

Termite Damage to Buildings in the Province of Córdoba, Spain

by

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ABSTRACT

In 1997 extensive and severe termite damage was reported in Palenciana, a small town in the Southwest of Córdoba. Following the inspection that showed nearly half of the buildings in the town were infested, we put forward an control project taking into account the characteristics of Spanish urbanization and construction practice.

The province of Cordoba is administratively divided into 74 towns plus the capital. The remaining towns were also surveyed for infestations in order to determine the impact of termites on the province. We have found termites in buildings in 66 (88%) towns. Although we did not find termites in 9 (12%) towns, this does not necessarily imply their absence there. The extent of the termite damage in each town varies. In 33 (45%) towns damage has been found in only a few houses but, one or more extended areas were affected in the rest.

A more elaborate survey was done in Palenciana by using mark-recapture methods to estimate foraging ranges and population sizes for some colonies. In Palenciana we have information from 350 of the approximately 640 houses, in which we found termite damage in 164. Because the affected area is clearly defined we have established a zone of 308 buildings (48.1% of the town), in which the damaged houses represent 53.2% of the zone but, we can anticipate that all will be eventually affected if no treatments are applied. Foraging territories of 6 colonies surveyed ranged from 50 to 2342 m², with estimated populations of 157,846 to 5,200,000 termites per colony.

KEY WORDS: Isoptera, Rhinotermitidae, *Reticulitermes lucifugus*, Urban pest, Spain.

INTRODUCTION

Two termite species are present in continental Spain, the drywood termite, *Kalotermes flavicollis* (Fabricius), which damages vineyards and trees in public gardens as well as buildings, and the subterranean

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2. Study of the Palenciana Village.

More intensive investigation was conducted in Palenciana, where residents were provided with questionnaires that asked about: building characteristics, the past presence of termites, the existence of factors favoring termite presence, controls applied, etc.

The infested houses were marked in the village map to define the damaged area. Before the control program, we studied some colonies in the affected area. We placed monitoring stations in some houses for monitoring the colonies (Su & Scheffrahn 1986). Triple Mark-Recapture method in conjunction with dye marker such as Neutral Red or Nile Blue, or spray paint (Su *et al.* 1991, Miller 1993, Forschler 1994, Evans 1997) were used to determine the colony population and their foraging territory (Su & Scheffrahn 1988).

RESULTS

All termites found in this study were the subterranean species *R. lucifugus*.

1. Termite survey in the towns and villages of Córdoba province.

The Table 1 and Fig. 1 summarize the results of our study. Previously, of the 75 localities surveyed, 13 (17%) was known to be infested with termites, but our current study showed that 66 (88%) of the villages were infested. The extent of damage revealed by our inspections was: 33 localities have been considered as having isolated infestation, 12 towns or villages were estimated as presenting medium infestation, 21 towns or villages have high infestations.

Because the inspections were principally made on the exterior of the houses, most of the termite damage was found in the frames of doors and windows. When we were allowed to inspect the interior of the houses, other damage was found in wooden beams.

2. Study of the Palenciana Village

Palenciana was subjected to more intensive study than the rest of Córdoba province. This revealed high termite activity. Palenciana is a small village in the Córdoba province (Fig. 1). The municipal district extends over 16 km², the village occupies an area over 100,000 m². The town has 640 houses with 1,580 inhabitants. Fig. 2 shows the town of Palenciana with the houses infested with termites indicated.

Table 2 shows the survey results. Because the damaged houses were located in the center of the village, we have delimited an infested area which includes 308 houses, and 164 of them were affected by termites. More than a half of the area of the town (60,000 m²) was infested with termites. The most frequent damages found corresponds to door and

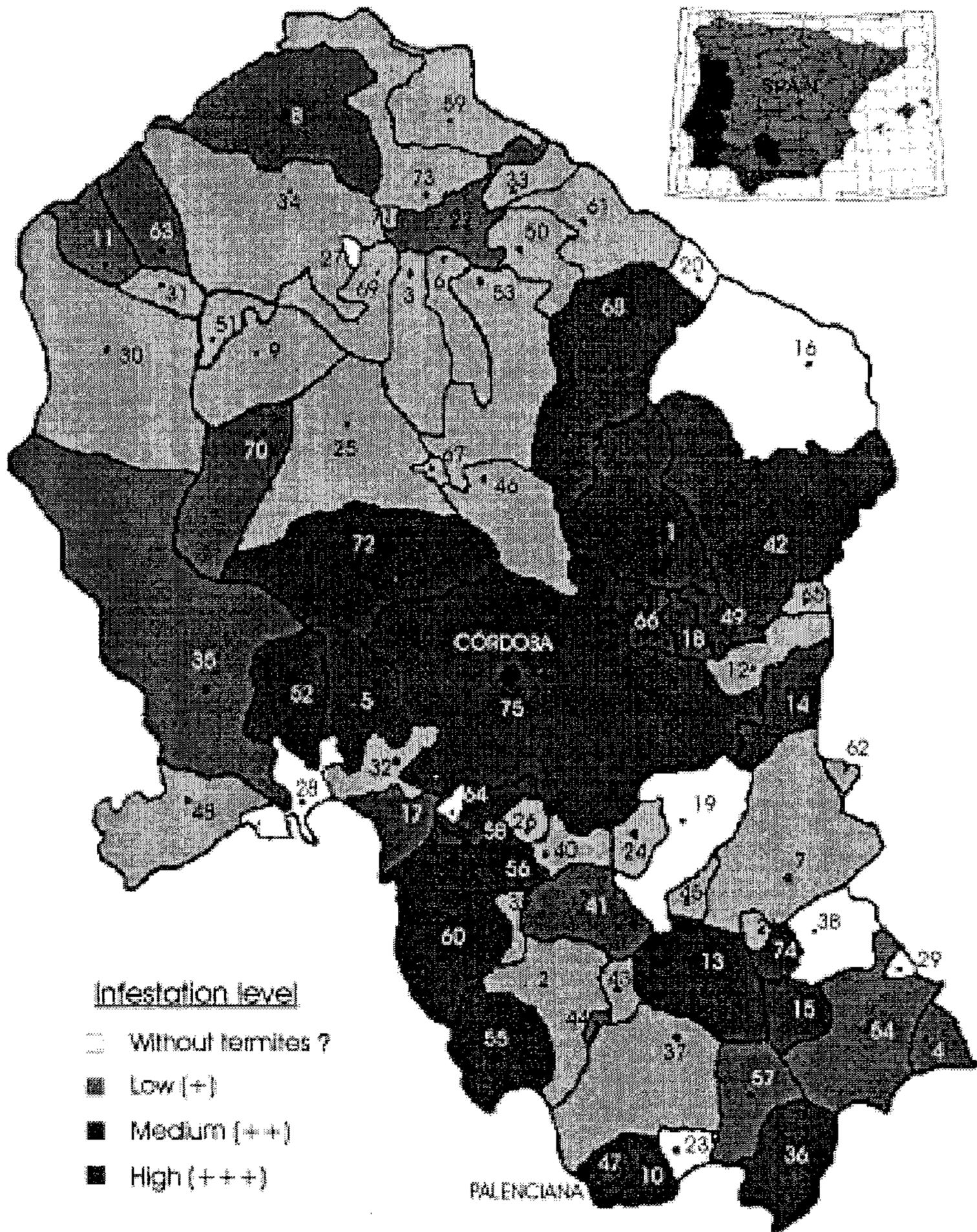


Fig. 1. Cordoba province. Locations of the 75 town/villages. The names of the towns, and their infestation levels are indicated in Table 1.

window frames. But a more severe situation occurs when the wooden beams are affected.

Palenciana was established in the seventeen century. Many houses are >100 years old, and some were >200 years old, so they are supported by old wooden beams. Some buildings have been partially destroyed and their ceilings have collapsed because of termite damage.

Table 3 shows the houses that are especially susceptible to termite

Table 1. Results of the termite damages for 75 town/villages in the province of Córdoba (Spain). Previously, the presence of termites were known only in 13 towns.

| TOWN / VILLAGE | No. | PREVIOUS KNOWLEDGE | RESULTS OF INSPECTION | DEGREE OF DAMAGE |
|------------------------|-----|--------------------|-----------------------|------------------|
| ADAMUZ | 1 | NO | YES | +++ |
| AGUILAR DE LA FRONTERA | 2 | NO | YES | + |
| ALCARACEJOS | 3 | NO | YES | + |
| ALMEDINILLA | 4 | NO | YES | ++ |
| ALMODOVAR DEL RIO | 5 | NO | YES | +++ |
| AÑORA | 6 | NO | YES | + |
| BAENA | 7 | YES | YES | + |
| BELALCAZAR | 8 | NO | YES | ++ |
| BELMEZ | 9 | NO | YES | + |
| BENAMEJÍ | 10 | NO | YES | +++ |
| LOS BLAZQUEZ | 11 | NO | YES | ++ |
| BUJALANCE | 12 | NO | YES | + |
| CABRA | 13 | NO | YES | +++ |
| CAÑETE DE LAS TORRES | 14 | NO | YES | +++ |
| CARCABUEY | 15 | NO | YES | +++ |
| CARDEÑA | 16 | NO | NO | - |
| LA CARLOTA | 17 | YES | YES | ++ |
| EL CARPIO | 18 | NO | YES | +++ |
| CASTRO DEL RÍO | 19 | NO | NO | - |
| CONQUISTA | 20 | NO | NO | - |
| DOÑA MENCÍA | 21 | NO | YES | + |
| DOS TORRES | 22 | NO | YES | ++ |
| ENCINAS REALES | 23 | NO | NO | - |
| ESPEJO | 24 | NO | YES | + |
| ESPIEL | 25 | NO | YES | + |
| FERNAN NUÑEZ | 26 | NO | YES | + |
| FUENTE LA LANCHA | 27 | NO | NO | - |
| FUENTE PALMERA | 28 | NO | NO | - |
| FUENTE TOJAR | 29 | NO | NO | - |
| FUENTE OBEJUNA | 30 | NO | YES | + |
| LA GRANJUÉLA | 31 | NO | YES | + |
| GUADALCAZAR | 32 | NO | YES | + |
| EL GUIJO | 33 | NO | YES | + |
| HINOTJOSA DEL DUQUE | 34 | NO | YES | + |
| HORNACHUELOS | 35 | YES | YES | ++ |
| IZNAJAR | 36 | YES | YES | +++ |
| LUCENA | 37 | NO | YES | + |
| LUQUE | 38 | NO | NO | - |
| MONTALBÁN | 39 | NO | YES | + |
| MONTEMAYOR | 40 | NO | YES | + |
| MONTILLA | 41 | YES | YES | ++ |
| MONTORO | 42 | NO | YES | +++ |
| MONTURQUE | 43 | NO | YES | + |
| MORILES | 44 | NO | YES | ++ |
| NUEVA CARTEYA | 45 | NO | YES | + |
| OBEJO | 46 | NO | YES | + |

Table 1. (continued from previous page). Results of the termite damages for 75 town/villages in the province of Córdoba (Spain). Previously, the presence of termites were known only in 13 towns.

| | | | | |
|---------------------------|----|--------|------|-----|
| PALENCIANA | 47 | YES | YES | +++ |
| PALMA DEL RÍO | 48 | NO | YES | + |
| PEDRO ABAD | 49 | NO | YES | +++ |
| PEDROCHE | 50 | NO | YES | + |
| PEÑARROYA-PUBLONUEVO | 51 | NO | YES | + |
| POSADAS | 52 | YES | YES | +++ |
| POZOBLANCO | 53 | NO | YES | + |
| PRIEGO DE CÓRDOBA | 54 | YES | YES | ++ |
| PUENTE GENIL | 55 | NO | YES | +++ |
| LA RAMBLA | 56 | YES | YES | +++ |
| RUTE | 57 | NO | YES | ++ |
| SAN SEBASTIAN BALLESTEROS | 58 | YES | YES | +++ |
| SANTA EUFEMIA | 59 | NO | YES | + |
| SANTAELLA | 60 | NO | YES | +++ |
| TORRECAMPO | 61 | NO | YES | + |
| VALENZUELA | 62 | NO | YES | + |
| VALSEQUILLO | 63 | NO | YES | ++ |
| LA VICTORIA | 64 | NO | NO | - |
| VILLA DEL RÍO | 65 | NO | YES | + |
| VILLAFRANCA DE CÓRDOBA | 66 | NO | YES | +++ |
| VILLAHARTA | 67 | NO | YES | + |
| VILLANUEVA DE CÓRDOBA | 68 | YES | YES | +++ |
| VILLANUEVA DEL DUQUE | 69 | NO | YES | + |
| VILLANUEVA DEL REY | 70 | NO | YES | ++ |
| VILLARALTO | 71 | NO | YES | + |
| VILLAVICIOSA DE CÓRDOBA | 72 | NO | YES | +++ |
| EL VISO | 73 | NO | YES | + |
| ZUHEROS | 74 | YES | YES | +++ |
| CÓRDOBA - CAPITAL | 75 | YES | YES | +++ |
| REMARKABLE RESULTS | | 13-YES | 9-NO | |

damage because they have wooden beams. It is significant that the 82.14% of the houses with wooden beams in the affected area have termites and 21.43% are in danger of collapse.

Prior to initiating a control program in the affected area, we placed monitoring stations in some houses for monitoring the termites. Table 4 and Fig. 3 show the monitoring results. Colony 1 was the biggest we studied, with an estimated population of more than 5 million foragers occupying an area of over 2,300 m². The linear foraging was 82 m. The other colonies were smaller than colony 1. The size of some of them may be underestimated because we did not have permission to install monitoring stations in some houses. Colony 4 was detected at only one monitoring station, so we could not determine the extension of their territory. In colony 6, too few termites were recaptured to estimate the number of foragers.

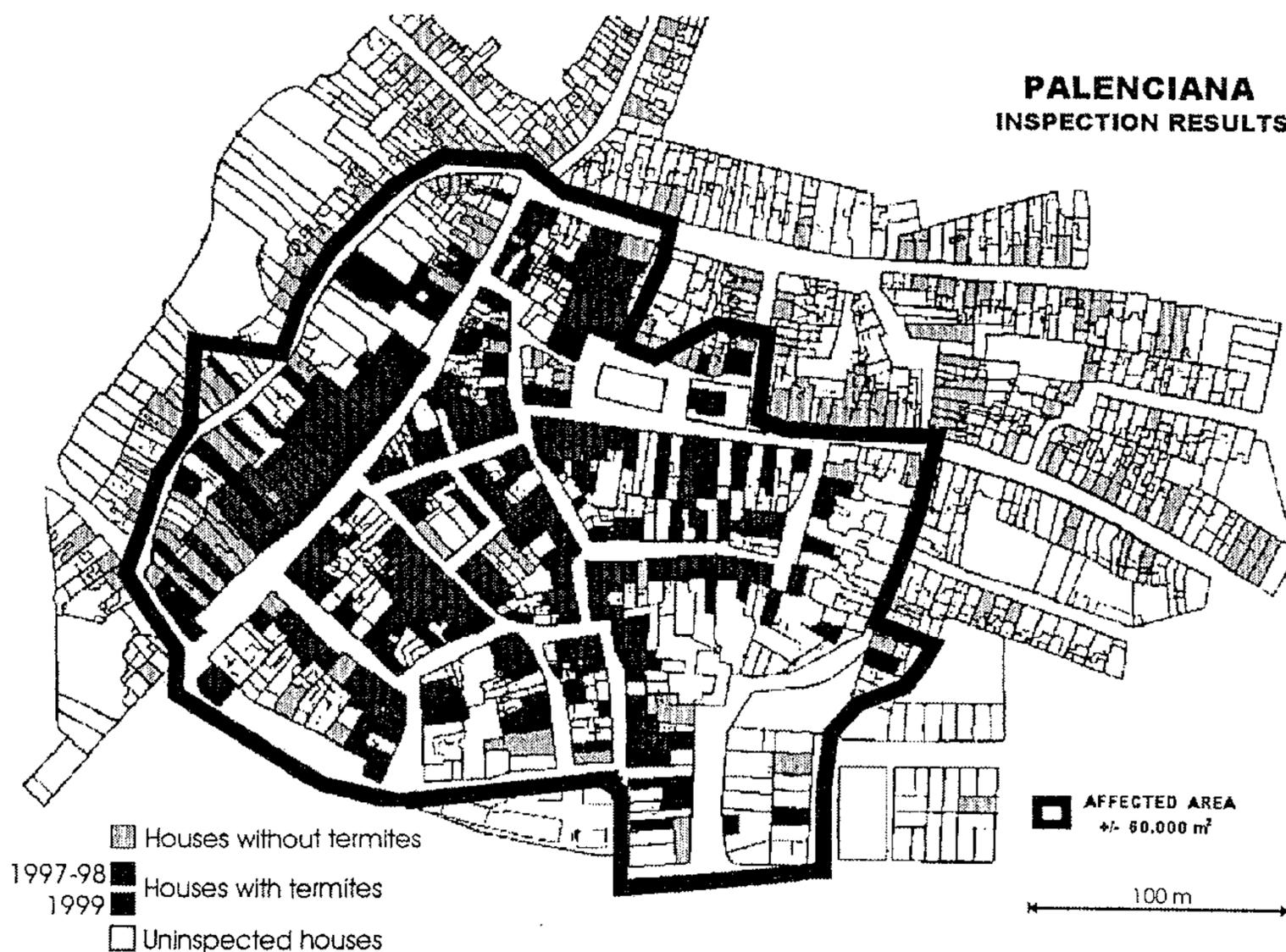


Fig. 2. Palenciana village. Results of the inspections. See tables 2 and 3.

Table 2. Results of the inspections in Palenciana urban area. The upper part of the Table shows the results for all the villages; the lower part are related to the affected areas.

| PALENCIANA VILLAGE | | |
|----------------------|-----|-------|
| | No. | % |
| Houses | 640 | - |
| Revised houses | 350 | 54.69 |
| Houses with termites | 164 | 25.23 |
| INFESTED QUARTER | | |
| | No. | % |
| Houses | 308 | - |
| Revised houses | 238 | 77.27 |
| Houses with termites | 164 | 53.24 |

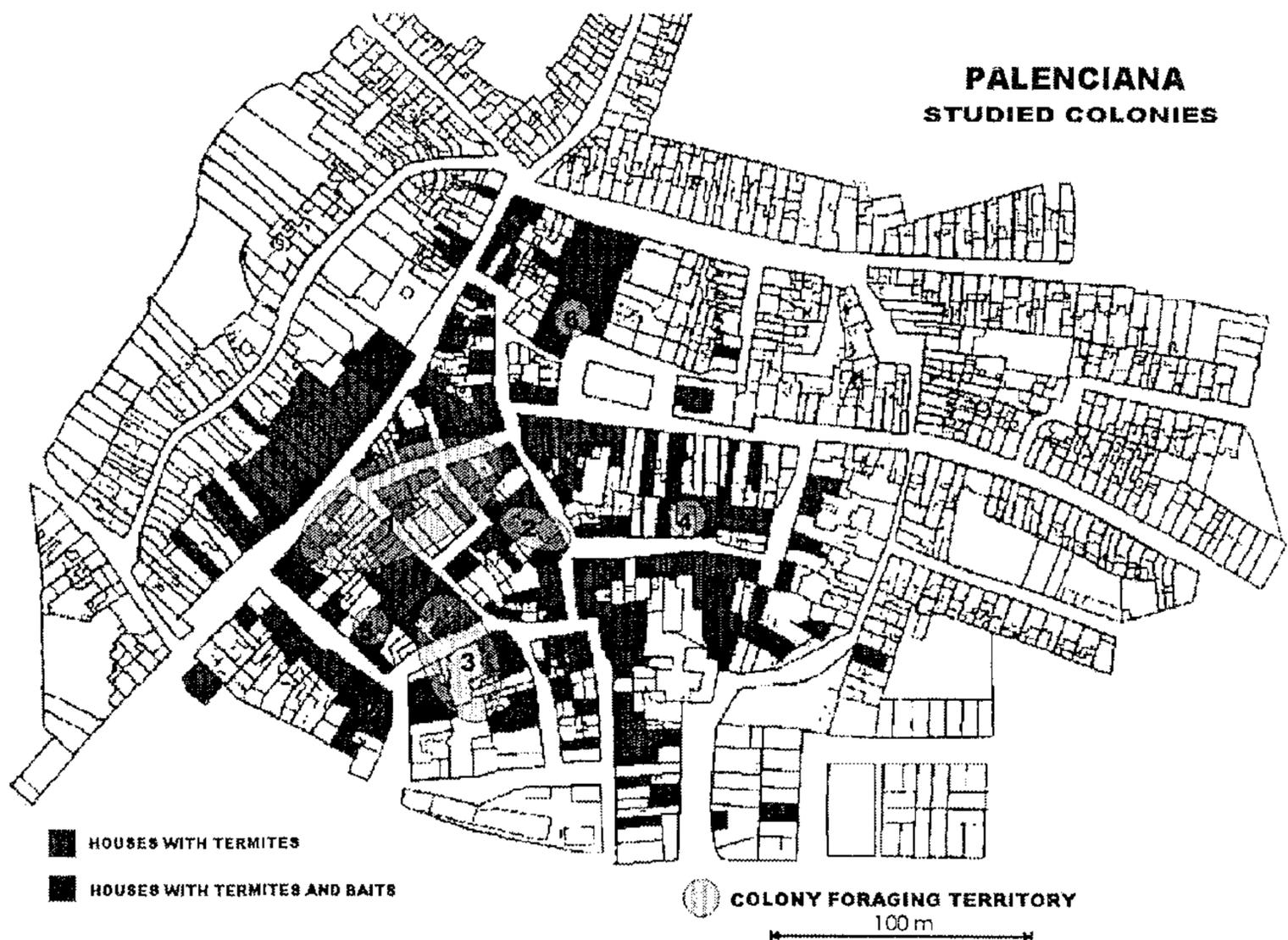


Fig. 3. Territory of the studied colonies. See table 4.

Table 3. Results attending the houses which are supported by wooden beams. The percentages have been related with the number of houses in Palenciana village (640), the houses in affected quarter (308) and the houses with wooden beams in affected quarter (84).

| | No. | Village houses % /640 | Houses in affected quarter % /308 | Houses with wooden beams in affected quarter % /84 |
|--|-----|--------------------------|--------------------------------------|---|
| Houses with wooden beams in the village | 108 | 16.87 | - | - |
| Houses with wooden beams in the affected quarter | 84 | 13.12 | 26.67 | - |
| Houses with wooden beams and termites | 69 | 10.78 | 21.90 | 82.14 |
| Houses with damaged wooden beams | 18 | 2.81 | 5.71 | 21.43 |

DISCUSSION

1. Termites in towns and villages of Córdoba

Our results were the first data in Spain on the presence of termites in all the towns and villages in one province. The results exceeded our expectations for the abundance of termites, with 88% of survey

locations (66 of 75) infested (Table 1). Moreover in 50% of these localities the level of infestation can be considered as medium or high (Table 1 and Fig. 1).

During the inspections we have obtained some data about the factors that could have influenced the spread of termites in the towns (Gaju & Bach 2000). We determined that the most important factor was the lack of knowledge on the part of the citizens and municipal administrators about termites and the signs of termite infestation. This lack of knowledge has allowed large infestations to become established in many locations. We suggested information about termite recognition and control be provided at all levels (Local Administrations and citizens).

Although Palenciana was the village studied in depth and probably the most affected, in many other locations the infestation level was quite high and if no action is taken, termites will spread freely and their future elimination will be extremely difficult.

2. Study of the Palenciana village.

The study of Palenciana was the most extensive ever conducted in Spain. Santa Cruz de Campezo (Aguinaga, 1993) and Sant Boi de Llobregat (Bach *et al.* 2000) were previously examined, but in both locations the infestation was far less extensive than in Palenciana. This study has provided the basic information for undertaking the treatment of the termites in Palenciana.

Our results about colony population and foraging territory agree with similar species from North America. Su (1994) reported foraging territories of 31 - 2,361 m² and estimated foraging populations of 470,000 - 2,847,000 termites for colonies of *R. flavipes* (Kollar) in the United States. Forager populations of 300,000 - 3,200,000 were reported by Myles (1996) for *R. flavipes* colonies in Canada.

In southern Europe, houses often share walls with the neighbors. This may make the application of chemical barriers inappropriate. We have calculated that to control termite infestations it will be necessary

Table 4. Population characteristics of 6 colonies as determined by using monitoring stations and mark-recapture

| COLONY | TERRITORY (m ²) | MAX.DISTANCE (m) | TERMITE POPULATION |
|--------|-----------------------------|------------------|--------------------|
| 1 | 2,342 | 82 | 5,200,000 |
| 2 | 297 | 26 | 361,312 |
| 3 | 1,023 | 45 | 1,166,523 |
| 4 | 50 | - | 2,441,180 |
| 5 | 50 | 10 | 157,846 |
| 6 | 100 | 6 | - |

to introduce into the soil and the walls of the houses of Palenciana more than 280,000 liters of chemical barrier, which is not ecologically admissible. We suggest a bait treatment with an IGR (Insect Growth Regulator). Some chitin synthesis inhibitors have been tested: Diflubenzuron, Hexaflumuron, and Lufenuron (Su 1994, Su & Scheffrahn 1993, 1996). Based on the satisfactory results obtained in many studies using hexaflumuron in other countries (Su 1994, Forschler & Rider 1996, Su *et al.* 1997, 1998, Haagsma & Bean 1998, Tsunoda *et al.* 1998, Ferrari *et al.* 1999, Yates & Grace 2000), treatment began in October 2000 with the application of the SentiTech System® from Dow AgroSciences which contains 0.05 % Hexaflumuron.

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REFERENCES

- Aguinaga, A. 1993. Plan estratégico de control de plaga de termes en Santa Cruz de Campezo. Memoria. 30 pp.
- Bach, de Roca, C., M. Saiz-Ardanaz & M. Gaju-Ricart 2000. Estudio de una infestación de termes en un pueblo de la Provincia de Barcelona. Diputación de Córdoba. Ambiental 99. Vol 1:198-203.
- Evans, T. A. 1997. Evaluation of markers for australian subterranean termites (Isoptera, Rhinotermitidae and Termitidae). Sociobiology 29(3):277-292.
- Ferrari, R; M. Marini & W. H. Robinson 1999. Subterranean termite *Reticulitermes* spp. (Isoptera: Rhinotermitidae) baiting and control in historical public buildings in Italy. Proceedings of the 3rd International Conference on Urban Pests. Czech University of Agriculture, Prague, Czech Republic 357-365-
- Forschler, B. T. 1994. Fluorescent spray paint as a topical marker on subterranean termites (Isoptera, Rhinotermitidae). Sociobiology 24(1):27-38.
- Forschler B. T. & J. C. Ryder 1996. Subterranean termite, *Reticulitermes* spp. (Isoptera, Rhinotermitidae), colony response to baiting with hexaflumuron using a prototype commercial termite baiting system. J. Entomol. Sci. 31: 143-151.
- Gaju, M. & C. Bach de Roca 2000. Las Plagas de termitas en las ciudades.

- Diputación de Córdoba. Ambiental 99. Vol 1:173-176.
- Haagsma, K. & J. Bean 1998. Evaluation of a Hexaflumuron-based bait to control subterranean termites in southern California (Isoptera: Rhinotermitidae). *Sociobiology*, 31(3): 363-369.
- Miller, L. R. 1993. Fluorescent dyes as markers in studies of foraging biology of termite colonies (Isoptera). *Sociobiology* 23(2):127-134.
- Myles, T. G. 1996. Development and evaluation of a transmissible coating for control of subterranean termites. *Sociobiology* 28(3): 373-457.
- Su, N.-Y. 1994. Field evaluation of a hexaflumuron bait for population suppression of subterranean termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology*, 87(2):389-397.
- Su, N.-Y. & R.H. Scheffrahn 1986. A method to access, trap and monitor field populations of the Formosan subterranean termite (Isoptera: Rhinotermitidae) in the urban environment. *Sociobiology*, 12(2): 299-304.
- Su, N.-Y. & R.H. Scheffrahn 1988. Foraging population and territory of the Formosan subterranean termite (Isoptera: Rhinotermitidae) in an urban environment. *Sociobiology*, 14: 353-359.
- Su, N.-Y., & R. H. Scheffrahn 1993. Laboratory evaluation of 2 chitin synthesis inhibitors, hexaflumuron and diflubenzuron, as bait toxicants against Formosan and eastern subterranean termites (Isoptera, Rhinotermitidae). *Journal of Economic Entomology* 86(5):1453-1457.
- Su, N.-Y., & R. H. Scheffrahn 1996. Comparative effects of two chitin synthesis inhibitors, hexaflumuron and lufenuron, in a bait matrix against subterranean termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology* 89(5):1156-1160.
- Su, N.-Y., P. M. Ban & R. H. Scheffrahn 1991. Evaluation of twelve dye markers for population studies of the eastern and Formosan subterranean termites (Isoptera: Rhinotermitidae). *Sociobiology* 19: 349-362.
- Su, N.-Y., P. M. Ban & R. H. Scheffrahn 1997. Remedial baiting with hexaflumuron in above-ground stations to control structure-infesting populations of the Formosan subterranean termite (Isoptera: Rhinotermitidae). *Journal of Economic Entomology*, 90 (3): 809-817.
- Su, N.-Y., J. D. Thomas & R. H. Scheffrahn 1998. Elimination of subterranean termite populations from the statue of liberty using a bait matrix containing an insect growth regulator, hexaflumuron. *Journal of the American Institute for Conservation*, 37: 282-292.
- Tsunoda, K., H. Matsuoka & T. Yoshimura 1998. Colony elimination of *Reticulitermes speratus* (Isoptera: Rhinotermitidae) by bait application and the effect on foraging territory. *Journal of the Economic Entomology*, 91(6): 1383-1386.
- Yates, J. R. & J. K. Grace 2000. Effective use of above-ground hexaflumuron bait stations for Formosan subterranean termite control (Isoptera: Rhinotermitidae). *Sociobiology*, 35(3): 333-365.

