Vespula austriaca*, also exist.^{1,2}

In Spain, vespids have been studied for several decades but in an isolated manner with no clear timeline.³⁻¹² Studies conducted on patients allergic to Hymenoptera venom have provided indirect data and have demonstrated inter-regional variability in the distribution of two main allergenic vespid genera with a predominance of *P. dominula* in southeastern Spain and *Vespula germanica* in the northwest.¹³⁻¹⁶ In Europe, to date, a considerable sensitization to venom from the genera *Vespula* and *Polistes* has been observed in the Mediterranean regions, while in the north and center of Europe sensitization to *Polistes* is rare.^{15,17} Furthermore, the arrival of new invasive species¹⁸⁻²¹ and the appearance of cases of allergy to their venom²²⁻²⁴ have led to an increase in the vespid species which are of interest to allergologists in Spain.

The objective of this study was to list the main social vespids found in Spain by elaborating distribution maps, and to correlate these data with the vespids responsible for allergic reactions in six Spanish provinces and their progression over time.

Material and Methods

A prospective observational study was conducted at the national level by entomologists and the Hymenoptera Committee of the Spanish Society of Allergy and Clinical Immunology (SEAIC) in which data on the distribution (presence) of 24 species of social vespids were collected: 10 from the genus *Polistes* (*P. associus*, *P. atrimandibularis*, *P. austroccidentalis*, *P. biglumis*, *P. bischoffi*, *P. dominula*, *P. gallicus*, *P. major*, *P. nimpha*, and *P. semenowi*), 4 of *Vespula* (*V. austriaca*, *V. germanica*, *V. rufa*, and *V. vulgaris*), 6 of *Dolichovespula* (*D. adulterina*, *D. media*, *D. norwegica*, *D. omissa*, *D. saxonica*, and *D. sylvestris*), and 4 of *Vespa* (*V. bicolor*, *V. crabro*, *V. orientalis*, and *V. velutina*).

Results were collected in the following two different but complementary ways.

Bibliographic review of published studies on the presence of different vespid species. The following sources were consulted:

- Entomological journals as cited in the References.
- Online access to databases of public and private organizations.
- An Internet search of entomology-related pages and discussion groups. Pages such as *Biodiversidad virtual* (Virtual Biodiversity) and Facebook fora were consulted.

Field sampling

The collection and identification of vespids captured (mainland Spain, the Balearic Islands, and Melilla) was carried out in two phases: in the first phase (2008-2012), data were collected from the southern half of Spain, and in the second phase (2016-2019), the northern part of the country was studied. The Canary Islands were excluded because they represent a different biogeographic area with a very different fauna. The provinces in which the field samples were taken in each of the phases of the study are shown in Figure 1.

At the same time, data (number of prescriptions) of Hymenoptera venom immunotherapy (HVIT) were collected retrospectively on yearly initiation and maintenance VIT at two time points separated by 10 years (2009 and 2019) in the Allergy Departments of six Spanish hospitals, three in the north (Hospital Universitario Lucas Augusti in Lugo, Hospital Universitario Araba in Álava, and Hospital Santa María in Lleida) and another three in the center and south of the country (Hospital Universitario in Guadalajara, Hospital General Universitario in Ciudad Real, and Hospital Reina Sofía in Córdoba). VIT was prescribed

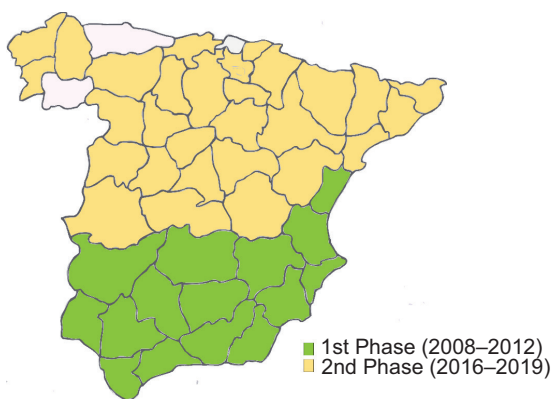


Figure 1 Spanish provinces in which field sampling was conducted with collection and identification of social vespids.

to all the patients diagnosed with hymenopteran venom allergy, who developed a systemic allergic reaction after a sting, and presented positive specific immunoglobulin E (IgE) against the venom involved. Data on VIT were collected against *Apis mellifera*, *Polistes dominula*, and *Vespula* spp., and double immunotherapy against *Polistes dominula* and *Vespula* spp. in patients in whom it was not possible to precisely determine the vespid involved. The cases of suspected allergic reaction to *Vespa velutina* and *Vespa crabro* requiring VIT were counted independently (although *Vespula* VIT was prescribed to all patients except one, who, due to molecular diagnostic profile, was prescribed *P. dominula* VIT).

Results

The most widely distributed species were *P. dominula* and *Vespula germanica*. These were followed in frequency by *P. nimpha* and *P. gallicus*. Among the very scarce species, the following are worth highlighting: *P. associus*, *P. atrimandibularis*, *P. semenowi*, *D. adulterina*, *D. omissa*, *D. saxonica*, and *V. austriaca*. Figure 2 shows the distribution data for the 24 studied vespids.

Concerning the results of the data on prescribing VIT, 582 prescriptions were recorded (108 initiation and 474 maintenance) in 2009, with bee venom predominating and accounting for 294 (50.51%) prescriptions.

In 2019, the overall number of prescriptions for VIT rose to 813 (28.41%). Of these, 177 (38.98%) were cases of VIT initiation and 636 (25.47%) VIT maintenance, in particular against vespids, which increased by 42.63% (*Polistes* increased by 35.92%, *Vespula* 14.47%, and double VIT by 78.57%). However, in the north of Spain, honeybee VIT fell by 40.88% (from 225 prescriptions in 2009 to 133 in 2019). In this area, when a comparison was made between *Polistes* and *Vespula* VIT, a 3.61-fold predominance (94/26) of cases of *Vespula* VIT was observed in 2009 and a 2.58-fold predominance (111/43) in 2019. Furthermore, in this area, 24 patients required VIT due to *Vespa velutina* venom. However, in the south of Spain, the predominance of *Polistes* VIT was 2.94 times (106/36) higher in 2009 and 3.97 times (163/41) higher in 2019. In both areas, the increase in prescriptions was higher for *Polistes*: in the north it

increased by 38.1% (26 in 2009 and 42 in 2019) as compared to VIT against *Vespula* which increased by 13.76% (94 in 2009 and 109 in 2019). In the south, *Polistes* VIT increased by 34.97% (106 in 2009 and 163 in 2019) and *Vespula* VIT by 12.2% (36 in 2009 and 41 in 2019). Figure 3 shows the comparison of VIT initiation by areas in 2009 and 2019.

Discussion

This study established the current distribution of social vespids in Spain and demonstrated the wide distribution of *P. dominula* in all Spanish provinces, closely followed by *Vespula germanica*, which is also a widely distributed species. The data available to date came from local entomological field studies focusing on a single species or inventories of species from a specific area and at a particular point in time (e.g., Nieves et al.)²⁵ and did not allow comparisons to be made with earlier similar studies.

As allergologists, we already have indirect data on the distribution of social vespids obtained from studies into the incidence and prevalence of allergic reactions following stings and VIT prescription, although this did not allow comparisons to be made over time.^{16,26,27} Thus, in the Spanish *Alergológica* studies conducted in 2005 and 2015 into the diagnosis of hypersensitivity reactions due to insects, a change was noted towards the predominance of sensitization to *Polistes* as compared to *Vespula* (2005: *Vespula* 27.3%, *Polistes* 23.4%; 2015: *Vespula* 27.3%, *Polistes* 36.8%).^{28,29}

The data obtained in our study demonstrated a prominent increase (43%) in the prescription of vespid VIT. The geographical differences remained the same for both areas, with *Vespula* being more common in the north and *Polistes* in the center and south of the peninsula, although with a greater increase in the prescription of *Polistes* VIT in both areas. *P. dominula* is a very widespread species, present in a diverse range of environments. It originates from the Mediterranean area and its expansion toward the center and north of Europe has been linked to global warming.³⁰ Furthermore, its invasiveness in parts of the world where it has been introduced is related to the shorter time needed for the larvae and pupae to develop, which gives it greater reproductivity potential than other *Polistes* species, thus displacing them in such countries.³¹ The invasion of *Vespa velutina* in the north of Spain and the severity of reactions in patients exposed to its venom have led to a fresh need for VIT, and it would be advisable to have available the corresponding diagnostic and therapeutic methods specific to this species.³² Finally, it is noteworthy that the prescriptions of *Apis mellifera* VIT have fallen by 41% in the north of Spain. These data need to be analyzed with caution, bearing in mind the sudden appearance of *Vespa velutina* and climate change.

The present study has its limitations, as the species mapping data were collected on the presence of species in particular areas but not their density, which logically has implications on the risk of stings and accounts for the differences in the distribution of VIT prescription. Another limitation was that we collected only VIT data from six hospitals; however, its distribution (three in the north and another three in the center and south of the country) supports the data representativeness. Furthermore,

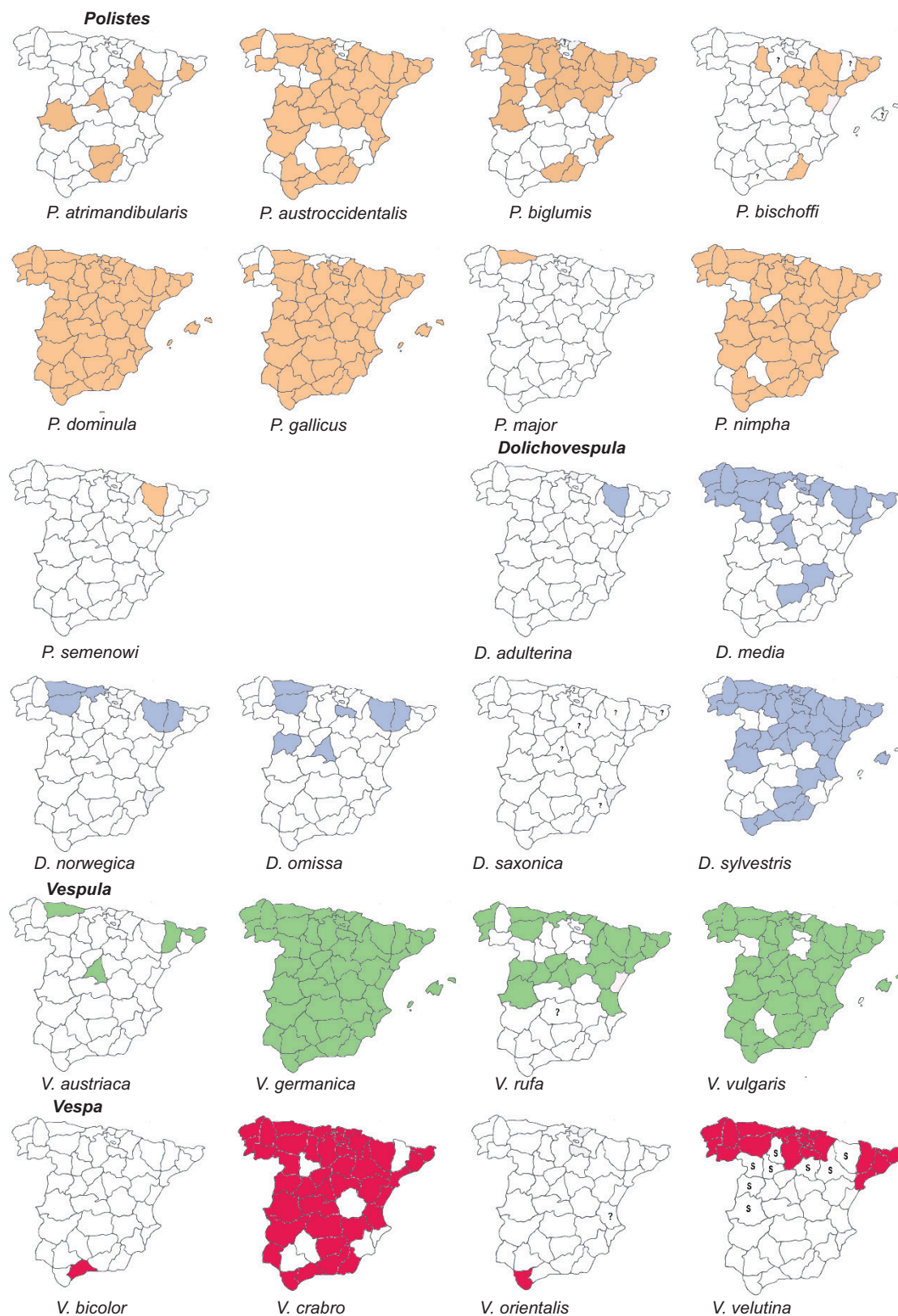


Figure 2 Distribution maps of Spanish social vespids. Confirmed presence= colored provinces; doubtful presence= ?; sporadic or accidental presence= S. Data were collected up to 31st December, 2019.

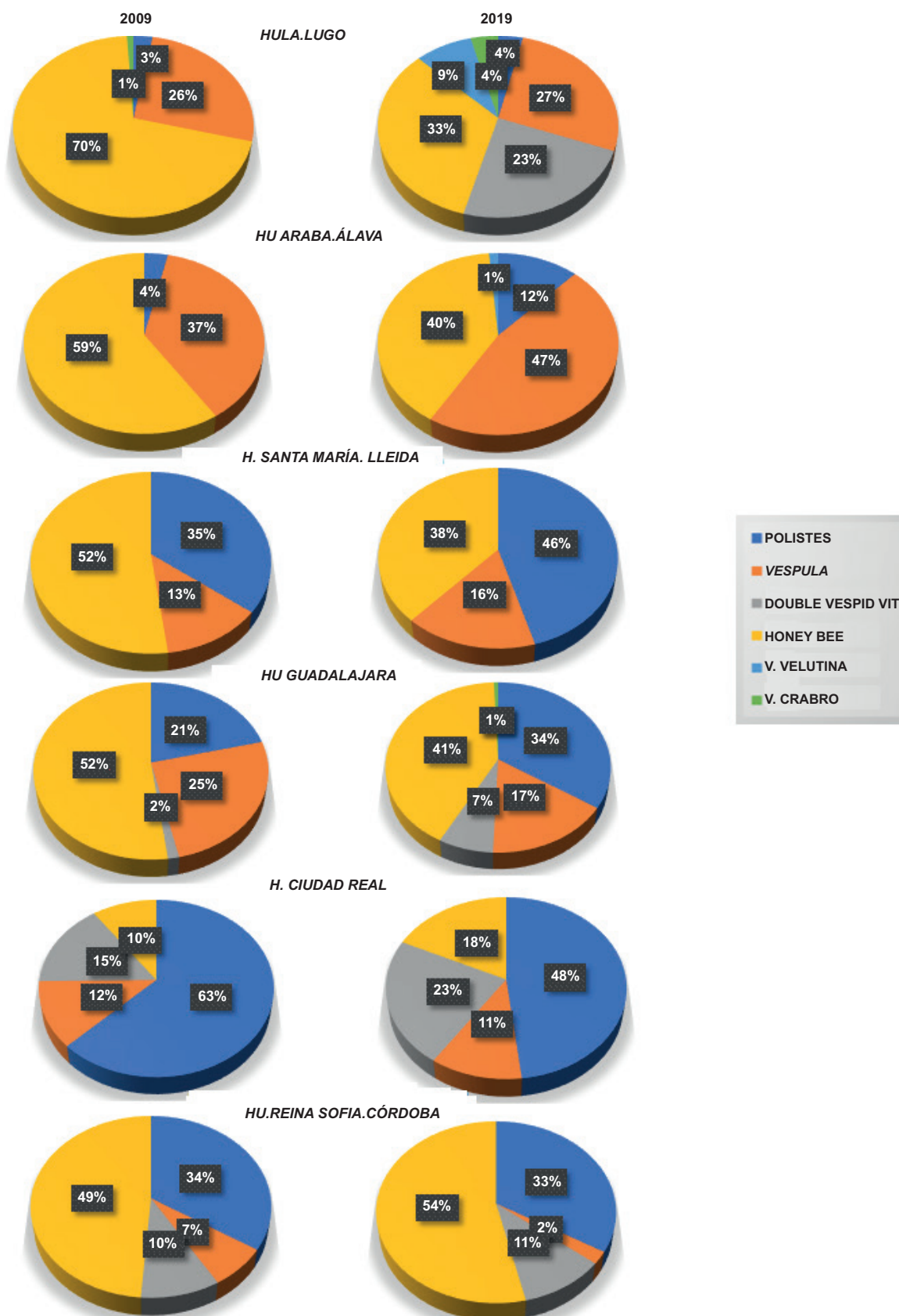


Figure 3 Hymenoptera venom immunotherapy in 2009 and 2019 in 6 Spanish hospitals.

for diagnostic purposes, we only had at our disposal commercialized venoms from some species, and the possible cross-reactivity between these makes difficult the precise diagnosis of the species involved.

Conclusions

This is the first study that compares the vespidae distribution maps with VIT prescription. A noteworthy finding is the presence of *P. dominula* in all provinces of Spain and the appearance of *Vespa velutina* in the northern part of the country. Data on the prescription of VIT reflect the inter-regional variability with the predominance of *Vespula* (due to *Vespula* and *Vespa*) in the north and that of *Polistes* in the center and south of Spain, although there was an increase of *Polistes* VIT in both areas. Global warming and the accidental introduction of invasive species will most likely continue to cause changes in the distribution of these and other insects which have repercussions for human health, changes which allergologists need to be aware of.

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