Nest-Site Tenacity and Dispersal Patterns of *Vespa crabro* Colonies Located in Bird Nest-Boxes

by

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ABSTRACT

There are numerous studies describing nest-boxes as breeding places for birds, and sometimes for mammals. However, our results show that in urban conditions nest-boxes are also important nesting places for Hornets (*Vespa crabro)*. The proportion of nest-boxes occupied by *V. crabro* in this study was between 8 and 20% and varied significantly from year to year. We did not find any relationship between birds' presence in nest-boxes in winter, as well as in spring, and nest-box occupancy by Hornets. We found high nest-site tenacity, defined as a preference to re-use the same nest-box during the study period. However, this tenacity did not persist in the last season when new boxes were added. The high occupancy level of nest-boxes we have observed might increase human-hornet conflicts. Therefore, when placing bird nest-boxes in urbanized areas it must be borne in mind that a substantial proportion may become occupied by this particular insect.

Key Words: *Vespa cabro,* bird nest boxes, Hymenoptera, Vespidae

INTRODUCTION

In urban landscapes the presence of wildlife is limited by the availability of habitats, human disturbance, collisions with vehicles and behavioral shyness (Fernández-Juricic & Jokimäki 2001, Randler 2003; Chace & Walsh 2006, Ditchkoff *et al.* 2006). To attract wildlife to urban areas various techniques are used. Among many different methods aimed at increasing the number of wild animals in urbanized areas, artificial sites for reproduction are the main solution. Nest-boxes are the best example of artificial sites for animal reproduc-

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tion and most are intended for birds. However, they are sometimes occupied by other animals, including undesirable pests, especially some mammals and insects (*e.g.* Berg & Berg 1998, Czeszczewik *et al*. 2008). The common secondary nesters in bird boxes are wasps, including hornets (Pawlikowski & Pawlikowski 2003, Abraham & Peters 2008, Stanback *et al.* 1999). The European Hornet *Vespa crabro* is a large, easily distinguishable wasp and in urban areas it can be a public nuisance. It has a range of potential economic and health impacts. The wasps make holes in ripe fruit to obtain sugar, scrape off the tender bark of young trees to obtain construction material and sugary sap. In summer and autumn, they can raid beehives and enter dwellings in the search for sugary foodstuffs for nourishment and for meat to feed their larvae. European wasps are also great scavengers and are usually found around areas of human habitation and activity (Antonicelli *et al.* 2003). This is why they can be a major social pest as they disrupt people's enjoyment of the outdoors (Beggs 2000). Furthermore they can also inflict dangerous stings (McGain *et al.* 2000). Most serious reactions to wasp stings are allergic in nature and the allergic reaction is often severe (called anaphylactic shock) and may be fatal unless treated promptly.

The typical habitat of the European Hornet is deciduous woodland. The wasp preferentially builds its nest in hollow trees, but because of a shortage of natural nesting places, hornets also nest in farms as well as in urbanized areas. The aboveground nests are built in barns, attics, holes and cavities in walls of buildings, in abandoned beehives or in bird nest-boxes. (Matsuura 1991 and references therein, Edwards 1997). Most information on occupancy of artificial nesting sites by hornets as well as other wasps are descriptive in nature. Little is known about the role of these sites for population persistence (*e.g*. occupancy rate) and factors affecting occupancy.

The main goals of this paper were to determine the level of occupancy of bird nest-boxes by the European Hornet and its potential relationships with breeding and wintering birds. We also checked nest tenacity between years, and tested if, and how, the placing of new boxes affected the earlier pattern of hornet colony distribution.

MATERIAL AND METHODS

The study was conducted in Poznań (16.55° E, 52.28° N), in the west

of Poland. The study area was the Morasko campus of Adam Mickiewicz University extending to about 1.2 km^2, with three large new buildings and a small forest containing mainly of Scots Pine (*Pinus silvestris*) at an age of about 40 years. One hundred new nest-boxes were hung on the trees on campus in October 2005. Nest-boxes were numbered 1-100 on their left external wall. The distance between nest-boxes was 8-400 m. The main bird occupying nest-boxes in both wintering and breeding seasons was the Great Tit (*Parus major*). For more details on the nest-box project, birds occupying nest-boxes during winter and the breeding season, and the study area see Ekner & Tryjanowski (2008).

During the bird breeding seasons of 2006-2009 we also checked for the presence of hornets in the nest-boxes. The nest-boxes were classified as occupied by hornets if either the beginning of, or a complete nest, was present. Every year, in October, old hornets' nests were removed from the nest-boxes. Other hymenopteran insects were also noted in nest-boxes, but occurred in very low numbers; we noted two cases of nest-box occupancy by *Vespula* sp. wasps and 13 cases by bumblebees (*Bombus* sp.) during the entire four year study.

To check if hornets prefer newly established nest-boxes, 50 new boxes were added in October 2008 and all boxes were checked the following summer.

Data are presented as the number (proportion) of nest-boxes occupied during the study years, and we assumed that the hornet population in late summer is a good measure of this species' density for the whole season. Differences between years in the proportion of boxes occupied by hornets were tested by a G-test. The occupancy rate in the new nest-boxes added in 2008 was compared to the older ones with a G-test. The relationships between presence of breeding and wintering birds and presence of hornets were investigated by Kendall tau correlation. To establish a measure of nest-site of hornets tenacity based on presence-absence data the Kendall tau correlation was calculated. All tests were two-tailed with $P = 0.05$ used as a threshold for significance testing.

RESULTS

During the study years 2006-2009 among the original 100 nest-boxes 18,

8, 20 and 8 were respectively occupied by hornets, and the proportion of occupied nest-boxes differed significantly between years (G-test, G = 10.59, df = 3, P = 0.014).

During the first year 13 out of 18 (72.2%) occupied nest-boxes had their entry holes destroyed by the gnawing behaviour of hornets. We did not find any significant relationship between presence of birds and hornets (all P > 0.200).

Hornets had a tendency to occupy the same nest-boxes between 2006 and 2007 (Kendall's tau b = 0.533, P < 0.0001), as well as between 2007 and 2008 (Kendall's tau b = 0.590, P < 0.0001), but this relationship was no longer present when new nest-boxes were added (2008 *vs*. 2009, Kendall's tau b = 0.037, P = 0.714).

Hornets significantly preferred new boxes; in 2009 their nests were located more often in new boxes (12 in 50 boxes) than in old ones (8 in 100 boxes) (G-test, G = 5.050, df = 1, P = 0.025).

DISCUSSION

Our results demonstrate that bird nest-boxes are important supplementary nesting site for colonies of hornets. The occupancy rate (ranging 8-24%) was much higher than was reported in other studies (0.8-6.7%, Pawlikowski & Pawlikowski 2003; Nadolski 2004). However, the aforementioned studies were carried out in a large forest and urban parks, respectively. Our study area had a low number of potential natural nest sites (*e.g*. tree holes) for European Hornets. However, the area is known for its rich potential food resources for hornets, *e.g.* fruiting trees and refuse bins. Therefore, the nest-boxes in this area probably provided valuable sites where hornets could reproduce and forage. It is interesting that nests of hornets in natural conditions are usually much larger than space available inside nest-boxes. High occupancy rates also indicate that bird nest-boxes may speed up an urbanization process in this wasp as nest-boxes are mostly placed in the neighborhood of human settlements. Interestingly, social wasps sometimes co-occur with birds inside nest-boxes (Beier & Tungbani 2006), but we did not observe this.

In our study, we have shown that the European Hornet has a high nest-site tenacity which could be anticipated from knowledge of wasp biology. In our experiment, hornet nests abandoned in the autumn were carefully removed

from the nest-boxes. When caged, hornet gynes were reported to prefer nest-boxes containing the abandoned early hornet nest, avoiding the empty box (Hoffmann *et al*. 2000), whereas in the natural environment, European Hornets tend not to re-use nests (Zucchi & Entling 1988). Nevertheless, semiochemicals are widely used in this species and we cannot exclude the possibility that the bird nest-boxes can carry the chemical signal originating from the hornets' comb. For instance, some *Polistes* wasps discriminate between natal and foreign nest fragments (Strassmann 1983, Ferguson *et al*. 1987) and the pheromone cues are present on the comb for the winter months (Starks 2003). Odour cues could save young gynes the energy needed for finding an appropriate habitat, as it would identify the place to be likely suitable for reproductive success.

Pheromonal signals deposited at/in the bird nest-boxes are not the only possible cause of the nest tenacity of hornets. Jeanne & Morgan (1992) reported that microclimate has been found to influence nest site selection and reproductive strategies in temperate *Polistes* wasps, *i.e.* warm sites were more attractive to female joiners and usurpers. Our study area was a homogeneous habitat (pine plantation) in which habitat conditions were virtually identical for all nest-boxes.

Although we can only speculate as to the reasons for the observed high nest tenacity, our results suggest that bird nest-boxes were preferred habitats for European Hornets in an urbanized area and satisfied the nest requirements of the species. Nevertheless, after we had erected new boxes in autumn 2008, the distribution pattern of *V. crabro* quickly changed and the wasps occupied more new boxes than expected. This result indicates that European Hornets prefer newly-built boxes, *i.e*. those made of fresh wood. In newly established boxes distinct traces of gnawing behaviour of the insects, particularly around the box entrance, were observed. We could not establish if the insects were gnawing the wood of two-year or older boxes.

PRACTICAL RECOMMENDATIONS

The high occupancy level we have observed might raise human-hornet conflicts. The hornet is not a vicious insect (Shaw & Weidhaas 1956) but its presence commonly raises fears in humans. Therefore, when placing new nest-boxes in urbanized areas it must be taken into consideration that a sub-

stantial proportion may be occupied by this particular insect. Although the hornet is an undesired species in human settlements we believe that in other habitats where human-insect conflicts are rare, *e.g.* farmland, the presence of hornets may be beneficial. It is a large species that may control some other pest species, mostly dipterans (Edwards 1980). In some regions the hornet is also a threatened species (Hoffmann *et al.* 2000). Therefore, in such areas bird nest-boxes may be a useful tool to increase number of hornet colonies.

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REFERENCES

Abraham, R. & R. S. Peters 2008. Nistkästen als Lebensraum für Insekten, besonders Fliegen und ihre Schlupfwespen [Nestboxes as habitat for insects, especially for flies and their parasitoids]. Vogelwarte 46(2): 195-205.

Antonicelli, L., M.-B Bilo, G. Napoli, B. Farabollini & F. Bonifazi 2003. European hornet (*Vespa crabro*) sting: A new risk factor for life-threatening reaction in hymenoptera allergic patients? Allergy. European Annals of Allergy and Clinical Immunology 35(3): 199-203.

Beggs, J. R. 2000. Impact and control of introduced *Vespula* wasps in New Zealand. *In*: Austin, A. D. & Dowton, M. (eds.) Hymenoptera: Evolution, Biodiversity and Biological Control. CSIRO Publishing: 404-409.

Beier, P., & A. I. Tungbani 2006. Nesting with wasps increases nest success of the Red-cheeked Cordon-Bleu. Auk 123(4): 1022-1037.

Berg, L. & Å. Berg 1998. Nest site selection by the dormouse *Muscardinus avellanarius* in two different landscapes. Annales Zoologici Fennici 35(2): 115-122.

Chace, J. F. & J. J. Walsh 2006. Urban effects on native avifauna: a review. Landscape Urban Planning 74 (1): 46-69.

Czeszczewik, D., W. Kalankiewicz & M. Stańska 2008. Small mammals in nests of cavity nesting birds: Why should ornithologists study rodents? Canadian Journal of Zoology 86(4): 286-293.

Ditchkoff, S.S., S. Saalfeld, & C. Gibson 2006. Animal behavior in urban ecosystems: modifications due to human-induced stress. Urban Ecosystems 9: 5-12.

Edwards, R. 1980. Social wasps. Their biology and control. Rentokil Ltd., East Grinstead.

Edwards, R. 1997. Provisional atlas of the aculeate Hymenoptera of Britain and Ireland. Part 1. Bees, Wasps and Ants. Recording Society. Huntingdon: Biological Records Centre.

Ekner, A. & P. Tryjanowski 2008. Do small hole nesting passerines detect cues left by a predator? A test on winter roosting sites. Acta Ornithologica 43(2): 107-111.

Ferguson, D., G.J. Gamboa & J.K. Jones 1987. Dicrimination Between Natal and Non-Natal Nests by the Social Wasp *Dolichovespula maculata* and *Polistes fuscatus* (Hymenoptera: Vespidae). Journal of the Kansas Entomological Society 60 (1): 65-69.

Fernández-Juricic, E. & J. Jokimäki 2001. A habitat island approach to conserving birds in urban landscapes case studies from southern and northern. Biodiversity and Conservation 10 (12): 2023-2043.

Hoffmann, W.R.E., P. Neumann & E. Schmolz 2000. Technique for rearing the European hornet (*Vespa crabro*) through an entire colony life cycle in captivity. Insectes Sociaux 47 (4): 351-353.

Jeanne, R.L. & R. C. Morgan 1992. The influence of temperature on nest site choice and reproductive strategy in a temperate zone *Polistes* wasp. Ecological Entomology 17 (2): 135-141.

Matsuura, M. 1991. Vespa and Provespa. *In*: Ross, K. G. & Matthews, R. W. (eds.). The social biology of wasps. Cornell University Press, Ithaca: 232-242.

McGain, F., J. Harrison & K.D. Winkel 2000. Wasp sting mortality in Australia. The Medical Journal of Australia 173 (4): 198-200.

Nadolski, J. 2004. Gniazda os społecznych (*Hymenoptera: Vespinae*) w skrzynkach lęgowych dla ptaków na obszarze Łodzi – wstępne wyniki badań. *In*: Indykiewicz, P. & Barczak, T., (eds.). Fauna miast Europy Środkowej 21. wieku [Nests of social wasps (*Hymenoptera: Vespinae*) in breeding boxes for birds in the town area of Łódź – preliminary results of investigation. *In:* Urban Fauna of Cental Europe in the 21st Century]. Bydgoszcz: 253-259.

Pawlikowski, T. & K. Pawlikowski 2003. Zasiedlanie skrzynek lęgowych dla ptaków przez osę saksońska *Dolichovespula saxonica* (Fabr.) (*Hymenoptera: Vespidae*) w Puszczy Boreckiej. [Wasp *Dolichovespula saxonica* (Fabr.) (*Hymenoptera: Vespidae*) settling wooden breeding boxes for birds in the Borecka Forest] Wiadomości Entomologiczne 22 (4): 201-210.

Randler, C. 2003. Reactions towards human disturbances in an urban Swan Goose Anser cygnoides in Heidelberg (SW Germany). Acta Ornithologica 38 (1): 47-52.

Shaw, F. R. & J. Weidhaas Jr. 1956. Distribution and Habits of the Giant Hornet in North America. Journal of Economic Entomology 49 (2): 275.

Stanback, M., A. Mercandante, W. Anderson, H. Burke & R. Jameson 2009. Nest site competition between cavity nesting passerines and golden paper wasps *Polistes fuscatus*. Journal of Avian Biology 40 (6): 650-652.

Starks, P. T. 2003. Natal nest discrimination in the paper wasp, *Polistes dominulus*. Annales Zoologici Fennici 40: 53-60.

Strasmann, J. E. 1983. Nest fidelity and Group Size Among Foundresses of *Polistes annularis* (Hymenoptera: Vespidae). Journal of the Kansas Entomological Society 56 (4): 621-634.

Zucchi, H. & P. Entling 1988. [First results about the distribution and colonization habits of the hornet (*Vespa crabro* L.) in Lower Saxony and Bremen.] Zeitschrift fuer Angewandte Zoologie 75 (1): 65-82. *Retrived 31 Mar. 2010 from:* http://www.fao.org/agris/search/display.do?f=./1989/v1512/DE89U0135.xml;DE89U0135