Fundamentals of Forest Beekeeping with Elements of Forest Apiculture

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Introduction

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To learn forest beekeeping or apiculture from literature is an impossible endeavour. You need practical preparation and specific skills to do so. We have to be honest with ourselves and accept it. So, why this book? A valid and simple question, but the answer is anything but simple and short.

I have been involved in creating the conditions for the development of forest beekeeping and apiculture for over a dozen years. Practically every day has brought and continues to bring new experiences and news. It is a never-ending story of new discoveries, surprises and occasional failures. The most important conclusion of the experience so far has been: constantly finding new publications on forest beekeeping, observing and analysing the activities undertaken, drawing conclusions, cooperating with forest beekeepers and apiarists. And, most importantly, this cooperation cannot be replaced by literature or videos from the internet (oh, the information havoc!). The main message of the actions taken must always be the welfare of the bee colonies, taking care of their health and ensuring their living conditions, mainly their food intake.

I would divide the forest beekeepers I have met and had the opportunity to work with into: professionals, enthusiasts and the so-called rest. For obvious reasons, I will discuss the first two groups.

Professionals are mainly people involved in forest beekeeping professionally in the strict sense of the word. They have been forest beekeepers for several generations, using tools handed down to them by their fathers, grandfathers and great-grandfathers. Even mor so, they even look after beekeeping trees with beehives that were scooped out over a hundred years ago. I have personally seen a beekeeping pine with a beehive uninterruptedly active for over 130 years. Such forest beekeepers are the staff of the Shulgan Tash Nature Reserve in the Republic of Bashkiria and a group of Bashkirian people involved in forest beekeeping and agriculture. Their practical knowledge is

invaluable. Often when asked why they do certain activities this way and not another, I heard the answer that this is how their fathers and grandfathers did it and they did not pry and did not know why. As an example, I can mention the slight tilting of the *zatwór*[1] after the spring inspection. After discussion we came to the conclusion that in their summer weather conditions this allows for better ventilation of the tree beehives. This is the kind of knowledge that you will not find in any textbook. However, we need to take into account specific local conditions and consider what can be used in our specific circumstances.

Enthusiasts are people fascinated by the forest beekeeping tradition. Among them, forest beekeepers who are interested in the welfare of the bee colonies that populate their tree and log beehives are a large and growing group. This is what I see as the future of forest beekeeping, a combination of tradition and current practice, caring for bee colonies not only by looking after them but also by improving existing conditions and creating new ones in the forest.

Forest beekeeping cannot be developed and maintained without the cooperation of apiarists. As long as apiarists are not forest beekeepers, and forest beekeepers are not apiarists, despite the best intentions and labour, we will continue to fail at the expense of bee colonies. The practical knowledge of apiarists is irreplaceable and not obtainable only from textbooks. I dare say that without the apiarian practice gathered alongside an experienced apiarist, the modern forest beekeeper may make mistakes resulting in the death of bees or the unnecessary weakening of bees.

I was tempted to make it a point to compile my experiences, observations, forest beekeeping activities to date and in forest ecosystems, and present them to potential forest beekeepers and forest beekeeping enthusiasts.

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[1] See the Forest Beekeeping Glossary at the end of this publication for definitions of the idiosyncratic Polish forest beekeeping terms provided in *italics* throughout the entire text. The terms have been retained with the Polish diacritical characters to enable the reader to further search and familiarize themselves with this specific Polish terminology.

Forest beekeeping from a few centuries ago was geared towards harvesting honey and wax. Over time, more and more attention began to be paid to bee husbandry, resulting in bees being taken out of the forest and into the vicinity of rural farms. The decline in the economic importance of bee products, changes in forest ownership and historical events led to the disappearance of forest beekeeping in Poland.

Forest beekeeping has been growing in popularity for several years. The return of the idea of recreating the traditions associated with tree and log beekeeping has several origins, but at present we can say that all forest bee-keeping activities are focused mainly on making new tree and log beehives. However, modern forest beekeeping requires actions related to the improvement of bee habitat and the conservation of native bee breeds with characteristics that allow them to live in forest ecosystems. Without these measures, we lose the main objective of modern forest beekeeping, which is to combine centuries-old traditions with the rescue of native bee breeds.

In addition to a brief historical outline of forest beekeeping, the publication presents experiences to date with the scooping out of tree and log beehives. It addresses issues related to the care of bee colonies in the forest. It describes the measures already taken and currently being taken by the State Forests to improve the existing conditions for bees in the forests. It concludes with a short beekeeping glossary and a list of literature related to forest beekeeping.

One of the pioneers of forest beekeeping in Poland, who spent many years in Russia as a deportee, Mikołaj Witwicki, wrote in 1835:

"The bee is naturally appointed to live in the forest."

The quoted sentence, interestingly enough, is posted on one of the objects of the forest bee path in the Shulgan Tash biosphere reserve.

Let us take the above quote as a great commitment to restore bees to forests and forests to bees.

Historical background of forest beekeeping

2

It is estimated that the first floral ground plants appeared around 110 million years ago. Since flowers developed, pollinators must also have appeared at that time. The oldest bee specimen was found in what is now Burma. The age of a bee immersed in amber was determined to be 100 million years. We can say that bees are contemporaries of the dinosaurs and that they survived their extinction (approximately 65 million years ago). The period of the appearance of homo sapiens in Europe is defined as between 100,000 and 40,000 years ago. Certainly, honey has always been a very valuable and sought-after food. The oldest discovered cave paintings depicting honey gatherers date to a period of fifteen thousand years BC. A painting from this period discovered in the Arana cave in Spain depicts a man hanging on a rope, taking honey in combs from bees living in crevices and rock overhangs.

If you want to know the history of forest beekeeping, you have to go back to the time when humans were gatherers, that is several thousand years ago. Initially, human tribes moved freely across the whole of European territory, making free use of the gifts of nature, which included honey. They penetrated the territory and took honeycombs without caring whether the bees survived or not. During the settlement period, there was an increasing focus on exploiting the land adjacent to the settlements or conducting barter trade. The keeping of bees in clay pots was confirmed in ancient Egypt, Greece and Rome. In the early Middle Ages, bees were kept in so-called baskets (woven straw baskets) in western Europe. In the rest of Europe, forest beekeeping was emerging at this time. In contrast to the previously mentioned methods of harvesting honey, attention began to be paid to the survival of the bee colonies and ensuring that tree beehives were used for a few to several dozen decades. The oldest log beehives have been found between the Elbe and the Oder rivers, and

are dated to between 100 and 200 AD. The oldest log hive in Poland, which was found in the Oder River, dates to the tenth century. The first legal regulations on forest beekeeping in Poland, including unwritten forest beekeeping rights, were included in the Wiślicki Statute of 1347 by King Casimir III the Great. The forest bee-keeping laws evolved depending on forest land ownership and historical events. Local forest bee-keeping legislation resulted from specific social, local and natural conditions. Forest beekeepers associated themselves and formed guilds. Each guild elected an elder forest beekeeper whose duties included keeping record of newly scooped out tree beehives, making sure that they were properly marked and that tribute was paid to the forest owner on time and in the correct amount. A forest beekeeping judge was also elected from among forest beekeepers, who selected the jury and the scribe. Two main courts were held during the year. One after Saint Adalbert (April 23rd) and the other after the feast of Our Lady of Sowing (September 8th). The forest beekeeping guild had a priest in their parish – the promoter of the forest beekeeping guild, who held a special service on the day of Saint Bartholomew the patron saint of forest beekeepers (August 24th).

The year 1888 can be considered the symbolic date of the disappearance of forest beekeeping in Poland, when Tsar Alexander III banned forest beekeeping in the Białowieża Forest **(photo No. 1)**.

Additional historical information on forest beekeeping can be found in the publications listed in the literature list.

The most recent forest beekeeping events known to me were as described below.

My first encounter with forest beekeeping was in the Knyszyńska Forest District. The forest district inspector at the time, Mr Edward Komenda, to whom I was deputy, initiated the establishment of three tree beehives and an educational exhibition in Krzemianka Forest administration region, located next to a three-thousand-year-old flint mine, as early as 1996. My next encounter with forest beekeeping

Photo No. 1
A forest beekeeper from the Białowieża Forest climbing an oak tree with the help of a *leziwo*.
Author: J. Karpiński

was in the Biebrzański National Park. On the initiative of Mr Hartmund Jungius and Mr Przemek Nawrocki from the WWF and the Park management, the first visit of a Russian delegation from Bashkiria took place in October 2003. The result of this visit was the establishment of cooperation with the director of the Shulgan Tash Reserve, Mr Mikhail Kosariev, and the exchange of delegations from Poland and Russia. It should be clearly emphasised here that the Polish visitors took advantage of the experience of the Bashkirian forest beekeepers, who had been continuing the forest beekeeping tradition uninterruptedly for centuries. At that time, it was not possible to acquire practical knowledge from anyone in Poland. All we had was written material, engravings and photographs, but there was no forest beekeeper to show us how to use the tools and how to look after the bees in the tree beehives. Initially, I and my colleagues were accused of taking over traditions from Bashkiria. As time passed, it was accepted that we were

Photo No. 2
Learning how to use the *cieślica*. The beekeeper standing on the left, holding a *piesznia*.
Author: A. Sieńko

Photo No. 3
The first inhabited tree beehive in the Biebrzański National Park in June 2006.
Author: A. Sieńko

using practical knowledge and centuries of experience **(photo No. 2)**. The visits of the delegation from remote Bashkiria were highly publicised in the media, which contributed significantly to the promotion of forest beekeeping and the desire to return to the traditions of Polish

Photo No. 4
The first in centuries new tree beehive in the Augustowska Forest – 11th April 2013, Augustów Forest District, Czarny Bród Forestry Office. In the photo standing from left: rev. Wojciech Kalinowski – the Chaplain of Foresters, Asylguzhin Ramazan – a forest beekeeper, Mikhail Kosariev – Director of Shulgan Tash Nature Reserve, Tatiana Baranowska – employee of the Shulgan Tash Nature Reserve, Tadeusz Wasilewski – District Forester of Augustów Forest District, Adam Sieńko – Deputy District Forester, beekeepers – Ryskulov Insur and Isianguzhin Syntimer, Adam Korzeniecki – Forester of Czarny Bród Forestry Office.
Author: R. Rogozinski

forest beekeeping. The first modern tree beehive was scooped out in April 2006 in the Biebrzański National Park. In June 2006, bees naturally colonised the tree beehive and lived there for several years **(photo No. 3)**. Further tree and log beehives were established in the Wigry National Park. In 2007, forest beekeepers from Bashkiria reached the Spal Forests. Between 2014 and 2016, in the four forest districts

of the Regional Directorate of State Forests in Białystok: Augustów, Browsk, Maskulińskie and Supraśl, a project financed from the Norwegian Funds entitled: "Traditional Forest Beekeeping to Save Wild Bees in Forests" was implemented. Partners in the project included the Beekeeping Department of the Warsaw University of Life Sciences and the Faculty of Law at the University of Białystok. On the basis of an agreement signed by the Director of the Regional Directorate of State Forests in Białystok, Mr Ryszard Ziemblicki, and Mr Mikhail Kosariev, Director of the Shulgan Tash Reserve, forest beekeepers from Bashkiria also participated in the project. One of the results was the scooping out of dozens of log and tree beehives (of which twenty-two in the Augustów Forest District) **(photo No. 4)**. They continue to be cared for by forest beekeepers. Several non-governmental organisations dealing with forest beekeeping were also established during this period, focusing on the restoration of traditional methods of scooping out of beehives and beekeeping tree climbing and the popularisation of forest beekeeping.

The Intergovernmental Committee on Intangible Cultural Heritage, at its meeting held on 14-19 December 2020, decided on a new entry under the UNESCO Convention on the Representative List of Intangible Cultural Heritage of Humanity of "Forest Beekeeping Culture" as a joint entry by Poland and Belarus.

In 2021, a new funding agreement was signed for a project entitled "The Augustowska Forest as an Opportunity to Save the Last Refuge of the Native Augustowska Bee. Forests to Bees, Bees to Forests." The Augustów, Głęboki Bród, Płaska, Szczebra and Pomorze forest districts participate in the project. Partners of the project are: District Beekeepers' Association in Augustów, the Shulgan Tash Reserve from Bashkiria (Russia) and Grodno Leschoz (Belarus). The participation of the latter two partners was revised by the outbreak of war in Ukraine. At the time of writing, fighting is ongoing and cooperation has been suspended. The Forestry Commission has made efforts and found new partners. Partnership agreements have been signed with the Hutsul National Nature Park from Ukraine and the Aukhtok National Park from Lithuania. The project is being implemented in the five forest districts of the Augustowska Forest: Augustów, Głęboki Bród,

Płaska, Pomorze and Szczebra (total area of 93,288 hectares). The project relates to the project "Traditional Forest Beekeeping to Save Wild Bees in Forests" implemented in 2014-2016.

The result of the project will be the reintroduction of the native Augustowska bee breed and many other pollinator species to forest ecosystems, which will significantly increase biodiversity. Improving the condition of the forest and saving the genetic purity of the Augustowska bee will reduce the influx of alien bee breeds. The project will also enable the development and implementation of forest management plans that take into account the role of pollinators. The resulting floral meadows and orchard-refuges will reduce the monolithic nature of forest ecosystems and improve landscape values. Small ponds will improve water retention in the forest. The results of scientific research clearly indicate an increase in the number of bat, bird, amphibian and insect species after similar tasks in previously implemented projects.

All information about the presented project and the project carried out previously can be found on the website:

www.tradycyjne-bartnictwo.pl

The year 2023 is the symbolic 135th anniversary of the ban on forest beekeeping in the Białowieża Forest. Can we say that forest beekeeping is returning to the primeval forests of Poland through the Augustowska Primeval Forest, thanks to foresters?

The Forest Act issued by Sigismund Augustus in 1568 contains, among other things, such a provision:

(....) połaźniki (forest beekeepers' superiors) are to diligently endeavour to contribute to the beekeeping tree every year and to settle it with bees, (...)

The Royal Augustowska Primeval Forest challenges us today to ensure that the provision of the law of 455 years ago remains relevant and obliges not only foresters to forest beekeeping activities for the benefit of forests and the public.

Choosing a beekeeping tree 3

The most commonly selected tree for scooping out a beehive is the Scots Pine (Pinus silvestris) **(photo No. 5)**. This is due to the tree's ability to achieve the right thickness parameters and the ability to scoop out beehive at the right height. Pine wood is also relatively

Photo No. 5
A perfect beekeeping pine, the so called Augustowska pine.
Author: J. Jadeszko

soft and does not require as much effort as when working in e.g. oak wood. The data in the available literature on the tree species selected for the beehives mention pine, oak, linden and aspen. The latter two tree species are found in the situation of already inhabited natural hollows, which, with little modification, allowed for the existence of bees. However, the lifespan of such tree hives was short and lasted for several seasons due to the breaking of the trees at the site of the hollow. Tree beehives scooped out in pine trees were in use even for several decades. In the literature, attention is often drawn to the selection of trees with the presence of rotten wood because of its ease of selection and the possibility of obtaining the appropriate size of the scoop-out without much effort. Attention is drawn to the presence of 'white' (hard) rot, which is acceptable, as opposed to 'black' (soft) rot, which eliminates a tree from being suitable for scooping out a hive. An important consideration here is the high moisture content of soft black rot, which is not accepted by swarms that could potentially colonise the tree beehive.

When singling out a tree, the question of the environment in which the tree grows and the parameters as well as characteristics of the particular tree are important.

When planning the location of a tree beehive, it is important to carefully survey the immediate surroundings of the tree and the area at least a few hundred metres away. The surroundings of the beekeeping tree must ensure that it can be harvested throughout the growing season. The beekeeping tree should not be shaded by undergrowth or battered by its branches. Ideally, there should be a mosaic of forest habitats around the selected tree. Locating a tree-beehive in a large complex, such as a fresh forest, will not ensure that the bees can harvest and gather supplies to overwinter their colonies. The location of a beekeeping tree in a dense, large deciduous complex also does not guarantee success, as after a short spring period there is only the possibility of harvesting honeydew, which is not a reliable benefit and occurs under certain weather conditions. In the vicinity of tree beehives there should be open areas e.g.: mid-forest meadows, new felling sites, wide division strips, hunting plots, orchards. The length of the effective flight of the

bees should absolutely be taken into account before designating a beekeeping tree. An important location requirement is a water source with care taken to ensure that it is not too large a body of water, which may be a barrier to optimal bee flight. It is advisable to consult the Forest Management Plan in terms of planned felling to avoid situations where the possibility of survival of a tree hive is only to leave it in an ecological clump, which is not always possible. An important element to consider when choosing a location for tree beehives is the presence of traffic routes. These can affect bee mortality in collisions with vehicles. Choosing locations near hiking trails is not advisable. This poses a risk of being stung, which in the absence of immunity can lead to the need for medical assistance. This is hindered due to the distance and can cause unnecessary conflicts.

A separate issue is the number of tree beehives in a given forest area. Analysis of data from the literature, supported by information on changes in forest ecosystems, indicate that there should be at least 70-75 hectares of forest per tree beehive, depending on the diversity of habitats, giving a circular area of about a 500-metre radius. A greater number of tree hives may lead to bee overcrowding of the forest environment and unnecessary competition between swarms. We also need to take into account the presence of apiaries both stationary in the forest environment and apiaries that periodically appear in the forest as part of making the forest available to beekeepers. An important and still unexplored aspect worth mentioning here is the potential competition between honey bees and other pollinator groups. Approximately 470 of the family Apidae species have been confirmed in Poland. The developmental biology of individual species is not fully understood. Forage plants are largely common to all of the family Apidae. There are species of the family Apidae with a long list of forage species like the honeybee. However, there are species associated with single plant species or a narrow group of them. Often, the built of insects and flowers is such that only individuals belonging to a particular insect species or family can pollinate them. If there are many bee colonies in an area, this may result in the lack of use of a particular plant species and the disappearance of the bee species associated with it. Therefore,

further honeybee colonies should be introduced carefully so as not to disturb the biological balance. At the same time, however, it is important to take into account the fact that the number of log and tree beehives not translate into their full colonisation.

When choosing a tree, we can be guided by the information contained in the publication of the Forestry Research Institute, *Rozprawy i Sprawozdania Seria*[1] *A* No. 49 published in Kraków in 1948 entitled: "Ślady dawnego bartnictwa puszczańskiego na terenie Białowieskiego Parku Narodowego"[2] by Jan Jerzy Karpiński. It documents the condition of the beekeeping trees made in the time defined by the professor as the years 1860 - 1888. The knowledge contained in the study is based on material traces and accounts of the last forest beekeepers or their descendants in the Białowieża Forest. In addition to a detailed description of basic forest beekeeping activities and equipment, professor J. J. Karpiński made an inventory of beekeeping trees. The detailed description of the beekeeping trees allows us to determine the basic parameters of the tree beehives and the criteria for selecting trees for scooping out. It should be noted that the area of the Park at the time of the inventory of the beehives was about 5,000 hectares, which gives about 70 hectares of forest per one described tree beehive.

The parameters that were analysed were:

1. Tree species
2. The height at which the beehives were scooped out
3. The breast height of beekeeping trees
4. Location of the tree beekeeping hole
5. Additional tree beehive entrance
6. Leaning of the beekeeping tree

Re. 1

Of the 68 described bee-keeping trees, 62 are pine, 4 oak and 2 trees are linden. It should be noted that in linden trees beehives had not been scooped out, but the already inhabited trees were

[1] Which roughly translates into *treaties and reports* [translator's footnote]

[2] Which roughly translates into *traces of former forest beekeeping in the Białowieża National Park area* [translator's footnote]

used with clear signs of rot. Also significant is the fact of the short longevity and in consequence low durability of beehives in linden trees. The predominance of pine as a beekeeping tree is due to the less labour-intensive nature scooping out due to the low hardness of the wood and the use of pines with rotten wood (hard rot rather than soft rot) at the site of scooping out of beehives.

Tree species	Pine	Oak	Linden	Total
Quantity (pcs.)	62	4	2	68
%	91	6	3	100

Re. 2

Tree beehives were scooped out at the height between 4 and 11 metres. More than a third of the tree beehives (34 %) were located at the height of 7 metres. A total of 75% of the tree beehives were scooped out at heights of between 6 and 8 metres. Less than 10% were scooped out below this range, and above 8 metres less than 20% of the beehives were scooped out. It follows that the optimum height for scooping out beehives in trees is around 7 metres. However, the surroundings of the tree must always be taken into account, particularly the presence of open areas. The location at the time was also due to the presence of bears and an attempt to limit the damage to the tree beehives caused by them.

Height of tree beehive (m)	Quantity (pcs.)	%
4	1	2
5	3	5
6	12	20
7	21	34
8	13	21
9	9	15
10	1	2
11	1	2
Total	61	100

Re. 3

The breast height (diameter of the tree at 1.3 metre from the ground surface) of the beekeeping trees ranged from 65 cm to above 120 cm. 71% of the beekeeping trees had the breast height between 81 and 100 cm (37% in the range of 81-90 cm and 34% in the range of 91-100 cm). 15% of the trees had the breast height between 71 and 80 cm.

Breast-height (cm)	Number of trees (pcs.)	%
65 – 70	4	6
71 – 80	9	15
81 – 90	23	37
91 – 100	21	34
101 – 110	1	2
111 - 120	2	3
Pow. 120	2	3
Razem	62	100

Re. 4

An analysis of the position of the tree beehive hole in relation to the directions of the world showed that 75.4 % of the trees had an opening facing: east (21.5%), south-east (38.5%) or south (15.4%). Other directions of the tree beehive hole were incidental.

Directionsof the world	Quantity	%
N	1	1,5
NE	9	13,8
E	14	21,5
ES	25	38,5
S	10	15,4
SW	2	3,1
W	1	1,5
WN	3	4,6
Total	67	100

Re. 5

In general, beehive entrance and exit openings were made in the *płaszka* (*zatwór)*. In the case of 30 of the 61 described tree beehives, the absence of additional openings was observed. In 31 beekeeping trees, additional entry holes were drilled, located on the left side of the *zatwór*: in the upper part (77.4%), in the middle (12.9%) and in the bottom part (9.7%).

The most interesting information is the absence of a wedge-shaped *oczkas*, which was utilised in tree beehives in Lithuania and Belarus, and for centuries to this day in Bashkiria.

Re. 6

For the scooping out of the beehives, mainly leaning trees were selected, which accounted for 55 (83 %) of the 66 described. Only 11 trees (17%) were upright trees. The beehives were scooped out on the leaning side of the tree. The choice of leaning trees protected the beehives from rainwater run-off and made it easier to climb the tree and care for the beehives.

Summary:

1. The main tree species chosen for scooping out beehives is Scots pine.
2. The optimum height at which the beehives were scooped out was about 7 metres.
3. Beehives were mainly scooped out in trees with the breast height between 81 and 100 cm.
4. The optimum position of the beehive hole is in the south-easterly direction.
5. Entry holes were drilled in the *płaszka* (*zatwór)*. If additional entry holes were drilled, they were drilled on the left side of the beehive hole in the upper part of the beehive.
6. Mainly leaning trees were chosen for beekeeping, which prevented the entry hole from collecting water, and made it easier to climb the tree and care for the beehive.

In none of the described beehives was the so called *oczkas* found, which is quite surprising. The descriptions and engravings known

to date, as well as existing accounts from Belarus, Lithuania and Bashkiria, include the *oczkas* as an entrance hole. Making the *oczkas* and the beehive entry hole – the *oko* – is difficult and requires a lot of work. Frequent excessive resin excretion of the surroundings of the beehive hole limits the colonisation of the beehive. Setting the wedge in the beehive *oko* is cumbersome and requires adjustments due to shrinkage and warping of the wood. Making entry holes in the *zatwór* is more advisable.

The presented analysis of the parameters of tree beehives in the Białowieża Forest unambiguously defines the principles of tree selection. It is worth emphasising that the data relate to the existing tree beehives of the time, which were scooped out by Polish forest beekeepers. They drew on the experience of their fathers and grandfathers, used inherited beekeeping tools and, most importantly, made their choice of beekeeping trees on the basis of centuries of experience, tradition and practical knowledge. I consider any deviation or experimentation to be unjustified and detrimental to our national tradition and culture.

Scooping out of a tree beehive and of a log beehive

4

The technique and method of scooping out of a tree and of a log beehive is no different apart from the fact that the log is scooped out on the ground. When starting to scoop out a beehive it is important to consider the location of the target *oczkas* (if you plan to make one). Consideration should be given to the location in relation to the directions of the world, as discussed earlier when choosing a tree. When scooping out a log, it is important that the log hangs in the direction the it was facing in the tree it was cut from. In short, "not upside down".

I firmly believe that the dimensions of tree and log beehives that we can find in the literature and taken from tree or log beehives made in the past, need not and should not be modified. The centuries-old practice of previous generations of forest beekeepers has sufficiently verified the effectiveness of their solutions. Tradition stems from good practices that ensure the best possible living conditions for bee colonies. We must remember that, unlike in a beehive, in a tree or log beehive it is not possible to narrow or enlarge the living space of a bee colony by changing the location and number of frames, which is possible and used in a beehive.

All available woodworking tools, both manual and mechanical, can be used for scooping out a tree or log beehive. For a long time, the toolkit consisted of four parts **(photo No. 6)**:

a) an axe (*barta, serka*)
b) an instrument for scooping holes *(piesznia, pieśnia*)
c) adze *(cieślica)*
d) a tool for smoothening the internal walls of a tree or log beehive *(skobliczka)*

Photo No. 6.
A set of traditional forest beekeeping tools. From left: *piesznia*, *cieślica*, *serka* axe, *skobliczka*.
Author: A. Sieńko

Re. a

An axe used for scooping out should have parameters suited to the scooper, such as: weight, length of handle, quality of steel, shape of the cutting part. It is important that it is not too heavy and that the cutting part is not too wide. The length of the handle should allow the axe to be easily handled inside the beehive. It is important to choose, by trial and error, an axe that feels comfortable in the hand. The axe should be selected so that it is easy to work, does not require too much force to cut wood and does not become blunt quickly.

Re. b

A *piesznia* is, in simplest terms, a chisel set on a long handle. The tool can be compared to an ancient javelin. The oak, acacia or ash handle should be able to be grasped by hand in such a way that it

can strike the wood vigorously and forcefully. The chisel should be made of high-quality steel and have an end with a cutting angle that will prevent excessive penetration into the wood, while still causing pieces of wood to chip away freely. An experienced blacksmith will use three qualities of steel to properly make the chisel, as different types of forces will act on the different parts of the chisel.

Re. c

A *cieślica* is a tool for hollowing out a tree or log beehive chamber and smoothing its walls. The *cieślica* combines the characteristics of an axe and a *piesznia*, but it is smaller and the cutting part is positioned perpendicular to the handle, known as helve. It makes it possible to cut and split wood at the same time. The spoon shaped of the metal part makes it easier to scoop out the wood in such a way that narrow and short pieces of wood can be split off and the walls of the tree or log beehive chamber can be obtained as relatively smooth.

Re. d

A *skobliczka* is used for the final work of smoothing the walls of a tree or log beehive chamber. A sharp metal tape bent in the shape of a bow similar to a circle is set on a short handle. The end of the tape must be very sharp and at such a cutting angle that thin layers of wood can be cut. The inclination between the seating of the cutting part and the handle should be close to 130 degrees to prevent chafing of the hand during scooping out.

The first step in scooping out is to determine the outer contour of *dzienia* (a scooped-out part of a tree or log beehive), the so-called *dłużnia* (a shutter, a small plank of wood used for plugging a beehive entrance). The width of the *dłużnia* should be 10 - 12 centimetres and the length 100 - 120 centimetres **(photo No. 7)**. I suggest to start with a width of up to 10 centimetres, so that when you have finished scooping out, you can still improve the edges of *dłużnia*, which may increase its width and make it necessary to use a wider *zatwór* (a shutter, a small plank of wood used for plugging a beehive entrance). Once the *dłużnia* has been marked out, the wood

Photo No. 7
Practical way of marking out the outline of a *dzienia-dłużnia* on a beekeeping log.
Author: J. Jadeszko

Photo No. 8
Making dagger incisions with a chainsaw in order to facilitate splitting the wood with a *piesznia* and *cieślica*.
Author: J. Jadeszko

Photo No. 9
Working with a *piesznia*. Visible dagger cuts made with a chainsaw.
Author: A. Sieńko

is gradually removed with the use of a *piesznia* so that the final internal dimensions of the *dzienia* are 30 to 40 cm deep and 25 to 35 cm wide. The cross-section of *dzienia* should be similar to the shape of a teardrop. It is important that the volume of the *dzienia* is large enough to accommodate the correct number of honeycombs and to allow the bee colony to form a cluster and survive the winter. If the *dzienia* is made too small, it will not allow the correct size of cluster to form for the wintertime and will lead to the death of the hive through hypothermia. On the other hand, a *dzienia* that is too large can result in a significant energy expenditure for the bees to maintain the right temperature and humidity inside, which can result in a weakened colony, susceptibility to diseases and even death of the swarm.

At the beginning of the work, a few dagger cuts can be made with a chainsaw, which will make it much easier to scoop out pieces of wood **(photo No. 8)**. Then, using the *piesznia* **(photo No. 9)** and the *skobliczka* **(photo No. 10)**, cut the wood so as to obtain the desired shape of the *dzienia*. It is important to ensure that the underside of the *dzienia* (or *pięta, pupa)* is slightly inclined towards the outside. This is to make it easier to sweep up the droppings and other impurities from the tree or log beehive, and at the same time to allow for the insertion of food containers (in case feeding is needed in spring or late summer). The top of the *dłużnia* (or *głowa*) is to face upwards towards the rear called *plecy*. Once you have the right shape and size of the *dzienia*, start smoothing out the walls with the *cieśliczka* **(photo No. 11)**. The smoother the walls, the easier it will be to keep the tree beehive tidy. Smooth walls will significantly reduce the possibility of spiders and other organisms that can negatively affect the development and health of the bee colony. It should be remembered that it is common practice among forest beekeepers to rub the walls with herbaceous plants growing near the beehive. This is to eliminate human odours, but in my opinion the main reason is to eliminate the mini resin and tannin leaks excreted when the wood cells are cut. Another element of the tree and log beehive is the *zatwór*. It is a rectangular piece of wood whose outer dimensions are to correspond to those of the *dłużnia*. Its cross-section is similar in

Photo No. 10.
Working with a *cieślica*. Visible traces of incisions made with a chainsaw after removing a large part of the wood with a *piesznia*.
Author: A. Sieńko

Photo No. 11.
Working with a *skobliczka*. Next to the kneeling forest beekeeper, from the left are: a *cieślica*, a *piesznia*, the second *cieślica*, a *serka* and a chainsaw. Behind the log lies a prepared *zatwór*.
Author: A. Sieńko

shape to a trapezoid, with the base of the trapezoid being equal to the outer part of the *dzienia*, and the upper wall corresponds to the inner width of the *dłużnia*. A one-piece *zatwór* can be used, but a two-piece *zatwór* is better and more practical. It can be divided into two equal parts, but practice shows that it is best when the upper part of the divided *zatwór* is two-thirds of its length **(photo No. 12)**. On the side edges of the *zatwór* we make incisions to allow the bees to enter. Observations indicate that it is best to make them in the upper part on the left side (for right-handed forest beekeepers). We can prepare a number of incisions and the bees will choose their own entry and exit points, and will seal the others. The depth and width of the incisions is to ensure a free exit for the bees, and to prevent hornets from entering the beehive. Incisions in the lower

Photo No. 12

A divided *zatwór* in a tree beehive. The lower part of the *zatwór* placed in the middle because the tree beehive is still aired, eventually it will be placed before the bees swarming period. Next to the *dłużnia* you can see *chamls* and hooks used for hanging tools and heat-insulating tree hives. On the right, you can see an *oczkas* placed in the *oko*.

Author: A. Sieńko

Photo No. 13
A view of debarked surrounding of an *oko* with an *oczkas* and the wood cleaned of resin. Visible heat-insulation made of lime twigs.
Author: A. Sieńko

Photo No. 14
Snozas, *ploskas* fixed crosswise inside a tree hive.
Author: A. Sieńko

part of the *zatwór* have been found in old tree beehives. In my opinion, these were intended as a ventilation method. In the case of the *oczkas*, no incisions are made, and the division of the *zatwór* should be made at its level. This makes it easier to carry out inspections and, most importantly, does not damage the honeycombs when opening the beehive. Parts of *zatwór* can be fitted with hooks to hang them during work on the hive. A bent nail of suitable thickness and length can serve this purpose. The aforementioned *oczkas* is a wooden wedge of sufficient length to reach the back wall of the hive when inserted into the so-called *oko*. It must be long enough to allow adjustment of the width of the entry slot for the bees. The *oko* measuring approximately 5 cm by 5 cm is similar in shape to a square. The *oczkas* then takes the shape of a rectangle approximately 4 by 5 cm in cross-section in the outer part, which will provide an entrance gap of approximately 5 millimetres. When scooping out a tree beehive and making an *oczkas*, it is important to complete the work on the outlet in such a way that there is no resin leakage **(see photo No. 12 and 13)**. Observations clearly indicate that when resin spills occur, the opening thus prepared is not used by the bees. Leaks can be avoided by debarking the surroundings of the exit and successively cleaning it of resin until the hive is closed. After the *dzienia* has been made, the so called *ploskas*, *snozas* or slats **(photo No. 14)** should be placed crosswise inside it. When we do not have the *oczkas*, we use two or three pairs of such slats, placed evenly inside the *dzienia*. They reach opposite walls, clasping against them and preventing the honeycombs from tearing off. Thin branches that have been suitably trimmed and sharpened can also be used as *ploskas*. When the tree or log beehive has the *oczkas*, two pairs of the *ploskas* below the *oczkas* should be used. Additional elements of the beehive are the hooks and the *śniot* **(see photo No. 12 and 14)**. The hooks, made of hardwood (e.g. oak, juniper, viburnum), are sharpened pegs hammered in next to the *dłużnia*. A few pegs, usually six, three on each side, are used when fascining (heat-insulating) the tree beehives. The remaining pegs (hooks) are hammered in at a certain distance from the *dłużnia* so that we can hang *śniot*, *zatwór* and beekeeper's tools on them. If we decide that we want to

Photo No. 15
Pieces of honey combs attached to a *głowa* of the tree hive to attract the swarm and inhabit the hive.
Author: A. Sieńko

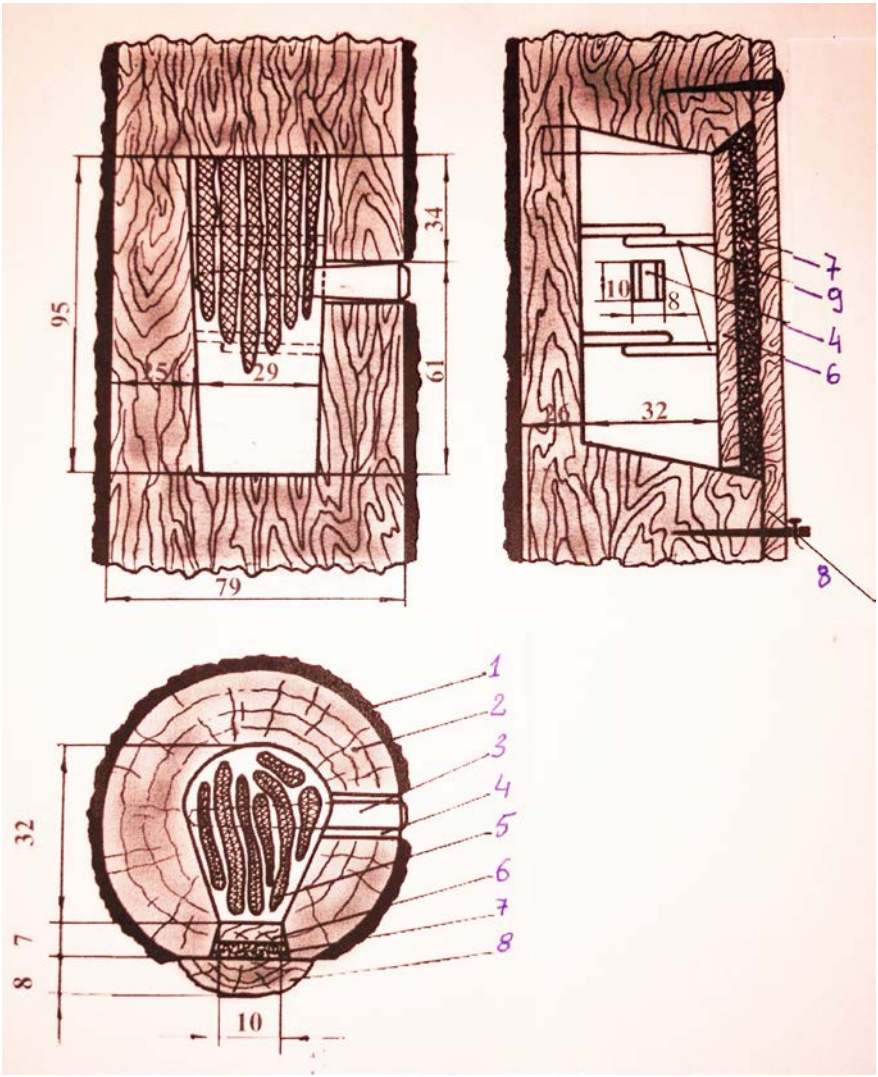

Photo No. 16

A schematic of a tree beehive, its components and approximate dimensions.

1. Bark
2. Wood of a beekeeping tree
3. *Oczkas*
4. *Oko*
5. Honey combs
6. *Zatwór*
7. Heat-insulation
8. *Śniot*
9. *Snozas*

Author: A. Sieńko, M. Kosariev

Photo No. 17
A forest beekeeping mark - *ciosno, klejmo*
Author: A. Sieńko

make the hive more secure, we need to make the *śniot*. It is a piece of wood which, when hung over the *dłużnia*, will cover the *dłużnia* with what is known as an overlap and completely cover the *zatwór*. It can be assumed that its dimensions are about 10 centimetres larger than the *zatwór* to be covered. The *śniot* was often made from what is known as slab, i.e. the outer part of a log. The thickness of the *śniot* is about 10 to 20 centimetres. We must bear in mind that each external element of a tree beehive, when inspections are carried out, requires it to be suspended or held in hands, so the weight of the individual elements resulting from their size is also important. Suspended *śniot* helps to maintain the right temperature in the *dzienia*, but mainly protects the hive from woodpeckers and martens. Often, bundles of twigs were placed under the *śniot* for the winter period to further insulate the hive **(photo No. 13)**.

Every log and tree beehive, after scooping out, must be opened for a period of several weeks in order to dry out and get rid of moisture **(photo No. 14)**. Closing it prematurely poses a risk of appearance of mould and the smell associated with it, which will effectively deter the bees. Only when we have concluded that the hive is dry, can we place the *snozas* and the *zatwór*. To attract and encourage bees, the walls of the hive are rubbed with herbaceous vegetation from around the beekeeping tree. It is advisable to place in the hive pieces of bee combs attached to the *głowa* of the hive with sharpened sticks **(photo No. 15)**.

A diagram of the hive, its components and approximate dimensions are shown in **photo No. 16.**

According to tradition, each tree or log beehive should be marked with a beekeeping mark attributed to the forest beekeeper who made it. The mark, known in the Polish forest beekeeping language as *ciosno* or *klejmo*, consists of several incisions made with an axe on the trunk of the beekeeping tree **(photo No. 17)**. It was customary for the next generation of a forest beekeeper to add one element to the old mark. A complex forest beekeeping mark meant that the beekeeper continued the traditions of his predecessors. The so-called establishment of a *ciosno* on a beekeeping tree gave the right to use the beehive only to the beekeeper who had placed the *klejmo*. Any infringement of the ownership of the beekeeping tree was and is deeply unethical and contrary to the forest beekeeping tradition.

The honeybee – built and biology

5

The species Apis mellifera L. honeybee belongs to the order Hymenoptera, family Apidae, subfamily Apinae, genus Apis L. In Europe, 8 subspecies and many breeds were identified within this species. In Poland, there are more than 470 species of the bee family. In our forest beekeeping and apiarian activities, we deal with the so-called Central European honey bee, Apis mellifera mellifera L.

The biology of bees is incredibly interesting, full of curiosities and still not fully understood. The exciting world of social life, the roles of the various castes of the bee colony, their interrelationships and the factors determining certain behaviour, present a peculiar world operating alongside us. And we do not yet know and understand everything. Many behaviours, reactions to specific changes in the environment can be models for man as the main inept manager of the natural environment. Practically every now and then, new information is released about the biology and life of the super organism that is the single swarm. A great deal of research is being conducted with a view to increasing honey production and improving the health of bee colonies. Negative changes in the natural environment are not without influence on the life and survival of bees. We know to what extent this is affected by human activity. What we do not know is when and if the induced effects of changes in the natural environment will be able to be overcome by the bees' defence mechanisms. Let us hope that the best possible knowledge of the biology of this insect, which is so important for the natural environment and human life, will contribute to an increasingly intelligent use of nature's gifts and allow us to coexist with bees.

The biology of the bee presented is necessarily very brief. I draw attention to the elements of biology relevant to the topics covered regarding forest beekeeping and apiculture conducted in the

forests. I encourage you to deepen your knowledge of bee biology. Rest assured that it is fascinating knowledge that has not yet been fully discovered. It brings a lot of satisfaction not only from the fact of possessing it, but, most importantly, it allows us to take responsible care of bees.

The honeybee is a social insect. It forms numerous colonies referred to as a super organism. A colony of up to 100,000 individuals consists of three groups called castes: queens, workers and drones. The morphological and functional characteristics are different for each caste group. The length of the bodies is respectively: queen 17-20 mm **(photo No. 18)**, workers 11-13 mm, drones 14-16 mm. Females are characterised by a slender body, with the queen having

Photo No. 18
A queen mother of the Augustowska bee surrounded by workers of another breed. Visible yellow marking of queens in 2022.
Author: A. Sieńko

a distinctly long abdomen. Male drones have a stocky body with large eyes meeting above the appendages and a curled abdomen. The colour of the hair of the individuals varies from greyish yellow through light brownish yellow to brown and even dark verging on black. The colour of the hair rubs off with age. The development period from egg to pupation is: queen 16 days, workers 21 days, male drones 24 days. The lifespan also varies: queen 2 to 5 or even 7 years, worker bees a maximum of 35-50 days (except for overwintering, living up to 5 months), drones 2 to 3 months. The honeybee is a polyphagous bee that collects pollen and nectar from many species of floral seeding plants, but it also collects honeydew. Worker bees make flights during the growing season of the plants between April and September (sometimes as late as October). Queens, as well as drones, make mating flights in June-July. Bee swarming also takes place in June-July. Swarming involves the division of the colony, with one part of the colony being taken by the old queen, also known as the queen mother, and the remaining part starting to care for the new queen. The young queen, after a period of five to 14 days after leaving the queen cell, makes her wedding flights. The queen copulates with several to a dozen drones during the flight. The drones that have taken part in the copulation become paralysed and die. If the lifespan of the drones reaches August, then the worker bees stop feeding them, remove them from the hive leading to their death by starvation. The mother, after the mating flight and returning to the tree hive after a few days (2-3 days after the last flight) starts to lay eggs. This is called brooding. The queen can lay up to two thousand eggs a day. The brooding queen, due to her greatly enlarged abdomen, which contains two ovaries where the eggs are formed and mature, cannot fly. When the eggs are already laid, the worker bees stop feeding the queen with royal jelly and start feeding with honey or pulp, which leads to the cessation of egg-laying and the reduction of the abdomen. Free-living bees build patches of wax on their frames from glands located on the underside of the workers' abdomen. Free-living bees establish combs attached to the walls of natural hollows or tree beehives. The honeycombs are formed by a number of hexagonal-shaped cells opposite each

other. One hundred square centimetres of a comb is made up of about 860 cells for workers on two sides, or 520 cells for drones. The 100 square centimetres of comb can accommodate about 280 bees.

Egg development takes between 72 and 76 hours. After emerging from the egg, the larva is checked practically every minute by the feeders who, when they deem it necessary, feed it with royal jelly. The larva gains weight very quickly. After a period of three days, there is a change of food, which determines the further life and role in the hive of the individual. The drones and worker larvae begin to be fed a pulpy diet consisting of honey, pollen and royal jelly. Future queens, whose larvae are in the so-called queen cells, are fed more royal jelly from the beginning. The period of feeding with royal jelly lasts up to 6 days. The next period of development is when the larva stays and pupates in the sealed cells. The cell in the queen cell with the mother larva is closed up after 4-5 days. The cell with the worker larva is closed up after 5.5 days, and the cell for a drone after 7 days. After closing up, the larva pupates and a pupa is formed from which the adult emerges after pupation. The whole process from the time the larva cocoon spinning to the transition to the pupa state and the conversion of the pupa through the 'liquid' state to the formation of the perfect insect is well-described, but no one has been able to determine how this happens and how new organs and body parts are formed from the state of a shapeless mass. This is one of the many wonders of nature for which there is no explanation. Such a process must be governed by an unearthly law of creation. Each individual, depending on its sex, has its own tasks to perform and fulfil its role in the bee family. It must be stressed again that a single individual honeybee cannot survive and will not lead to the formation and development of a new bee colony. Depending on their age, worker bees perform the following tasks (in brackets is provided the age of the worker): cleaning the comb cells (1-2); feeding the older larvae (3-6); feeding the younger larvae (7-14); collecting nectar and converting it into honey, beating the pollen in the comb cells, sealing the cells with honey (8-14); building the combs (15-18); defending the nest (19-21); collecting reserves (21 and more). Obviously, such a division is a simplified one, and depending on both external and

Photo No. 19
A view of the inside of a beekeeping log populated after bee-swarming period. Combs not yet drawn much, a visible *oczkas*.
Author: A. Sieńko

Photo No. 20
A view of an open beekeeping log at the end of the season. Visible large combs and a colony congregated in the upper part of the *dzienia*.
Author: A. Sieńko

Photo No. 21
A beekeeping log at the Augustowska Forest District Headquarters before the winter season. Honey combs about one metre long. A strong swarm can be seen in the upper and middle part of the *dzienia*.
Author: A. Sieńko

internal conditions of the bee colony, the distribution of activities performed by worker bees is modified and depends on the needs of the colony. The role of a drone is to fertilise the queen during the mating flight. Only some drones manage to take part in the fertilisation. Drones in the swarm are fed by feeders, but only until the amount of nectar brought decreases. Drones that are not fed have a very limited ability to take honey which results in their weakening and leads to death. At the latest in autumn, drones are removed from the hive and die of starvation.

The life and all activities of the bees are determined by the cycle of the seasons. The winter period is, of course, the least active one, which does not alter the fact that a great deal of effort is needed to heat the cluster. When the ambient temperature drops to twelve degrees, the bees begin to congregate next to each other for the duration of the winter, gathering in a ball-like cluster called a cluster. The cluster is located just below the honey reserves. The worker bees gradually move with the cluster towards the top of the comb, consuming the stored honey supply. The activity of the worker bees generates heat through muscle twitching. In the cluster the temperature even in severe frosts outside a tree hive or conventional hive is between 20 and 30 degrees with the temperature inside the tree hive or conventional hive below zero. When the temperature outside starts to exceed eight degrees in spring, the bees start their first spring test flights, during which they have to get rid of the faeces from the whole winter period. At the same time, already in late January and early February, the bees raise the temperature inside the cluster to 35 degrees and the queen begins to lay eggs. In early spring, the process of replacing the old generation of bees with the new generation begins. This process continues until mid-May. During this time, the queen mother is still laying eggs until she is forced to lay eggs in the queen cells. Thereafter, she is fed less royal jelly and the proportion of honey and nectar in the food increases. The mother is also constantly disturbed by worker bees. This results in the return of flight ability. The swarming period begins. When the queen cells are closed up, the bees encourage the queen mother to fly out of the hive. Up to more than sixty per cent of the bee colony

leaves with her **(photo No. 19)**. Such swarming flight may be repeated several times. In the original colony, new workers are fretting their way out all the time. As a result of a fighting between queens (which remain in the hive) and those that have left the queen cells, one queen remains in the hive. Together with the workers she destroys the queen cells still in existence. The new queen takes the mating flight on day 5 and starts laying eggs 2 or 3 days after copulation. The colonies that have formed as a result of swarming, after finding a new habitat and the colony that have remained in place, from June to August enter a period called the main nectar, pollen and honeydew collecting period. This is associated with the period of abundant flowering of plants. During this time, the bees accumulate reserves of honey produced from the processed nectar **(photos No. 20 and 21)**. The period of abundance is followed by autumn with less food. In the colonies, there is a phase of dying out of the work-worn bees and their replacement with bees that will survive the next five months. This is possible because the new generation no longer feeds the larvae and eats large amounts of pollen, leading to a stockpile in the fat body of the bees. One of the activities to prepare for winter during this period is to cement the exit openings and crevices in the hive or tree hive with propolis.

6 The Augustowska honeybee – characteristics of the breed

The honey bee, through adaptation to natural and environmental conditions, is represented by many breeds. Breeds adapted to the natural cycle and the associated rhythm of development of forage plants have emerged. In Poland, bees associated with forest environments were originally predominant. The breed living in Polish primeval forests was referred to as the forest bee or black bee (more rarely as the northern bee). Over the last few decades, as a result of the 'importation' of breeds not found in Poland, there has been a mixing of native breeds, mainly with the Krainka and Italian bees. The Augustowska Primeval Forest region did not escape that fate. The bee Apis mellifera mellifera living in the Augustowska Primeval Forest, known as the Augustowska bee, has been displaced by hybrids. Apiarists are breeding the Augustowska bee to a negligible extent, and changes in the forest ecosystem and the disappearance of forest beekeeping have further exacerbated the disappearance of the indigineuos Augustowska breed. How is the Augustowska bee different from other breeds and why should we aim at reintroduction of the indigineuos breed?

The characteristics that distinguish the Augustowska bee from other breeds can be divided into:

1. Morphological differences

The distinctive feature of the Augustowska bee visible at first glance is the colour.

Unlike other breeds, it is distinctly darker with brown or grey hair. The queen mothers, as well as the workers and drones, have a dark, uniform colouration. In the brooding queen, lighter legs and colouring, brown flare of the sternites, tergites and legs (without yellowing), and lighter colouring of the hair are observed. The length of the

uvula is defined as shorter than other breeds, between 5.75 and 6.5 millimetres. The width of the fourth abdominal tergite is between 2.04 - 2.60 millimetres. The cubital index has been set at 50 - 80 %.

2. Behavioural differences

At the outset, it should be noted that the specific characteristics of the Augustowska breed (as with other breeds) are due to climatic conditions and the quantity, and quality, of forage plants. As far as the Augustowska bee is concerned, this mainly relates to the harsh continental climate and poor nectar and pollen forage. This manifests itself in starting flights even at a temperature of 5°C. In the absence of food, flights take place in cool and windy weather. The Augustowska bee is also distinguished by its very good winter hardiness, being able to overwinter to a much greater extent than other non-native imported breeds. This is favoured by the way the supplies are stored in the combs, mainly where the winter cluster will be. In addition, food from the parts of the outermost parts of combs that will not be in the cluster is transferred to the inner parts of combs. The Augustowska breed makes very good use of a variety of forage, unlike the breeds used in mobile apiaries, as it is able to collect pollen and nectar from many plant species at the same time. This is due to the fact that there are no honey-yielding plant fields in the forest and to the need to make the maximum use of flight. Despite the fact of rapid colony development, the Augustowska bee broods after the weather stabilises. Increased nectar collection results in rapid colony development. In the event of constricted space in the hive, the bee colony reacts with a swarming mood that is difficult to control. Pollen is accumulated around the brood or in the cells between the brood. The bees pile it up in a disorderly manner on many combs. In times of food shortage, the queen mothers stop brooding, which has a significant impact on the survival of the swarm and does not weaken the colony. Already in late summer, the Augustowska bee completes the rearing of offspring and forms small colonies for the winter. During wintering, the bees are very economical in their use of supplies. A characteristic feature is the behaviour of the Augustowska bee when removing frames from the hive. During inspections, the bees are very mobile, running

quickly on the combs. The bees do not cling to the combs, but flow in a characteristic way towards the bottom of the frame, forming hanging clusters. A very frequently raised issue in relation to the Augustowska bee is that of aggressiveness and the problems associated with this when caring for hives. However, it can be argued that this applies to hybrids with the Augustowska bee. Hybrids are distinguished by their aggressiveness which is far greater than that of other breeds or the pure Augustowska bee. Contrary to popular opinion, the Augustowska bee is not inferior to other breeds in terms of its honey yield. Such a conviction results from comparing the amount of honey with breeds living in definitely better forage conditions. In apiaries located in the Augustowska Forest, the Augustowska honeybee does not differ in its yield from other breeds. A feature which is very important and significant in these days and in the problems of bee vitality is that the Augustowska bee is definitely more resistant to diseases than hybrids and other breeds. A greater resistance and limited spread of varroa in Augustowska bee swarms has been confirmed, which is an important condition for improving bee health.

Bee diseases and pests

7

The state of knowledge of bee diseases and pests is becoming more complete every year. With the progress of scientific research, the causative agents of diseases - viruses, bacteria, protozoa, fungi, mites and insects - can be better identified. Almost without exception, different behaviour of the bees, abnormal depletions in the swarm, unnatural body changes, contamination of the hive or its surroundings can be a manifestation of a disease or several diseases in a bee colony. Generally, weakening a colony with one disease opens the 'gateway' to other diseases. Weakened bees are susceptible to further disease agents. The ability to prevent and react swiftly to the onset of a disease differs between a conventional hives and tree hives. In the conventional hive, the bee colony can be observed daily. In the case of a tree or log hive, the possibility of observation is more difficult and is practically limited to inspections in spring and summer. If you lack beekeeping experience, any disturbing symptom in the behaviour or appearance of the bees should be consulted with an experienced beekeeper. Underestimating and waiting for the problem to go away can result in weakening of the colony or even its complete collapse. The most common diseases causing the greatest losses in conventional hives and tree hives in Poland include varroa, acarapidosis, braulosis, nosema, foulbrood, chronic and acute bee paralysis.

Varroa is the most dangerous disease of Polish apiaries and tree hives. It is caused by the Varroa destructor mite, which has the Polish name of *dręcz pszczeli* (~ bee plague). The lack of natural enemies, the ability to spread at different stages of development, both of the parasite and of attacking different stages of bee development, leads to very rapid parasitic expansion and reinfection of bee colonies. The size of the females reaches 1 mm in length and 1.6 mm in width.

It takes 5-6 days for the male to develop and 7-8 days for the female. Males and juvenile forms feed in cells with brood, and after a bee gnaws its way out, they die. Females can prey on mature bees for up to 1 month. Between seven and 12 generations of the parasite can occur during a single season. The parasite feeds on the haemolymph and fat body of the victims. This results in a reduction in the body weight of the bees which gnaw their way out and shortening of their longevity. Very often the brood dies off. It should be remembered that when bees swarm, up to 30% of the parasite's adults are carried away with the migrating swarm to a new location. Due to the prevalence of the mite, treatment of colonies should be undertaken preventively and carried out throughout the season. The most common and effective methods are fumigation and strip-hanging. It is essential to follow the manufacturers' recommendations. Treatment in tree hives is limited to fumigation in spring and summer, as it is impossible to hang strips. In apiaries, integrated methods are used, i.e. a combination of pharmacological and mechanical treatment. Treatment must be consulted with an experienced beekeeper.

Acaropidosis or mite disease is caused by the Acarapis woodi mite (bee tracheal mite). The parasite only lives on young adult bees in the tracheas, feeding on haemolymph. Large numbers of parasites cause blockage of the tracheas and result in bee hypoxia. The parasite is sensitive to the acaricides used to treat varroa and has therefore declined in occurrence, but it should be remembered that before varroa it was the culprit of one of the most dangerous bee diseases.

Braulosis is caused by the fly Braula coeca (bee louse). Individuals of the parasite locate between the thorax and abdomen and on the head of adult bees. They feed by irritating the bee's lower lip until royal jelly is yielded. A condition conducive to the development of the disease is the maintenance of weak colonies and old combs with sealed honey supplies in the hive. Fortunately, the varroa treatments used also effectively eliminate bee lice.

Nosemosis is a very dangerous disease caused by the fungus Nosema apis (bee sporozoan). The fungus attacks the intestinal epithelial cells of adult bees, leading to their death and desquamation.

Spores of the parasite persist in honey for up to a year and in faeces for up to two years. There may be spores wherever the faeces of diseased bees can be found, i.e. on virtually every part of the hive and its surroundings. Therefore, healthy and infected colonies should not be combined. It is important to disinfect hives and beekeeping tools. The symptoms of the disease are diarrhoea, the presence of faeces on the exit bridge and the front wall of the hive taking the shape of a beaded path. Sick bees have a bloated abdomen. To control the disease, comb disinfection with glacial acetic acid vapour is used. After the first test flight, the diseased colonies should be moved to the disinfected hives, the combs replaced with new ones and the colony fed.

Foulbrood is another very dangerous contagious disease. It is caused by the bacterium Paenibacillus larvae. It attacks the sealed brood causing it to die and turn into a sticky substance with a bad smell. Three to five weeks after infection, a dark spot appears on the sealed cells. Ongoing disease can lead to the death of many colonies.

Chronic bee paralysis is a chronic disease of adult bees caused by the SPV virus. The virus is found in the honey sack. Infected bees lose their ability to fly, circle around the exit, lose their hair and congregate in warm areas of the hive.

Acute bee paralysis is caused by the ABPV virus. The virus develops in the epithelial cells of the midgut. It then enters the nervous system. Infected bees immediately lose their ability to fly, are driven out of the hive and emit an unpleasant smell. Both chronic and acute bee paralysis result in colony collapse.

The aforementioned diseases and their treatment require apiarists and forest beekeepers to constantly improve their knowledge of the conditions conducive to their appearance, methods and means of treatment. New preparations and rules for their use are constantly being developed. Undoubtedly, one thing does not change, however, and that is the principle of cleanliness and hygiene in the maintenance of apiaries and tree hives, their systematic inspection and the use of disinfected beekeeping tools.

Photo No. 22
A hornets' nest located inside a beekeeping log above the *oczkas*.
Author: A. Sieńko

Photo No. 23
Traces of bite marks and marten entry into a log bee hive above the *zatwór*.
Author: A. Sieńko

Pests of apiaries and forest hives include: insects, spiders, birds and mammals. From the group of insects, we can mention: bee wolves, hornets **(photo No. 22)**, wasps, wax moths, black oil beetles, ants. In addition to wax moths, which destroy combs, hornets and wasps destroy adult insects, and black oil beetles destroy brood. Ants, on the other hand, eat up honey, but more damage is caused by their presence in the hive and disturbing the bees. Spiders are a numerous group and their negative impact comes down to trapping bees in webs. Birds can be serious pests. Tits especially in spring hunt at the exits and sometimes provoke bees to fly out and then catch them. Woodpeckers can be a big problem, as they loosen conventional hive walls and the *zatwór* of tree beehives to get to the bee cluster. Of the mammals, martens **(photo No. 23)** and mice are pests. Martens chew through the walls of the conventional hives and the *zatwór* of tree beehives to get to the honey and wax supplies. Mice disturb the bees by setting up nests in the hive, which leads to weakening and even to the collapse of bee colonies during the winter.

The care of tree and log beehives

8

The care of tree and log beehives, due to their location at certain heights in or on a tree, is difficult. The act of opening of a tree or log beehive is practically limited to three or four times a season. The possibility of intervening in the development of the bee colonies and stimulate their behaviour as in a conventional hive in the apiary is impossible. In the conventional hive, by being able to position, rearrange and remove frames and extensions, we can, among other things, reduce the swarming mood, stimulate the queen to brood, stimulate the worker bees to stockpile, cut out queen cells. Access to the inside of the tree hive is limited by the presence of a few to several combs (usually 6 to 8 arranged perpendicular or parallel to the *zatwór*). It is practically impossible to eliminate the queen cells, except when they are at the edge of the visible parts of the comb. Opening a tree or log hive always affects the outer parts of the combs adjacent to the *zatwór*. It is important to bear this in mind and not to open a tree hive without a reason. It should be recalled that a split *zatwór* minimises the disturbance of the combs **(photo No. 24)**. Honey supplies and cells with brood are located in the upper part of the combs, so in case of the need to open a tree hive, removing the lower part of the *zatwór* does not disturb the swarm life. Treating varroa with strips is also impossible, as there is no way to place them between the combs as between the frames in a domestic hive. When caring for tree hives, we have to accept the fact that the bees swarm, and a large part of the swarm leaves. This often leads to a strong weakening of the remaining part of the swarm and even to the collapse of the colony. This is the case when the remaining queen does not brood in sufficient numbers and the worker bees do not manage to build up an adequate supply of honey and pollen for the winter. Failure in one tree hive, however, is a possible

Photo No. 24
Damaged honey combs after removal of the upper part of the *zatwór*.
Author: A. Sieńko

Photo No. 25
Fumigation of a tree hive to control and treat varroa.
Author: A. Sieńko

success for the colony that flew out after swarming. If we have other tree or log hives prepared in or near the forest, they will inevitably be colonised. Contemporary forest beekeeping should be aimed at increasing the number of bee colonies in the forest. The number of colonised tree and log hives even in Bashkiria, where forest beekeeping has been going on for centuries, does not exceed 30 %. It is difficult to imagine a situation of 100 % colonisation of tree and log hives. We need to take care of the balance of the environment. The optimum number of tree and log hives must be prepared, and bee colonies must be allowed to grow freely in a forest that provides foraging opportunities. Despite the above conditions, the following treatments and activities must be carried out. According to the modern concept of bee care, the forest beekeeping season starts with an autumn inspection of tree hives, which is carried out depending on the weather conditions and the ongoing vegetation of the melliferous plants. If the year is dry or cool, the inspection is carried out sooner, and if the year is warm and humid, the inspection is done later. It is essential that the bees are fumigated against varroa during the inspection. At the moment, fumigation is the only effective and proven method of controlling varroa in tree hives **(photo No. 25)**. We can put a white sheet of paper on the underside of the tree hive and determine the degree of infestation of the colony from the falling mites. During the autumn inspection, we decide whether there is a need to feed for the winter. When the temperature still allows the bees to fly, the food should be placed near the hives. Sticks should be inserted into the food containers to allow the food to be collected and the bees to fly out. The food must be protected from ants. It is best to hang the bucket on a tripod made of branches, next to the beekeeping tree **(photo No. 26)**. In situations of already cold weather, the food bucket can be placed inside the tree or log hive. The food can be given in the form of a dough, preferably with pollen added. After feeding is complete, the hive can be fascined. This consists in placing bundles of thin tree or shrub twigs between the *zatwór* and the *śniot*. It is often used to secure the bundles of just twigs with string and wooden stakes driven in the tree or log **(photo No. 13)**. Such insulation also protects the hive from birds and

Photo No. 26
Feeding bees. Visible tripod with a suspended bucket of food.
Author: J. Jadeszko

martens. Simply hanging the *śniot* will also protect against robbery. I have encountered the protection of tree hives with metal nets. I have seen tree hives that have had the *zatwór* sealed with clay for the winter period to protect against heat loss. The sealing must be done when the *zatwór* is already loosely inserted in the *dłużnia*. During the winter period, the fact that the bee colony is alive is evidenced by the frosted surroundings of the *oczkas*. The spring inspection is done when the temperature is above ten degrees. Remember that the forest has its own microclimate, which is different from that in

open areas. This is important to avoid chilling the swarm in the hive if we open it too soon. Even before opening the hive, we can make sure that the bee colony has overwintered by listening for the characteristic buzzing sound. After opening the hive, the hive should be cleaned by sweeping the bottom to remove any impurities. Note how many bees have dropped, whether they are dry or mouldy, what the smell is like in the hive. We check the impurities for pests and diseases. If there is a 'honey' dry smell in the hive, it means there are no diseases and the colony has overwintered properly. By observing the combs with supplies, we decide whether the bees need to be fed or whether there is enough supplies before flowering of the forage plants begins. We carry out the feeding in the same way as during the autumn inspection.

Apiary in the forest

9

We place itinerant and stationary apiaries in the forest. The stationary apiaries located deep in the forest are much smaller and comprise several hives because of limited foraging opportunities. Itinerant apiaries appear in the forest at specific times and are located close to areas with specific plant species, from which pollen and nectar, and possibly honeydew, are to be collected. The main determinant of the location of a stationary apiary in the forest is the forage base. Placing hives in a particular location is intended to ensure that the bees take enough food to survive. There is a need to discern the layout of the plant communities in the immediate area. It is important that this is a mosaic of plant communities with flowering species throughout the growing season. It is also necessary to consider the amount of honey intake and the need for feeding for the winter season. An important factor influencing the location of the apiary is the provision of water collection. Placing hives next to a large body of water will limit the bees' ability to fly. Smaller bodies of water are not a barrier and provide clean water, plus there is always shoreline vegetation with long flowering periods. Being too far away from places where bees can collect water will negatively affect colony strength and force them to collect rainwater from puddles, which will affect colony health. The forest apiary should be set up in a dry, slightly shaded area. Exits should face south, preferably south-east, to ensure faster bee activity during the day. The hives should not stand in an open area. This creates a risk of overheating the hives on hot windless days. A little shade will help to maintain the right temperature in the hive, and on windy days will reduce the cooling of the hives during the winter period. Immediately around the hives, the vegetation should be low to facilitate the flying out and return of the bees to the hive. At the same time, at some distance the vegetation should provide shelter from the winds. In the forest, natural places to set up apiaries are flower meadows,

Photo No. 27

A mini apiary located on the border between a forest and a flower meadow. Feeding receptacles visible by the hives.
Author: A. Sieńko

pastures, hunting fields and felling areas **(photo No. 27)**. Such a location also allows access to the apiary and makes it easier to plan and carry out any apiary activities. The hives are placed on stands and, due to the greater presence of ants in the forest compared to non-forest areas, the legs of the hive should be protected to prevent ants from entering the hive. Proper levelling of the hives will allow for an even construction of the combs. The distance between hives should ideally be about 4 metres, so that neighbouring colonies are not disturbed during inspections and other work. It is worth noting that to set up an apiary in a forest, permission is required from the local forestry officer and a free land lease agreement must be signed. Signing the agreement ensures that motorised vehicles are allowed in the forest. When signing the agreement, information on other apiaries located in the forest is provided. A suitable distance from existing apiaries will eliminate robbery, the possibility of bee disease transmission and reduce competition for food. The forest district office will also provide information on hiking trails, camping areas and other places where outsiders may be potentially exposed to stinging.

10 Improvement of conditions for subsistence of bees in the forest.

The living and subsistence conditions for pollinators in the forest have changed radically over the last few centuries. Along with economic and social changes, the extent and share of forest area in the total area covered by human activity has changed. In addition to area changes, there have been significant changes in the ownership structure. All these changes were compounded by changes resulting from forest management, i.e. changes in species composition, age structure and spatial structure. These changes and transformations are compounded by the effects of climate change. The extent to which pollinators can keep up with these changes is difficult to determine, but we can already speak of the decline and disappearance of individual species and the reduction in numbers of individual pollinator groups. The rate of change is reducing the ability of species to adapt through an evolutionary process. It appears that bees, despite having existed for tens of millions of years, may not survive for decades to come, but for years counted not in millions but in mere years.

In our European conditions, the original habitat of bees was the forest. The forest of centuries ago was very different from the forest of today. Nowadays, the forest is completely subject to management. Open areas not covered by trees and unmanaged areas have almost completely disappeared. The proportion of such areas is negligible. In addition, in order to increase the productivity of the forest in accordance with social expectations, the utilisation of the forest area has been maximised. The degree of ground cover (canopy) by the prevailing tree species has increased, which affects the reduced proportion of herbaceous vegetation in the undergrowth - the main source of the pollinator forage base.

Can we, based on the existing legal acts: laws, ordinances and rules on breeding and protection measures, improve the habitat of pollinators? Certainly yes, and moreover, create new habitats for them. How can this be achieved? On the basis of experience to date from completed and ongoing projects, this can be achieved by taking action in the areas listed below:

1. Improvement of water relations
2. Designation of non-managed areas
3. Shaping of the forest-to-open area transition zone
4. Management of the forest from felling to stand: regeneration, silvicultural and protective measures
5. Management of so-called economic land: orchards, meadows and pastures
6. Shaping of the landscape and surroundings of forest settlements
7. Cooperation with apiarists and forest beekeepers
8. Scientific and veterinary protection

Re. 1

Taking steps to increase the retention of forest land is a huge challenge both organisationally and financially. Participation in programmes such as the *Mała Retencja* (small retention) makes it possible to achieve this goal. There are sources of funding for the construction of hydrological structures. This includes minimising the impact of former drainage facilities mainly ditches and building new water reservoirs. Any unit of the State Forests can undertake such measures. And in the current water deficit situation, it is even an obligation to participate in externally funded programmes. However, it should be strongly emphasised that without substantive and organisational support, the forest districts themselves will not be able to carry this out. The setting up of new hydrological structures that slow down water run-off and increase water retention for a longer period than before, significantly increases biodiversity in the world of plants and animals. An increase in the number of plant species and their abundance in the area of influence of the created structures has already been confirmed. Plant species associated with wetlands and humid areas are very important in the pollinator

forage base. In addition to the aspect of new foraging opportunities, they also influence the possibility of foraging over a longer period of time, thus minimising the effects of so-called foraging famine periods in the forest. Similar activities, but already implemented on a smaller scale, include the establishment of small ponds in the forest **(photo No. 28)**. Current legislation allows the establishment of small ponds with a total area of up to 5,000 square metres by means of a water law declaration. This is not a complicated procedure and the effect is not much less than for large investments. For example, the one-off creation of 12 small ponds with a unit area of up to 400 square metres, if appropriately spatially dispersed, will improve water availability over an area of several hundred hectares of forest. Access to water will be provided not only for pollinators,

Photo No. 28.
A small pond made on the surface of a mid-forest meadow. Next to it, on the left, a mini apiary.
Author: J. Jadeszko

but also for the entire animal world. Pollinators act as an umbrella species in this case. So far, scientific monitoring studies of animals associated with the newly created small ponds in the Augustowska Forest District show an increase in the number of animal species and their numbers.

The small ponds are used by: insects, fish, amphibians, reptiles, birds and mammals. The use of the ponds by many protected species has already been confirmed. It can be concluded that the new small ponds are forest oases used by everything from the proverbial mosquito to the largest forest mammal, the European bison. Increasing biodiversity can be helped by managing the surroundings of the small ponds. This can be achieved, for example, by planting willows, whose pollen and nectar are hugely important in early spring. We can also plant a few dozen fruit trees and shrubs in the immediate vicinity of the small ponds, which, after a few years of suitable protection against gnawing by deer and rodents, will significantly improve living conditions for more than just pollinators. It would be advisable to locate new small ponds in the immediate vicinity of flower meadows, which will be discussed later. The emergence of aquatic vegetation, bank vegetation and vegetation in the immediate vicinity of water bodies, which are affected by the presence of water, increases the forage base of many pollinator species. The diversification of the species composition of herbaceous plants will significantly increase the biodiversity of the forest.

Re. 2

Current legislation allows for the designation of non-managed areas in the forest known as ONG[1]. This mainly concerns wetlands and damp areas. However, such areas can be designated because of their importance to the pollinator world. This will not have the effect of reducing the productivity of the forest and, in the long term, will improve it by increasing biodiversity and tree stand resistance to disease factors. It is important to disperse such areas throughout the forest. Such an area could be, for example, a loose fragment of

[1] The acronym of the Polish phrase ***o****bszary* ***n****ie objęte* ***g****ospodarowaniem* [translator's footnote]

a stand with varied undergrowth cover. It could be a single small broadleaved woodland providing a diversity of herbaceous species. It could be a small mid-forest meadow or an open space covered with undergrowth. There is no need to afforest or restore 100% of the woodland. An important role can be played by a fragment of forest with a higher than usual number of tree species. This could be a fragment with a high proportion of linden or maple. With the right 'sensitivity' we will find plenty of such places. As an example, I will present a situation where all linden trees have been felled alongside oak clump and its surroundings. When asked what would be planted there, the answer was linden trees. This was never done again and, as of today, this forestry district has the highest proportion of admixture species. When designating non-managed areas, it is important to maintain the continuity of the forest with the changes that occur in the respective development phases. It must not lead to a situation where the abandonment of management leads to the loss of the objective of designating a non-managed area.

Re. 3

The topic of management of the forest-to-open area transition zone is well known and described, but still in my opinion underestimated and marginalised. And because of pollinators, this area is of utmost importance. Its most significant role is to ensure that it can be used for foraging over a long period of time throughout the growing season. In addition to the vegetation of open areas, it can determine the survival of bee colonies. Already at the stage of drawing up a sketch of the felling site, a 'boundary' area can be designated, which will be less intensively cleared off of all trees. It is possible to plan at this stage to leave the existing undergrowth and brushwood with a particular focus on melliferous species such as linden, maple or willow. It is important that the remaining trees guarantee the possibility of further development once they are exposed. The 'skeleton' of the transition zone left in this way is supplemented at the restoration stage with additional planting of melliferous trees and shrubs. Attention must be paid to the existing and future light conditions. Such zones cannot be limited to single or double row

plantings. After a few years and the development of the main forest-forming species, such a zone will disappear and will not fulfil its role. We must remember that the separation of the transition zone will significantly affect the biological resistance of the stands. Creating a habitat for many animal species, such as hymenoptera, will significantly reduce the development of harmful insect species.

Re. 4

Virtually in every phase of a tree stand development, actions can be taken to improve existing and create new conditions for pollinators. All silvicultural measures aim at a harmonious development of the stand with a smooth transition from the cultivation phase to the subsequent development phases. At each stage of development, the silvicultural measures can be carried out in such a way as to create the best possible conditions for the existence of pollinators in the forest in a respective area. The following measures can decisively increase the biodiversity of the forest and thus create new ecological niches for many animal groups, including pollinators. It is important that treatments are carried out comprehensively and not only on a limited area. The spatial localisation of the measures, in addition to improving site-specific living conditions, will also provide opportunities for pollinator migration, which is extremely important in maintaining a diverse gene pool in the forest environment. Already at the stage of crop establishment, the distribution of microhabitats in the area should be taken into account, the species composition should be adapted to the habitat conditions and the share of biocenotic species should be taken into account as much as possible in accordance with the Forest Organisation Plan and the Silvicultural Principles. By selecting the species composition of the crop appropriately, using micro-habitats and spontaneous self-sowing of biocenotic species, this can be achieved without too much effort or intervention. It is advisable to identify valuable clumps of honey-yielding species at the tree-felling stage. It is important to remember that the possibility of foraging from such species occurs at the right age. If we artificially introduce seedlings of admixture species, the effect will be appropriately later. However, if we manage

to leave, for example, a clump of linden trees at least twenty years old, the effect will be immediate. When carrying out agrotechnical land reclamation, it is worth leaving compact, valuable groupings of shrubs of melliferous species. Planting them with melliferous tree species when establishing a crop will create a biogroup which is extremely important for pollinators. Cultivation is mainly concerned with regulating the species composition in line with the habitat and maintaining an appropriate compactness, which ultimately also ensures appropriate forms of mixing. At this stage, care should be taken to ensure an adequate proportion of biocenotic admixture species. This can be achieved by not removing all trees and shrubs valuable to pollinators, such as willow, hazel, linden or alder buckthorn. Leaving appropriate clumps of melliferous species will improve biodiversity and, as a result, also improve the overstory structure of the target tree stand. Leaving a group of the aforementioned species at the edge of the area, or next to a branch line or road will excellently create a buffer zone, valuable for many animal species. When removing the so-called competing vegetation, removal of all herbaceous vegetation must be avoided. There will always be parts of the crop where mowing can be avoided. This will provide an opportunity for many species of flowering plants, which are the food base of pollinators. Another treatment on renewed areas is early cleanings. These are aimed at ensuring adequate compactness and species composition. The schematic removal of trees of non-main species can lead to a loss of biodiversity. An appropriate number of admixture trees should be left. Their number should be based on species compositions suitable for the habitat and the woodland. The proportion can, according to silvicultural principles, be between 10 and 30 % of the species composition of the tree stand. The aforementioned sensitivity of the forester and observation of the changes taking place in the area will help to achieve a healthy and biologically diverse young forest. No forester wants to achieve a mono-species young forest without biocenotic admixtures. Similar principles should be followed in late clearing operations. At the stage of a compact young forest, the species composition is already established and we can only stabilise the biodiversity. Sometimes it

is necessary to provide proper light conditions for valuable admixture species at the expense of the main species. The fully-formed young forest entering the next phase of development, which is the high-pole stand, has the potential to form a second storey of biocenotic species or permanent biogroups of them. At this stage, a buffer zone with a high proportion of shrubs (including melliferous shrubs) should already be clearly established. Subsequent early and late thinning stabilises the stand, shapes the overstorey structure and ensures proper sanitary condition. At this stage, it is worthwhile not to be oblivious to the biocenotic biogroups. For example, logging trails can be laid in such a way as to light up valuable admixture species. The basic principle should be the absence of schematism, an individual approach to each area and an understanding of the need to care for biodiversity. A forest, unlike a rape patch, will never provide the opportunity for pollinators to forage over large areas. This is why every clump of admixture species is important, as is adequate lighting, e.g. of blueberry patches. In conclusion, it is not possible to manage a forest with pollinators in mind, but we can manage it in such a way that the conditions for their existence are permanently present.

Re. 5

We should remember that in forests are open areas such as hunting fields or meadows. These areas can be treated in such a way as to create and maintain habitat for pollinators. In addition to the obvious purpose of pastures and hunting fields, their potential capacity and importance in creating habitats for pollinators, among others, can and should be taken into account. On each such area, a couple of ares can be set aside for a mid-forest preserve formed by honey-producing shrubs. Without losing the purpose of maintaining meadows and pastures, a few ares can be set aside to create a flower meadow. The benefits for pollinators will then be obvious. Mowing dates should be correlated with the flowering periods of the plants so that insects can derive maximum benefit from the flowering plants. It is advisable to use seed mixtures containing melliferous species **(photo No. 29)**. The importance of baulks, the

Photo No. 29
A mid-forest floral meadow.
Author: A. Sieńko

role of which can be played by unploughed strips of land along pastures and hunting fields, must be recognised. This space is not only used by pollinators.

Re. 6

In addition to activities undertaken during silvicultural and protective operations in specific forest divisions, we can undertake many activities not directly related to the economic activity of the state forests. One such example is the management of space in the surroundings of forest settlements. Nothing stands in the way of dedicating a part of the area within the boundaries of a forester's lodges, offices and residential buildings to the establishment of pollinator feeding plots. Setting aside an area of one to several ares to be sown with honey-yielding species does not appear to be much

of a problem. Part of a traditional lawn, which is mown several times and is practically a green desert not only for the world of pollinators, converted into a flower garden will significantly improve living conditions for many species of animals. If, in addition, we manage to plant a few native species of trees and shrubs that are melliferous, we will create a plant complex that is very attractive in live in, not only for pollinators. Apart from the aesthetic value (which will be improved), the educational function of such a flower garden is also important. A small plaque informing about the purpose and role of such an activity will also significantly raise environmental awareness among the public. If such an action is transferred into the surroundings of all homeowners, the effect on a national scale will be amazing. Given the dispersal of such flower gardens, the local importance of such a measure would be extremely important not only to ensure the collection of nectar, pollen and honeydew, but would also provide opportunities for pollinators to migrate and ensure their survival over a much larger area. It is extremely important that, when establishing flower gardens and planting melliferous trees and shrubs, indigenous species should be used which, in addition to being adapted to our climatic conditions, also have the characteristics to ensure the possibility of collection of nectar, pollen and honeydew, and at the same time ensure their pollination and development. The introduction of non-native plant species goes against the principles of good management and, as we now know for a fact, can lead to the invasion of species that eliminate the native ones. Lists of domestic melliferous plants are widely available in the age of the internet and should be taken advantage of. It is important to know the soil, light and moisture requirements to avoid disappointment. Even the smallest flower garden should consist of annual and perennial species. This will ensure the sustainability of the area and enable additional species to be introduced gradually. One of the advantages of establishing flower gardens is that, compared with an ordinary lawn, there is no need for mowing, which generates noise, exhaust emissions and electricity consumption. It might seem that one garden is not much, but on a national scale the effect will be enormous. Orchards are still maintained at many

settlements, but they are often neglected and need to be renewed. Ideally, we should go back to growing fruit trees of so-called old native varieties. The growing season of the old varieties correlates much more closely with our weather conditions and secures a higher collection of nectar, pollen and honeydew by insects and benefits the strength of the bee colonies. It also results in better fruit-bearing of fruit trees. In orchards, flower meadows can be created between tree seedlings. The role of such orchards would be immense for many species of insects and other animals.

Re. 7

Once again, we should draw attention to the importance of cooperation between forest beekeepers and foresters with apiarists. Their knowledge and practice will, in many situations, multiply the effect of the measures taken and, more than once, protect against mistakes. Areas of cooperation include exchanging experience and knowledge, identifying bee diseases and undertaking treatments, organising work and treatments in forest apiaries and tree hives, and undertaking feeding. The location of permanent and temporary apiaries must be agreed between apiarists and forest beekeepers. In the case of closed bee-keeping areas, permission to set up an apiary in the forest must be preceded by certification of the purity and affiliation of the bee colonies to the Augustowska breed. This is a necessary requirement. Without compliance with the provisions of resolutions of provincial assemblies, the aim of maintaining e.g. the Augustowska breed, will continue to be uncertain and the measures taken will be less effective.

Re. 8

In forest beekeeping and apiculture, we come across various negative statements concerning the management of apiaries, treatment, feeding, the characteristics of particular breeds, the technique of making beehives and tree hives, the timing of actions taken and many other aspects resulting from tradition and individual practice. The first beekeeping activities met with, to put it mildly, a cool reception from beekeepers. Objections were raised as to the need to

Photo No. 30
An example of a combination of a hunting field, flower meadow and mini apiary.
Author: J. Jadeszko

restore, or even the harmfulness of 'wild swarms'. Scientific research and veterinary protection carried out since the start of forest beekeeping have proven that forest beekeeping and free-living swarms in the forest pose no threat to beekeeping and beekeepers. Leaving aside the aspect of national and cultural heritage, which was not objectionable, a consensus was reached with apiarists. Many apiarists are becoming forest beekeepers. The results of research into health, purity of breeds, collection of nectar, pollen and honeydew and honey quality are of great importance to all those dealing with bees. There is still a need for continuing scientific research. This requires cooperation with research and scientific institutions. The State Forests can support this research, but there must be greater involvement of the scientific world. Without scientific research and its results, mistakes in the management of pollinators in the forest environment will not be avoided. Nowadays, there is no room or time for mistakes in environmental management and for the loss of pollinators including bees in forests **(photo No. 30)**.

11 Forest beekeeping presently and in the future

Undoubtedly, the last few years have been a time of marked interest in forest beekeeping. Every now and then, new information about various activities related to forest beekeeping appears. In the age of electronic information, news spreads with unheard-of speed. Virtually any one news item is read on all continents at the same time. But is it followed by quality, reliability and truth? Unfortunately, the information is often shallow, unsubstantiated and many times laced with emotional manipulation. In exceptional situations, the recipient of such news verifies its reliability and truthfulness. This also applies to issues related to forest beekeeping.

In my view, today's activities in Poland related to forest beekeeping, cultural heritage and pollinator protection are dispersed and inconsistent. They are based mainly on the passion and actions of individual people acting mainly in their own area. Attempts to organise joint action and on a larger scale have so far failed. Legal and organisational aspects stand in the way, on the one hand, and the unhealthy ambitions of individuals on the other. The unreliable media also do a lot of harm. In their search for sensationalism or an attractive topic, they focus on one-sided coverage that does not reflect the complexity of the issue. For instance, forest beekeeping is portrayed as a form of recreation and active outdoor leisure. Where is there room here for responsibility for the environment, the biological balance, caring for the health of bees, adhering to current legislation. Pretty photographs and circular platitudes of selected 'forest beekeepers' create a false image of true forest beekeeping. Today, the close connection between forest beekeeping traditions and the care of biodiversity and the improvement of pollinator habitat must be strongly emphasised. Tradition alone will not ensure the sustainability of forest beekeeping.

The starting point for present-day forest beekeeping in Poland should be knowledge of the law in force. The fact is that it needs to be amended and take into account the societal expectations in terms of access to the forest and regulation of forest beekeeping activities. Currently, there are no legal possibilities to ensure the full development of forest beekeeping. The provisions of the law and its interpretation constantly stand in the way. There are, as of today, no settlements regarding the ownership of tree or log beehives in the forests. There are no provisions regarding safety and responsibility for accidents that may occur while scooping out and handling a tree beehive. There is also an unresolved issue concerning bee colonies in tree beehives, their registration, treatment as in the case of apiaries. Another challenge today is the responsibility for maintaining the biological balance in the forest ecosystem. There are no regulations on the location and number of tree beehives in the forest. The scooping out of beehives and hanging log beehives without considering the natural aspects and food competition among pollinators is deeply irresponsible and unacceptable. An equally important aspect of today's forest beekeeping is the issue of cooperation with apiarists. The presence of mobile apiaries in the forest is regulated by law, but there is no reference in the law as to the correlation with beekeeping trees. This applies both to bee breeds and to the health of bee colonies. Outside the protection areas for a specific breed such as the Augustowska bee, different breeds are brought into the forest in hives of various breeds and their crossbreeds. What is their impact on naturally occurring pollinators in the forest? This is still an unexplored topic and we do not know the effects of periodic residence of bees from apiaries in the forest and the interrelationships concerning breed purity and disease transmission with naturally occurring bees in the forest. The role of supervision by District Veterinary Officers in relation to bee colonies living in tree or log hives is unregulated. The problems highlighted significantly restrict the development of responsible forest beekeeping. A clear distinction must be made between forest beekeeping activities relating to environmental education and the cultivation of traditions and national heritage. This is a very important activity which raises

environmental and historical awareness. When conducted in a competent manner, it will bring in supporters and potential forest beekeepers.

Nonetheless, the future poses challenges far greater than the present ones. There is a need for systemic solutions, comprehensively regulating and enabling the functioning of forest beekeeping in Poland. The first task to be solved is to define the role of the State Forests as the manager of the State Treasury assets, which the Polish forests are. Centuries ago, the question of forest beekeeping was regulated by forest beekeeping law established by forest owners, be it the king for royal forests or owners of land or forest. Today and in the future, whether one likes it or not, we operate and will continue to operate within the framework of the law in force. In my opinion, there is no need to change the parliamentary laws. They sufficiently enable forest beekeeping in Polish forests. What is needed, however, are regulations in the form of general orders issued by directors of the State Forests and executive orders issued by district foresters.

Forest beekeeping glossary

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Barć – a hollow scooped out in a tree, ready (*snozas, wlotek, śniot, zatwór, oczkas*) to be naturally inhabited by bees or populated by bees by a forest beekeeper

Barta (also known as *serka*) – a small axe for scooping out trees or logs to be used as beehives

Bartnica (also known as *piesznia*) – a beekeeping tool shaped as a chisel attached to a long handle, looks similar to a spear

Bartnik – a person making (scooping out) tree or log beehives, caring for bee swarms which inhabit hives

Borówka – a wild forest bee

Bór bartny – a part of a forest with 60 tree beehives. Half beekeeping forest contained 30 hives; quarter bee-keeping forest contained 15 hives

Cech bartny – a beekeeping association/guild based on beekeeping law

Cieślica – a beekeeper's axe for scooping out a beehive chamber (*dzienia*)

Chmal – a wooden peg driven into a tree or log hive used for hanging beekeeping tools and implements

Dań miodowa – beekeeping levy or tax

Dłużnia (also known as *zatwór, płacha, dłuziec, zatuła, dłuźnica*) – a small plank of wood used for plugging a tree or log beehive entrance

Dzianie – the act of scooping out wood material from a tree trunk in order to form a hollow (*dzienia*) used as a habitat for bees

Dzienia (also known as *dzianka* or *dzień*) – a scooped-out part of a tree or log beehive

Dzień (also known as *dzianek*) – a beekeeping tree with a scooped-out chamber

Farbować – to dye, to cover the interior of a tree beehive with herbal brew or to rub the walls with a bundle of vegetation in order to lure bees into the tree beehive

Głowa – the top part of a tree beehive

Klejmo (also known as *ciosno, klejno*) – a symbol carved into a beekeeping tree being a signature or seal of a particular forest beekeeper or a forest beekeeping family

Kunne – a permit-fee for marten-hunting; originally it was one marten skin

Leziwo – a rope-and-bench tree-climbing implement used by beekeepers

Nakrywać – the placing of ordinal numbers onto tree beehives by beekeeping master

Nabić barć – to place in the upper part of tree beehive (*głowa*) pieces of wax with the use of thin sharpened sticks

Nogi (also known as *pupa*) – the lower part of a tree beehive

Oczkas – a wooden wedge placed in the *oko* of a tree beehive which regulates the width of the entrance opening, reaching the *plecy* (the rear wall) of a tree beehive and supporting the honeycombs

Ocznik – the central part of a tree beehive

Ogacić – to place bundles of twigs between the *dłużnia* and *śniot* for protection against birds, wind and dampness

Oko – a circular or rectangular opening in a tree beehive wall used by bees to fly out and enter the tree beehive

Ostrowa – the top of a spruce with branches (long knots) used as a ladder

Plecy – the internal, rear side of a tree beehive

Podcin – a beekeeping tree whose top has been removed (cut off)

Podkłod – a tree with a beekeeping symbol placed on it (*ciosno, klejmo, klejno*)

Pszczołołupca – a robber who steals honey and wax from tree beehives

Samobitnia – a bell, a piece of wood hanging on a rope and nailed to a beekeeping tree which hinders a bear from entering a tree beehive

Skobliczka – a tool for smoothening the internal walls of a tree beehive

Snozy (also known as *płoski, laski*) – twigs or thin slips attached crosswise inside a scooped-out tree or log for supporting honeycombs

Stań (also known as *adior, oder*) – a scaffolding built around trees on top of which beekeeping logs were placed

Starosta bartny – beekeeping master, senior beekeeper selected for keeping count of newly scooped out tree beehives, who maintains order among forest beekeepers and supervises the correct beekeeping levy (tax) collection

Stręp – a beekeeping tree with the top broken-off

Śniot (also known as *śniat, śnit*) – a plank of wood which from the outside covers a tree beehive closed with a *dłużnia*

Świepiet (also known as *ślepiet*) – a tree with a hollow occupied by bees

Wiecha – a bundle of twigs used to *ogacić*, i.e. to protect against birds, wind and dampness

Zaleszczyć – to attach *snozy* (*ploski, laski*) crosswise inside a tree beehive

Zatwór (also known as *dłużyca, zatuła, dłużnia*) – a plank of wood which closes up a tree beehive

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