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Bees in the City

Pszczoły w wielkim mieście

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Abstract: For many years, the need to increase food production, both globally and locally, has been directly related to agriculture intensification. The need to systematically increase the doses of both artificial fertilizers and chemical plant protection products increases the threat to the components of the natural environment. This condition is hazardous and has far-reaching consequences for pollinating insects, especially bees. Consequently, the number of these is decreasing, and their susceptibility to numerous diseases is increasing significantly. The research results indicate that they pollinate 80% of plants on our planet, especially such essential utility species as vegetables and fruits. To counteract and limit the harmful effects of chemical plant protection products on the life of these insects, in 2018, the European Union issued a ban on the use of the most potent pesticides, i.e., neonicotinoids, and glyphosate, the main ingredient of Roundup. One method of helping these insects are urban apiaries which can help in reducing their exposure to diseases and, consequently, their mortality. The practice of establishing beehives in the cities of Europe and other countries around the world has been observed for several decades now, and in Poland it has a tradition of several years. The number of such apiaries is increasing, as the urban landscape provides a rich and varied diet for bees.

Keywords: honey bee, apiaries on the roofs of the world, Polish urban apiaries

Streszczenie: Od szeregu lat konieczność zwiększenia produkcji żywności zarówno w skali globalnej jak i lokalnej związana jest bezpośrednio z procesem intensyfikacji rolnictwa. Konieczność systematycznego zwiększania dawek zarówno nawozów sztucznych jak i chemicznych środków ochrony roślin potęguje zagrożenie dla komponentów środowiska przyrodniczego. Stan ten jest szczególnie groźny i dalekosiężny w skutkach dla owadów zapylających, a zwłaszcza pszczół. W konsekwencji liczebność tych owadów maleje, a podatność ich na liczne choroby istotnie wzrasta. Wyniki badań jednoznacznie wskazują, że to one zapylają 80% roślin na naszej planecie, zwłaszcza tak ważne gatunki użytkowe, jak warzywa i owoce. Chcąc przeciwdziałać i ograniczyć negatywne skutki jakie stwarzają dla życia tych owadów chemiczne środki ochrony roślin, w 2018 r Unia Europejska wydała zakaz stosowania pestycydów o najsilniejszym działaniu tzn. neonikotynoidów, oraz glifosfatu głównego składnika Roundup. Jedną ze skutecznych metod pomocy pszczołom oraz ograniczenia ich śmiertelności i narażenia na choroby są pasieki powstające w miastach. Trend ten oraz rozwój miejskiego pszczelarstwa w krajach Europy oraz na świecie trwa od kilkudziesięciu lat, a w Polce ma już kilkunastoletnie tradycje. Liczba miejskich pasiek wzrasta a krajobraz miast stanowi źródło bogatej i urozmaiconej diety dla pszczół.

Słowa kluczowe: pszczoła miodna, pasieki na dachach świata, polskie pasieki miejskie

> If the bee disappeared off the surface of the globe, then man would only have four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man.
>
> Charles Darwin

Introduction

Bees play a crucial role both in nature and in our daily lives. They guarantee pollination of 80% of the plants on the planet, and this includes crop plants such as vegetables and fruits. Research data indicate that we owe one in three spoonfuls of the food we eat to the diligence of these insects. Due to the latest Greenpeace data, global benefits of bee pollination, as measured by the value of crop yields, are estimated at more than 270 billion euros annually.

The genus *Apis* commonly known as the honey bee appeared on Earth 30 million years before humans. This is evidenced, among others, by fossil record found in Baltic amber dating back to the early Eocene (Crane 1999). Human interest in bees and their products goes back to the emergence of *Homo sapiens* in Africa, Europe and Asia, where bee nests were collected. Cave paintings dating between 20,000 and 10,000 B.C., discovered in Spain in 1924, feature collection of honey from bees with the use of smoke (Crane 1999).

According to historical sources, in ancient times, the Mediterranean basin was the cradle of world beekeeping. The place from where the knowledge of bees spread was Crete (20th century B.C.), which laid the foundation for the development of beekeeping in Greece and Rome. The Cretans at that time were well aware of the nutritional value of honey, the medicinal value of propolis and the economic value of wax. They stored honey in cellars and caves or exported it to Greece, Asia Minor and Egypt (Wróblewski 1991; Prabucki 1998).

In ancient Egypt, in the 10th century B.C., bees found good conditions to thrive in the Nile Valley despite the area's being devoid of forests and other nesting places for these insects. The Egyptians built artificial enclosures for them in the shape of pipes, which they stacked, covering them with clay mixed with river silt. At the time, honey and wax were part of the farmers' tribute, and honey, due to its balsamic properties, was considered in Egypt food of the gods. Wax, on the other hand, was used there for mummification and in magic rituals while propolis was used in healing (Wróblewski 1997).

Beekeeping significantly gained on importance in the new medieval countries of Europe. Italian, Frankish, German, English and, from the 12th century onward, Czech, Ruthenian and Polish chronicles document the developing rural economy including its important branch, i.e., beekeeping.

In the Polish lands, bees were kept as early as the 10th century, as reflected in the notes of merchants and chroniclers including those of Gallus Anonymus, which tell about a land abundant in numerous riches including honey and wax. Beehives were found throughout the Polish lands, and from the 14th century onward apiculture began to develop alongside traditional beekeeping. It can be assumed that the productivity of the apiary at that time was quite high, as it was calculated per 1kg of wax, which, combined with its sale, allows to estimate the number of bee colonies at 800,000 – 2 million (Wróblewski 1991; Wróblewski 1997).

Since the 16th century, there has been a systematic expansion of bees around the world. The economic development of countries as well as seafaring and related trade greatly contributed to this process. Interest in beekeeping spread to other continents and consequently, in 1530, bee colonies reached Brazil, South and Central America, in 1638, North America, and in 1822, Australia and, finally, in 1842, New Zealand. Thus, already two centuries ago, the honey bee, *Apis mellifera*, had taken over the entire globe except the Arctic (Wilde and Prabucki 2008).

The progress of recent centuries and the development of civilization fuelled the rapid growth of industry and modern technology.

At the same time, the need to feed the exponentially increasing population, made it necessary to implement radical changes in agriculture. The process of its intensification and the strive to increase yields, has required and still requires a large-scale use of chemical fertilizers as well as a systematic increase in the doses of chemical and systemic plant protection products.

These compounds have become a serious danger and threat to insect pollinators including bees. The agricultural landscape of our country also underwent significant transformations during this period. The former widespread fragmentation of farms was favourable for a greater mosaic of crops, among which an important element were pastures and extensively used meadows mowed 1-2 times during the growing season. These provided a rich food base for honey bees and other pollinators.

Currently, significant areas of farmland are dominated by monocultures, and among them about 70% of crops are cereals, which, being wind-pollinated plants, do not produce nectar, such an important component of the bees' diet (Sulborska 2018; Walerowicz 2019). Another side effect of land consolidation has been the disappearance of the formerly common mid-field coppices, clumps of shrubs, roadsides, balks, and fallow land, which, due to the richness of various species of plants growing there, used to serve as "luxurious canteens" for bees. Depletion of plant biodiversity has consequently led to the creation of the so-called food deserts for these insects. The need to increase the chemicalization of agriculture and the use of chemical fertilizers, pesticides and herbicides has resulted in a significant decline in bee populations. Apart from the use of chemical compounds, it was also the failure on the part of many farmers to observe the proper spraying season which has contributed to the poisoning and elimination of a significant number of bee colonies (Sulborska 2018).

The findings of many years of scientific research conducted in numerous countries, have clearly indicated that the widespread use of pesticides irreversibly disrupts the metabolism of bees, including the so important bee navigation which threatens their life, and thus significantly reduces their numbers. It should also be noted that these compounds carried by insects to the hive also penetrate the honey. Because of these dangers, in 2018 the European Union banned the use of the most potent pesticides, i.e., neonicotinoids, and glyphosate, the main component of Roundup.

1. Urban apiaries – just a trend or a form of rescue?

The practice of setting up hives on the roofs of buildings in cities around the world, where bees find favourable living conditions has been observed for many years now. What is more, as it has been shown by the research data, bees have a higher survival rate and produce significantly greater amounts of honey in urban conditions than in rural areas. This is largely due to urban greenery, availability and abundance of plants that provide nectar, honeydew, or pollen, i.e., those guaranteeing bees a varied available diet. Another important factor is that the "urban canteen" attracts bees from early spring to late autumn, while agricultural and horticultural crops grown with the use of chemical fertilizers, bloom for a short time during their growing season. Plants in urban conditions are within the effective bee flight range, i.e., up to 3 km, which allows the bee-gatherers to make significantly more flights and thus increase the supplies of food stored in the hive.

It is also worth noting that due to the formation of the so-called urban heat islands, i.e., areas where the average annual temperature is about 1-3°C higher (such as in cities, with a population of 1 million) compared to areas outside the city, bees can work "overtime", increasing honey production (Sulborska 2018; Walerowicz 2020).

The abundance of nectar, honeydew and pollen sources provided to bees by trees, shrubs, as well as perennial and annual

Tab. 1. Selected urban plant species - a source of food for honey bees

Species	Flowering date	Flowering duration	Honey yield	Pollen yield or pollen weight
EARLY SPRING BEE FORAGE				
TREES AND SHRUBS				
Common hazel	II-III	Up to 3 weeks.	no nectar production	168 g/shrub; 8.4 kg/100 m row
Goat willow	III-IV	1-3 weeks.	26-150 kg/ha	30-45 kg/ha
Gray willow	III-IV	1-3 weeks.	60-70 kg/ha	30-45 kg/ha
PERENNIAL PLANTS				
Common snowdrop	II-III	Up to 4 weeks.	No data	1.3 kg/ha
Coltsfoot	III-IV	2-3 weeks.	~ 60 kg/ha	15-20 kg/ha
LATE SUMMER AND AUTUMN FORAGE				
TREES				
Small-leaved linden	VII	~ 2 weeks.	200-300 kg/ha	10-100 kg/ha
Crimean linden	VII	~ 2 weeks.	300 kg/ha	90 kg/ha
PERENNIAL PLANTS				
New England aster	IX-X	~ 5 weeks.	50-60 kg/ha	No data
Common ivy	IX-X	~ 4 weeks.	150-500 kg/ha	No data
Purple coneflower	VII-VIII	~ 6 weeks.	190 kg/ha	~ 100 kg/ha
Canadian goldenrod	VII-IX	6-8 weeks.	480-1000 kg/ha	45-90 kg/ha
ANNUAL AND BIENNIAL PLANTS				
Variegated dahlia	VII-IX	8-9 weeks.	180-190 kg/ha	~ 600 kg/ha
Woolly burdock	VII-IX	6-8 weeks.	100-120 kg/ha	do 160 kg/ha
Himalayan balsam	VII-IX (X)	> 3 months.	300-700 kg/ha	400-600 kg/ha

plants that add to the colour of our cities during particular seasons of the year is evidenced by the following data (Pogorzelec 2019).

2. Bees in Polish cities or the "inventory"

On June 29, 2022, on the initiative of the European Parliament Office in Wrocław and the University of Environmental and Life Sciences, the European Bee Garden, hosting hundreds of thousands of bees in 8 wooden hives, was opened on the grounds of the Faculty of Biology and Animal Science. The European Parliament has been working for years to protect bees and pollinating insects playing a key role in EU agriculture, as 84% of all plant species and 76% of European food production depends on them for pollination.

Apart from the European Bee Garden, a floral meadow was created to provide food for the apiary's inhabitants. Hotels for pollinating insects built by children were also hung on the trees. The hives are cared for by the APIS Beekeepers' Student Science Club.

In 2011, the first apiary was placed on the roof of the luxurious Regent Hotel in Warsaw. It gradually began to grow, which was facilitated by the proximity of the Royal Baths and the Morskie Oko Park both places guaranteeing rich and varied food for the bees. Currently, there are 8 hives hosting about 350,000 bees. Experts estimate that the bees can produce over 175 kg of honey in two weeks. In 2018, from May to September, the hotel harvested nearly 600 kg of honey which it later served its guests with great success (Falencka-Jabłońska 2018).

According to estimates, there are now about 500 beehives in the capital, and the development of urban apiaries is facilitated by favourable legislative changes. The Polish

Parliament has long since set up its own apiary in the Sejm garden in Warsaw.

There are even Polish "bee" records, as the apiary on the roof of the 88-meter Orco Tower skyscraper in Warsaw, is the highest located one in our country! In terms of the location height, it ranks third after Frankfurt am Main, where beehives have been placed on the top of the Jumeirah Hotel at a height of 90 meters, and Hong Kong.

In addition, in 2013, 5 bee houses were set up on the roof of an office building by the author of the "Pszczelarium" beekeeping project, Kamil Baj. In the next stages of the project implementation, more beehives were placed on the roofs of skyscrapers in the capital, including the Arkadia Shopping Centre, the Palace of Culture and Science and the Agora Publishing House at Czerska Street, as well as Galeria Wileńska and Galeria Mokotów shopping malls or the Grand Theater. Experts claim that the Mokotów honey differs in taste from the Praga or Żoliborz honey. The first honeys of the year are horse chestnut-hawthorn and horse chestnut-acacia.

In 2017, 4 beehives were established in Romuald Traugutt Park in Warsaw, administered by the Public Land Management Board, at the intersection of Sanguszki Street and Wisłostrada Street, creating a downtown apiary. The initiative was financed from the civic participatory budget, thanks to the votes of the capital's residents cast for the Urban Bees project. The apiary is fenced and equipped with information boards specifying safety rules and forbidding entrance to outsiders without the supervision of the apiary's caretaker. At the same time, they include contact information of the caretaker, apiary administrator and city services. Bees from this apiary have easily adapted to the parkland, where already in early April, flowering maple trees and fruit trees constitute a rich feeding base for those insects. More information about the downtown apiary in Warsaw can be found at (Ztp.waw.pl. 2022).

Urban apiaries have become very popular in the last decade and their number in Poland is steadily increasing. They can be found in Lublin or Kraków, where since 2016, 6 hives have been placed on the roof of the AGH University of Science and Technology, where about 300 thousand bees live. It is estimated that with favourable weather conditions and good state of health of the bee colony, it is possible to obtain up to 100 kg of lime honey from the hive. Since 2017, the Old Theatre has also had an apiary on its roof (Falencka-Jablonska 2018).

The urban conditions created by numerous parks, gardens, enclaves of greenery, or the so-called "flower meadows" which are becoming increasingly popular, as well as hotels for insects, guarantee availability and diversity of food and are thus favourable and friendly for bees. The results of scientific analysis of honey samples from urban apiaries have shown that they meet the required quality standards and, what is important, do not contain harmful aromatic hydrocarbons or heavy metals (Sulborska 2018).

3. Urban apiaries in Europe and around the world

At the beginning of the 20th century, 1,000 beekeepers ran apiaries in Paris their number dropping significantly to 400, after World War II. Today, the hives are placed in the vicinity of the Notre Dame Cathedral.

In London, the first beehive was set up in 1930, near London Bridge, and in 1960 next to Waterloo station. It is said that London honey from these apiaries reaches the royal table every day and it even met with a favourable opinion of the Queen. The president of the London Beekeepers Association (Walerowicz 2020) has had custody of these apiaries since 2009.

It is estimated that there are over 5,000 hives in London and at the peak of the summer season there are 250 million bees in the city, which means 30 times more than people (Falencka-Jablonska 2018).

In Berlin, there are over 15,000 hives cared for by 750 beekeepers. 150 tons of honey is harvested there annually. Those interested can find on beekeepers' website detailed

information on the principles of running a city apiary and tips on how to organize joint "beekeeping" with neighbours. There are also indications of what species of honey-giving plants are worth planting in order to create a canteen with a rich menu for bees (Lorenz and Stark 2015; Schuetze and Karasz 2019).

In 2010, the first hives were set up on the roof of the Penthouse, one of New York's most expensive hotels, at the initiative of the culinary director. Honey from this apiary has an excellent reputation for its exceptional flavour, greatly appreciated by the hotel's guests (Day 2018).

In Tokyo, bees have their hives in the most exclusive district of Ginza and enjoy the benefits of the surroundings of the nearby Imperial Palace and Hamarikyu Gardens. The honey they produce is labelled according to the source of the nectar i.e.: chestnut, orange, clover, mint. Each package of honey bears the date it was collected (harvested). The restoration of bee colonies in this metropolis is of exceptional importance, as thanks to them the cherry trees have begun to bear fruit again. This, in turn, has restored the richness of insects and birds in the disrupted system of the urban biocenosis. There are plans to set up 20 more beehive farms near the Tokyo Station in the future (Yoneda 2009).

Conclusion

Global data on insects indicate that 2.5% of the biomass of these organisms is depleted each year. The rate of their extinction is eight times faster than that of vertebrates, and this data refers even to protected areas. The role of pollinating insects, including bees, in nature and in human lives is enormous, therefore it seems well worthwhile to popularize ways of creating conditions that would reduce the threat of their extinction.

One way to counteract the depletion of bee population is by systematically increasing the number of apiaries in the urban landscape, thus providing them as well as other pollinators with a friendly space where diverse vegetation constitutes a rich source of nectar, pollen, and honeydew. In the cities, they are not exposed to chemical pesticides, and under the guidance of expert caretakers, are less exposed to frequent and massive diseases. Urban beekeeping and its promotion has therefore a positive effect on increasing the honeybee population.

It should be noted that some scientists criticize the practice of favouring the honeybee in city apiaries indicating that the increased presence of these insects may pose a threat to native species of wild bees. However, by drawing on the knowledge of beekeeping experts, it is possible to minimize these dangers and keep all pollinators in balance.

In Poland, the "Społeczny Monitoring Pszczół" (Social Monitoring of Bees) project aimed at studying the state of the bee population, is being implemented as part of civic education. Anyone can join the researchers and support their work just by taking a photo of a bee spotted, be it, during a walk or while working in the garden. The information on the time and place of observation should then be noted down and submitted to the website: www.monitoringpszczol.pl. It is important to remember that bees warn us about the changes taking place. By helping the bees, we help the environment and ourselves.

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