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SUCCESSFUL CONTROL OF *TAPINOMA MAGNUM* (HYMENOPTERA: FORMICIDAE) IN THE CITY OF ZURICH, SWITZERLAND

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Abstract In Switzerland *Tapinoma magnum*, an invasive ant species in northern and central Europe, was first observed in the canton of Vaud in 2012 and 2018 found in the cantons of Geneva and Zurich. In the spring of 2019, the Urban Pest Advisory Service collected ants from the front yard of a residential estate of 11 houses in the city of Zurich, where massive ant colonies were troubling inhabitants. Bernhard Seifert, the European ant specialist in Germany determined the species as *T. magnum*. The Urban Pest Advisory Service monitored the extent of the ant colony, which turned out to be very limited. A pest control company was ordered to eliminate the *T. magnum* ants on this site. The pest management professional applied 13 treatments from May until the beginning of October. By mid-October no more *T. magnum* were sighted. The site will be checked for *T. magnum* in spring 2020 and further control measures will be taken if necessary.

Key words Ants, invasive species, outdoor colonies, Dolichoderinae, monitoring, control measures.

INTRODUCTION

Invasive organisms are increasingly posing a threat to the ecological balance of the world's ecosystems in times of global trade. Unintentional imports of these organisms disturb the balance in our ecosystems. They displace indigenous species or compete strongly for the same resources or as natural enemies of other indigenous species. High costs can result if the invasive organisms turn out to be pests. Under the 100 of the world's worst invasive alien species we can find 14 insects, of which 5 are ants. (Lowe et al., 2000). This is not by chance but because ants are highly socially organized which results in their dominance in most terrestrial environments. In Switzerland two invasive ant species have established big colonies in outdoor environments: Species of the *Tapinoma nigerrimum*-complex in the surroundings of Lausanne, Geneva and Zurich (Freitag and Cherix, 2019) and *Lasius neglectus* (Van Loon, Boomsma and Andrásfalvy, 1990) in the region of Geneva and Zurich (Landau et al., 2017).

In this report we show how the invasive ant *Tapinoma magnum* (MAYR, 1861) was controlled in a housing estate in the city of Zurich. We show which factors contributed to the success of the operation and give recommendations on how to prevent introductions of this species and how to deal with further cases. *T. magnum* belongs to the species complex of *Tapinoma nigerrimum* (Nylander, 1856). This complex is divided into the four cryptic species *T. nigerrimum*, *T. magnum*, *T. ibericum* (SANTSCHI, 1925) and *T. darioi* sp.n. (Seifert et al., 2017), which are differentiated by cluster analyses of multiple characters. These species differ in the morphology of all castes, in colony demography, in geographic distribution, in invasive potential, and in mtDNA data. Species of the *T. nigerrimum-complex* can be distinguished morphologically from indigenous species by the form of the clypeal notch and the large variation in worker's size (Seifert et al., 2017; Noordijk, 2016). Additionally the indigenous species show no supercolonial behavior. The four species of the *T. nigerrimum-complex* originate from the Mediterranean area (GBIF—the Global Biodiversity Information Facility, 2020). *T. magnum*, *T. ibericum*, and *T. darioi* sp.n. form strong, polygynous supercolonies and have become invasive in urban areas north of 48° N to which they were most probably introduced with plant material (Seifert et al., 2017).

In Europe north of 46° N, *T. magnum* has established populations in cities in Germany, Belgium, Switzerland, England and the Netherlands (Seifert et al., 2017; Heller, 2011; Noordijk, 2016; Freitag and Cherix, 2019). Lenoir and Galkowski (2017) describe two invasive *T. magnum* colonies in the region of Aquitaine at a latitude of 43°. Bracko (2019) describes invasive colonies of *T. magnum* and *L. neglectus* in Izola (Slovenia) at a latitude of 45°. Here *T.*

magnum ants react very aggressive to disturbances in the cemetery where they have established their colony. In Switzerland there are four known colony sites around Lausanne and one in Versoix near Geneva (Freitag and Cherix, 2019). Another site has been found in Oetwil near Zurich in 2018 (Sämi Schär, pers. comm.).

End of April 2019 the manager of a residential housing estate in the city of Zurich asked the Urban Pest Advisory Service (UPAS) for help because his gardeners and even a pest control company could not solve the ant problem of the estate. The density of the ants was so high at several house entrances, that the people felt disturbed by them. The UPAS identified the ants morphologically as belonging to the *Tapinoma nigerrimum*-complex, which was at first confirmed by the local ant specialist Rainer Neumeyer. In a second step Bernhard Seifert, the German ant specialist, using a cluster analysis of multiple characters identified the ants as *T. magnum.* Being an invasive species the section Neobiota of the Environment Department Canton Zurich (SNEKZ) was informed about the situation. Together with the UPAS they decided to have this ant colony eliminated.

MATERIALS AND METHODS

History of the residential housing estate

In 2015 the estate was renovated and in autumn the front yard was replanted with ornamental shrubs and trees. In 2018 the ants had invaded a cellar heating room of the estate on the southeast side and a pest control company was called to control them. They also sprayed an insecticide along the house wall outside of the cellar and the affected house entrances. The gardeners applied an insecticide from the garden center against the ants as well, but by the end of April 2019 the ants were again disturbing the tenants at five house entrances of the affected buildings and massive ant trails were sighted along the wall along the sidewalk.

Ant survey

The UPAS visually monitored the whole city block of the private estate along the house wall, along the wall to the sidewalk, in front of the house entrances and along other structures (Figure 1, thick black line). If ants looked different from the massively occurring dark looking *T. magnum*, we took samples, especially in the inner courtyard. We also examined the other side of the street to be sure not to miss any migrating ants.

Once the extent of the *T. magnum* colony was detected, the UPAS ordered the two house owners to have the ants controlled professionally. According to the cantonal ordinance on general and residential hygiene (Kanton Zürich, 1967), the authorities can enforce house owners to commission a pest control operation on their property and to bear the resulting costs.

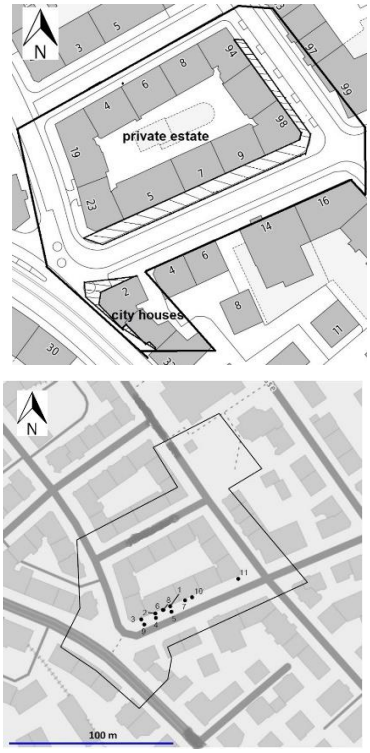

Figure 1, 2. Examined area by UPAS in May 2019 (within thick black line) and extent of *T. magnum* colony (shaded area). Area sampled by ant specialist mid-August 2019 (within the black line) and *T. magnum* findings (black dots).

The UPAS discussed the ant control measures with a pest management professional (PMP) and both agreed on using gel baits along house structures and obvious nest sites and permethrin granules in the soil. Additionally, the PMP applied a permethrin solution to the ant trails along the sidewalk. The permethrin (granules and solution: 0.5 %) used is called Killgerm Spezial Ameisenmittel PM. It is registered for outdoor use. The gel baits used are Advion Ant Gel (Indoxacarb, 0.05 %) and Fortissimo Ant Gel (Imidacloprid, 0.01 %). The treatments dates and times were communicated to the gardeners of the private estate to avoid interference with watering and other gardening upkeep. Also gardeners were instructed to control aphids and mealy bugs on the plants. The flowers excreting nectar from ornamental bushes were cut away as well. All this serves to remove the ant's food sources. At first treatments were repeated weekly. After six treatments the PMP expanded the treatment intervals to 10 to 14 days. The UPAS monitored the site after each treatment and transmitted the results to the PMP, so he could focus on the control application.

The SNEKZ ordered a quailified pest control company to survey the tree nursery that had supplied the ornamental shrubs and trees for the private estate in 2015 for *T. magnum*. SNEKZ also ordered an external ant expert to verify the extent of the infested area in mid-August.

RESULTS AND DISCUSSION

We found a strong infestation along the southeast side and a weak infestation along the northeast side of the block of houses of the private estate (Figure 1, shaded area). Nests on the southeast side were mainly found at sunny exposed places along walls and granite ground plates that warmed up in the sun. The ant trails went along the wall bordering the sidewalk from the garden of the private estate. Here nests were in cracks between the wall and the sidewalk surface or under the granite slab covering the wall. Nests were also in the soil in the midst of ornamental grass plants. Across the street the infestation was found along two houses belonging to the city and in a public tree-bed with a diameter of 4 meters (Figure 1). Here the ants nested in the shade of the princess tree (*Paulownia tomentosa*) in the soil, but had their food source, the aphids, up on the tree and ant trails along the tree bark could easily be discerned. These findings indicate that the source of infestation was on the lower southeast side of the house block. Around 500 m^2 (420 m^2 at the private estate and 80 m^2 at the city houses) of ground was infested with the *T. magnum* colony. No other ant species could be detected in the range of the *T. magnum* colony. Ants found in the inner courtyard belonged to the species *Lasius niger*. Other ant species found outside the marked area were *Lasius emarginatus* and *Tetramorium* sp.

The first treatment of the private housing estate started beginning of June. The first treatment of the additional city houses on the other side of the street started beginning of July. After four treatments along the city houses and the princess tree bed, no more *T. magnum* ants could be found in this section. After six treatments of the area of the private estate all *T. magnum* ants had disappeared from the northeast side of the estate. The applications drastically lowered the density of the population on the southeast side of the house block. The remaining ants came from small cracks in the house wall, the wall along the sidewalk and from cracks in the pathway to the house doors. All nests in the soil were eliminated by this time. The monitoring results of the external ant expert in middle of August (Figure 2) confirmed our results. End of August we found one new weak *L. niger* colony in front of the southeast side of the houses of the private estate.

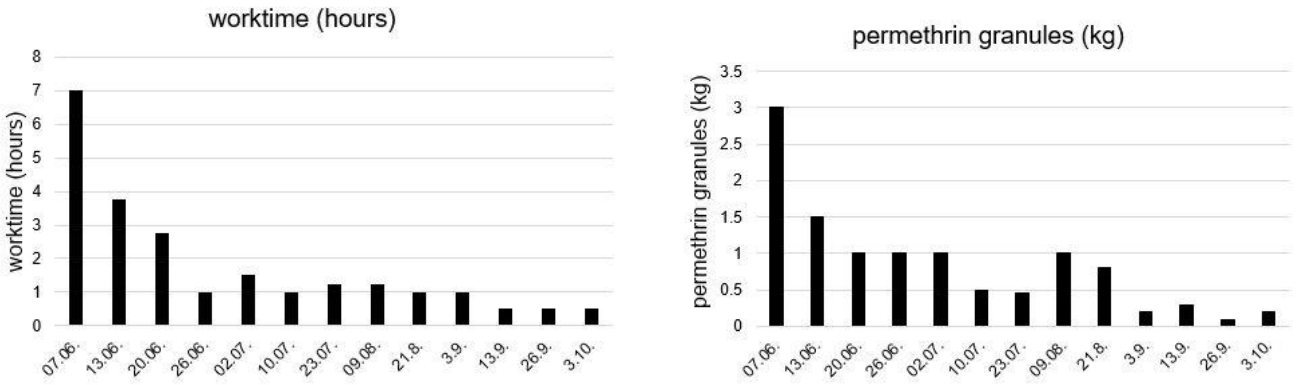

Figure 3, 4. Work hours of the PMP during the season. Amount of permethrin granules and spray applied during the season.

Both gel baits were well accepted on the first two treatment dates. If both gels were placed next to each other, the one with Indoxacarb was preferred to the one with Imidacloprid. After the first two treatment dates the gel bait acceptance turned low, so the PMP stopped using the gel baits. When the PMP started the treatment along the two city houses and the princess tree he used Indoxacarb on the later with good acceptance. The permethrin granules and spray had a good effect on direct contact e.g. on the ant nests in the soil or to eliminate ant trails along the house or along the wall to the sidewalk. However, the penetration was low where ants were nesting in small cracks and crevices along and in the walls or under the sidewalk paving. For the last five treatments the PMP mainly used gel bait to enable the ant workers to import the gel to the immatures of these nests. Some permethrin was sprayed on foraging surfaces to keep the ants from finding other food sources.

By mid-October after 13 treatments no more *T. magnum* ants could be observed on the site. This could be due to a successful eradication or also partly due to the advanced season with dropping temperatures. Altogether, the PMP spent 23 hours of work time (excluding the travel time) (Figure 3) to control the ants on the infested site. The UPAS required 13 hours for the monitoring, sampling and communication with the house owners and the PMP. The PMP overall used 11 kg of permethrin granules (Figure 4) and 345 grams of ant bait (11 ½ tubes) (Figure 5) for the ant control in 13 control applications.

The costs for the treatment of the private estate amounts to Euro 4650 ($ 5170), the costs for the two city houses were Euro 900 ($ 1000). The overall cost for the treatment of the infested area by the PMP amounts to Euro 5550 ($ 6170), which had to be paid by the property owners according to §17 of the cantonal ordinance on general and residential hygiene (Kanton Zürich, 1967). The costs of the UPAS to accompany the ant control amounts to Euro 2340 ($ 2600). These costs are not imposed to the property owners as a good cooperation and a successful eradication is in the interest of the city authorities.

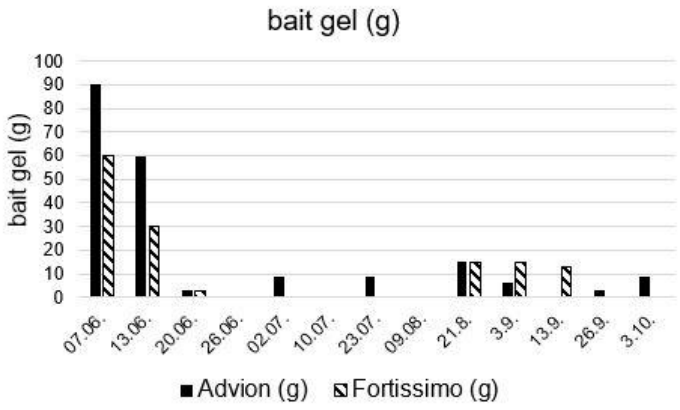

Figure 5. Amount of gel bait used by the PMP during the season.

During the survey for *T. magnum* in the tree-nursery that had supplied the ornamentals for the private estate in 2015 no *T. magnum* were found. Probably the plants had been freshly imported and sold directly with the ants in the root ball in the autumn of 2015. Reproduction of the ants in the private estate then would have started in spring 2016.

CONCLUSIONS

The following factors have contributed to the successful control of the *T. magnum* colony: Correct ant identification; accurate monitoring to locate the extension of the ant colony; small, limited infestation area and young ant colony (approximately 3 years); only two involved property managers; good cooperation with the property managers and the gardeners; well-timed and accurate control applications; good agreement and communication between authorities and the pest control company; only one pest control company, the same PMP in charge of the control; acceptance of the bait gel by *T. magnum* in the beginning; monitoring after each control application allowed targeted control measures.

Both invasive ant species *T. magnum* and *L. neglectus* form supercolonies with massive occurrence in the surroundings. Gardeners and PMP's should be regularly informed about invasive organisms they could encounter so they can react and supply samples to identification services if they find ants or other suspicious arthropods in the areas they service. According to some of the literature (Heller, 2011; Noordijk, 2016; Seifert et al., 2017) *T. magnum* is imported with plants from the Mediterranean area by local tree-nurseries and garden centers. The managers and the gardeners of these companies should be informed about possible ant imports with plants from these regions and should know where to send suspicious ants in order to prevent their spread.

Control efforts need to be efficient. This can be achieved by checking the area for ant activity in warm and sunny weather conditions before treating. Both the UPAS and the PMP did these checks in order to selectively treat the places with *T. magnum*-activity. The weather report needs to be consulted before applying products. Under warm conditions the ants are more active and activity areas can be better spotted and treated. No treatment should be done if rain is predicted. Otherwise the insecticide or the gel can be washed from zones that are not protected from the rain.

Gel bait acceptance by the ants is important for the success of the treatment. Aphids and other food sources compete with the gel bait. There is less competition from other food sources if you can start early in the season, because aphid and other insect populations that serve as food sources have not yet built up. Still the PMP applying the bait should test different gels for their palatability each time because ants can quickly change their preference. Dekoninck et al. (2015) successfully used applications of microencapsulated lambda cyhalothrin against *T. magnum*. In Switzerland no products with this active ingredient are registered for pest control. The used permethrin product gave satisfying results.

This case shows that small colonies can be eliminated with enough perseverance. Large colonies of an expansion of 2.5 ha like in Cully near Lausanne (Freitag and Cherix, 2019) are very difficult to control, because it is difficult to find and eliminate all nest sites and it would need a lot of people to do the work, not talking about the costs for such a control effort.

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