The Buzz Changes within Time: Native *Apis mellifera mellifera* Honeybee Subspecies Less and Less Popular among Polish Beekeepers Since 1980

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Abstract: Socio-cultural research might address anthropocentric reasons for honeybee (*Apis mellifera*) conservation. In some regions, particular honeybee subspecies are considered to be native; *A. mellifera mellifera* (“dark bee”) in the north-east and *A. mellifera carnica* in the Island Beskids in Poland. Additionally, *A. mellifera caucasia* (often incorrectly called *A. mellifera caucasica*) and Buckfast are reported across Poland. In order to verify the actual choice of beekeepers, a survey on honeybee subspecies kept in apiaries was conducted annually from 1980 to 2018. This is a way to verify if conservation management towards the dark bee influenced its maintenance at a sufficient level for their restoration. The analysis revealed that Polish beekeepers know what is “buzzing” in their hives, and the awareness of which subspecies/types of honeybee they maintain has grown through the years. Initially, they kept up to four different subspecies per apiary, but now most have only one (maximum of two). Currently, Polish apiaries approach a homogeneous share with the exclusive presence of *A. mellifera carnica* subspecies. The popularity of indigenous *A. mellifera mellifera* has declined over time and is low now. It seems that new solutions should be considered to increase the effectiveness of dark European bee conservation management efforts.

Keywords: apiculture; apiary management; bee trade; citizen science; dark bee; pollinator decline

1. Introduction

Socio-cultural and ecological research is most important to address insect declines because many of the reasons for conservation have an anthropocentric nature [1]. However, humans are poor at perceiving gradual change that takes place within their lifetime [2]. The honeybee (*Apis mellifera*) is one of the animals domesticated so early that it has not only become an indispensable element of the anthropogenic environment but has also settled in as a part of the traditional economy brand [3–5]. Within this species, there are numerous subspecies that, over the years, have adapted to the conditions prevailing in a particular ecotype and are treated as native. It is possible to trace back honeybee populations to the patterns of natural postglacial recolonizations and match the naturally endemic subspecies distribution, including footprints of human management [6,7]. In Poland, the ranges of two native honeybee subspecies overlap. Historically, *Apis mellifera mellifera* Linnaeus, 1758 (so-called “dark bee”) was distributed as a native subspecies across whole Poland. Afterward, its original populations remained only in the north-eastern regions of Polish territory [8,9]. The second native subspecies *A. mellifera carnica* Pollmann, 1879, is located in the Carpathian Mountains partly within the Polish borders. Unfortunately, it is believed that the pure breed of *A. mellifera mellifera* declined in popularity with the appearance of imported *A. mellifera carnica* and *A. mellifera caucasia* Pollmann, 1889 (often incorrectly called *A. mellifera caucasica*) [10,11]. As a precaution, conservation measures as early as in the 1970s...
with dedicated legislation were introduced in order to maintain pure *A. mellifera mellifera* in its remaining localizations. Recently, new legislation was also introduced to protect native lines of *A. mellifera carnica* within the limits of its natural occurrence in the Island Beskids located in southern Poland [6]. However, in Poland, there are also non-native *A. mellifera carnica* introduced by beekeepers. Oleksa et al. [12] claimed that the genetic diversity of the northern and western European subspecies of *A. mellifera mellifera* is severely endangered due to hybridization with introduced honeybees of evolutionary branch C and revealed the presence of hybrids in populations formerly considered to be the purest populations of “dark bees” in Poland. Pętnek-Zakar et al. [13] claimed that genetic differences were detected between Polish and Hungarian *A. mellifera carnica*, suggesting the existence of at least two different gene pools within native populations.

Every beekeeper may have individual preferences on honeybee subspecies. The reasons for their choice can vary, and to mention a few, honey yields, gentleness, resilience on environmental conditions or swarming tendency may be considered [14]. Overall, some features are believed to be typical for particular subspecies/types (see the short comparison in Table A1 and conservation breedings localization in Figure A1). Research has proven that morphometrics supported by typical behavioral traits can be used for the identification of individual subspecies and results are comparable with genetic identification (e.g., [15–18]). Additionally, it is worth remembering that it is a good honeybee management practice (supported by scientific recommendations) to change an old queen for a new one—so beekeepers may buy a particular subspecies of honeybee queen according to their own preferences [19].

In order to verify the actual choice of particular honeybee subspecies/types kept across Poland, the survey among Polish beekeepers was conducted annually from 1980 to 2018. This is the way to verify if conservation management helped in the stabilization of the popularity of protected *A. mellifera mellifera* honeybees at a sufficient level in Poland. Considering the economic criterion of honey productivity, it was assumed that this had contributed the most to beekeepers’ preferences towards honeybee subspecies.

2. Materials and Methods

2.1. Survey Design

Annually hard copies of 1500 questionnaires were sent to several beekeepers’ associations all over Poland and to individual beekeepers who had declared their cooperation with The National Institute of Horticultural Research. It was at the discretion of the respondents to complete the questionnaire and send back individual answers to the address of the Apiculture Division of The National Institute of Horticultural Research. Questionnaires collected from 1980 to 2018 in which beekeepers responded to, i.a., such questions as: (1) maintained honeybee subspecies/types, (2) number of colonies in the apiary, (3) geographical location of the apiary, (4) obtained amount of harvested honey, were analyzed (Table A2). Questionnaires covered more ground with no relevance to the results presented in this analysis (e.g., queen management practices elaborated by Bieńkowska et al. [19])—the full translated version is provided and available as Supplement S1.

Collected data were compiled and analyzed in terms of:

- Maintained honeybee subspecies/types reported by beekeepers:
  - *Apis mellifera carnica* (distinguishing native and non-native was not possible);
  - *Apis mellifera caucasia*;
  - *Apis mellifera mellifera*;
  - Buckfast;
  - Unknown origin—in this category beekeepers declarations stating the following were included: unknown origin of queen from previous generation and colonies from swarming.
- Apiary size, as follows:
  - Small apiaries, from 1 to 20 colonies;
Medium apiaries, from 21 to 60 colonies;
Big apiaries, above 60 colonies.

• Geographical location, distinguished in accordance to cardinal directions of voivodeships on the map of Poland:
  West (lubuskie, zachodniopomorskie);
  North (pomorskie, warmińsko-mazurskie);
  East (lubelskie, podlaskie);
  Central (kujawsko-pomorskie, łódzkie, mazowieckie, świętokrzyskie, wielkopolskie);
  Southwest (dolnośląskie, opolskie, śląskie);
  South (małopolskie, podkarpackie).

• The 4–5 year timeslots, as follows: (1) 1980–1983, (2) 1984–1988, (3) 1991–1994, (4) 1996–2000, (5) 2001–2005, (6) 2006–2010, (7) 2011–2014, (8) 2015–2018;

• Average annual amount of harvested honey per colony.

2.2. Statistical Analysis

In the first step, some questionnaires were discarded from analysis due to missing data. The 68 questionnaires were excluded due to lack of declaration regarding kept honeybee subspecies/types. Additionally, 67 questionnaires were excluded due to lack of honey harvest declaration.

The number of honeybee subspecies/types kept in the apiary and the occurrence of each subspecies/type were analyzed in relation to: 4–5 year timeslots, apiary sizes and regions of Poland. The second-order interaction effects were also considered. In order to avoid underestimation, due to the low data frequency (less than 5 questionnaires received), triple “timeslot × apiary size × region” interactions could not be analyzed. Due to the fact that the descriptors were non-normally distributed, generalized linear models (GLMs) were used for the analysis of the data. The numbers of honeybee subspecies/types kept in apiaries were analyzed by means of GLMs, with a logarithmic link function and Poisson distribution functions. The occurrence of each honeybee subspecies/type was treated as binomial variable and modeled by using GLMs with a logistic link function. The likelihood ratio test (LRT) was used to test the goodness-of-fit of the final version of model and to test significance of individual effects (Supplement S2). When the significance of a given effect was detected, the differences between levels were tested by Wald’s test.

In the case of estimating the influence of the tested effects on honey harvest, the classical linear ANOVA model was applied. The significance of differences among levels was evaluated using Tukey’s HSD test for unequal samples and t-test for unequal variances.

Calculations and analyses were made by using STATISTICA v. 13 (Dell Inc., Austin, TX, USA, 2016).

3. Results

With each result, we gave the total number of responses because due to the somewhat low response rate among beekeepers, the presented results should be approached with some caution. When analyzing the results, it is also important to bear in mind that the respondents may have been different from year to year—some respondents answered every year, some beekeepers answered only once; in some cases, there was a generational change in apiaries. We have made every effort to present the results objectively and to anonymize the data before analysis in order to present results as close to reality as possible.

The maintenance of *A. mellifera carnica* has gradually increased since 1980 (Figure 1). In the last year (2018) included in the analyses, the *A. mellifera carnica* percentage reached a peak at over 90% value. On the contrary, the percentage of *A. mellifera caucasia* has never exceeded the 20% level, and since 2009 it has dramatically fallen below 10%, never meeting a sufficient increase. The percentage of *A. mellifera mellifera* dropped from about 40% to below 10% through the analyzed period. Levels of percentage occurrence of *A. mellifera caucasia* and *A. mellifera mellifera* crossed each other in about 2003, and since then, their
popularity has switched a few times. On the basis of the analyzed surveys in the 1990s, Buckfast honeybees appeared in Polish apiaries, and their popularity grew after 2007, and since then, it fluctuated around the 10% level. On the basis of the survey, it can be stated that the percentage of *A. mellifera carnica* significantly exceeds other subspecies and types of honeybees through all except the first analyzed period.

![Figure 1](image)

**Figure 1.** Percentage of honeybee subspecies/types kept by beekeepers in Poland based on annual declarations in the survey from 1980 to 2018 analyzed in 4-5 year timeslots. A line chart shows the average percentage of a given subspecies/type of honeybee reported by beekeepers in relation to all surveys collected in a given timeslot. Some beekeepers could have mentioned more than one honeybee subspecies/type (according to the actual state in their apiary); therefore, the sum of percentages in a given year does not equal 100%. The same letters in the row of the table indicate that percentage of honeybee subspecies/types are not significantly different among timeslots according to Wald’s test at *p* ≤ 0.05.

Figure 2 shows a change in the awareness of Polish beekeepers with regard to the subspecies/types of honeybees they maintain. Since the 1980s, approximately 30% of beekeepers did not know exactly what kind of honeybees they were keeping. However, since the mid-1990s, there has been a sharp downward trend, and no more than about 10% of beekeepers were unable to identify the exact origin of their honeybees (or it was uncertain/unconfirmed—see our qualification strategy in subsection “Survey Design” in the “Methods” section).

The majority of beekeepers (from 65.7% in 1980–1983 to 89.8% in 2015–2018) maintained one subspecies/type of honeybee in the apiary (Table 1). However, there is a slight statistical fluctuation among a minority of those who kept more than one origin of honeybees. On average, over 20% of beekeepers kept two honeybee subspecies/types between 1980 and 2005. In the 1980s some interviewees decided to keep even four honeybee types, and a significant downward change of that trend may be observed since then. Until 2000, over 5% of beekeepers kept honeybees of three origins, and afterward, this trend steadily declined. Since 2001, there have been no beekeepers declaring maintenance of four subspecies in one apiary. After 2010, the percentage of beekeepers declaring maintenance of honeybees of one origin raised slightly, with a parallel decrease of those keeping two or three honeybee subspecies/types.
Table 1. Number of honeybee subspecies/types kept in apiaries by beekeepers in Poland based on annual declarations in the survey from 1980 to 2018 analyzed in 4–5 year timeslots. For each timeslot mean, standard error and maximum/minimum values are provided. The same letters indicate that number of honeybee subspecies/types are not significantly different among timeslots according to Wald’s test at \( p \leq 0.05 \).

| 4–5 Timeslot | Number of Bee Subspecies/Type Kept in Apiary (%) | Mean ± SD | \( n \) |
|--------------|-----------------------------------------------|-----------|-----|
| 1980–1983    | 65.7 ± 3.0 24.1 ± 4.6 7.8 ± 1.0 2.4 ± 0.5 | 1.47 ± 0.74 abc | 510 |
| 1984–1988    | 69.3 ± 2.8 22.0 ± 3.4 6.5 ± 0.8 2.3 ± 0.7 | 1.42 ± 0.72 ab | 820 |
| 1991–1994    | 75.7 ± 3.6 18.5 ± 2.6 5.3 ± 0.7 0.4 ± 0.1 | 1.31 ± 0.59 bd | 449 |
| 1996–2000    | 72.0 ± 3.2 22.3 ± 2.9 5.5 ± 1.0 0.3 ± 0.1 | 1.34 ± 0.59 abc | 364 |
| 2001–2005    | 74.1 ± 3.5 23.0 ± 3.2 2.9 ± 0.6 0.0 ± 0.0 | 1.29 ± 0.51 bd | 274 |
| 2006–2010    | 81.6 ± 2.9 14.1 ± 2.6 4.3 ± 0.7 0.0 ± 0.1 | 1.23 ± 0.51 cd | 185 |
| 2011–2014    | 90.2 ± 3.7 6.8 ± 0.8 3.0 ± 0.6 0.0 ± 0.0 | 1.13 ± 0.42 cd | 132 |
| 2015–2018    | 89.8 ± 3.6 8.8 ± 0.8 1.4 ± 0.2 0.0 ± 0.0 | 1.12 ± 0.36 cd | 147 |

Figure 3 shows the general percentage trend in the choice of honeybees and the number of subspecies/types and their geographical distribution in regions of Poland. Until 2000, a roughly proportional percentage distribution in diversity of honeybees subspecies/types could be observed. After that time, the presence of *A. mellifera carnica* increased in the south, and this trend was followed by other regions in the following years. At the same time, the lowest occurrence of *A. mellifera mellifera* was always noted in the southwest and south regions. Since 2011, overall, the presence of *A. mellifera mellifera* has been worryingly low, or they are even absent. Currently, a high share of *A. mellifera mellifera* is still noticed only in the eastern region. From Figure 3, it can be concluded that in all regions, popularity of *A. mellifera carnica* has grown simultaneously. Buckfast first occurred in the southwest region of Poland in 1980–1983, and is currently declared in the majority of the country.
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2000, a roughly proportional percentage distribution in diversity of honeybees subspecies/types could be observed. After that time, the presence of *A. mellifera carnica* increased in the south, and this trend was followed by other regions in the following years. At the same time, the lowest occurrence of *A. mellifera mellifera* was always noted in the southwest and south regions. Since 2011, overall, the presence of *A. mellifera mellifera* has been worryingly low, or they are even absent. Currently, a high share of *A. mellifera mellifera* is still noticed only in the eastern region. From Figure 3, it can be concluded that in all regions, popularity of *A. mellifera carnica* has grown simultaneously. Buckfast first occurred in the southwest region of Poland in 1980–1983, and is currently declared in the majority of the country.

![Figure 3. Overview on general percentage trend of particular subspecies/types of honeybees in selected regions of Poland, divided into 4–5 year periods from 1980 to 2018. Regions were distinguished in accordance to current voivodeships administrative borders: west (lubuskie, zachodniopomorskie), north (pomorskie, warmińsko-mazurskie), east (lubelskie, podlaskie), central (kujawsko-pomorskie, łódzkie, mazowieckie, świętokrzyskie, wielkopolskie), southwest (dolnośląskie, opolskie, śląskie), south (małopolskie, podkarpackie). Statistical analyses were based on number of declarations; however, results are visualized in percentage terms and the total number of responses for a given region for a given timeslot was treated as 100%. Only in the cases when there were enough answers for valid statistical analysis a circle diagram is given; otherwise, there is no answer. The same letters indicate that percentage of honeybee subspecies/types are not significantly different among regions according to Wald’s test at $p \leq 0.05$.]

In general, data analysis presented in Table 2 showed that there is no difference in the number of honeybee subspecies/types kept by beekeepers regardless of apiary size. However, results from 2015–2018 revealed there is an overall reduction of maintained subspecies/types in an apiary (it corresponds with results presented in Table 1).
Table 2. Number of honeybee subspecies/types kept in small (1–20 colonies), medium (21–60 colonies) and big (>60 colonies) apiaries by beekeepers in Poland based on annual declarations in the survey from 1980 to 2018 analyzed in 4–5 year timeslots. For each timeslot mean, standard error and maximum/minimum values are provided. The same letters indicate that number of honeybee subspecies/types are not significantly different among different apiary sizes, for each timeslot separately, according to Ward’s test at $p \leq 0.05$.

| 4–5 Timeslot | Apiary Size | Number of Be Subspecies/Type Kept in Apiary (%) | Mean ± SD | n  |
|--------------|-------------|-----------------------------------------------|-----------|----|
|              | 1–20 colonies | 21–60 colonies | >60 colonies | 1 | 2 | 3 | 4 |             |
| 1980–1983    | 69.4 | 24.6 | 5.2 | 0.7 | 1.37 ± 0.62 a | 134 |
| 1984–1988    | 78.0 | 20.0 | 4.5 | 0.5 | 1.31 ± 0.58 a | 200 |
| 1991–1994    | 71.4 | 20.7 | 7.1 | 0.7 | 1.37 ± 0.65 a | 140 |
| 1996–2000    | 87.2 | 9.0  | 2.6 | 1.3 | 1.18 ± 0.53 a | 78 |
| 2001–2005    | 76.4 | 22.2 | 1.4 | 0.0 | 1.25 ± 0.47 a | 72 |
| 2006–2010    | 89.3 | 8.9  | 1.8 | 0.0 | 1.13 ± 0.38 a | 56 |
| 2011–2014    | 89.2 | 8.1  | 2.7 | 0.0 | 1.14 ± 0.42 a | 37 |
| 2015–2018    | 88.9 | 11.1 | 0.0 | 0.0 | 1.11 ± 0.32 a | 45 |

Figure 4 shows that the subspecies/types composition in apiaries of different sizes varied in the 1980–1983 and 1984–1988 timeslots. Since 1996, preferences towards the maintenance of *A. mellifera carnica* have shot up in all apiaries regardless of their size, and the trend steadily rose to the very end of this study. In 1980–1983 *A. mellifera mellifera* was the most popular in small apiaries, and the same pattern appeared in 1991–1994. Although, it reversed in 2006–2010, when beekeepers from the biggest apiaries preferred *A. mellifera mellifera*, more than owners of small and medium ones. Yet, analyses revealed that in most timeslots, there are no differences in preferences of beekeepers, regardless of the size of their apiary.
Figure 4. Percentage share of particular subspecies/types of honeybees kept in small (1–20 colonies), medium (21–60 colonies) and big (>60 colonies) apiaries by beekeepers in Poland based on annual declarations in the survey from 1980 to 2018 analyzed in 4–5 year timeslots. Bar graphs show the average percentage of a given subspecies/type of honeybee reported by beekeepers in relation to all surveys collected in a timeslot. The same letters indicate that percentage share of particular subspecies/types of honeybees are not significantly different among different apiary sizes, according to Wald’s test at \( p \leq 0.05 \). Some beekeepers could have mentioned more than one honeybee subspecies/type (according to the actual state in their apiary); therefore, the sum of percentages in a given timeslot does not equal 100%.

From Figure 5, it can be seen that beekeepers keeping one honeybee subspecies/type harvested significantly more honey from those who kept two subspecies/types.

Figure 5. Average amount of honey harvest per colony depending on the number of honeybee subspecies/types kept in apiaries by beekeepers in Poland based on annual declarations in the survey. This is the analysis of the average values reported by beekeepers from 1980 to 2018. Means followed by the same letters are not significantly different according to Tukey HSD test at \( p \leq 0.05 \).
In the case of the presence of every honeybee subspecies/type, there was a significant difference between average amount of honey harvest per colony (Figure 6). Beekeepers harvested more honey only when *A. mellifera carnica* or Buckfast honeybees were present in the apiary, whereas honey harvest was lower in those apiaries where only *A. mellifera caucasia*, *A. mellifera mellifera* or honeybees of unknown origin were present.

![Figure 6](image-url)

**Figure 6.** Average amount of honey harvest per colony depending on the honeybee subspecies/types maintained in the apiary. This is the analysis of the average values reported by beekeepers from 1980 to 2018. This is the analysis assuming the presence (=1) or absence (=0) of the honeybee subspecies/types in the declaration. As “presence”, only those questionnaires in which one analyzed subspecies was declared, whereas in “absence”, all other declarations in which analyzed species were not mentioned, regardless of number of subspecies kept in apiary, were considered. (****) means are significantly different according to *t*-test for unequal variances at *p* ≤ 0.001.

4. Discussion

The Food and Agriculture Organization of the United Nations, on a basis of research conducted in 2018, identified 34 subspecies (including hybrids) of *A. mellifera* [20]. Honeybees subspecies have been estimated to diverge 0.7–1.3 million years ago [21,22], and ecotypes have developed behavioral and phenological adaptations to local environments, characterized by specific climatic conditions and patterns of resource availability [7,23]. Four subspecies/types: *A. mellifera carnica*, *A. mellifera mellifera*, *A. mellifera caucasia* and Buckfast are continuously reported across Poland. However, since 1991, there has been a significant decline in the maintenance of number of subspecies/types from four to three and then since 2011, respectively, from three to a maximum of two kept by a singular beekeeper in one apiary. In Poland, indigenous *A. mellifera mellifera* has been proven to lose currency, whereas *A. mellifera carnica* gained popularity among beekeepers. Polish apiaries approach a homogeneous share with the exclusive presence of *A. mellifera carnica* subspecies. Consequently, *A. mellifera mellifera* has become a niche—limited mainly to conservative breeding [24]. It is worth noting that the “dark bee” is still present in its remaining range of occurrence. These results follow the statement of Hassett et al. [25] that the natural range of *A. mellifera mellifera* has been significantly reduced in recent years as a result of the import and replacement of queens with those of other honeybee subspecies. Additionally, it is common knowledge that each honeybee subspecies requires a different
approach in terms of management. Therefore, it might be understandable that in the 1980s, beekeepers kept more subspecies/types than in recent years because they looked for a suitable one for their management style, and once they found their best match, they reduced the number of kept subspecies/types per apiary. Simultaneously, already in the early 1990s, Moritz [26] stated that German honeybee breeders have tried to replace the autochthonous honeybee population of *A. mellifera mellifera* with *A. mellifera carnica* for more than 40 years. This is due to a belief that *A. mellifera carnica* is more adaptable to management practices.

Several reports have shown that native honeybees have some advantages over exotic ones. As a case in point, Alqarni [27] stated that in the Arabian Peninsula, the native *A. mellifera jemenitica* colonies had significantly more active pollen-gathering foragers than the exotic *A. mellifera carnica*. Another example of differences between indigenous and exotic honeybee subspecies might be the statement of Ali et al. [28] that there is a strong inverse correlation between smaller hypopharyngeal glands’ acini size and lipofuscin accumulation of native *A. mellifera jemenitica* in comparison with two imported honeybee subspecies (*A. mellifera carnica* and *A. mellifera ligustica*). According to Iqbal et al. [29], the native *A. mellifera jemenitica* were relatively slow learners with reduced memory retention compared to the other two introduced European bees (*A. mellifera carnica* and *A. mellifera ligustica*). All these differences mentioned above indicate that origin of honeybee subspecies matters, and whereas it might be without clear economic importance for beekeepers, it allows honeybees to adapt better to the native environment. Additionally, Saltykova et al. [30] showed that purebred *A. mellifera mellifera* and *A. mellifera caucasia* had some advantages over hybrids in the development of the protective response with the participation of antibacterial peptides. What is more, Ostroverkhova [31] claimed that the majority of honeybee colonies covered by the study infected by *Nosema* were hybrids. Additionally, some populations have been found to naturally survive Varroa mite infestation [32]. However, when removed from their native environment, these populations became non-resistant, suggesting that the mechanism of resistance is dependent on genotype–environment interactions [33–35]. Unfortunately, as specified by Hassett et al. [25], a substantial amount of *A. mellifera mellifera* populations throughout Europe are heavily hybridized. The data of Moritz [26] indicate that the honeybees of Germany form hybrid types between *A. mellifera mellifera* and *A. mellifera carnica*. Therefore, pure populations of *A. mellifera mellifera* still need to be protected. Hence, it is a positive remark that currently only approximately 10% of Polish beekeepers declared maintenance of hybrids, an unknown origin of the queen from previous generation or colonies from swarming in their apiaries.

One interesting finding of Kovačić et al. [36] is that generally, colonies with purebred queens from breeding programs had better scores for defensive behavior, calmness and swarming. In Poland, it is recommended to replace at least 30% of queens every year. Bieńkowska et al. [19] stated that Polish beekeepers generally replace almost 52% of their queens, 21% of which are purchased. In the last decade, there was an upward trend in the percentage of beekeepers replacing queens throughout Poland. Additionally, it is a strong belief that the increase of beekeepers’ awareness in regard to subspecies performance and apiary management practices was higher in recent years due to courses and seminars provided for beekeepers through the Agricultural Production Support Project [37]. This has led beekeepers to turn their attention to the most economically viable subspecies. Additionally, it is worth noting that the Polish Association of Honeybee Queen Breeders was only established in 2019 [38] to provide Polish beekeepers with easy access to high-quality purebred queens. This indicates that there may be good prospects for future honeybee conservation and management.

According to the report published by European Commission in spring 2020, Poland is one of the countries with the largest honey production in the EU. Currently, Poland is in third place in terms of the number of hives and second in terms of the number of beekeepers in the EU Member States [39]. Poland is also the second EU Member State in
terms of the number of professional beekeepers [40]. The results of the presented study indicated that there were no preferences among small, medium and big apiary owners with regard to how many subspecies/types to maintain, as well as (with a slight distinction) in terms of chosen honeybee subspecies/types. Eventually, all beekeepers in Poland turned to *A. mellifera carnica*, which is the most reliable and efficient subspecies/type of honeybee in the country in terms of honey yield. Additionally, results designated, maintenance of only one optimal subspecies per apiary gives better outcomes for honey harvesting. These may be causes of such great economic performance of Polish beekeepers in comparison with other EU countries. However, we should consider that intensive beekeeping threatens the extinction of native/local honeybee subspecies and populations by favoring the expansion of only the most productive and adaptive subspecies or ecotypes [41].

In order to control the state of honeybees’ population, the non-profit honeybee research association COLOSS (Prevention of honeybee COLony LOSSes) [42] monitors honeybee colonies following international standards. As a result of this initiative, honeybee control via citizen scientists, beekeepers or crowdsourcing has been carried out for a couple of years in a number of countries (e.g., Austria is just one example of highly efficient data collection and great involvement of beekeepers themselves [43]). Scientists from COLOSS demonstrated strong interactions of honeybees’ genotype and environment. Consequently, the conservation of honeybee diversity and the support of local breeding activities is indicated to be prioritized in order to prevent colony losses, optimize sustainable productivity and enable a continuous adaptation of honeybees to environmental changes [33,44]. It is worth noticing that the conservation of honeybees raises a lot of controversy with arguments for and against such actions (e.g., [45–50]). Therefore, it is important to emphasize following Alaux, Le Conte and Decourtye [41] that “there is a need for implementing adequate policies to protect native and locally adapted honeybees since they provide an important reservoir of adaptation for beekeeping activity and crop pollination services. For that purpose, rather than creating opposition between managed honeybees and wild pollinators, and creating conflicts between stakeholders, we need to find ways to reconcile wild pollinator conservation with responsible and sustainable beekeeping practices (… )”.

In Poland, both COLOSS-connected research and independent surveys showed, as already mentioned in this paper, the increasing impoverishment of the honeybee subspecies composition. Therefore, it is worth considering the effectiveness of the country’s conservation policy. Amendments of conservation management and policy are necessary to promote maintenance of native subspecies at a sustainable level as current measures seem to be scarce or are not persuasive enough for beekeepers. Additionally, the rapid expansion of cultivation of many pollinator-dependent crops has the potential to trigger future pollination problems for both these crops and native species [51]. Such environmental costs implicate consideration during the development of agriculture and conservation policies. Lack of political will, followed by low national priority for collection of honeybee population data and a lack of funding for such research, are principal reasons for inaction among some countries [20]. All these arguments point to the need for a change that considers the current honeybees’ situation and also for continued research funding on the topic.

5. Conclusions

- Awareness within Polish beekeepers as to which subspecies/types of honeybees they maintain has grown through the years.
- *Apis mellifera carnica* is the most popular among Polish beekeepers.
- Currently, approximately 90% of beekeepers in Poland maintain only one subspecies/type of honeybees in a single apiary.
- It should be recommended to consider novel solutions, e.g., in legislation, to increase the effectiveness of conservation management efforts as the popularity of native dark European bee (*A. mellifera mellifera*) has declined over time and Polish beekeepers are less and less willing to choose it for their apiaries.
Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/agriculture11070652/s1, Supplement S1: Full version of the questionnaire (translated into English); Supplement S2: Probability (p) of LRT statistic of tested effects for descriptors.

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Appendix A

Table A1. Compilation of characteristics of honeybee subspecies/types present in Poland. Information compiled on basis of Adam [52]; Demianowicz [53]; Ruttner [23].

| NAME                      | Apis mellifera mellifera | Apis mellifera carnica | Apis mellifera caucasia | Buckfast               |
|---------------------------|--------------------------|------------------------|-------------------------|------------------------|
| STATUS                    | Native in northern regions | Native and non-native  | Non-native              | Non-native (synthetic) |
| SIZE OF BODY AND TONGUE   | - Large body size;       | - Medium body size;    | - The smallest european | There is no size       |
|                           | - Short tongue (from 5.90 | - Medium-length tongue | honeybee;               | standard               |
|                           | to 6.30 mm)              | (from 6.40 to 6.80 mm) | - The longest tongue    |                        |
|                           |                          |                        | (from 6.70 to 7.25 mm)  |                        |
| COLORATION                | Dark without yellow      | Dark and covered with  | Grey with a silvery     | wide, yellow stripes   |
|                           | stripes, and the hair is | short but very thick   | tint covered with short | on tergites            |
|                           | relatively long but rare | hair with a silvery    | hairs                   |                        |
|                           |                          | shade                  |                         |                        |
| GENTleness                | Aggressive in defending  | Very gentle, and during | Gentle, and during the   | Very calm and gentle,  |
|                           | the colony and fairly    | the inspection, they   | inspection they hold    | strong hold on to the  |
|                           | mobile; they form clusters| calmly and strongly    | strongly on to the      | combs, low tendency to |
|                           | on the lower bar after   | hold on to the combs   | combs                   | swarm                  |
|                           | removing the combs       |                        |                         |                        |
|                           | from the nest            |                        |                         |                        |
Table A1. Cont.

| NAME | Apis mellifera mellifera | Apis mellifera carnica | Apis mellifera caucasia | Buckfast |
|------|--------------------------|-----------------------|-------------------------|----------|
| DEVELOPMENT | Develop slowly in spring, whereas in late summer, the queens lay eggs very intensively so that the colonies overwinter in great strength | - Spring development is early and very dynamic | - Perform forage flights in lower temperatures than other honeybees | - Create big and strong colonies |
| | | - Create strong colonies | - Creates quite small colonies | - Overwinter well |
| PRODUCTIVITY | | High honey productivity | Ability to quickly find new food resources | Forage high quantities of pollen and do not produce a lot of propolis |
| OTHER | Shows increased resistance to certain diseases (such as nosemosis) | Use propolis poorly in their nests | - Increased tendency to robbery; | - Glue down their nest heavily before overwintering |

Figure A1. Localization of honeybee conservation breedings in Poland. On basis of Farm Animal Genetic Resource Protection Programs [24].

Table A2. Number of questionnaires with sufficient answers to be included in statistical analyses.

| TIMESLOT | APIARY SIZE | CARDINAL DIRECTIONS ON THE MAP OF POLAND 1 | IN TOTAL |
|----------|-------------|--------------------------------------------|---------|
|          |             | West | North | East | Central | South-West | South |       |
| 1980–1983 | 1–20        | 17   | 7     | 4    | 51      | 25         | 30     | 134   |
|          | 21–60       | 32   | 28    | 32   | 69      | 67         | 32     | 260   |
|          | >60         | 18   | 19    | 15   | 44      | 13         | 7      | 116   |
| 1984–1988 | 1–20        | 15   | 18    | 12   | 84      | 29         | 42     | 200   |
|          | 21–60       | 62   | 67    | 61   | 126     | 89         | 69     | 474   |
|          | >60         | 18   | 26    | 19   | 42      | 17         | 24     | 146   |
## Table A2. Cont.

| TIMESLOT       | APIARY SIZE | CARDINAL DIRECTIONS ON THE MAP OF POLAND | IN TOTAL |
|----------------|-------------|------------------------------------------|----------|
|                |             | West | North | East | Central | South-West | South |          |
| 1991–1994      | 1–20        | 11   | 12    | 21   | 53      | 20          | 23     | 140      |
|                | 21–60       | 27   | 28    | 34   | 57      | 34          | 42     | 222      |
|                | >60         | 16   | 15    | 16   | 25      | 5           | 10     | 87       |
| 1996–2000      | 1–20        | 1    | 10    | 15   | 30      | 19          | 3      | 78       |
|                | 21–60       | 27   | 28    | 30   | 68      | 30          | 30     | 213      |
|                | >60         | 15   | 7     | 7    | 23      | 5           | 16     | 73       |
| 2001–2005      | 1–20        | 3    | 8     | 10   | 41      | 10          | 0      | 72       |
|                | 21–60       | 20   | 2     | 21   | 41      | 31          | 17     | 132      |
|                | >60         | 8    | 7     | 3    | 27      | 6           | 19     | 70       |
| 2006–2010      | 1–20        | 3    | 5     | 14   | 23      | 7           | 4      | 56       |
|                | 21–60       | 4    | 2     | 23   | 40      | 11          | 14     | 94       |
|                | >60         | 12   | 2     | 2    | 12      | 4           | 3      | 35       |
| 2011–2014      | 1–20        | 4    | 7     | 3    | 16      | 0           | 7      | 37       |
|                | 21–60       | 14   | 7     | 15   | 26      | 4           | 1      | 67       |
|                | >60         | 9    | 1     | 4    | 11      | 3           | 0      | 28       |
| 2015–2018      | 1–20        | 0    | 4     | 8    | 17      | 0           | 16     | 45       |
|                | 21–60       | 8    | 3     | 14   | 8       | 3           | 2      | 34       |

1 Distinguished in accordance to voivodeships: west (lubuskie, zachodniopomorskie), north (pomorskie, warmińsko-mazurskie), east (lubelskie, podlaskie), central (kujawsko-pomorskie, łódzkie, mazowieckie, świętokrzyskie, wielkopolskie), southwest (dolnośląskie, opolskie, śląskie), south (małopolskie, podkarpackie).

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