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An estimate of honeybee colony losses and their perceived reasons during two years in Qena and Luxor Governorates, Upper Egypt.

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Abstract: Honeybees, *Apis mellifera* L. are the most economically valuable pollinators of agricultural crops worldwide. This study was to estimate extent and possible causes of honeybee colony losses in Upper Egypt (Qena & Luxor Governorates) during the fall and winter of 2009/2010 and 2010/2011. The survey of colony losses and potential causes was via questionnaire method. Data of 318 questionnaires completed by beekeepers were analyzed. The collected data indicate that, the number of managed honeybee colonies dropped an estimated 15.15% in the 2009/2010 fall and winter and 30.73% in the 2010/2011 fall and winter with average losses 23.28% during the two years. Survey information indicates that, colony losses range widely depending on operation size. Commercial beekeepers (those operating more than 150 colonies) experienced lower total losses as compared to hobbyist; intermediate and semi-commercial beekeepers. Oriental hornet (*Vespa orientalis*); weather; American foulbrood (AFB) and poor quality queens were the leading self identified reasons of losses in their operations as reported by most beekeepers. This survey data indicates that, 13.36% of all the colonies lost during the two years, died with CCD-like symptoms. Also, more recent estimate reflects a possible increase in the rate of managed colony losses. This report is the first in Egypt to assess the loss in honeybee colonies during the fall and winter. Finally, it must circulate such as this questionnaire to the general Egypt to stand on the extent of the problem and try to understand as well as find the resolving **Key words:** honey bee, *Apis mellifera*, colony loss, mortality, CCD, Upper Egypt, questionnaire

Introduction: The importance of honeybees, *Apis mellifera* to the global world economy far surpasses their contribution in terms of honey production, because bees are used for the pollination of many major crops. More than three-quarters of all flowering plants must be pollinated by an animal visitor. A number of agricultural crops are almost totally (90-100%) depend on honeybee pollination (Klein *et al.*, 2007). The ability to easily move and manage honeybee makes them ideal for this purpose. Commonly cultivated bee stocks in Egypt are *Apis mellifera*

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carnica and *A. m. ligustica*, in addition to the local native race keeping industry, since 1869, there have been at least 18 discrete episodes of unusually high colony mortality documented internationally (Underwood and vanEngelsdorp, 2007). Older records report massive bee colony losses without obvious disease symptoms from Australia in 1872 (Beuhne, 1910). Honeybee colony losses are not uncommon. However, losses in recent years differ from past situations in that colony losses are occurring mostly because bees are failing to return to the hive (which is largely uncharacteristic of bee behavior); bee colony losses have been rapid; colony losses are occurring in large numbers; and the reason(s) for these losses remains largely unknown (Johanson, 2010). High honeybee mortality appears to be widespread, as Canada (Pernal, 2008), Germany, France, Great Britain, and the Netherlands have reported elevated losses over the last several years (Biesmeijer *et al*., 2006). These losses are often poorly documented and epidemiological details, such as symptoms of death, extent of mortality, etc. are mostly non-existent. Such documentation, however, is critical for tracking trends and suggesting underlying causes of mortality.The underlying reason for high colony losses in not completely understood. Queen failure, starvation and *Varroa* mites were identified as leading causes of winter mortality (vanEngelsdorp *et al*., 2008). Another important of *A. m. lamarkii*. Large-scale losses are not new to the bee contributor to mortality has been Colony Collapse Disorder (CCD). One of the key characteristics of this syndrome is that, bees from colony suddenly disappear. Only a handful of young bees with their queen, brood and food stores are found in the hive (Kaplan, 2008). Lack of hard field data on losses, limits a better understanding of the causative factors (Neumann, 2008). The aim of the present study was to investigate the extent of colony losses problem and point out potential causes.

Materials and Methods

This work was carried out in Qena and Luxor Governorates, Upper Egypt from May, 2010 to May, 2011. Sixteen districts were used for surveying the honeybee colony losses during the period from 1st of September 2009 to 1st of March 2010 and during the period from 1st of September 2010 to 1st of March 2011. Nine of these districts belong to Qena Governorate namely: Abu-tesht; Farshut; Nag hammadi; Deshna; El-wakf; Qena; Qift; Naqada and Qus. The other seven districts belong to Luxor Governorate namely: Al-zayneah; Luxor city; Al-qurna; Al-beadiah; Al-tud; Arrmnt and Esna.

Questionnaire method was used to determine the colony losses rate by meetings the beekeepers. 160 and 158 questionnaire were collected at 2009/2010 and 2010/2011, respectively. Ques-

tionnaire form contained mainly the following questions:

In what district do you keep your hives?

How many colonies did you have alive in September?

How many colonies did you have alive in March?

To what do you attribute the cause(s) of death for the colonies that died?

To compare possible differences in colony losses between different sizes of operation, operations were stratified into four groups, namely hobbyist beekeepers (≤ 50 colonies); intermediate beekeepers (51-100 colonies); semi-commercial beekeepers (101-150) and commercial beekeepers (150+ colonies). The mean number of dead colonies per beekeeper was divided by the mean number of colonies alive before winter. The resulting fraction was multiplied by 100 to give a percentage. The mean colony loss rate was calculated for each district; for various group classifications and for each possible cause.

Results

In the year of 2009/2010, the makeup of the beekeepers who contributed the data, 56.25% of respondents, operate less-than or equal to 50 colonies (Fig. 1, a). 40% of respondents operate 51 to 150 colonies. While, the respondents operate more than 150 colonies were 3.75% only. During 2010/2011, 49.37% of respondents own less-than or equal to 50 colonies. 42.4% of respondents operate 51 to 150 colonies. While, 8.26% of respondents were own more than 150 colonies (Fig. 1, a).

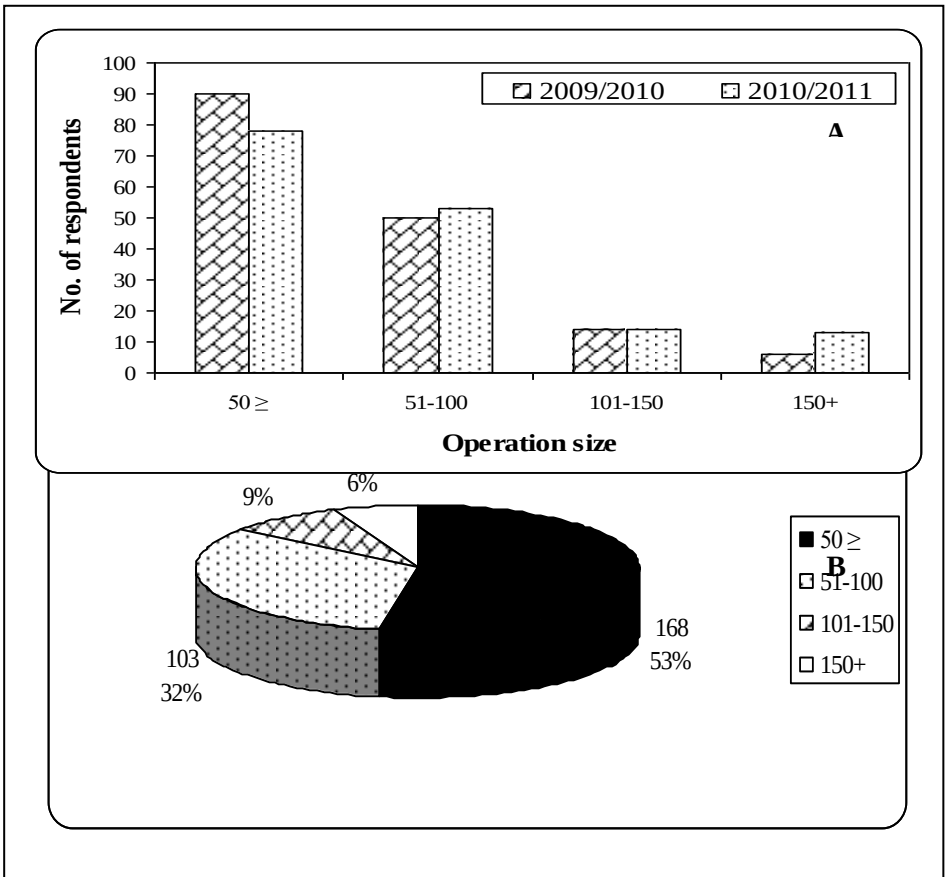

Fig. 1: Distribution of beekeeping operation size among respondents to the survey:
a)2009/2010and2010/2011percentage.b)Generaltotal and mean %.

In general, the makeup of beekeepers who contributed the data, 52.83% of respondents, hobbyist beekeepers, operate ≤ 50 colonies. 32.39% of respondents, intermediate beekeepers, operate 51-100 colonies. 8.81% of respondents, semi-commercial beekeepers, operate 101-150 colonies. In addition, only nearly 6% of respondents, commercial beekeepers, operate 150+ colonies (Fig. 1, b).

Losses by district:

Table (1): Total number and percentage of colony losses in districts of Qena and Luxor Governorates during two years, 2009/2010 & 2010/2011.

District	Colony losses					
	2009/2010			2010/2011		
	No. of colonies (1st September 2009)	No. of colony losses (1st March 2010)	% losses	No. of colonies (1st September 2010)	No. of colony losses (1st March 2011)	% losses
Abu-tesht	604	92	15.23	607	190	31.30
Farshot	804	126	15.67	817	225	27.54
Nag ham-madi	732	106	14.48	693	215	31.02
	678	99	14.60	980	254	25.92
Deshna	646	92	14.24	519	189	36.42
El-wakf	748	124	16.58	821	244	29.72
Qena	895	121	13.52	936	311	33.23
Qift	851	126	16.78	1260	305	24.21
Naqada	843	120	14.23	740	238	32.16
Qus						
Al-zayneah	495	87	17.58	648	229	35.34
Luxor city	551	96	17.42	622	230	36.98
Al-qurna	512	84	19.95	542	208	38.38
Al-beadiah	461	78	16.92	553	158	28.57
Al-tud	613	82	13.38	538	188	34.94
Arrmnt	634	99	15.62	731	212	29.00
Esna	773	110	14.23	820	238	29.02
General Total & Mean	10840	1642	15.15	11827	3634	30.73

The number and percentage of colony losses by district are summarized in Table 1 and Fig. 2. It should be noted that, there wasn't considerable variation in the average percentage of

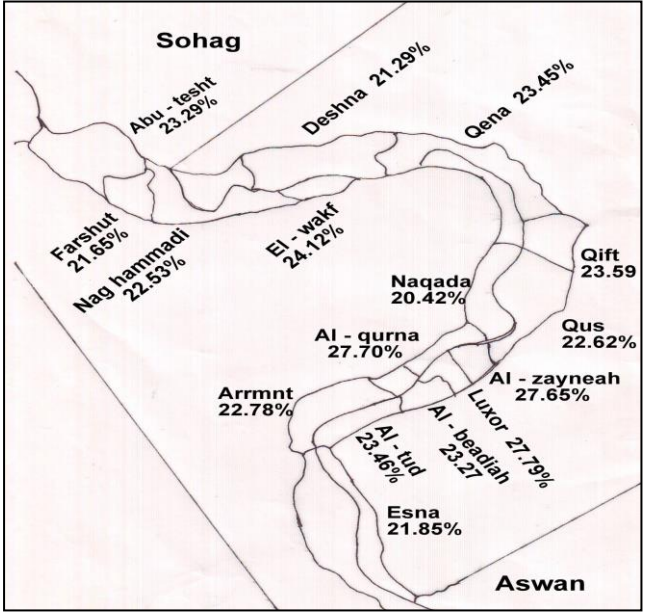

Fig. 2: Average percentage loss of honeybee colonies during two years, 2009/2010 & 2010/2011 in districts of Qena and Luxor Governorates.

colony losses in both 2009/2010 and 2010/2011 and general mean. The data showed during 2009 / 2010 beekeepers in Qena & Luxor Governorates lost 15.15% of their bee colonies. While, they loss 30.73% during 2010/2011 (Table 1). The observed mean colony losses for all districts in 2009/2010 were substantially higher in 2010/2011. The general percentage of colony losses in both two years was about 23.3% (Fig. 2).

Losses by operation classification:

The collected data represent 7384 colonies (52.83%) since most of the replying beekeepers owned small operations, less-than or equal to 50 colonies, (Table 2 & Fig. 1,b). Only 4125 colonies (almost 6%) of the replying beekeepers owned large operations (more than 150 colonies).

The number and percentage of colony losses by operation size are recorded in Table 2 & Fig. 3. There was considerable variation in the percentage loss suffered by operation size. The high percentages loss 19.05% was noticed for the size class less-than or equal to 50 colonies in 2009/2010. While, the low percentage loss 9.07% was showed for the size operation more than 150 colonies in the same year.

Table (2): Total and percentage colony losses experienced by all responding beekeepers in Qena and Luxor Governorates during two years, 2009/2010 & 2010/2011.

Years		Colony losses				
		≤ 50	51-100	101-150	150+	General total and mean
2009/2010	No. of respondents	90	50	14	16	160
	No. of Colonies (1st September 2009)	3964	3709	1767	1400	10840
	No. of colony losses (1st March 2010)	755	559	201	127	1642
	% losses	19.05	15.07	11.38	9.07	15.15
	Rank	1	2	3	4	
2010/2011	No. of respondents	78	53	14	13	158
	No. of Colonies (1st September 2010)	3420	3977	1705	2725	11827
	No. of colony losses (1st March 2011)	1398	1379	358	499	3634
	% losses	40.88	34.67	21.00	18.31	30.73
	Rank	1	2	3	4	

The same trend was found in 2010/2011, where, the high percentage loss 40.88% was recorded for the operation size ≤ 50 colonies. Also, the low percentage loss 18.31% was noticed for the size operation 150+ colonies.

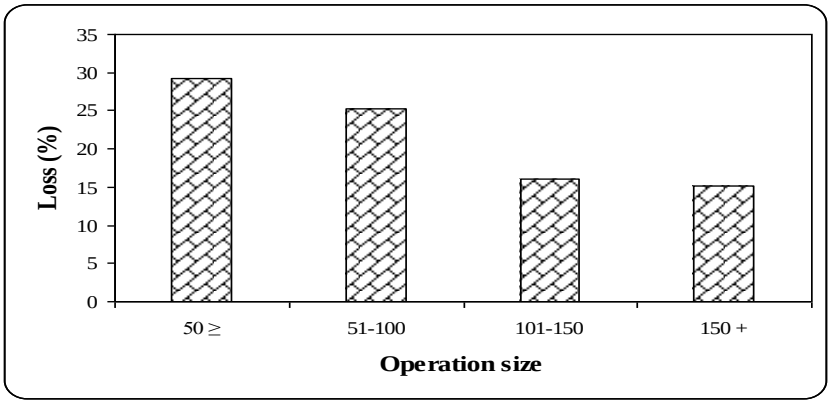

Fig. 3: Average loss levels among the responding beekeepers divided according the operation size during 2009/2010 & 2010/011.

Generally, from obtained data in Fig. 3, we can say that, the level of losses varied widely among the operations. Reversing our report, smaller operations are more likely to have suffered more severe losses than largest operations. Overall, the average percentages losses 29.16; 25.21; 16.10 and 15.18% were recorded for the hobbyist; intermediate; semi-commercial and commercial beekeepers, respectively.

Perceived reason(s) loss:

Respondents were asked to identify why they thought their colonies died. Beekeepers listed eight different potential causes of colony mortality most frequently (Table 3). The importance of these causes listed by beekeepers clearly differed between questionnaire 2009/2010 and 2010/2011. For instance, Oriental hornet, *Vespa orientalis* caused 32.76 and 14.2% of colony losses in 2009/2010 and 2010/2011, respectively. Another example, weather caused 2.45 and 22.56% of colony losses in 2009/2010 and 2010/2011, respectively. The loss caused by AFB had decreased from 25.58% in 2009/2010 to 11.48% in 2010/2011. Due to the fact that AFB disease is being kept reasonably under control. While, the important of poor quality queens nearly wasn't differentiating. Of poor quality queens, caused 16.32 and 14.89 of colony losses during two years 2009/2010 and 2010/2011, respectively.

Table (3): The eight most commonly perceived reasons of colony losses in Qena & Luxor Governorates.

.		Reasons of colony losses								
		Qw	AFB	Starvation	Poor quality queens	Weather	Mites	Pesticides	CCD-like symptoms	Total
2009/2010	No. of colonies losses (1st March 2010)	538	420	53	268	40	28	74	221	1642
	% out of total	4.96	3.87	0.49	2.47	0.37	0.26	0.68	2.04	
	% of losses	32.76	25.58	3.23	16.32	2.44	1.71	4.51	13.46	100
	Rank	1	2	6	3	7	8	5	4	
2010/2011	No. of colonies losses (1st March 2011)	516	417	674	541	820	33	149	484	3634
	% out of total	4.36	3.53	5.70	4.57	6.93	0.28	1.26	4.09	
	% of losses	14.20	11.48	18.55	14.89	22.56	0.91	4.10	13.32	100
	Rank	4	6	2	3	1	8	7	5	

Overall, the mainly reasons given to explain colony loss were oriental hornet (19.98%); weather (16.30%); AFB (15.86%); poor quality queens (15.33%); starvation (13.78%); Colony Collapse Disorder (CCD)-like symptoms (13.36%); pesticides (4.23%) and mites (1.16%). In CCD, bees from a colony suddenly disappear (Fig. 4). Only a handful of young bees with their queen; brood and food stores are found in the hive (Kaplan, 2008). One of the defining characteristics of CCD is the complete absence of dead bees in the hive or apiary (vanEngelsdorp *et al*., 2009).

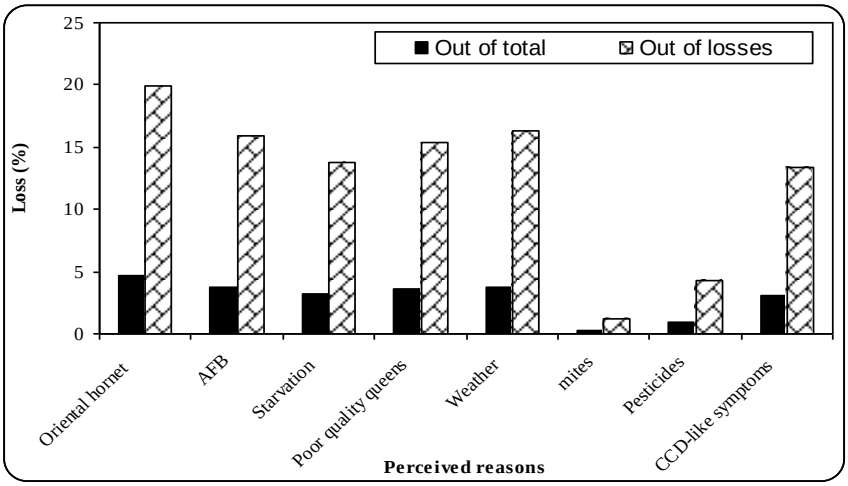

Fig. 4: Average percentage loss of honeybee colonies experienced by respondents classified by self-identified leading cause(s) of mortality during two years 2009/2010 & 2010/011.

Discussion:

This survey records the first year of overwintering colony losses well above the level Egyptian beekeepers consider acceptable. Furthermore, for the second year of colony losses, the average losses were higher than those in the first year (with increasing about 100%). This is agreement with vanEngelsdorp *et al*., 2010, who recorded the total loss nearly doubled from 20% in 2007/2008 to 39% in 2008/2009. The distribution of colony losses in 2009/2010 and 2010/2011 showed a small variation between districts(Table 1 and Fig.2).The highest number of beekeepers who had lost about 29% of their colonies was within the group which had less-than or equal to 50 colonies (Fig. 3). This suggests apiary management plays an important role. Apiaries of this size are usually kept to make some extra money and the main source of income lies outside beekeeping. Therefore, beekeepers often cannot devote sufficient time to dealing properly with their problems or to prevention and controlling of bee disease. May be due to they have not enough experiences. Also, professional management might have played a significant role in prevention of losses. Also, higher losses in small operations were found in Poland (Topolska *et al*., 2008) and in Israel (Soroker *et al*., 2011) but not in US (vanEngelsdorp *et al*., 2008).Responding beekeepers most frequently self identified reasons, such as oriental hornet; weather; AFB and poor quality queens, as the leading causes of mortality in their operations (Table 3). To minimize the damage or loss resulting from the wasps must hunt and kill queens and the transfer of apiaries from infected areas and that in the fall. Also, destroying nests in the spring and summer is clearly a good method of reducing the overall wasp population. In addition to placing wasp traps in apiary as well as, reduce the hive entrance to make it easier for the bees to defend the colony. This survey information indicates that, about 13.4% of all the colonies lost during

2009/2010 and 2010/2011, died by CCD-like symptoms. As a result of climatic differentiation, there are differences between the countries and the regions for reasons lead to colony losses. In US, poor queen and starvation played a key role in colony losses from fall 2007 to spring 2008 (vanEngelsdorp *et al*., 2008). The primary perceived problem for beekeepers was poor queens (31% out of losses). Determining the factors that result in low-quality queens is therefore of fundamental importance for improving colony productivity and fitness. Malnutrition is a stress to bees, possibly weakening the bee's immune system. A weak immune system can affect a bee's ability to fight pests and diseases as well as immunosuppressant may be caused by pathogen or parasite attack (Glinski & Kostro, 2007). While, in Poland, like in Canada, *Varroa destructor* (with associated virus infections) and *Nosema spp.* Played the same role in colony losses during the winter of 2007/2008 (Pernal,2008). A mixture of original research articles; review articles; notes and comments address the possible causes of honeybee colony losses: virus (Berthoud *et al*., 2010; Carreck *et al*., 2010 a, b; Martin *et al*., 2010); *Nosema ceranae* (Paxton, 2010; Santrac *et al*., 2010); *Varroa destructor* (Carreck *et al*., 2010 b; Dahle, 2010; Martin *et al*., 2010); Pesticides (Chauzat *et al*., 2010; Medrycki *et al*., 2010); the effects of acaricides (Harz *et al*., 2010); the loss of genetic diversity (Meixner *et al*., 2010) and loss of the habitats (Potts *et al*., 2010). Scientists are investigating the lack of genetic diversity and lineage of bees, both related to queen quality, as possible causes of CCD. This lack of genetic biodiversity can make bees increasingly susceptible to any pest or disease that invades the system. The importance of genetic diversity has been noted at the individual, the colony, the population, subspecies level in honeybees. There are examples of reduced fitness at the individual and colony level, due to reduced genetic diversity.Increased rates of colony losses in Upper Egypt are probably the result of regional differences in weather patterns that affected forage availability of bees; starvation; *Vespa*; foulbrood and other diseases, in addition to poor quality queens and pesticides. These stresses interacting in combination with each other affected colony survival are believed to be the most important factors related to colony loss in Upper Egypt.**Conclusion** This report documents winter colony losses of 2009/2010 and 2010/2011 in Upper Egypt. This survey effort records high rates of mortality in overwintering colonies. Losses suffered by small sized operations were higher than the losses suffered by larger operations. These results all point to the continuing need to describe colony losses on an annual basis. Concentrated efforts aimed at understanding the un-

derlying causes of these losses are also needed. This report is the first in Egypt to assess the loss in honeybee colonies during the fall and winter. From the above we can recommend the following:

It must circulate such as this questionnaire to the general Egypt to stand on the extent of the problem and try to understand as well as find the resolving.

Effective action to tackle bee colony losses collaboration among the various stakeholders, including government, scientists, beekeeping community and the agriculture industries. Collaborative partnerships between beekeepers and farmers are a key part of the solution.

Further scientific research is needed to identify appropriate solutions to all the relevant factors negatively impacting on bee health.

Knowledge transfer needs to be optimized to ensure that beekeepers have access to knowledge on best practice in bee husbandry.

Local genetic diversity could be useful in reducing colony losses.

Strong healthy colonies are better able to defend themselves.

Improved bee nutrition is a key in dealing with most of the stress factors affecting honey bee health.

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تقدير لفقد طوائف نحل العسل وأسبابه المحتملة خلال عامين في محافظتي قنا والأقصر بصعيد مصر

محمد فتح الله عبد الرحمن و أدهم مصطفى مصطفى

قسم بحوث النحل - معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة - مصر

الملخص العربى

يعتبر نحل العسل (آبيس ميلليفرا) الأكثر قيمة إقتصادية كملقحات للمحاصيل الزراعية في جميع أنحاء العالم. وأجريت هذه الدراسة لتقدير مدى حجم طوائف نحل العسل المفقودة والأسباب المحتملة للفقد وذلك في صعيد مصر (محافظتي قنا والأقصر) خلال فصلي الخريف والشتاء من عامي ٢٠٠٩/٢٠١٠ و٢٠١٠/٢٠١١. تم حصر الطوائف المفقودة والأسباب المتوقعة للفقد بإستخدام طريقة الإستبيان. لقد تم تحليل ٣١٨ إستبيان تم إستيفائها بواسطة النحالين. وتشير البيانات التي تم جمعها إلى أن أعداد طوائف نحل العسل فقدت بمقدار ١٥.١٥٪ في خريف وشتاء ٢٠٠٩/٢٠١٠ وبما يقدر ب٣٠.٧٣٪ في خريف وشتاء ٢٠١٠/٢٠١١ وبمتوسط فقد ٢٣.٢٨٪ خلال العامين. وتشير معلومات الحصر إلى أن معدل فقد الطوائف يعتمد وبصورة كبيرة على حجم الطوائف. فقد وجد أن النحالين التجاريين (أولئك الذين يتعاملون مع أكثر من ١٥٠ طائفة) لديهم إجمالي فقد أقل بالمقارنة مع النحالين الهواه أو المتوسطين أو شبه التجاريين. كما قرر معظم النحالين أن الدبور الشرقي والطقس وتعفن الحضنة الأمريكي والملكات الرديئة هي أهم الأسباب التي تؤدي إلى فقد طوائفهم. وتشير بيانات الحصر إلى أن ١٣.٣٦٪ من جميع الطوائف التي فقدت خلال العامين قد ماتت بسبب أعراض تشبه ظاهرة إختفاء طوائف نحل العسل. أيضا تعكس التقديرات الأخيرة إحتمالية تزايد معدل فقد الطوائف التي يتم تربيتها. ويعتبر هذا هو التقرير الأول في مصر لتقدير فقد طوائف نحل العسل خلال فصلي الخريف والشتاء. وفي النهاية يجب تعميم مثل هذا الإستبيان في عموم مصر للوقوف على حجم المشكلة ومحاولة فهمها وإيجاد حلول لها.