Biol. Stud. 2022; 16(1): 13–26 • DOI: https://doi.org/10.30970/sbi.1601.675
www.http://publications.lnu.edu.ua/journals/index.php/biology

UDC: 592

# THE ROLE OF ARTIFICIAL NESTING BOXES AND BIRDS' NESTS IN MAINTAINING VITAL ACTIVITY OF THE VESPIDAE AND APIDAE FAMILIES

***O. O. Yarys*, *A. B. Chaplygina***
*H. S. Skovoroda Kharkiv National Pedagogical University*
*29 Alchevskyh St., Kharkiv 61002, Ukraine*

Yarys, O. O., & Chaplygina, A. B. (2022). The role of artificial nesting boxes and birds' nests in maintaining vital activity of the Vespidae and Apidae families. *Studia Biologica*, 16(1): 13–26 • DOI: https://doi.org/10.30970/sbi.1601.675

**Background.** During 2019–2021, from the first decade of March to the third decade of July on the territory of northeastern Ukraine, ornithological studies on hollow-nesting birds populating artificial nestings were carried out. It is common knowledge, that in urban landscapes, the presence of wildlife is limited. Among the many different measures aimed at increasing the number of different groups of animals in urbanized areas, artificial nesting is the main solution for the reproduction and conservation of the population. Therefore, the aim of the study was to investigate the role of artificial nesting in maintaining vital activitiy of the families Vespidae and Apidae.

**Methods.** When checking and examining artificial nestings, 80 nests were found 69 of which were populated by representatives of the family Vespidae and 11 – by Apidae. For identification of nests and establishing the taxonomic status of representatives of the Vespidae and Apidae families in artificial nestings, keys were used.

**Results.** In the territory of northeastern Ukraine, studies have been carried out in recreational areas: Homilsha Woods National Nature Park near Zadonetske and Gaidary villages (Kharkiv Region), Hetman National Nature Park near Klementove and Kamyanka villages, as well as in "Vakalivshchyna" tract near Vakalivshchyna village (Sumy Region). Among representatives of the Vespidae family in artificial nestings on the territory of northeastern Ukraine, two species – *Vespa crabro* and *Vespula vulgaris* were identified; among the family Apidae – one representative species – *Bombus terrestris*.

**Conclusions.** Representatives of the families Vespidae and Apidae begin to populate artificial nestings from the third decade of April till the second decade of July (21.04–10.07). On the studied territories of northeastern Ukraine, in Hetman National

Nature Park near Kamyanka village, the number of nestings by *V. vulgaris* was maximal throughout all the years of study, besides, the number of individuals increased over the period. During inspections of the artificial nestings on the territory of the regional landscape park “Feldman Ecopark”, nestings of representatives of the Vespidae and Apidae families were found.

***Keywords:*** common wasp, common hornet, European bumblebee, artificial nesting boxes, hollow-nesting birds, northeastern Ukraine

## INTRODUCTION

The representatives of the Vespidae are persent in all regions of the world with the largest number of species in tropical regions. This family contains about 4500 species, belonging to about 250 genera and six subfamilies: Euparagiinae, Eumeninae, Masarinae, Stenogastrinae, Polistinae and Vespinae (Dvořák, & Straka, 2007). Four of them (Eumeninae, Masarinae, Polistinae and Vespinae) are found in Europe.

The Apidae family includes more than five thousand species from 170 genera (Lester, & Beggs, 2019). Representatives of the Apidae are diverse in external structure (from densely pubescent to non-pubescent) and size (from small to large forms). The Apidae, like other bees, play a critical role in pollination of entomophilous plants. So, in particular *Bombus* spp. improves the fruiting of crops, regardless of the number of *Apis mellifera* (L., 1758). In recent decades, the number of representatives of the Vespidae and Apidae families has decreased worldwide. In temperate climates, these species are essential for pollination of trees, shrubs, grasses and functioning of most terrestrial ecosystems (Williams, Corbet, & Osborne, 2015). Intensive use of agricultural land, fragmentation of the habitat, anthropogenic activity – all this affects the diversity and vital activity of the Vespidae and Apidae families (Vaudo *et al.*, 2011). On the other hand, it can provide for an increase in the sources of food and the expansion of nesting sites (Olsson *et al.*, 2015).

Representatives of the Vespidae and Apidae families, in most cases, willingly populate AN (Lezhenina *et al.*, 2009; Chaplygina, Bondarets, & Savinskaya, 2014; Rahimi, Barghjelveh, & Dong, 2021; Yarys, 2021). In nature, they make tunnels in bare ground, use existing cavities, remove dead wood and build nests in the hollows of trees, burrows of rodents and termites (Kremen *et al.*, 2007), on the treetops (Haeseler, 1988), under the roof of the decks, garages, houses (Ertürk, & Sarikaya, 2020). Among the many different measures aimed at increasing the number of different groups of animals in urbanized areas, artificial nesting is the main solution for the reproduction and conservation of the population (Yarys, Chaplygina, & Kratenko, 2021; Yarys, 2021). Therefore, the aim of the study was to investigate the role of artificial nesting in maintaining the vital activitiy of the Vespidae and Apidae families. However, it is necessary to take into account the negative role of representatives of the Vespidae and Apidae families as potentially dangerous objects during research. There is evidence in the literature that members of the Vespidae family can cause serious injury and even death.

## MATERIALS AND METHODS

During 2019–2021, from the first decade of March to the third decade of July on the territory of northeastern Ukraine, ornithological studies on hollow-nesting birds

inhabiting artificial nestings (AN) were carried out. In total, on the territory of northeastern Ukraine, ANs (n = 590) were placed at a height of 1–3 m above the ground. The research was carried out in recreational areas of the Homilsha Woods National Nature Park (NNP) near Zadonetske and Gaidary villages (Kharkiv Region), Hetman NNP near Klementove and Kamyanka villages, as well as in "Vakalivshchyna" tract near Vakalivshchyna village (Sumy region) (**Fig. 1**).


**Fig. 1.** Map showing the location of ANs on the research areas in northestern Ukraine: *1* – "Vakalivshchyna" tract near Vakalivshchyna village; *2* – Hetman NNP near Klementove village; *3* – Hetman NNP near Kamyanka village; *4* – Homilsha Woods NNP near Gaidary village; *5* – Homilsha Woods NNP near Zadonetske village

The territory of the Homilsha Woods NNP near Zadonetske village (49°38′38″ N 36°21′32″ E) is located in the south of the Left-Bank Forest-Steppe, on the border between the forest-steppe and steppe zones. *Pinus sylvestris*, *Acer campestre, Tilia cordata* prevail in the tree stand. *Acer tataricum*, *Prunus spinosa*, *Crataegus curvisepala*, *Ulmus suberosa*, *Rhamnus cathartica*, *Rubus idaeus* grow in the shrub layer. Among the herbaceous plants of the forest are: *Festuca beckeri*, *Centaurea jacea*, *Knautia arvensis*, *Hypericum perforatum*, *Anthericum ramosum*, *Euphorbia nicaeensis*, *Convallaria majalis*, *Pulsatilla pratensis*, *Viola odorata*.

In the oak forest of the Homilsha Woods NNP near Gaidary village (49°38′12″ N 36°18′27″ E), deciduous forests stretch along the right bank of the Siversky Donets River in an area of 7–8 km in length and up to 4 km in width. Maple, ash tree, linden and oak forests Prevail there. The main forest-forming species is *Quercus robur*, which together with *Fraxinus excelsior* form the first tier of the forest. The second tier includes *Acer platanoides*, *T. cordata*, *Pyrus* sp., *Malus* sp. and *A. campestre*. The shrub layer is more pronounced near meadows and consists of *P. spinosa*, *Crataegus laevigata*, *Rhamnus cathartica*, *A. tataricum*. The herbaceous layer during June–July is dominated by *Glechoma hederacea*, *Aegopodium podagraria*, *Asarum europaeum*, *Chelidonium majus*. The northeastern and central part of Hetman NNP is located on the spurs of the Middle Upland, the south-western part – within the Poltava Plain. The overwhelming part of Hetman NNP territory belongs to the Sumy upland region of the east Ukrainian forest-steppe and only the lands in the lower 10–15 km of the Vorskla River bed – to the East Poltava upland region in the forest-steppe zone on the left bank of the Dnipro River. In the central part of the NNP near Klementove village (50°22′57″ N

34°55′34″ E), the tree stand is represented by monoculture *P. sylvestris*, closer to the Vorskla River are old-growth *Q. robur*, *A. platanoides*, *T. cordata*, which form the second layer. In the undergrowth there are *Sorbus aucuparia*, *Frangula alnus*, *Corylus avellana*, *A. tataricum*. The dominants of the herb-shrub layer are *Carex pilosa*, *Stellaria holostea*, *C. majalis*. In anthropogenically disturbed places, the undergrowth is formed by *Sambucus racemosa*, *R. idaeus*, and *Humulus lupulus*. In the herbaceous layer, dominate synanthropic species such as *C. majus*, *Geranium robertianum*.

In the eastern part of the NNP near Kamyanka village (50°24′55″ N 35°04′16″ E), the tree stand is represented by *P. sylvestris* and *Q. robur*, *F. excelsior*, *A. platanoides*. The second layer is formed by *Ulmus glabra*, *A. campestre*. The dominants in the undergrowth are *C. avellana*, *Padus avium*, *Euonymus europaea*, with freequent occurrences of *Viburnum opulus* and *A. tataricum*. In the herbaceous layer there are *A. podagraria*, *C. pilosa*, *Galium odoratum*, *Lamium galeobdolon*, *S. holostea*. Spring synusia with a total projective cover of up to 30–60 % is dominated by *Scilla siberica*, *Gagea lutea*, *Corydalis solida*, the dominant of the herbaceous layer is *Pteridium aquilinum*.

"Vakalivshchyna" tract (51°01′44″ N 34°55′57″ E) is near Vakalivshchyna village on the outskirts of a large array of upland and humid deciduous forests. The forest-cenotic structure of this tract is dominated by maple-linden-oak and ash-oak forests with a 90–120-year-old stand (Chaplygina, Bondarets, & Savinskaya, 2014). In the undergrowth you can find *Philadelphus coronarius*, *C. avellana*, *P. padus*. In the herbaceous layer of the forest there is *Lapsana communis*, *Polygonatum multiflorum*, *V. odorata*, *Anthriscus sylvestris*. The Biostationary Garden of Sumy State Makarenko Pedagogical University has *Agrimonia eupatoria*, *Trifolium pratense*, *Lathyrus pratensis*, *H. perforatum*, *E. esula*, *Lactuca serriola*, *Solidago canadensis*, *Myosotis* sp., *Plantago* sp., *Ranunculus acris*, *Medicago falcata*, *Poa* sp., *Leucanthemum vulgare*, *Crepis sibirica*, *Erigeron annuus*, *Origanum vulgare*.

When checking and examining the ANs, 80 nests were found, 69 of which were populated by representatives of the Vespidae family and 11 – by the Apidae. For collecting and counting invertebrates in ANs we used universal equipment – entomological net, exhauster and mordants (Bogolyubov, 2001). For identification of nests and establishing the taxonomic status of representatives of the Vespidae and Apidae families in ANs, we used keys (Blüthgen, 1961; Medvedev, 1978).

Software used for calculations: Microsoft Office Excel 2010.

## RESULTS AND DISCUSSION

Among representatives of the Vespidae family in ANs in the territory of northeastern Ukraine, two species – *Vespa crabro* and *Vespula vulgaris* – were identified as well as one representative of the Apidae family – *Bombus terrestris*. During the study period, the dominant population in ANs was *V. vulgaris*, with the share of 59.2 % (47), and a smaller share of 27.1 % (22) of *V. crabro*. The smallest part of ANs were populated by *B. terrestris* – 13.5 % (11).

In natural places of recreational zones, nests of representatives of the Vespidae and Apidae families were not found, but the recorded number of their occurrences in flight on this route was 23 (**Fig. 2**).

In "Vakalivshchyna" tract near Vakalivshchyna village the maximum share of *V. vulgaris* species nesting in ANs in 2020 was 1.9 % (n = 160), in 2021 it was 0.6 % (n = 160).

In the territory of Hetman NNP near Kamyanka village, the share of nesting in ANs by the species was much larger in 2021 – 8.3 % (n = 120), in 2020 – 3.3 % (n = 120). In Hetman NNP near Klementove village in 2020, the maximum share of nesting was 3.6 % (n = 110); in Homilsha Woods NNP near Zadonetske village during 2020–2021 it was 4.0 % (n = 100). Throughout all the years of study, the smallest share of nesting in the territory of Homilsha Woods NNP near Gaidary village was 1.0 % (n = 100) in 2019 and 2021, in 2020, no nestings were found in ANs.

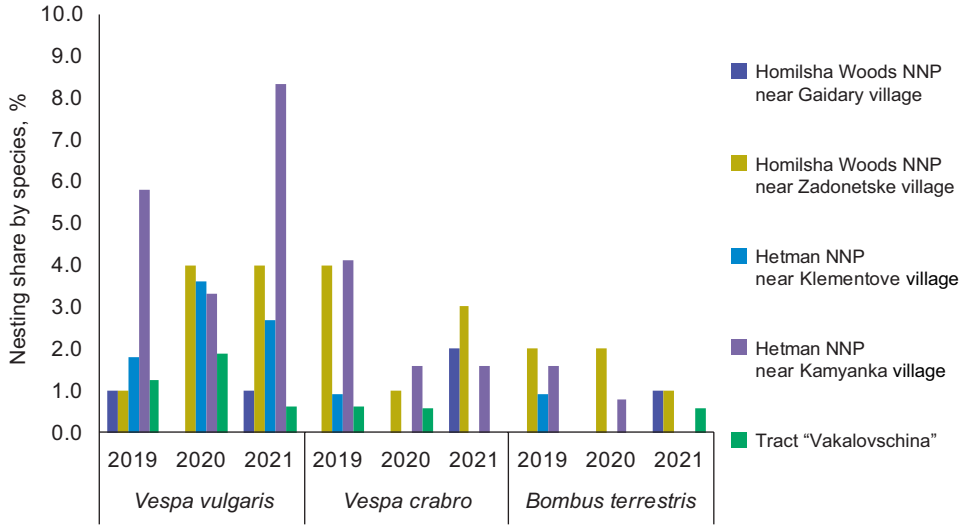


**Fig. 2.** Share of nesting in ANs by *V. vulgaris*, *V. crabro*, *B. terrestris* in the territory of northeastern Ukraine during 2019–2021

During 2019–2020, the share of nesting in ANs in "Vakalivshchyna" tract by *V. crabro* was smaller – 0.6 %, compared with *V. vulgaris* over the same period. In 2019, a fairly large share of nesting in ANs was recorded on the territories of Hetman NNP near Kamyanka village – 4.1 % (n = 120) and the Homilsha Woods NNP near Zadonetske village – 4.0 % (n = 100). In 2020, in the Homilsha Woods NNP near Zadonetske village the share was smaller – 1.0 % (n = 100). In Hetman NNP near Kamyanka village in 2020–2021, the share decreased to 1.6 % (n = 120).

Despite the relatively high number of meetings and number of representatives of the genus *Bombus* in various anthropogenic and natural landscapes, the shares of nesting in ANs in pine forests and broadleaf forests is equivalent. So, the share of nesting in ANs by *B. terrestris* in the Homilsha Woods NNP near Zadonetske village in 2021 was 1.0 % (n = 100), near Gaidary village, over this research year – 1.0 % (n = 100), in 2019, in pine forests of Hetman NNP near Kamyanka village and Homilsha Woods NNP near Zadonetske village – 2.0 % (n = 100).

For representatives of the Vespidae and Apidae families the spring period is the signal for life activity. Places for wintering for *V. vulgaris*, *V. crabro*, *B. terrestris* are old log cabins, attics, house cladding. After wintering, the female (queen) starts to search places for nesting, later begins the construction of the first cells, further – lays eggs, from which larvae appear (**Fig. 3**).

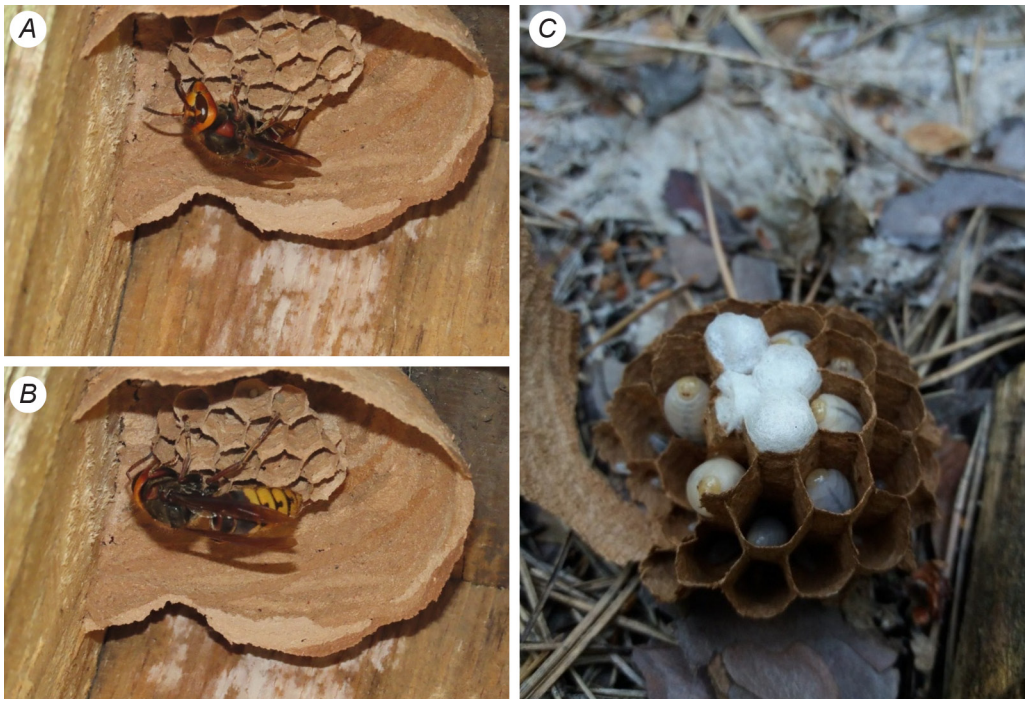


**Fig. 3.** ***A*** – The female (queen) of *V. crabro* in a honeycomb with cells; ***B*** – The female (queen) of *V. crabro* lays eggs in honeycomb cells; ***C*** – *V. crabro* Larvae in honeycomb cells (after accidental removal from AN)

Representatives of the Vespidae and Apidae families begin to populate ANs from the third decade of April to the second decade of July (21.04–10.07). In the third decade of July (21.07–30.07), *V. crabro* and *V. vulgaris* nests are already abandoned, which is evidenced by several factors: 1) discoloration of the nest (they fade over time); 2) thin layer formation; 3) exfoliation of several layers of the nest in AN; 4) presence of cobwebs; 5) free honeycomb (no larvae). In case of *B. terrestris*: 1) free honeycomb (no larvae), 2) presence of cobwebs; 3) lack of response (within 30 seconds) to short-term sound shocks on ANs (**Fig. 4**).

In Hetman NNP near Kamyanka village, the maximum peak of nesting in ANs by *V. vulgaris* occurs during the first ten days of June (01.06–10.06) at an average daily temperature of +16 °C. A smaller number of nestings was observed in Klementove village in the third decade of May (21.05–30.05) at an average daily temperature of +14 °C and in the first decade of Jule (01.07–10.07) at an average daily temperature of +19 °C. In the territory of the Homilsha Woods NNP near Zadonetske village, *V. vulgaris* started to nest in ANs earlier than in other territories of northeastern Ukraine – in the first decade of May (01.05–10.05) at an average daily temperature of +10 °C.

*V. crabro* begins to to nest in ANs in the third decade of April (21.04) with an average daily temperature of +7 °C in the territory of the Homilsha Woods NNP near Zadonetske village. The peak in the number of *V. crabros* similarly to the species *V. vulgaris*, occurs during the third decade of May (21.05–30.05) at an average temperature of +14 °C and the second decade of June (11.06–20.06) at an average daily temperature of +15 °C in Hetman NNP near Kamyanka village. From the second decade of May (11.05) with an

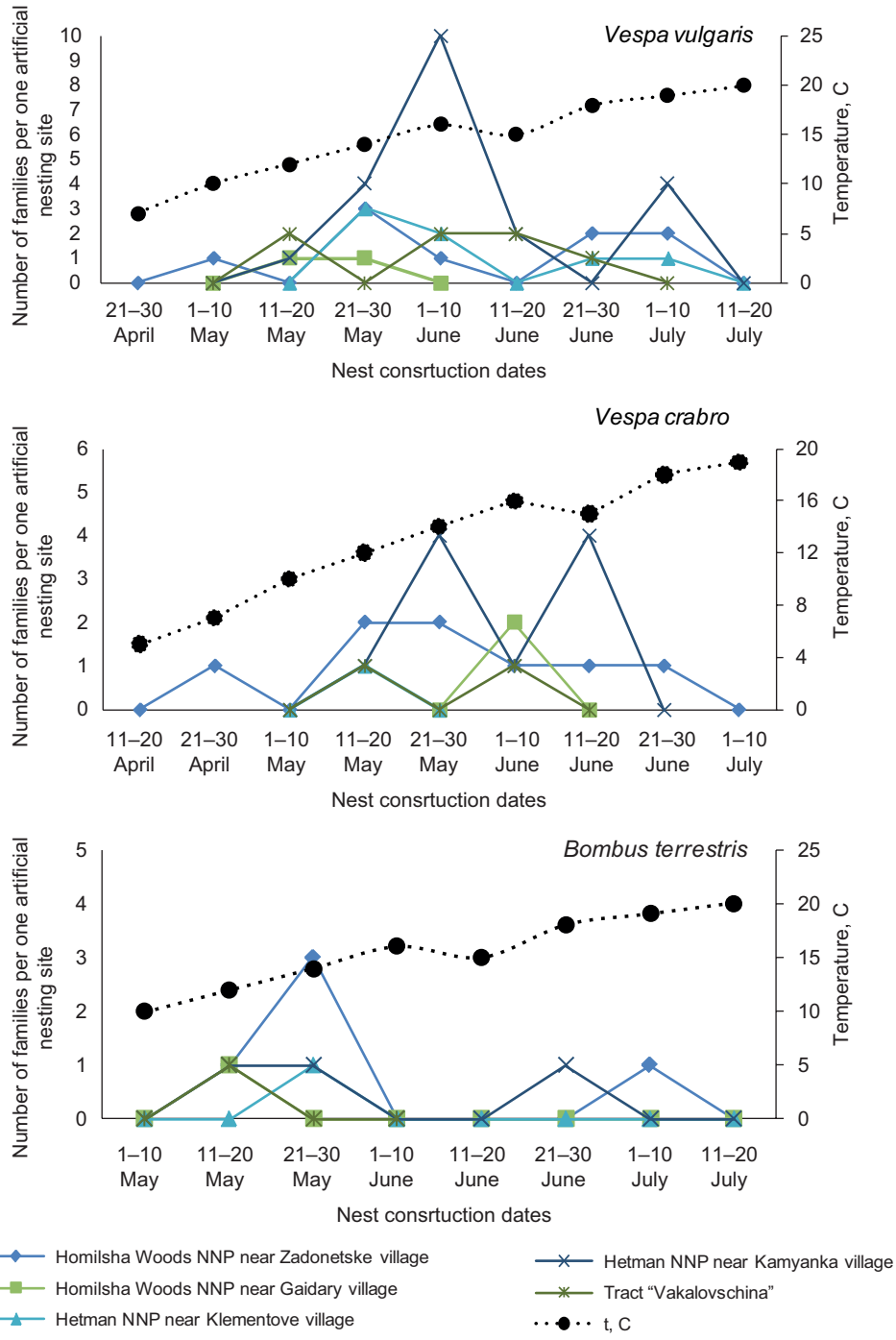


**Fig. 4.** Seasonal nesting and dependence of *V. vulgaris*, *V. crabro*, and *B. terrestris* on temperature in ANs on the territory of northeastern Ukraine during 2019–2021

average temperature of +12 °C to the third decade of May (30.05) with an average daily temperature of +14 °C, the number of nestings was the same in the Homilsha Woods NNP near Zadonetske village. An identical number of nestings was recorded in this territory in the second decade of April (21.04) with an average temperature of +7 °C, and in the first (01.06) and third decades of June (30.06) with an average monthly temperature of +18 °C. In "Vakalivshchyna" tract the smallest number of nestings was recoded in the second decade of May (11.05) with an average daily temperature of +12 °C and the first decade of June (01.06) with an average temperature of +15 °C.

The maximum peak of nesting in ANs by *B. terrestris* was registered in the Homilsha Woods NNP near Zadonetske village in the third decade of May (21.05–30.05) with an average temperature of +14 °C. The rest of the study areas had the same numder of nestings in ANs throughout the season, starting from the second decade of May (11.05) with an average temperature of +12 °C to the first decade of July (10.07) with an average daily temperature of +19 °C. Moreover, from the first to the second decade of June (1.06–20.06) with an average temperature of +15.5 °C no *B. terrestris* were found in the ANs.

In the course of statistical calculations it was found that the average value of the correlation coefficient between the indicators designates a low plasticity of the strategy for choosing AN by representatives of the Vespidae and Apidae families in places with a wide range of vegetation species composition. It should be noted that the choice of ANs is also influenced by the exposure, because the location of nests in areas exposed to direct sunlight during the day leads to an acceleration of the emergence of adults, while environmental conditions and the availability of food resources may be insufficient. This phenomenon is well documented by H. Honchar *et al.* (2020).

During the inspection of the ANs, there were cases when *B. terrestris* nests remained empty, approximately in the middle of the season, and a few days later, *B. terrestris* were again settled in other ANs. The reason for this "recession" is swarming. Its essence is that with a rapid increase in the number of working individuals in the nest, it becomes too cramped for them, bumblebees do not work. In such conditions, bumblebees begin to lay special queen cells, called swarms, and just before the young queen emerges, the old queen flies out of the hive along with old flying bumblebees in search of a new place for the family. Depending on the state of the female (queen), swarming may stop after one, two, sometimes three swarms emerge. Then, in case the family does not have a young enough brood to raise a new queen for itself, it is doomed to perish.

Often, during checks, in addition to residential nests of *V. vulgaris*, *V. crabro*, and *B. terrestris*, abandoned nests with clutches of hollow-nesting birds were found (**Fig. 5**).

In the territory of northeastern Ukraine (Yuzyk & Chaplygina, 2016), in the litter of F. albicollis nests in ANs, the following species were found: *V. vulgaris*, *V. crabro*, *Vespula austriaca* (Panzer, 1799), *Polistes gallicus* (L., 1761), *Eumenes* sp., *Xylocopa* sp., *A. mellifera*. In the nests of *P. major* (L., 1758) the following nidicols were found: *V. vulgaris*, *V. austriaca*, *Paravespula rufa* (L., 1758). Much attention is devoted to the study of food objects of hollow-nesting birds in ANs. D. I. Yuzyk (2016) suggests that passeriformes in the forest biocenosis are characterized by insignificant selectivity in the choice of food items and the ability to switch to mass species of insects, depending on their number and timing of the season. As components of forest biogeocenoses, birds are a factor limiting the number of phytophagous insects in forests, gardens and parks. Research carried out by D. I. Yuzyk (2016) showed that in the diet of chicks of *F. albicollis* in the

Homilsha Woods NNP were included representatives of Hymenoptera – a superfamily of stinging hymenopods (Apoidea Latreille, 1802) 0.23 % (n = 1), (Thomson, 1869), and a representative of the Halictidae family of bees *Halictus* sp. 0.23 % (n = 1). In the same territory, in the diet of chicks of *Erithacus rubecula* (L., 1758), among invertebrates, 0.68 % (n = 3) of representatives of the Vespidae family were found; in *P. major's* diet – 1.10 % (n = 1). in Hetman NNP near Klementove village, in the diet of chicks of *Passer montanus* (L., 1758), a representative of the Apidae family was identified 0.68 % (n = 1). A great diversity of invertebrate species in the diet of chicks of *Phoenicurus phoenicurus* (L., 1758) was detected. In particular, 0.99 % (n = 1) of representatives of Apoidae, 0.99 % (n = 1) of Vespoidea, and 0.99 % (n = 1) of Apocrita were identifies. The largest number of invertebrates in the diet of chicks was found in the "Vakalivshchyna" tract, namely: 0.56 % (n = 2) of representatives of the Vespidae family, 3.64 % (n = 13) of representatives of the Eumenidae family, 0.28 % (n = 1) of representative of the Apoidea superfamily, and 0.28 % (n = 1) of representative of *Halictus* sp., the Halictidae family. P.J. Lester & J. Beggs (2019) point out that *Turdus merula* (L., 1758), *Corvus* spp. (L., 1758) and *Sturnus vulgaris* (L., 1758), sometimes eat wasps.


**Fig. 5.** ***A*** – The nest of *Ficedula albicollis* (Temm., 1815) with eggs and the nest of *V. vulgaris* in AN in the Homilsha Woods NNP near Zadonetske village (Kharkiv region); ***B*** – The nest of *F. albicollis* with chicks and nest of *V. vulgaris* in AN in Hetman NNP near Kamyanka village (Sumy region)

In the course of this research, it was found that the peak of nesting by *V. vulgaris* in ANs depends on temperature. *V. crabro* are less dependent on temperatures (from +7 to +18 °C). For the representatives of *B. terrestris*, the dependence on temperature (from +12 to +19 °C) was not established. The main condition for *B. terrestris* nesting in ANs on the territory of northeastern Ukraine is the presence of a significant proportion of moss, branches, fur from animals Rodentia, Carnivora, and anthropogenic materials. Tit nests meet these requirements.

When checking the ANs, we discovered that representatives of the Vespidae and Apidae families periodically force hollow-nesting birds to leave previously built nests or nests with eggs. In New Zealand, cases have been reported of *Vespula germanica* (Fabricius, 1793) attacking chicks of birds, and this was probably initiated by the smell of protein from eggs from which the chicks had recently hatched (Lester, & Beggs, 2019). M. V. Tarantovich (2012) reported that *Coracias garrulus* (L., 1758) can leave the nest with chicks if *V. crabro* nests in the AN. At the Biological Station of the Zoological Institute of the Russian Academy of Sciences, located on the Curonian Spit of the Baltic Sea, ANs for hollow-nesting birds were also populated by *Vespula* sp. In most cases, after wasps nested in ANs, these nesting sites were not occupied by anyone else, but after their removal, birds occasionally nested in them (6 times *P. major* and 1 time *F. hypoleuca*). *Bombus* sp. nested in ANs only once, where they were found on May 15, 2001. In an abandoned nest of *P. major*., *V. crabro* were registered in ANs during 2003–2006, and in 2008. They usually nested in ANs from two (four cases) to three (once) (Shapoval, 2019) times a year. In the UK, birds' nests of *Cyanistes caeruleus* (L., 1758) (14), *P. domesticus* (L., 1758) (2), *P. major* (1), *P. ater* (1), were also conested by *Bombus*. There was only one case of an attack by a European green woodpecker (*Picus viridis* L., 1758) on the nest of *B. pascuorum* (Scopoli, 1763). According to M. Detoni *et al.* (2011), passeriformes use existing nests of the Vespidae family as landmarks for choosing nesting sites. We have found that hollow-nesting birds populate ANs in the event that there are no potential nests of representatives of *V. vulgaris*, *V. crabro*, or *B. terrestris*.

Cleaning and restoration of ANs after the season plays a great role in maintaining species diversity. Many parasites and ticks remain in the nests and cracks in ANs, which disturb insects and chicks overwinter and during the next year, causing their death. During the season, it is also necessary to clean ANs, in case the nests are abandoned (**Fig. 6**).

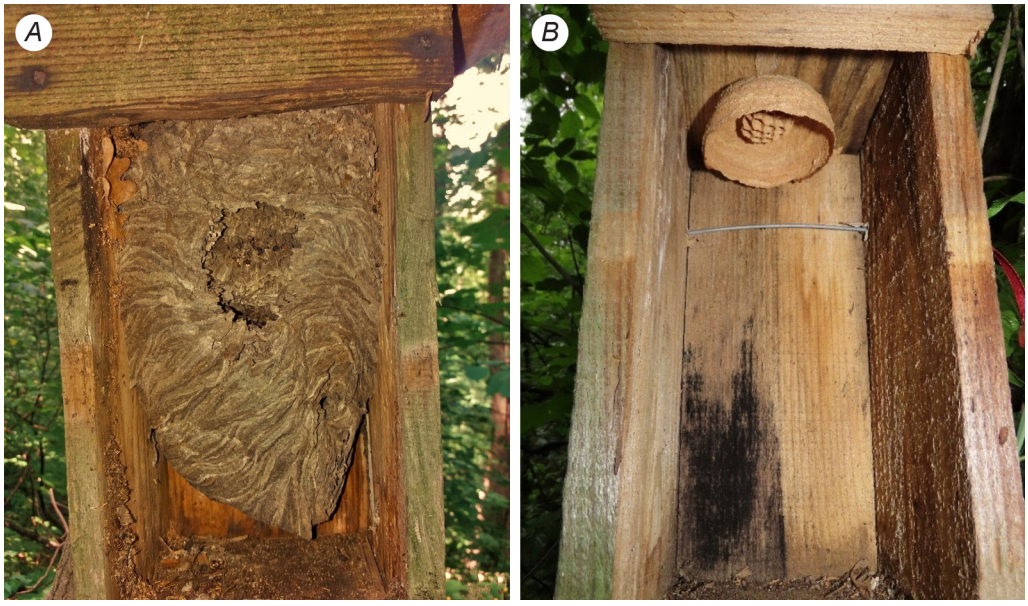


**Fig. 6.** ***A*** – An abandoned nest of *V. crabro* in an AN on the territory of "Vakalivshchyna" tract near Vakalivshchyna village (Sumy region); ***B*** – An abandoned nest of *V. crabro* in an AN on the territory of Homilsha Woods NNP near Zadonetske village (Kharkiv region)

It should be noted that in parallel, research was conducted on the territory of the regional landscape park "Feldman Ecopark" (Kharkiv region) in oak-linden-maple forests. On this territory, ANs (n = 100) are positioned at a height of 2 m. During the inspections, representatives of the Vespidae and Apidae families were not found. The main reasons for this are the high recreational load and the height of the AN placement. At the same time, according to the data reported by H. Y. Honchar (2020), in the territories belonging to the recreational zones of the city of Kyiv (little changed areas, the Botanical Garden, the Dnieper Islands, parks) the maximum variety of wild bees was present. However, the territories of residential areas, roadsides and railway structures were distinguished by a depleted composition of groups of bees.

## CONCLUSIONS

Among representatives of the Vespidae family in ANs in the territory of northeastern Ukraine, two species were identified – *V. crabro* (L., 1758) and *V. vulgaris* (L., 1758); the Apidae family had one representative – *B. terrestris* (L., 1758). Representatives of the Vespidae and Apidae families begin to populate ANs from the third decade of April to the second decade of July (21.04–10.07). On the studied territories of northeastern Ukraine, in Hetman NNP near Kamenka village, the number of nestings by *V. vulgaris* was maximal throughout all the years of study (59.2 %), besides, the number of individuals increased over the period. The smallest share of nesting in ANs was that by *B. terrestris* – 13.5 %. In the third decade of July (21.07–30.07), nests of *V. crabro*, *V. vulgaris* were abandoned, this was evidenced by several factors: 1) discoloration of the nest (they fade over time); 2) thin layer formation; 3) exfoliation of several layers of the nest in the AN; 4) presence of cobwebs; 5) free honeycomb (no larvae). In case of *B. terrestris*: 1) free honeycomb (no larvae), 2) presence of cobwebs; 3) lack of response (within 30 seconds) to short-term sound shocks on ANs. Cleaning and restoration of ANs after the season plays a great role in maintaining species diversity. Many parasites and ticks remain in the nests and cracks in ANs, which disturb insects and chicks overwinter and during the next year, causing their death. During the season, it is also necessary to clean ANs, in case the nests are abandoned.

## ACKNOWLEDGMENT

All the representatives of invertebrates were identified to species by Dr. V. M. Gramma and Dr. O. V. Govorun, Ph.D. – assistant professors of the Department of Biology and Methods of Teaching Biology of Sumy State Pedagogical University named after A. S. Makarenko, for which we express our sincere gratitude.

## COMPLIANCE WITH ETHICAL STANDARDS

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Human Rights:** This article does not contain any studies with human subjects performed by any of the authors.

**Animal studies:** The experiment was conducted in compliance with bioethics, in accordance with the provisions of the Convention on the Protection of Vertebrate Animals Used for Experimental and Other European Scientific Purposes (Strasbourg, 1986), and

does not violate the conventions on wildlife protection in Europe Berne Convention), the Law of Ukraine “On Fauna” (March 3, 1993), the Law of Ukraine “On Environmental Protection” (June 26, 1991).

## AUTHOR CONTRIBUTIONS

Conceptualization, [O.O.Y.; A.B.Ch.]; methodology, [O.O.Y.; A.B.Ch.]; validation, [A.B.Ch.]; formal analysis [O.O.Y.; A.B.Ch.]; investigation, [O.O.Y.; A.B.Ch.]; investigation, [O.O.Y.; A.B.Ch.]; resources, [O.O.Y.; A.B.Ch.]; data curation, [O.O.Y.; A.B.Ch.]; writing – original draft preparation, [O.O.Y.]; writing – review and editing, [A.B.Ch.]; visualization, [O.O.Y.; A.B.Ch.]; supervision, [O.O.Y.; A.B.Ch.]; project administration, [O.O.Y.; A.B.Ch.]; funding acquisition, [O.O.Y.; A.B.Ch.]

## REFERENCES

Blüthgen, P. (1961). *Die Faltenwespen Mitteleuropas* (*Hymenoptera, Diploptera*) [*The wasps of Central Europe* (*Hymenoptera, Diploptera*)]. Akademie-Verlag. Berlin. doi: 10.1515/9783112537084 (In Deutsch)
Crossref ● Google Scholar

Bogolyubov, A. S. (2001). *Izuchenie lesnykh bespozvonochnykh* (*2 chast: travianoi iarus, krony, vozdushnaia sreda*) [*Study of forest invertebrates.* (*Part 2: grass layer, crowns, air environment*)]. Ecological Field Studies Instructive Manuals. M., 12. (In Russian)
Google Scholar

Chaplygina, A. B., Bondarets, D. I., & Savinskaya, N. O. (2014). Monitorynh zaselenosti shtuchnykh hnizdivel duplohnizdnykamy na terytorii NPP “Homilshanski lisy” [Monitoring population of artificial nesting sites hollow-nesting birds on the territory NNP “Gomolsha Forest”]. *Journal of Luhansk Taras Shevchenko National University* (*Biological sciences*), 8(291), Part I, 56–62. (In Ukrainian)
Google Scholar

Detoni, M., Feás, X., Jeanne, R. L., Loope, K. J., O’Donnell, S., Santoro, D., Sumner, S., & Jandt J. M. (2021). Evolutionary and Ecological Pressures Shaping Social Wasps Collective Defenses. *Annals of the Entomological Society of America*, 114(5), 581–595. doi:10.1093/aesa/saaa063
Crossref ● Google Scholar

Dvořák, L., & Straka, J. (2007). Vespoidea: Vespidae (vosovití) [Vespoidea: Vespidae (wasps)]. *Acta Entomologica Musei Nationalis Pragae*, 11, 171–189. (In Czech)
Google Scholar

Ertürk, Ö., & Sarıkaya, A. (2020). Determination of some structural features of the nest paper materials of *Vespa crabro germana* Christ, 1791 (Hymenoptera: Vespidae) in Turkey. *Journal of the Kansas Entomological Society*, 93(1), 1–13. doi:10.2317/0022-8567-93.1.1
Crossref ● Google Scholar

Haeseler, V. (1988). A nest of *Paravespula vulgaris* (L.) (Hym., Vespidae) in a juniper-tree. *Journal of Applied Entomology*, 105(1-5), 14–18. doi:10.1111/j.1439-0418.1988.tb00155.x
Crossref ● Google Scholar

Honchar, H., Kumpanenko, A, & Koniakin, S. (2020). Vykorystannia shtuchnykh hnizdovykh konstruktsii dlia peretynchastokrylykh komakh (Hymenoptera, Aculeata) u misti [Using artificial nesting structures for hymenopteran insects (Hymenoptera, Aculeata) in the city]. *Environmental sciences*, 5(32), 82–90. doi: 10.32846/2306-9716/2020.eco.5-32.12 (In Ukrainian)
Google Scholar

Medvedev, G. S. (ed.) (1978). *Opredelitel nasekomykh Evropeiskoi chasti SSSR* [*Keys to the insects of the European part of the USSR. Hymenoptera*]. Part II, Nauka, 3, 584. (In Russian)
Google Scholar

Kremen, C., Williams, N. M., Aizen, M. A., Gemmill-Herren, B., LeBuhn, G., Minckley, R., Packer, L., Potts, S. G., Roulston, T., Steffan-Dewenter, I., Vázquez, D. P., Winfree, R., Adams, L., Crone, E. E., Greenleaf, S. S., Keitt, T. H., Klein, A. M., Regetz, J., & Ricketts, T. H. (2007). Pollination and other ecosystem services produced by mobile organisms: a conceptual framework for the effects of land-use change. *Ecology Letters*, 10(4), 299–314. doi:10.1111/j.1461-0248.2007.01018.x
Crossref ● PubMed ● Google Scholar

Lester, P. J., & Beggs, J. R. (2019). Invasion success and management strategies for social *Vespula* wasps. *Annual Review of Entomology*, 64(1), 51–71. doi:10.1146/annurev-ento-011118-111812
Crossref ● PubMed ● Google Scholar

Lezhenina, I. P., Gramma, V. N., Chaplygina, A. B., & Savinskaya, N. A. (2009). Chlenystonohye v hnezdakh mukholovky-belosheiky v nahornoi dubrave (Kharkovskaia oblast) [Arthropoda in nests of Muscicapa albicollis in highland oak-grove (Kharkov region)]. *Belgorod State University Scientific Bulletin. Natural Sciences*, 3(58), 95–100. (In Russian)
Google Scholar

Michener, Ch. D. (2007). *The Bees of the World*. Baltimore, London: John Hopkins University Press. Second edition, 953.
Google Scholar

Olsson, O., Bolin, A., Smith, H. G., & Lonsdorf, E. V. (2015). Modeling pollinating bee visitation rates in heterogeneous landscapes from foraging theory. *Ecological Modelling*, 316, 133–143. doi:10.1016/j.ecolmodel.2015.08.009
Crossref ● Google Scholar

Rahimi, E., Barghjelveh, S., & Dong, P. (2021). Using the Lonsdorf model for estimating habitat loss and fragmentation effects on pollination service. *Ecological Processes*, 10(1). doi:10.1186/s13717-021-00291-8
Crossref ● Google Scholar

Shapoval, A. P. (2019). Ispolzovanie iskusstvennyih gnezdoviy dlya ptits drugimi zhivotnyimi na Kurshskoy kose. [Use of artificial nests for birds by other animals on the Curonian Spit]. *Russian Ornithological Journal*, 28(1746), 1294–1297. (In Russian)
Google Scholar

Tarantovich, M. V. (2012). Gnezdovaia biologiia sizovoronki (*Coracias garrulus*) v Belarusi [Nesting biology of the European roller (*Coracias garrulus*) in Belarus]. *Materials of the Republican Scientific and Practical Conference* (*Grodno, March 2-4, 2012*). Grodno: GRSMU, 149–152. (In Russian)
Google Scholar

Vaudo, A. D., Ellis, J. D., Cambray, G. A., & Hill, M. (2011). The effects of land use on honey bee (*Apis mellifera*) population density and colony strength parameters in the Eastern Cape, South Africa. *Journal of Insect Conservation*, 16(4), 601–611. doi:10.1007/s10841-011-9445-0
Crossref ● Google Scholar

Williams, I. H., Corbet, S. A., & Osborne, J. L. (1991). Beekeeping, wild bees and pollination in the European Community. *Bee World*, 72(4), 170–180. doi:10.1080/0005772x.1991.11099101
Crossref ● Google Scholar

Yarys, O., Chaplygina, A., & Kratenko, R. (2021). Breeding phenology of Common Redstart (*Phoenicurus phoenicurus*) and its reproduction biology with artificial nests in Northeastern Ukraine. *Ornis Hungarica*, 29(2), 122–138. doi:10.2478/orhu-2021-0024
Crossref ● Google Scholar

Yarys, O. O. (2021). Fenologiya ta biologiya rozmnozhennya *Ficedula albicollis* (Temminck) u shtuchnih gnizdivlyah na teritoriї regional'nogo landshaftnogo parku "Fel'dman Ekopark" [Phenology and biology of *Ficedula albicollis* (Temminck) reproduction in artificial nests on tne territory of regional landscape park Feldman Ecopark]. *Biodiversity, ecology and experimental biology*, 1(23), 42–51. doi:10.34142/2708-5848.2021.23.1.06 (In Ukrainian)
Crossref ● Google Scholar

Yuzyk, D. I., & Chaplygina, A. B. (2016). Synytsia blakytna (*Parus caeruleus* L.) v systemi konsortsii v umovakh lisovykh tsenoziv Pivnichno-Skhidnoi Ukrainy [Blue tit (*Parus caeruleus* L.) in the system of consortia in the minds of forest cenoses in North-Eastern Ukraine]. *III International Scientific and Practical Conference "Regional aspects of floristic and faunal studies"* (*May 13-14, smt. Putila, Chernivtsi, Ukraine*), 83–87. (In Ukrainian)
Google Scholar

## РОЛЬ ШТУЧНИХ ГНІЗДІВЕЛЬ І ГНІЗД ПТАХІВ У ПІДТРИМАННІ ЖИТТЄДІЯЛЬНОСТІ РОДИН VESPIDAE, APIDAE

***О. О. Ярис, А. Б. Чаплигіна***

*Харківський національний педагогічний університет імені Г. С. Сковороди*
*вул. Алчевських, 29, Харків 61002, Україна*

**Вступ.** Протягом 2019–2021 рр. з першої декади березня по третю декаду липня на території північно-східної України проводили орнітологічні дослідження щодо заселення птахів у штучних гніздівлях. Серед багатьох різноманітних заходів, спрямованих на збільшення чисельності різних груп тварин на урбанізованих територіях, штучні гніздівлі є основним рішенням для відтворення та збереження популяції. Тому метою дослідження є вивчення ролі штучних гніздівель у підтриманні життєдіяльності родин Vespidae, Apidae.

**Матеріали та обговорення.** На території північного сходу України дослідження проводили у рекреаційних зонах: Національний природний парк "Гомільшанські ліси" поблизу с. Задонецьке та с. Гайдари (Харківська обл.), Національний природний парк "Гетьманський" поблизу с. Кам'янка та Климентове, а також в урочищі "Вакалівщина" поблизу с. Вакалівщина (Сумська обл.). У ході перевірки та дослідження штучних гніздівель визначено 80 гнізд: представників родин Vespidae – 69 і Apidae – 11. Серед представників родини Vespidae роду Vespa у штучних гніздівлях на території Північно-Східної України виявлено два види – *Vespa crabro* та *Vespula vulgaris*; родина Apidae мала одного представника – *Bombus terrestris*.

**Висновки.** Представники родини Vespidae, Apidae починають заселяти штучні гніздівлі з третьої декади квітня по другу декаду липня (21.04–10.07). Серед досліджуваних територій північного сходу України, а саме на території Гетьманського НПП поблизу с. Кам'янка, чисельність угруповання популяції *V. vulgaris* була максимальною протягом усіх років. Крім того, за роки досліджень чисельність угруповання кількість виду збільшувалася. Під час перевірки штучних гніздівель на території регіонального ландшафтного парку "Фельдман Екопарк" заселеність представниками родин Vespidae, Apidae не виявлено.

***Ключові слова:*** оса звичайна, шершень звичайний, джміль земляний, штучні гніздівлі, дуплогнізні птахи, північний схід України

| Received / Одержано | Revision / Доопрацьовано | Accepted / Прийнято | Published / Опубліковано |
|---|---|---|---|
| 03 February, 2022 | 21 February, 2022 | 28 March, 2022 | 11 April, 2022 |