

Local responses to a global invasive species. Varying reasons for controlling the Argentine ant in the Madeira archipelago (1850-2014)*

Ana Isabel Queiroz ¹
Daniel Alves²

Resumo

A formiga argentina (*Linepithema humile* Mayr) é identificada na Madeira em meados do século XIX, sendo este o seu primeiro registo fora da região Neotropical, de onde é originária. Ideias e respostas aos impactos desta espécie invasora constituem o argumento desta narrativa histórica, baseada em publicações científicas, livros de viagens e diários, documentos oficiais e notícias de jornais da época. Diferentes razões fundamentaram a tomada de medidas de controlo em diferentes episódios da praga. Esta espécie foi percebida como uma praga urbana e uma praga agrícola durante um vasto período. Recentemente, ao nível local, ela é considerada uma ameaça para a biodiversidade nativa.

Palavras-chave

História Ambiental, Respostas Societais, Formiga Argentina, Espécies Invasoras, Madeira

Abstract

The Argentine Ant (*Linepithema humile* Mayr) has been present in Madeira since the mid-nineteenth century, when its first occurrence outside the Neotropical Region was recorded. The varying ideas and responses over time to the impacts of this invasive alien species constitute the argument of this historical narrative, based on scientific publications, travel books and diaries, official documents and newspapers. Different reasons have justified the various control measures implemented in the course of repeated outbreaks. This species has long been perceived as an urban and plant pest. Recently, at the local level, it has been considered a threat to the native biodiversity.

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¹ Institute of Contemporary History, FCSH, NEW University of Lisbon. Avenida de Berna 26-C, 1069-061 Lisbon, Portugal. *E-mail*: ai_queiroz@fcs.unl.pt.

² Institute of Contemporary History, FCSH, NEW University of Lisbon. Avenida de Berna 26-C, 1069-061 Lisbon, Portugal. *E-mail*: alves.r.daniel@gmail.com.

Keywords

Environmental History, Societal Responses, Argentine Ant, Invasive Species, Madeira

Introduction

Many plant and animal species, originating from distant locations, were introduced successfully into the Madeira archipelago, just as they were into many other islands in the temperate regions of the world, as the settlers intentionally brought in new crops and livestock in order to guarantee their livelihood. Beyond satisfying their basic needs, plants and animals were introduced not only in order to diversify the diet, but also for aesthetic reasons and subsequently to provide goods for trading purposes. A number of unwanted organisms, such as weeds and plant pests, also arrived accidentally on the island, spreading to wherever they could find suitable ecological conditions for their establishment.

Madeira was uninhabited until 1425, when the navigator João Gonçalves Zarco founded a Portuguese settlement on the main island, the captaincy of Funchal. Woodlands were extraordinarily extensive and vigorous, which motivated the first settlers to call the island *Madeira* – i.e., the Portuguese word for “wood”. But the native forest (*laurissilva*) was unable to resist grazing and over-cutting for very long, at least on the southern slope, which soon became covered with fields of wheat, sugarcane and vines, among other crops. Agriculture and cattle breeding were possible in this region, due to its favorable climatic conditions, its plentiful supply of water, and its fertile soil.

From the sixteenth century onwards, Madeira became a regular stopover on the transatlantic trade routes. In the nineteenth century, it was also converted into a place of rest and recovery from tuberculosis for a (mostly British) foreign community, who began to settle in the city of Funchal as early as the seventeenth century. They supplied the local market with imports, traded local goods (especially wine and sugarcane liquor), and invested in agriculture (particularly in the vineyards) and the local handicrafts (for example, in wickerwork and embroidery) (Câmara, 2002; Vieira, 2003).

The environmental history of Madeira is, to some extent, the tale of the efforts made to control or eradicate invasive, non-native species. That was certainly the case in the 1870s and 1880s, when the vines were attacked by the phylloxera plague, and the sugarcane by the fungus *Conyothurium malasporum* (Câmara, 1998). Despite its subsequent spread worldwide, the Argentine Ant (*Linepithema humile* Mayr) made its first known appearance outside South America in this region (Wetterer et al, 2009). Through the reclassification of a few ant specimens stored at the British Natural History Museum (London), a recent study established the first occurrence of the species in Madeira (Wetterer et al, 2006). These specimens had been collected before 1858, by Thomas V. Wollaston, an English

entomologist who visited Madeira numerous times, from 1847 onwards. This occurrence predates even that of other specimens collected in Buenos Aires (Mayr, 1868).

“Think globally, act locally” is a phrase that is often repeated in environmental activism and international politics, and it is one that has proved useful in the academic field of environmental history: “no historical phenomenon, even if occurring on a worldwide and global scale, can be understood without observations made at a local or regional level in terms of empirical analysis. It is also at a local level that the effects of global phenomena are identified and can be studied” (Polónia, 2015: 66). Among the academics from different fields who study the global circulation of plant and animal species, historians can contribute to the understanding of the local responses to invasive species over time (Crosby, 1986; McNeill, 1994; Grove, 1996). Although there is an extensive scientific literature on the Argentine ant’s spread worldwide, only a few papers have mentioned the outbreaks in the Madeira archipelago, which on several occasions have presented the islanders with a very serious challenge.

This paper focuses on the local perceptions and responses to the invasion of this ant species, registered in scientific publications, literary writings, newspapers, and official archives. It also examines the invasion and control measures undertaken in the Madeira archipelago, from the mid-nineteenth century onwards. Basically, it aims to answer the following research questions:

- When did the outbreaks first start?
- Who was affected by the outbreaks?
- Which have been the most affected areas?
- How have people come to regard the invasion of this ant species over time?
- What are (and have been) the arguments used to implement control measures?

Methods

Local responses to the Argentine ant’s invasion, from the nineteenth century onwards, highlight the population’s perceptions, the extent of scientific knowledge about this subject, and the control measures undertaken. To be able to study these responses, despite their wide time span, data had to be brought together from different types of sources. Qualitative discourse analysis, combined with quantitative approaches and digital methods, produced a chronological narrative that focused on critical impact periods.

Data for qualitative and discourse analysis were collected from travel accounts, written during the second half of the nineteenth century by British travelers who had stayed in Madeira. These accounts were compared to, and complemented by, an exhaustive search of the scientific literature. In addition, local newspapers, dating from the time of previously identified outbreaks, were analyzed. These included local reports, small news articles and advertisements, with information about the traditional or popular control measures taken by the locals. The citations included in this paper have been translated from the original texts in Portuguese.

Although it is known from other sources that there were other official attempts to control the Argentine ant, the Madeira Regional Historical Archive only saved data on the control measures taken between 1920 and 1947, by the Entomological and Pathological Services of the Madeira Agrarian Station (*Serviços Entomológicos e Patológicos/Estação Agrária da Madeira*). Comprehensive records for the period from 1929 to 1938 include information about the services rendered to precise locations (e.g., the street address or the estate's name), the people making the request, the date of the control measure and the plant pests found *in situ* (Serviços Entomológicos e Patológicos, 1929). The records from 1930, 1933, and 1935 run from January to December; the ones from 1929, 1934, and 1938 do not comprise the entire year; and no records were found for the years 1931, 1932, 1936, and 1937. The name *formiga* (the Portuguese word for ant) is one of the common names used to identify the pest. However, the specific identification was inferred from other sources describing the Argentine ant as a pest in Madeira at that time (Grabham, 1924; Sarmiento, 1937). These data were analyzed within a Geographic Information System, which contributed to the study of the spatial dimension of the invasion in the city of Funchal.

Results and discussion

Ants at home at the end of the nineteenth century

In the last decade of the nineteenth century, people became aware of the damage that an introduced ant species could cause to their territory. Auguste Forel, who identified specimens collected on the main island, wrote: “to my surprise Mr. Schmitz twice sent me from Madeira the typical *Iridomyrmex humilis* Mayr [the Latin name then assigned to the Argentine ant] from the Neotropical fauna, which is already a house and land pest in

Madeira” (Forel, 1895: 230). This finding was a harbinger for what would, very soon, be described as a true invasion:

[I]n Funchal and its outskirts the ants have been a real pest and public calamity for a few years now. Millions invade everything – fields, kitchen-gardens and gardens, especially the houses – where the sideboards, cabinets, commodes, tables and even the beds are invaded; places are not protected from anything that can arouse their appetite. (Schmitz, 1896: 55)

In the nineteenth century, the city of Funchal was a pebble beach, with a few seaside streets and many grand estates scattered around the hills. On his arrival, the foreigner would have a panoramic view of how the urban area was arranged: “[I]t looks white and brilliant, house above house, and street above street, climbing up the mount side; and outside the city, still on higher terraces, are the cottages and ‘quintas’ or country residences” (Blackburn, 1860: 11). These ‘quintas’ afforded

much fascinating matter to one who loves gardens and gardening (...) The most favored zone for ‘quintas’ is that which extends from a mile to two miles from the center of the town – the distance, owing to the configuration of the terrain, generally appears greater than it is in reality – and many very fine examples are to be met with within this radius. (Koebel, 1909: 174)

The ring of beautiful estates around the narrow streets of the old town hall housed the wealthiest merchants and the foreigners visiting the island. The British community dedicated particular care to these areas, especially in the arrangement of the outdoor green spaces, which were used to plant specimens from different parts of the world. The love of botany found a perfect setting for its physical materialization in the physiographic conditions of Madeira. Given the demand, the renting of ‘quintas’ became a flourishing business: “[I]odgings in Madeira are plentiful and good. For a family, the most comfortable plan is to take a *Quinta*, that is to say, a house with a garden, standing in the suburbs of the town. The price asked for the season of six months varies according to their size, from £50 to £200” (Hadfield, 1854: 71).

Meanwhile, the Argentine ant found, in this archipelago, a suitable habitat in which to multiply, causing a widespread feeling of unease. Schmitz talked about damages that

are incalculable: some houses and even splendid estates, expressly built for wealthy foreigners who wish to spend the winter season in Madeira, find themselves infested in such a way that they are abandoned after vain efforts directed against the terrible invaders and do not find tenants; not to mention the losses suffered by crops, grapes, fruit trees. (Schmitz, 1896: 56)

In the first two decades of the perceived invasion (1890–1910), the ant was mostly considered as a terrible urban pest and described, in the travel books, as a local problem:

[t]he island, however, is suffering to an increasing extent from the ravages of a peculiarly voracious species of ant (...) They are often unpleasantly common in houses, and are much given to haunt sugar basins and other receptacles of sweet stuffs. Even in death they contrive to annoy, as one may reflect grimly on watching them drown in the cup of morning tea. (Koebel, 1909: 206–207)

In 1896, the ant's invasion was already arousing the attention of the local newspapers. On February 25, a news article made reference to the study of Ernest Schmitz. On March 13, a letter from a foreign resident, Baron Charles van Beneden, mentioned the discomfort caused by the presence of ants at his “quinta,” and suggested “several recipes to kill ants” and to prevent them from invading the “furniture” and “gardens”. Furthermore, the newspapers advertised formicides, sold through a shop in Lisbon (*Diário de Notícias da Madeira*, 25 February 1896: 2; 13 March 1896: 2; 15 March 1896: 1; 11 October 1896: 2; 26 October 1896: 2; and 6 November 1896: 2).

At Funchal town hall, the authorities were also debating possible measures to control the ant's invasion of the city's parks and gardens. In August, 1896, the municipality instructed one of its officials to contact the Lisbon Municipal Council, in order to receive “instructions on the devices used to extinguish ants” in the capital. One month later, the same official proposed buying one of these devices. The source text is vague, but it probably refers to a sprayer, later advertised in the same newspaper (*Diário de Notícias da Madeira*, 7 August 1896: 1; 11 September 1896: 2; 11 October 1896: 2).

The Argentine ant was not the first ant to invade the city of Funchal. Outbreaks of other invasive species can be traced back in time. The entomologist O. von Herr described a new species that, he thought, could be native to the island. It was, after all, the African tropical species *Pheidole megacephala*, described by Fabricius, in 1793. Ants

creep up the table legs, along their edges, upon the tables themselves, and even into chests of drawers, boxes, etc. Being extremely small, they can get in through the smallest cracks and holes. You may kill thousands on thousands, and yet perceive no decrease of them; they are continually replaced by new hosts in the rear. (Heer, 1856: 212–213)

Personal notes on invasions of unidentified ant species can also be found, as well as testimonies to their impact on people's welfare in Madeira. In 1851, Edward Harcourt mentioned that

[t]here are several species of ants: a very minute one which pervades the houses is highly destructive; it is next to impossible to preserve any specimens of birds or insects from its ravages. You eat it in your puddings, vegetables, and soups, and wash your hands in a decoction of it (Harcourt, 1851: 125).

Describing her honeymoon in 1853, the Englishwoman Isabella de Franca also remembered that “[a]nts are a perfect nuisance; nothing can be kept from them unless surrounded by water” (Franca, 1970: 115).

A plant pest in the first half of the twentieth century

The damage caused by ants to vineyards and fruit trees dates back to 1895, when it was considered “one of the greatest evils that currently threatens our agriculture” (*Diário de Notícias da Madeira*, 27 August 1895: 2; 4 September 1895: 1). But the relationship between aphids and ants was only revealed to the public in 1903: “[i]t is mainly trees that are invaded by *woolly aphids* that are most attacked by ants. Since it is known that the *woolly aphid* is the ant's cow, and that ants are greedy about the sweet honey-like liquid they excrete.” Advice was given to those who worried about the invasion of ants: before all else, they

“should combat or exterminate the woolly aphids” on the trees (*Diário de Notícias da Madeira*, 30 September 1903: 2). In 1905, another article insisted on the extermination of the *woolly aphids* “because ants are very greedy over them and only seek those trees in order to satiate their constant appetite” (*Diário de Notícias da Madeira*, 2 October 1905: 2).

In 1908, the newspaper that had issued the first warning expressed concern about the possible combined impact of these various plant pests on the fruit trees. It was difficult for the fruits from Madeira to compete with the fruits from other regions, in the international market, particularly those from the Canary Islands. It was highlighted that “the invasion of ants, of coccidia and other insects” tended to “plague the trees and damage the fruits,” which in turn was responsible, according to the author of this article, for “Madeira’s fruit declining rapidly in both quantity and quality” (*Diário de Notícias da Madeira*, 31 May 1908: 1).

Similar concerns were officially expressed in the years that followed. In 1910, a republican revolution overthrew the monarchy in Portugal, leading to a change in the structure of the local authorities and the reorganization of the administrative services. The *Junta Agrícola da Madeira* governed agricultural policy in the archipelago, between 1911 and 1919. The economic development strategy recommended for the region, at that time, was to foster the production of fruit, wine and sugarcane. Besides soil and water, the territory had excellent weather conditions. Yet, the same temperate and humid climate that benefited these crops also favored the proliferation of plant pests, especially fungi and insects.

Michael Comport Grabham emphasized the Argentine ant’s status as a plant pest, in the first two decades of the twentieth century, declaring to his British compatriots that: “[t]he Madeira experience of the Argentine ant certainly justifies the American opinion that we have in this pest an agent of destruction comparable to the Colorado beetle or the Cotton Boll weevil” (Grabham, 1919: 8). Grabham understood, from his personal experience, the partnership between this ant, the scale insects and the mealybugs that live in the sugarcane: “the fostering influence of the new pest [the Argentine ant] became at once manifest in the startling increase and activity of the cane parasite” (Grabham, 1924: 262). The ant was playing the role of the villain.

Killing ants by any means

Although, until the end of the nineteenth century, the advertisements in the press included products available at shops in Lisbon, in the decades that followed, the focus turned to shops in Funchal, which promised to perform “wonders” in the fight against ants and other pests.

Until 1910, references to specific brands of insecticides were unusual. There were some advertisements for “Lyzol,” a product with a composition that was based on benzene and gypsum (*Diário de Notícias da Madeira*, 30 September 1903, 2) and “Ballikinrain”, “a preparation (...) intended to exterminate ants, wasps, cockroaches, etc.” Although the discourse was already very commercial, guaranteeing that “there is nothing better for the full removal of these disgusting insects,” or that “one of the [product’s] specialties is to get rid of ants in fruit trees” (*Diário de Notícias da Madeira*, 21 November 1907: 1), the propaganda focused on the product’s chemical compounds. Advertisements talking about “nicotine sulphate,” “copper sulphate” or simply a kind of “honey to destroy ants, cockroaches, wasps and rats,” appeared almost every year, normally at the beginning of winter and in spring (*Diário de Notícias da Madeira*, 11 November 1904: 1; 14 December 1904: 2; 31 December 1904: 3; 16 May 1908: 2; 14 March 1909: 4; 4 April 1909: 3; 9 May 1909: 3).

The homemade recipes were based on sulphates. In 1906, it was assured that “one of the best ways to destroy the ants is to mix together equal shares of borax powder [sodium borate] and sugar and to pour this mixture on the invaded sites” (*Diário de Notícias da Madeira*, 9 May 1906: 2). A couple of years later, the press published another solution which had “proven satisfactory” in the control of “ants and other insects that attack the gardens’ plants.” The recipe included “half-a-kilo of copper sulphate well dissolved in 5 gallons of water” and a “half-a-kilo of calcium oxide dissolved in 5 gallons of water.” These solutions should then be mixed together, again dissolved in water and applied “three times a week: the ants and other insects disappear quickly.” Afterwards, it should be enough “to water every two months” (*Diário de Notícias da Madeira*, July 9, 1909: 2). The recipes could also be imaginative and include “natural” solutions like “rotten lemon, or water in which lobsters or crabs have been boiled”, which would “put the ants to flight,” or so it was said (*Diário de Notícias da Madeira*, 2 October 1905: 2). During winter, the farmer should take the “opportunity” to carry out some preventive “work against coccidia, ants, phylloxera, nymphs of other insects, etc.” He should use “a wire mesh glove, Sabaté [sic] system, or

another coarse and resistant fabric” to remove “from the trunk and branches of the vines, the old and dry shell that serves for nothing but to shelter the tree’s enemies that wait there for the return of spring to invade” the plants once more (*Diário de Notícias da Madeira*, 24 December 1906: 1). Farmers could also combine the two methods, “first taking care of cleaning the tree, which can only be achieved by gently scraping the bark without hurting the plant,” using “steel mesh gloves (Sabaté gloves),” and then “washing the trunk with an iron sulphate solution” (*Jornal da Madeira*, 25 June 1935: 1).

To reinforce the benefits of a particular recipe, the press would publish alleged scientific discoveries, associating a particular researcher’s name with the description of the recipe. This was the case with “Dr. Matiffat,” an expert who supposedly “conducted various experiments to put an end to the ants,” concluding that “the easiest, most inexpensive and non-poisonous method that produces best results is as follows: spray with a solution of sodium hyposulphite (1 kilogram of hyposulphite in 10 liters of water) all the spots ants have as their usual places of visit.” It was guaranteed that “with these sprays, repeated every 15 days, you will be completely free of ants” (*Diário de Notícias da Madeira*, 28 December 1910: 3). Clearly, this recipe did not differ much from the ones suggested previously, but the semblance of a scientific discourse certainly helped in convincing the public. Commercial companies used a similar approach for selling insecticides (including formicides), in order to improve the advertisement of these products’ advantages and benefits. However, they often ignored the possible impact that these products might have on the environment and public health.

The first decades of the twentieth century were a transition period, as far as commercial offers were concerned. International brands redirected their expenditure to advertising these insecticides, in an attempt to dominate the market. Nevertheless, it was still possible to find drugstores that sold “insulating pulp for ants on trees” (*Diário de Notícias da Madeira*, 2 August 1930: 3) and similar generic products, like “pulp and paper to isolate the trees from the ants” (*Jornal da Madeira*, 13 June 1935: 4; 29 June 1935: 3).

Tanglefoot was one of the most active brands. Its advertisements, which announced “the best and cheapest American insecticide”, could sometimes occupy almost a third of the page. It promised to “kill flies, mosquitoes, moths, cockroaches, butterflies, ants and many other insects” (*Diário de Notícias da Madeira*, 10 May 1930: 3) and “guaranteed its quality, its efficiency and the fact that it challenged all other competition” (*Diário de Notícias da Madeira*, May 27, 1930: 4). Although the message and size of the commercial could vary, the discourse was very similar to that found in the case of other brands. For

example, the “FORMICIDE MARVIS” was advertised as the one that “radically makes ants disappear” (*Diário de Notícias da Madeira*, 7 April 1935: 3).

As a result of other social concerns, the advertisements sometimes included a scientific or medical guarantee of the product’s harmless effects on men and pets, occasionally even asserting that it was beneficial for their health. The “FLIT” brand claimed that it was the “most POWERFUL of pesticides” and that people could vaporize it “without the slightest fear, inside closets, drawers and wardrobe” (*Diário de Notícias da Madeira*, 19 June 1930: 2). Besides being a “ruthless destroyer of all domestic insects and parasites,” it also guaranteed costumers that it did “not stain or erode”, and that, although it had “a smell,” that could even be “enjoyable for many people”, it would disappear “quickly” (*Jornal da Madeira*, 22 June 1930: 3). Produced by the Standard Oil Company, FLIT contained 5% DDT, which is now known to be highly dangerous. In 1930, Tanglefoot promised a high-value cash prize “to the honorable doctor who presented himself and could prove that the spraying of the liquid ‘Tanglefoot’ was harmful to human health and pets,” and another prize to anyone who could prove “that the marvelous ‘Tanglefoot Powder’ does not exterminate ants and cockroaches,” (*Diário de Notícias da Madeira*, 5 August 1930: 3). The same brand announced that it “was chosen in Lisbon from among all other similar products for use in Sanatoriums for the National Assistance of Tuberculosis” (*Diário de Notícias da Madeira*, 27 May 1930: 4), associating itself with a leading institution that was a major reference in the Portuguese medical services at the time. The product created sticky barriers, where insects became trapped—the action was strictly mechanical. The “Whiz Fly Fume” (a brand with a suggestive skull as its logo) guaranteed that it was “the great destroyer, the uncompromising enemy of the FLIES, MOSQUITOES, BED BUGS, FLEAS, ANTS, COCKROACHES, and their larvae and eggs,” and that it could also “protect your health and your well-being and preserve your clothes from damage caused by moths” (*Diário de Notícias da Madeira*, 25 May 1930: 5).

The local responses in Madeira were not far removed from the global ones. Several methods to control the Argentine ant were also suggested by American entomologists. These comprised the use of repellents and poisons, such as sticky barriers, zenoleum powder on the floors of infested houses, “ant tapes” made by soaking ordinary cotton tape in a corrosive sublimate solution, and sweetened arsenical solutions (Newell and Barber, 1913). Due to the impact of these poisons on bees, the Spanish entomologist Font de Mora reported his preference for homemade insulator rings, with non-toxic substances (resin and fish oil), that prevented ants from climbing up the fruit trees. Still “these glues have the

disadvantage of remaining fresh for a short time, allowing the ant to move after very slightly drying, and serving in many cases as support points for ants that ventured to continue on their way” (Font de Mora, 1923: 77–78). France, Italy, and Portugal adopted legal instruments to compel owners to eliminate the Argentine ant from their lands, using mainly arsenical poisons (Chopard, 1921; Paoli, 1922; Silva Dias, 1955).

Control measures taken by agricultural agencies

The outbreaks that occurred in the first half of the twentieth century affected the sugarcane plantations, vineyards and orchards. Even when fruit trees were isolated or few in number, the owners were compelled to act against this uncontrolled proliferation. Archive documentation shows that the plant pathology services were very active in fighting existing plant pests. Each control intervention was paid for in accordance with the pest in question and the extent of the treatment given, justified by the manpower and materials used in the process.

In the four municipalities of the south coast, residents requested interventions from the plant pathology services from 1929 to 1938. These interventions took place predominantly along the coastline, a large majority of which (97%) were located in the municipality of Funchal (Figure 1a). The same location registered frequent calls for ant control intervention, in different years and different months of the same year. Some of these locations, in the city, were subject to persistent invasion and the treatments applied in each intervention could not solve the whole issue at once. In some of these interventions, other pests are also referred to, for example scale insects, mealybugs and aphids, which, as mentioned above, have a beneficial interaction with these ants.

Locations from 1930, 1933 and 1935 were projected onto an adjusted map of the city of Funchal (“Planta do Funchal,” 1938), showing the dispersion of interventions both within the urban area (overlapping the street map) and external to the urban area, in that period (Figure 1b). The streets nearest to the shoreline (the oldest part of the city) required fewer control measures. A ring of locations is distributed in areas immediately above the beach neighborhood, where houses with back gardens and *quintas* were the family homes typically built from the eighteenth century onwards. Small orchards were integrated into the residential area without a clear distinction between rural areas (cultivated fields) and urban areas (buildings) (Quintal and Groz, 2001).

Assuming that the area of pest control measures is indicative of the range of the Argentine ant's invasion at that time, a terrestrial area of the minimum convex polygons, drawn from the sites, was calculated for the periods 1929-1938 (all data available), 1930, 1933 and 1935 (Figure 1c). The range of 1930 is similar to the cumulative range of 1929-1938 (20.43 km²). Over subsequent years, the invaded area apparently decreased and the number of locations subject to pest control was clearly beginning to fall.

The local department of the national board for the promotion of fruits (“Junta Nacional de Frutas da Madeira”) played a major role in the fight against plant pests in the 1940s (Pereira, 1940: 658). Nonetheless, the Argentine ant was still a major concern:

[m]easures are needed not only for saving our fruit trees and agriculture in general but also for the great benefit of men and animals. Although the ant has weakened its advances because it has become more acclimatized and more widespread, its extermination should however not be disregarded (Pereira, 1940: 457).

In 1947, the species was considered “the most serious problem for agriculture and perhaps the most serious problem for the whole economic life of Madeira” (Schultze-Rhonhof, 1947). In August, 1949, “the Argentine ant remains a pest that most concerns the fruit growers and gardeners (...) the scourge’s adverse effects are felt most severely in the orchards, the vineyards and the garden crops that usually suffer attacks from these scale insects” (“A formiga Argentina,” 1949: 257).

Living with ants, or not at all?

Amid the chorus of negative perceptions, there were, nonetheless, some voices that found the presence of the Argentine ant beneficial. Among the utility services, the ant's presence was seen as a sign that there would be atmospheric changes, predicted with the sensitivity of a barometer predicting rain and heat, leading to “the precipitate abandonment of hives due to the danger of asphyxia and insolation”. Moreover, the species was considered an effective predator of the larvae of wasps (Pereira, 1940: 457). The Argentine ant also controlled another plant pest, the *Sesamia nonagrioides* (synonym, *Nonagria sacchari*)—larvae of this moth live inside the stalks of sugarcane, opening galleries and promoting the fermentation of tissues (Silva and Meneses, 1940: 292–293). In 1930, the local newspaper recalled the impact of this pest in the first decades of the century, referring to these ants as “evils that always bring some benefit.” It “happened that, faced with this ant, the *sugarcane*

bug, its fierce enemy, was forced to retreat, and so, due to the rarity of the bug, it seemed to be a time when agriculture would finally break free of such a harmful parasite.” The ant, however, “lost its warrior qualities of the early days, and over the last fifteen years in various parts of Madeira the *Nonagria sacchari* has returned to occupy reed areas” (*Diário de Notícias da Madeira*, August 13, 1930: 1).

People have regularly combated outbreaks using every possible means and product available; however, the inhabitants of Madeira are still bothered by ants. They have failed to control them in public facilities, homes, gardens, orchards and natural habitats. The products that are now used, besides being less dangerous to all other living beings (including humans), have shown increased efficiency, minimizing the impact of the outbreaks in urban and agricultural lands. Instead of repellents, formicide baits are now used to fight the entire colonies (Britto, 2016). These attract the worker ants, who then carry the deadly food to the nest and share it with the other animals, including the immature forms and the queen.

In Madeira, there are at least two active pest control companies. Extermínio (which literally means “extermination”) has existed since 1990, performing interventions in private homes and enterprises. It includes four species of ants in its pests guide, including the Argentine ant (<http://www.exterminio.pt/pt/pest/pest-141>). Rentokil mentions some habits of the Argentine ants, which make their proliferation a serious problem for society: “the worker ants follow long trails to a food source, so their nests are not easy to find; they prefer sweet foods, but they also eat living or dead insects, meat, cereals and rotten fruit; they drive all the ants of other species out of their area.” (<http://www.rentokil.pt/formigas/especies-de-formigas>) Additionally, it warns its customers about the losses that they can suffer due to these ants: “they contaminate food and other products that will then go to waste, costing you money and resources (...) [i]nfestations in places such as hospitals and nursing homes can spread pathogens and alarm patients or residents and endanger hygiene standards (...) if your reputation suffers, your profits also suffer when customers are placed in the presence of ants.” (<http://www.rentokil.pt/formigas/como-acabar-com-as-formigas>).

In the last few decades, the scientific knowledge gathered about the Argentine ant distribution has shown new locations of its occurrence in the Madeira archipelago. The Argentine ant has not been restricted to the coastal areas and it has colonized natural habitats (Wetterer et al., 2007; Queiroz and Alves, 2016). In the 1990s, it was identified in mountainous areas, such as the deep valley of Curral das Freiras. In the last two decades,

scientists and conservation authorities have identified the presence of the Argentine ant in the region's nature reserves included in the EU Natura 2000 network: on Deserta Grande (2003), which is uninhabited and has been designated as a nature reserve since 1990; on the west end of the main island, and on its adjacent islet, both of which are included in the nature reserve of Ponta de São Lourenço. Recently, it was found in large numbers on the small islets surrounding Porto Santo, namely on the Ilhéu de Cima, in the area of distribution of the high priority terrestrial mollusk species. These surveys show that the invertebrate communities are less diverse in the areas that have been heavily invaded by the ants (AAVV, 2014). Furthermore, ornithologists in Madeira have noted that the ants have been attacking young nesting birds, biting the bird's mucous membranes (eyes, mouth and nasal cavity), which could have deadly consequences, especially during very dry years (Boieiro and Menezes, 2014). This behavior has also been described in the literature, since 1920, where the victims have usually been domestic animals, reared in henhouses and hutches (Chopard, 1921).

The Argentine ant has been responsible for damage to the native biodiversity all over the world. The species is included in the Spanish Catalogue of Invasive Species (Royal Decree 630/2013, of August 2; last modified on June 17, 2016), but no control measures have so far been taken for conservation purposes. In the Canary Islands, the Official College of Biologists warned about the presence of thousands of specimens of this species on the islands of El Hierro and La Palma, revealing that "because they are geologically younger islands with simpler wildlife ecosystems," the "invasive species are more ecologically aggressive" ("La hormiga argentina (*Linepithema humile*) en la isla de El Hierro," 2011). In La Palma, the Argentine ant has been identified in banana plantations, associated with *Dysmicoccus grassii*, a scale insect that represents a major phytosanitary problem in the Canary Islands (Hernandez et al, 2015). A few years ago, the Balearic environmental agency published a full study on the Argentine ant in the territory (Gomez and Espalader, 2005), and, more recently, it promoted a study that focused on the S'Albufera des Grau (Menorca) (Abril and Gomez, 2012), in order to evaluate the distribution and degree of invasion of this species in the protected area. There, the Argentine ant was not found in natural areas, far from urban centers, and no control measures were proposed. This ant has displaced the indigenous ant species in northern California (Human and Gordon, 1996) and south-eastern Australia (Rowles and O'Dowd, 2006). It is consistently better at foraging for food than other species, and its interspecific aggression contributes greatly to its competitive success. Furthermore, the Argentine ant

does not disperse seeds in the same way as the native species of the Cape region (South Africa) do. This is an important ecosystem service on which many plants depend to recover from the effects of fire, such as the endemic proteas of this region in South Africa. Consequently, 20% of this “Fynbos” flora is threatened by the invasive Argentine ant (*Argentine Ant Invasion in Fynbos*, <http://www.proteaatlas.org.za/antarg.htm>).

Is the Argentine ant also threatening the biodiversity of the Madeira archipelago? Which species are being affected? Scientists and nature conservation authorities are concerned about this possibility, so that they have designed a few control campaigns to be undertaken on the islets of Porto Santo, in Ponta de São Lourenço (Madeira) and on the Desertas islands (Boieiro and Menezes, 2014), approved and financed by EU funds for nature conservation.

Conclusions

The narrative of the Argentine ant’s impact on nature and society is an ongoing story, not only in the Madeira archipelago, but anywhere where it has found the conditions it needs to proliferate.

Over time, different assessments of the situation have determined the actions of different regional entities. Ranging from individual responses to interventions by the Funchal Municipal Council, from the agricultural supervisors to environmental departments, from several layers and sectors of the general public to their administrations, all have had the Argentine ant on their agenda. At the beginning of its transatlantic journey, the Argentine ant was regarded as a particular nuisance due to its role as an urban pest. This evaluation has since been replaced by a major economic concern over the losses that this plant pest has caused in the last 100 years. Currently, new control measures are being implemented, in protected areas, due to concern over the conservation of nature.

Islands are known to be environmentally, socially, and politically vulnerable territories. But it is, after all, surprising how such a tiny dark creature, with a harmless appearance, can mobilize so many resources and energies.

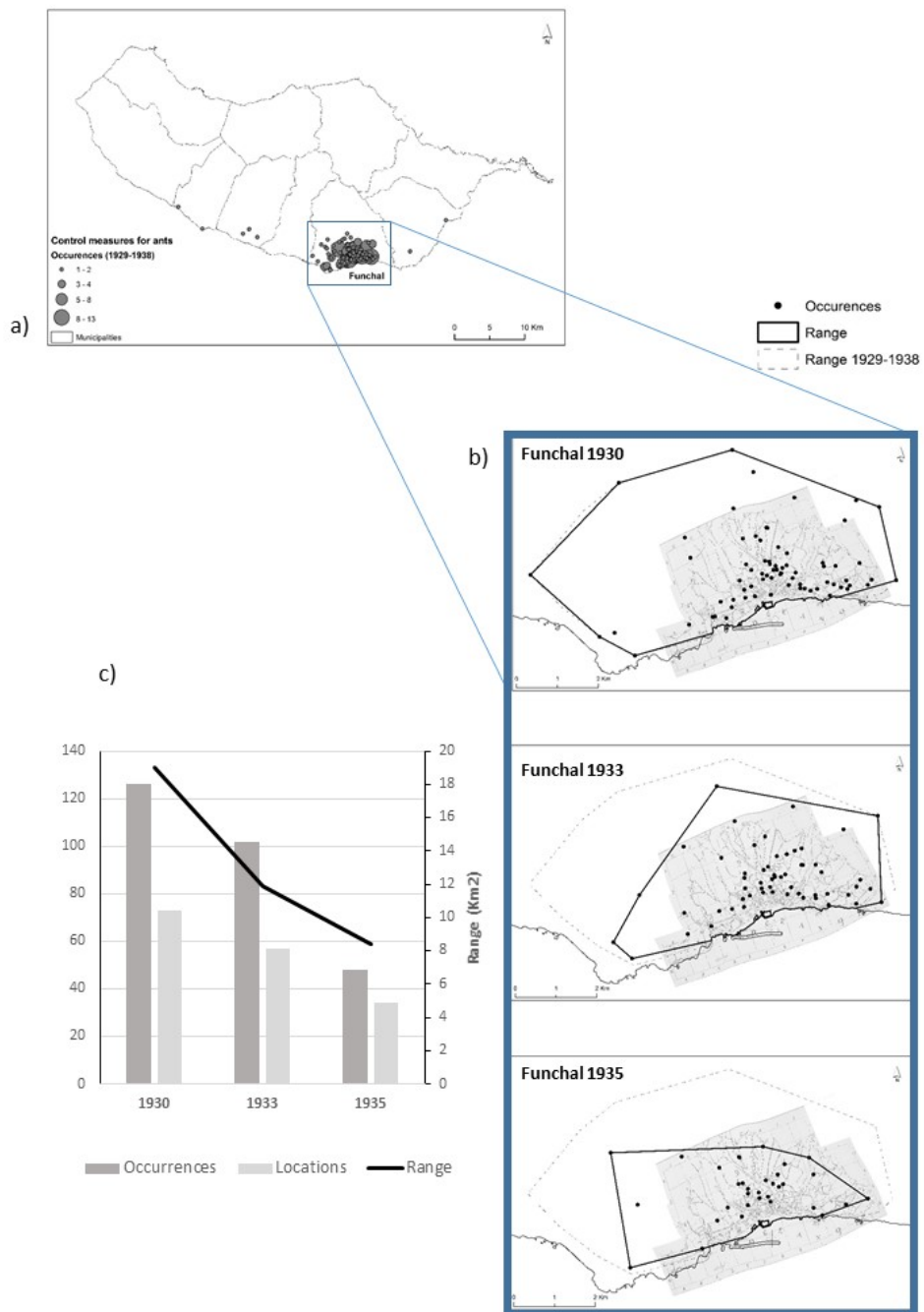


Figure 1 – Spatial analysis of the recorded control measures for ants taken by the plant pathology services: a) interventions from 1929 to 1938 on the island of Madeira (all data available); b) locations and the invasion range in Funchal per year vs. the total invasion range (1929-1938), with a 1938 map of the city in the background; c) chart of the number of interventions, number of locations and the invasive range per year, in Funchal.

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