The identity of nest-site scouts in honey bee swarms

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Abstract – The identity of the scout bees in a swarm of honey bees (*Apis mellifera* L.) is determined by 1) which bees of the parental colony leave in the swarm, and 2) which bees of the swarm scout for nest sites. This study identifies the nest-site scouts by comparing the age distributions of the parental colony, the foragers of the parental colony, the swarm, and nest-site scouts in the swarm for four prime swarms and two afterswarms. Statistical differences were found between the age distributions of the swarm and the parental colony, the scouts and the swarm, and the scouts and the foragers. The median age of the swarm bees was lower than that of the colony bees, that of the scouts was higher than that of the swarm bees, and that of the scouts was slightly less than that of the foragers. These results suggest that the nest-site scouts are primarily middle-aged bees which have foraging or flight experience. Functional hypotheses for these results are discussed. © Inra/DIB/AGIB/Elsevier, Paris

***Apis mellifera* / honey bee / swarm / scout bee / age distribution**

1. INTRODUCTION

Honey bees (*Apis mellifera* L.) have evolved an elaborate system for colony-level reproduction, commonly known as swarming. This process begins when a queen and about two-thirds of the workers scramble out of the hive and launch into flight [7]. The bees then quickly cluster nearby, where they may remain for up to a week while searching for a new nest site [19].

Within the cluster, the bees are divided between two behavioral states. The vast majority of the bees in the swarm are inactive. Engorged with honey, these bees function as the swarm's food reservoir [2]. A small minority of the bees, however, are active. They serve as the nest-site scouts, flying from the swarm cluster to discover and inspect potential nest cavities. They then return to report their discoveries by performing waggle dances on the surface of the swarm cluster. Though

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some aspects of this process have been studied in detail ([13], reviewed by [11] and [19]), little is known about the nest-site scouts themselves. This study identifies the nest-site scouts by examining the age distribution of the bees who engage in scouting activities for both prime swarms and afterswarms.

The age distribution of the nest-site scouts is determined by a two-step process. First, each scout bee must leave the nest in the swarm, and second, each scout bee must engage in scouting. Thus, the scouts are a subset of bees in the swarm (hereafter referred to as 'swarm bees'), which are a subset of the bees in the parental colony (hereafter referred to as 'colony bees'). If bees of each age are not equally likely to leave the nest in the swarm, then the identity of the scouts is determined, in part, during the swarm's initial departure. Therefore, this study focuses on two questions:

1) Are the colony bees of each age equally likely to leave in the swarm?

2) Are the swarm bees of each age equally likely to serve as scouts?

Are the colony bees of each age equally likely to leave in the swarm?

To address this question I test one set of hypotheses:

$H1_O$: the age distribution of the colony matches the age distribution of the swarm, therefore colony bees of each age are equally likely to leave in the swarm.

$H1_A$: the age distribution of the colony does not match the age distribution of the swarm, therefore colony bees of each age are not equally likely to leave in the swarm.

Are the swarm bees of each age equally likely to serve as scouts?

To address this question I test the following set of hypotheses:

$H2_O$: the age distribution of the swarm matches the age distribution of the scouts, therefore swarm bees of each age are equally likely to serve as scouts.

$H2_A$: the age distribution of the swarm does not match the age distribution of the scouts, therefore swarm bees of each age are not equally likely to serve as scouts.

If the evidence supports $H2_A$, then the question arises, Who are the scouts? An experiment performed by Lindauer [5] suggests that the scouts are bees that recently served as foragers prior to swarming. Lindauer marked a large proportion of the nectar and pollen foragers in a colony. Then, when the colony swarmed 8 d later, these marked bees consistently appeared among the bees that investigated several artificial nest sites that he had set up. His conclusion was that forager bees had given up their previous occupation to become scout bees. While illuminating, this result does not provide a complete picture of the scout bees' identity because it shows only that *some* scouts were previously foragers; it does not show that *all* scouts were previously foragers. Lindauer's experimental design did not allow him to determine whether bees besides the foragers participate in scouting.

Are all nest-site scouts bees that were previously foragers?

To answer this question I test the following set of hypotheses:

$H3_O$: the age distribution of the scouts matches the age distribution of the foragers prior to swarming, which suggests that all nest-site scouts are bees that had been foragers in the parental colony prior to swarming.

$H3_A$: the age distribution of the scouts does not match the age distribution of the foragers prior to swarming, which indicates that all nest-site scouts are not bees that had been foragers in the parental colony prior to swarming.

To test these three sets of alternative hypotheses the age distributions of four groups of bees are needed: 1) the bees of

the parental colony, 2) the foragers of the parental colony, 3) the bees of the swarm produced by this colony, and 4) the nest-site scouts of this swarm. These age distributions were obtained by establishing bees of known age in each of five colonies and allowing them to swarm naturally. Four prime swarms and two after-swarms were used in the study.

2. METHODS

2.1. Study site and observation hives

Observation hives were established at the Liddell Field Station, in Ithaca, New York state (42°26' N, 76°30' W). The area is composed predominantly of mixed forests and fields, which provide both ample foraging and many possible nest sites. In early May, each of five observation hives was stocked with a queen, brood, and roughly 2 000 bees of the Italian variety (*Apis mellifera ligustica*). The hives were similar in design to the one described by Seeley [12], holding two frames each, with internal dimensions of approximately 49.5 × 48.6 × 4.3 cm. The bees entered each hive through a transparent 63.5 × 5.7 × 5.1-cm Plexiglas tunnel which led into only one side of the comb in order to create an easily watched dance floor. A pair of 2.5-cm diameter holes (normally covered by wire mesh) was present in the top of each hive to facilitate the introduction of new bees. The hives were installed with entrances facing approximately north, and were spaced approximately 3.1 m apart. The entrances opened onto a small lawn with trees nearby (12 m on average), providing cluster sites for swarms.

2.2. Establishing colonies containing bees of known age

Between 5 May and 22 July 1996 a cohort of 100 0-d-old bees was added to each of the five hives every 3 d. Every bee was marked identically on the thorax with a dot of paint, composed of a mixture of ground artist pigment and shellac. The bees used in these cohorts were sisters of the bees installed in the observation hives. To obtain the 0-d-old bees, brood frames were removed from apiary colonies, brushed free of bees, and placed in an incubator at 34 °C for approximately 18 h. The bees which had emerged at the end of this period were designated as '0 d old'.

2.3. Handling the swarms

During the peak of the swarming season in Ithaca, from late May through early July [4], the observation hives were watched closely for signs of swarming. Most conspicuous among these is the construction of queen cells, culminating in their capping, usually 1 d before or on the day of swarming [19]. When a colony began to swarm, the transparent entrance tunnels of the hive were covered with black cloth to facilitate the bees' exit from the hive. The swarm was then dealt with in one of two ways. If the queen was seen exiting the hive, she was caught and quickly transferred to a small, wooden cage which was then wired to a 1.3-m-tall wooden observation cross hammered into the ground. The bees then assembled on the observation cross. If the queen was not seen or captured, the swarm was allowed to settle where it desired. Usually this was on a tree branch, which was then cut and wired to the observation cross. The second most common settling site was on the outside wall of the Liddell Field Station. If this occurred in a location where the swarm was difficult to observe, the swarm was knocked off the wall onto a sheet, the queen was found, and she was put in a cage wired to the cross, as above. If the swarm clustered on the wall in a convenient location it was simply observed where it was. On all but the rainiest days, when the bees were not active, observations continued from about 0830 hours until dusk, when the bees ceased dancing.

2.4. Determining the age distributions of the colonies

The age distribution of the labeled bees in each observation hive was determined by making periodic censuses. These were conducted after dark, when all of the bees were in the hive. Both sides of each hive were divided into 16 sectors (roughly 12.4 × 12.2 cm each) covering all the comb surface. The number of bees in each age cohort within each sector was then recorded. This was repeated for the other side of the hive and for the entrance tunnel. Cen-

suses were taken every 3 d or when deemed necessary according to the state of the colony. Because not every bee in the hive could be seen, these censuses represented a sample, not a complete survey, of the bees in the colony.

2.5. Determining the age distributions of the foragers

As soon as the first cohort of bees of known age began to forage, I started making records of the age distribution of the foragers. This was realized by observing the number of foragers of each age returning to the hive through the transparent entrance tunnel. Bees with pollen loads on their hind legs were recorded as foragers. Pollen foragers were used almost exclusively because even partially full pollen baskets are conspicuous. However, nectar foragers seen performing waggle dances were sometimes included in the sample, especially when there were few pollen foragers. The target number of observations was 50 foragers per hive. Data were normally collected every 3 d (weather permitting), but nearly daily for colonies about to swarm.

2.6. Determining the age distributions of the scouts

While the bees were in the swarm cluster, nest-site scouts of known age were recorded and marked distinctly on the thorax with an additional paint mark to prevent double counting any bee. Because foraging is virtually absent during swarming [6], waggle dances observed on the surface of the swarm were assumed to be for potential nest sites. Any bee performing the dance was recorded as a scout. The target number of observations was 50 scout bees of known age for each swarm, but the number actually recorded varied greatly depending on swarm size, proportion of bees of known age, and weather conditions. If the queen was not caged, all observations had to be completed before the swarm finished choosing a nest site in order to prevent its departure and subsequent loss of data on its age distribution.

2.7. Determining the age distributions of the swarms

Once the observations for each swarm were completed, the swarm was transferred to a hive stocked with frames of comb. The hive remained at the site of the observation cross for the remainder of the day to enable all scout bees to return to it. In the evening, the entrance holes were plugged and the swarm was killed by pouring about 50 mL of xylenes inside the hive. All the bees of known age and the scouts were then counted. The number of unmarked bees was estimated by dividing the total weight of the unmarked bees by the average weight of a bee from that swarm.

2.8. Statistical tests

To test whether the age distributions of two groups of bees (*a* and *b*) matched, the number of bees *observed* in each age class of group *a* was compared to the number of bees *expected* in each age class of group *b* if the size of group *b* were the same as that of group *a*. The G-test for goodness of fit, as described by Sokal and Rohlf [16], was used to test for the significance of the differences between the observed and expected age distributions.

3. RESULTS

3.1. Summary and classification of swarms

Table I presents a summary of the six swarms used in this study. The swarms emerged between 11 June and 22 July. Four were prime swarms and two were afterswarms. Prime swarms occurred only when a hive was crowded to capacity (roughly 7 500 bees). A swarm was classified as an afterswarm if it followed a prime swarm and was headed by a virgin queen. Swarm E was the second prime swarm to depart from colony E, the first being much earlier in the summer and not used in this study. Both afterswarms emerged about 2 weeks after a prime swarm, though at least one unsuccessful attempt to leave the hive preceded each successful emergence by an afterswarm. The average size of the prime swarms was 2 209 bees, though one swarm (D) was notably smaller than the rest. The size of afterswarm A is unknown because it abandoned the

Table I. A summary and classification of the swarms used in this study.

Colony of swarm origin	Class	Date of emergence (1996)	Size (# of bees)	% scouts
B	prime	11 June	2 414	5.26
C	prime	11 June	2 460	14.29
D	prime	28 June	325	5.71
E	prime	22 July	3 635	3.20
A	afterswarm	25 June	unknown	unknown
D	afterswarm	12 July	1 900	3.26

hive in which it was placed before it could be censused.

Within 30 min of the formation of the swarm cluster, bees were seen advertising nest sites by performing waggle dances on the surface of the swarm cluster. These dances were usually accompanied by rapid locomotion and brief flights from the cluster. Bouts of weaker dances of a shorter duration were also performed by mildly excited bees. Roughly 10 % of the bees in each swarm were of known age. Of these bees, a (geometric) mean of 5.37 % participated in scouting (*table I*).

3.2. Are the colony bees of each age equally likely to leave in the swarm?

Figure 1 shows, for each swarm, the observed age distribution of the swarm bees and the expected age distribution based on that of the colony bees. The bees of both the prime and afterswarms showed significant differences in age distribution relative to the colonies from which they came ($P < 0.005$ in all five cases). Therefore, $H1_O$ may be rejected in favor of $H1_A$: the age distribution of the colony does not match the age distribution of the swarm. Bees of all ages accompanied the swarms, but there were many more young bees and many fewer old bees in the swarm than one would expect based on the age distribution of the bees in the parental colony. The median age of the swarm bees was always smaller than the median age of the colony bees, except for swarm E, where young bees were rare. The age distribution of swarm E roughly parallels that of its parental colony.

3.3. Are the swarm bees of each age equally likely to serve as scouts?

Figure 2 shows, for each swarm, the observed age distribution of the scout bees and the expected age distribution based on the age distribution of the swarm bees. In all cases the difference is highly significant ($P < 0.005$). Therefore $H2_O$ may be rejected in favor of $H2_A$: the age distribution of the swarm does not match the age distribution of the scouts.

The nest-site scouts were mostly middle-aged and older bees. In the June swarms (C, B, D, and afterswarm A) almost all of the scouts were 15–37 d old, while for swarm E, later in the season, the age range was broader, with scouts as young as 8 d and as old as 47 d. Bees under 1 week old were never seen to adopt the task of scouting, but were always present in the cluster. The median age of the scouts was always higher than the median age of the swarm bees, even in swarm E, which

contained a more even distribution of ages than did the other swarms. The disparity between the median age of the swarm bees and the median age of the scouts is noticeably greater for afterswarm D than for the prime swarms.

3.4. Are all nest-site scouts bees that were previously foragers?

Figure 3 shows, for each swarm, the observed age distribution of the scouts compared to the expected age distribution

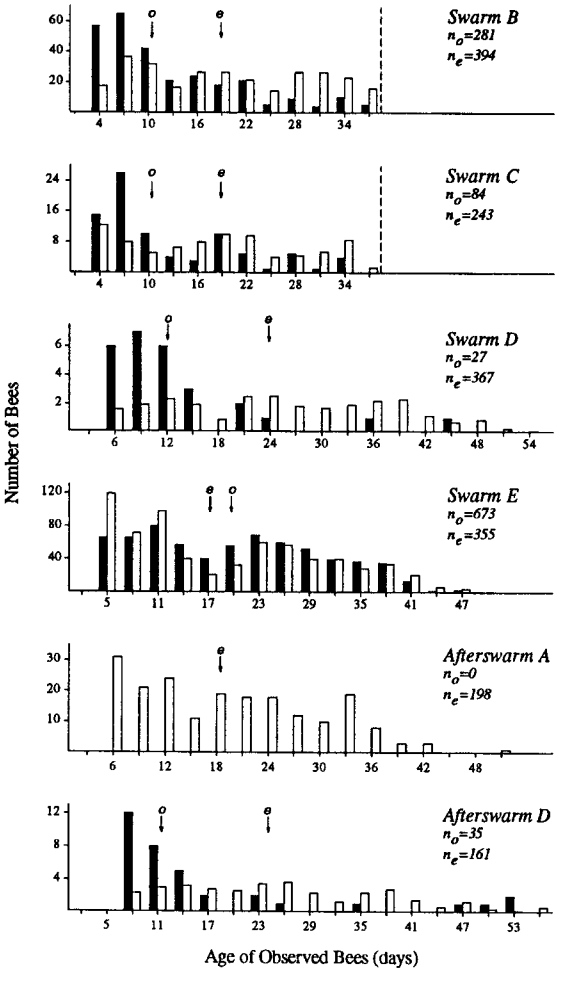

Figure 1. The age distributions of the swarm bees versus the age distributions of the colony bees. The solid bars represent the number of bees observed in the swarm, open bars represent the number of bees expected if the swarm were composed of bees randomly drawn from the parental colony. The dashed lines indicate a truncation of data; the oldest cohort of bees of known age was only 38 d old when swarms B and C occurred. The sample size for both the observed (swarm) and expected (colony) distributions are given. The 'o' and 'e' indicate the median age class for the observed and expected distributions, respectively. The age distributions of the swarms do not match those of the parental colonies.

based on the foragers of the parental colony. In all cases the difference between the two distributions is highly significant (for prime swarms B and C, and afterswarms A and D, $P < 0.005$; for prime swarms D and E, $0.005 < P < 0.01$). Therefore $H3_O$ may be rejected in favor of $H3_A$: the age distribution of the scouts does not match the age distribution of the foragers.

There appear to be more young bees and fewer old bees scouting than would be expected if the scouts were drawn ran-

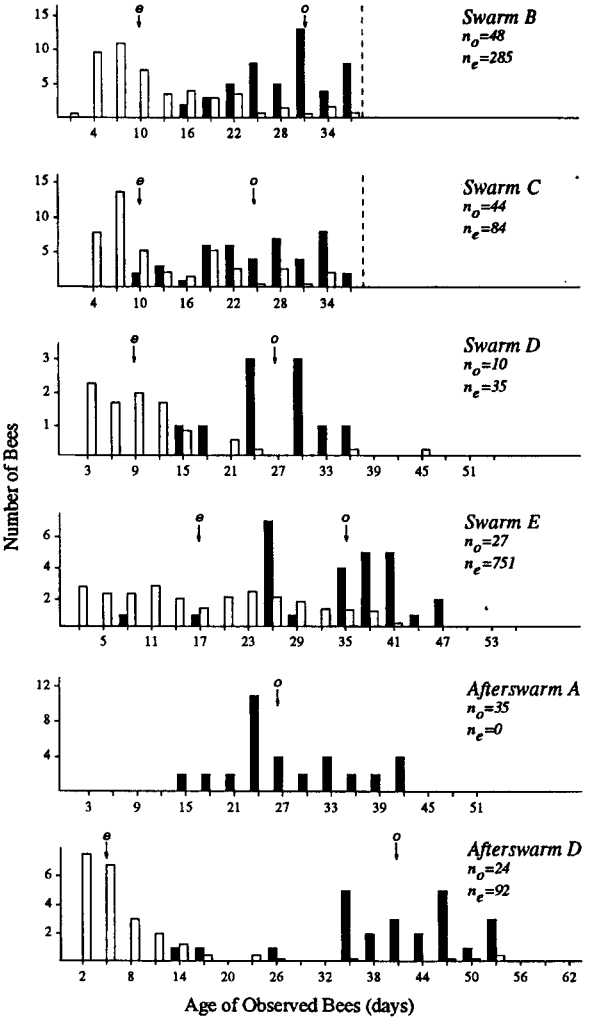

Figure 2. The age distributions of the nest-site scouts versus the age distributions of the swarm bees. Solid bars represent the number of scouts observed in the swarm, open bars represent the number of bees expected if the scouts were drawn randomly from the bees of the swarm. The sample size for both the observed (scouts) and expected (swarm) distributions are given. The 'o' and 'e' indicate the median age class for the observed and expected distributions, respectively. The age distributions of the scouts do not match those of the swarms.

domly from the pool of foragers. For every swarm, except afterswarm D, the median age of the nest-site scouts was slightly lower than that of the foragers. The ranges of the two distributions are similar, though every swarm had at least one age class of younger bees which contained scouts but not foragers. The converse of this trend (age classes of older bees with foragers but not scouts) may exist as well, but this is less clear due to the absence of the oldest age classes for swarms B and C.

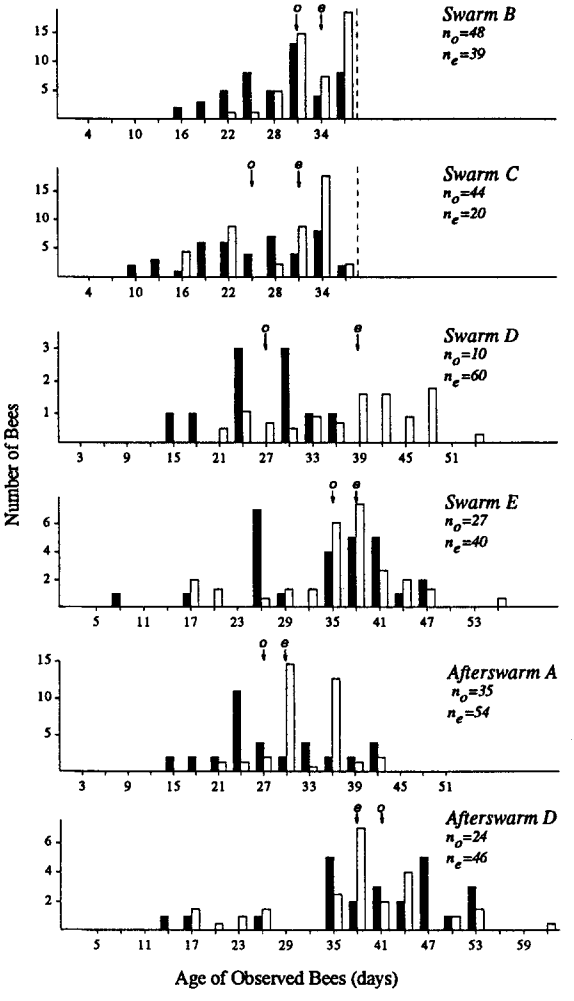

Figure 3. The age distributions of the nest-site scouts versus the age distributions of the foragers in the parental colonies. Solid bars represent the number of observed scouts, open bars represent the expected number of bees expected if the scouts were drawn randomly from the pool of foragers. The sample size for both the observed (scouts) and expected (foragers) distributions are given. The 'o' and 'e' indicate the median age class for the observed and expected distributions, respectively. The age distributions of the scouts do not match those of the foragers.

4. DISCUSSION

4.1. The colony bees of each age are not equally likely to leave in the swarm

Swarm composition has been studied in detail, but with inconsistent results (summarized in Simpson and Riedel [15] and Severson [14]). It was originally proposed by Sturges [17] that swarms are composed mostly of older bees, but Rösch [9] concluded that bees of all ages are present in the same proportion as the parent colony. Then Butler [1] reported that it is mostly the young and middle-aged bees that make up a swarm, though all ages are represented. Since then it has been suggested that only relatively young bees swarm [18] and again that bees of all ages accompany swarms [8, 15]. The results of this study agree with Butler [1] in that there are more young bees and fewer old bees in a swarm than there would be if a swarm's members were a random sample of the parental colony. Winston [19, 20] suggested that this trend is due to the fact that when a new colony is established there is a delay in the production of workers. Even if the queen could begin laying the day the colony was founded, there would still be 21 d until the colony had a new batch of workers. Considering that forager mortality has been estimated at 10 % per day ([3, 10]; cited by Seeley [12]), if primarily older bees (foragers) accompanied the swarm then mortality during this period would be high and might endanger colony survival. Because of this we might expect somewhat younger bees to accompany a swarm. Whether or not forager mortality is the ultimate cause of this pattern, we should expect a high proportion of young bees in a swarm because, as Butler [1] points out, swarming occurs during the late morning and early afternoon when a large number of the older bees are away from the hive foraging, and thus are not present to join the swarm's departure from the hive.

4.2. The swarm bees of each age are not equally likely to serve as scouts

The oldest bees of the swarm are the nest-site scouts. There may be several explanations for this. The first possibility to be considered is that this pattern is an artifact of the experiment. It may have been that the composition of the swarm changed between when the scouts were observed and when the swarm was censused, and that in this time interval a large number of the older swarm bees were lost. This could be a result of severe mortality of older bees, a flow of the older bees back to the parent colony, or perhaps because a group of older bees moves to a prospective nest site to guard it. However, the persistence of individually marked scouts over the course of the observational period (recovery of 25 of 27 scout bees in swarm E) suggests that the effect of these processes is not great enough to explain the high proportion of old bees that acted as scouts. A possible functional explanation for this pattern is that it is in the best interest of the swarm to conserve young bees because several weeks will pass before the new colony produces more bees, as suggested by Winston [19] and Winston and Otis [20]. A third reason for old bees to serve as scouts may be that young bees are not able to function as well as older bees in the task of nest-site scouting. This explanation meshes well with the results of this study and with Lindauer's [6] suggestion that the experience gained from foraging is a prerequisite of nest-site scouting.

4.3. All the nest-site scouts may be bees that were previously foragers

The comparison between the nest-site scouts and the foragers does not allow us to conclusively answer the question of whether all the nest-site scouts were pre-

viously foragers. Despite the statistical differences between the two age distributions, their ranges are very similar for all but swarm D (*figure 3*), and the differences between the median ages of the scouts and foragers are small. Therefore the hypothesis that all the scouts are bees which had previously been foragers cannot be refuted.

There are several plausible explanations for why the median age of the scouts is slightly lower than the median age of the foragers. First, the age distribution of the scouts in the swarm was compared to the age distribution of the foragers in the parental colony, not to the age distribution of the foragers in the swarm. Since the bees of the parental colony are not represented equally in the swarm (*figure 1*), the colony's older foragers may have remained with the colony during swarming, thus creating a swarm containing mostly young foragers. Second, the occurrence of age classes which were observed scouting, but not foraging, may be due to an incomplete sample of the foragers of the colony. Stochastic effects arising from small sample sizes could result in a failure to detect all age classes that contained foragers, causing one or two age classes to contain scouts but not foragers. Third, even if there were age classes with bees that scouted without having previously foraged, their number may be exaggerated somewhat by the sampling technique that was used. Since scouting and foraging data were not taken concurrently, but were separated by an average of 1.5 d (with a range 0–4 d), a young bee who was not a forager while the foraging data were being taken might, by the time the hive swarmed, have become a forager. If this bee then scouted, she would have contributed to an age class for which I would have recorded bees scouting without having previously foraged.

Because the task of nest-site scouting is similar to the task of foraging (both involve long-distance flights from a central location), it is easy to imagine that bees which had previously foraged might be the best scouts. However, the real prerequisite for scouting may be flight experience, not foraging experience. If so, then all scouts need not have been foragers previously, since bees perform their orientation flights starting a week or more before they begin foraging [19]. This could explain the occurrence of young age classes for which scouting, but not foraging, was observed. Only further studies of nest-site scouts will conclusively answer the question of whether all nest-site scouts have previously served as foragers.

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Résumé – L'identité des éclaireuses à la recherche d'un site de nidification dans les essaims d'abeilles (*Apis mellifera* L.) On sait peu de choses concernant les individus qui dans les essaims d'abeilles font œuvre d'éclaireuses à la recherche d'un site de nidification (RSN), mais il a été suggéré que ce pourrait être des abeilles qui ont été auparavant butineuses dans la colonie mère. L'identité des éclaireuses d'un essaim dépend de deux facteurs : a) dans la colonie, quelles

abeilles essaiment, b) dans l'essaim, quelles abeilles partent en reconnaissance. Cette étude identifie les éclaireuses RSN en répondant aux trois questions suivantes : a) les abeilles des différentes classes d'âge de la colonie sont-elles toutes également susceptibles d'essaimer ? b) les abeilles des différentes classes d'âge de l'essaim sont-elles toutes également susceptibles d'être éclaireuses ? c) toutes les éclaireuses RSN ont-elles été auparavant butineuses ? On a obtenu les réponses en déterminant a) si la répartition de l'âge des abeilles de la colonie correspondait à celle des abeilles de l'essaim, b) si la répartition de l'âge des éclaireuses correspondait à celle des abeilles de l'essaim et c) si la répartition de l'âge des éclaireuses correspondait à celle des butineuses. Les quatre répartitions d'âge ont été obtenues en introduisant des abeilles d'âge connu dans chacune des cinq colonies et en les laissant essaimer naturellement. Quatre essaims primaires et deux essaims secondaires ont été obtenus (*tableau I*). Des différences statistiques entre les répartitions d'âge ont été trouvées dans les trois cas. L'âge médian des abeilles de l'essaim est inférieur à celui des abeilles de la colonie (*figure 1*), ce qui peut être une adaptation à fonder une colonie avec plus de succès. Ce résultat est en accord avec ceux des études précédentes. L'âge médian des éclaireuses est supérieur à celui des abeilles de l'essaim (*figure 2*), ce qui suggère que les jeunes abeilles ne remplissent pas cette tâche aussi bien que les vieilles. L'âge médian des éclaireuses est semblable à celui des butineuses en un peu moins élevé (*figure 3*). Ces résultats suggèrent que les éclaireuses à la recherche d'un site de nidification sont principalement des abeilles moyennement âgées qui possèdent une expérience de butinage ou au moins de vol.

***Apis mellifera* / essaimage / éclaireuse / répartition de l'âge**

Zusammenfassung – Erkennung von Nisthöhlen – Kundschafterbienen in Schwärmen der Honigbienen. Über die Bienen, die in Schwärmen der Honigbienen (*Apis mellifera* L.) als Kundschafterinnen zur Nisthöhlensuche dienen, ist nur wenig bekannt. Es wurde aber vermutet, daß es sich um solche Arbeiterinnen handeln könnte, die zuvor dem Bienenvolk als Sammlerinnen dienten. Die Identität der Kundschafterinnen eines Schwarms wird zunächst dadurch festgelegt, welche der Bienen des Bienenvolks schwärmen, und dann weiterhin dadurch, welche hiervon kundschaften. In dieser Arbeit werden die Nisthöhlen-Kundschafterinnen durch die Untersuchung von drei Fragen bestimmt: 1) Verlassen die Bienen jeden Alters das Volk mit gleicher Wahrscheinlichkeit? 2) Werden die Schwarmbienen jeden Alters mit gleicher Wahrscheinlichkeit zu Kundschafterinnen? 3) Waren alle Nisthöhlen-Kundschafterinnen zuvor Sammlerinnen? Zur Untersuchung dieser Fragen wird untersucht ob 1) die Alterszu- sammensetzung des Schwarms der der Bienen im Volk entspricht; 2.) die Alterszusammensetzung der Kundschafterinnen der der Schwarmbienen entspricht, und 3) die Alterszusammensetzung der Kundschafterinnen der der Sammlerinnen entspricht. Zur Bestimmung der hierzu notwendigen vier Altersverteilungen wurden in fünf Bienenvölkern Arbeiterinnen bekannten Alters erzeugt. Diese Völker bildeten dann auf natürliche Weise Schwärme: vier Vorschwärme und zwei Nachschwärme (*Tabelle I*). Bei allen drei Fragen ergaben sich statistische Unterschiede der Alterszusammensetzung. Der Median des Alters der Schwarmbienen war niedriger als der der Arbeiterinnen des Volkes (*Abb. 1*). Dies könnte eine Anpassung zur Erhöhung der Erfolgsaussicht bei der Koloniegründung sein. Dieses Ergebnis stimmt mit früheren Untersuchungen überein. Der Median des Alters der Kundschafterbienen war höher als der der Schwarmbienen (*Abb. 2*). Dies könnte

bedeuten, daß junge Bienen als Kundschafterinnen weniger geeignet sind als ältere Arbeiterinnen. Der Median des Kundschafterinnenalters war ähnlich, aber geringer, als der von Sammlerinnen (*Abb. 3*). Diese Ergebnisse weisen darauf hin, daß Nisthöhlen-Kundschafterinnen Arbeiterinnen mittleren Alters sind, die bereits Erfahrung als Sammlerinnen oder zumindest Flugerfahrung haben.

***Apis mellifera* / Honigbienen / Schwärme / Kundschafterinnen / Altersverteilung**

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