Definition, Survey, Monitoring and Efficiency of Directions of Bird-Trapping Nets for Trapping the Bee-eating Birds (Merops: Meropidae) Attacking Honey Bee Colonies

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Abstract- Experiment was carried out during 2009 and 2010 in two honey bee apiaries belong to Agricultural Extension Department, Ministry of Agriculture, Riyadh, Kingdom of Saudi Arabia. The results showed that there were three species of bee-eaters belonging to family (Meropidae) in the considered location, European bee-eater (*Merops apiaster* Linnaeus, 1758); Olive bee-eater (*Merops superciliosus* Linnaeus, 1766) and Green bee-eater (*Meropa orientalis* Latham, 1802). The three species recorded were migratory and they were found in the apiaries during two seasons (spring and autumn). In spring, they were first appearance in the bird-trapping nets on March 28, 2009, and on April 02, 2010, meanwhile, they were last time in the bird-trapping nets on May 01, 2009 and April 20, 2010. In autumn season, they appeared in the considered apiaries on September 23, 2009 and October 11, 2010, meanwhile, the last time they were appeared in the apiaries on November 04, 2009 and November 01, 2010. Results suggest that the direction of bird-trapping nets significantly affected the number of trapped bee-eaters, the placing of bird-trapping nets in the east side of the apiary and above the apiary led to a significant trapping of more of bee-eaters than when placed in west, north and south directions. In addition, no significant difference was found in trapped bee-eaters during the two inspection periods, in the morning (9 am) and in the evening (5 pm).

Key words- Honey bees, *Apis mellifera*, bee-eating birds, Merops, Merobidae, European bee-eater (*Merops apiaster*), Olive bee-eater (*Merops superciliosus*), Green bee-eater (*Merops orientalis*), definition, survey, monitoring, bird-trapping nets.

1 INTRODUCTION

Bee-eating birds belong to the genus Merops constitute a characteristic part of the bird fauna. Most species are to be found in the savanna biotope and are approximately equally distributed through the tropical part of the continent. The staple diet consists of hymenopters (Order: Hymenoptera), principally honey bees which are captured in flight. The morphological and ecological differences within the group are remarkably small with consideration to the large number of species (18 African). [1] stated that the family: Meropidae includes 24 species, which are divided among seven genera. However, [2] has proposed a reduction from seven to only three genera. They are widely distributed and listed as a problem to beekeepers and beekeeping endeavors in many parts of the world, particularly in Africa and Asia, where they preying on bee yards and in conjunction with honey bee queen-rearing operations [3], [4], [5], [6], [7], [8], [9]. [10] reported that the bee-eaters particularly dangerous to the beekeeping operation because of the tendency of some of the species to attack bees in an apiary in flocks of up to 250 birds. They are found throughout the temperate and tropical areas of the old world; most species are migratory, at least on a local basis [11]. [12] observed 47 species bee-eating birds near the apiaries in Thailand, over 47 species observed nine of them consumed honey bees, but *Merops leschenaulti* and *M. orientalis* ate appreciable numbers. [13] stated that the birds *Nectarina asiatica* and *Merops orientalis*, were major predators of *A. mellifera* in India. [14] studied bee-eaters at sites in southern and central Slovakia, samples of pellets and food remains revealed the presence of 1786 prey objects from over 160 insect species. Although diet diversity was high, honey bees were (28.2-42.4%) and bumble bees, Bombus spp. (16.1-39.5%), constituted the main part of the diet at all sites. He also concluded that of the honey bees (*Apis mellifera*) caught, 53.5% were drones and 46.5% were workers. [15] found that the birds preyed upon drones extremely sporadically and not in a specific way. Hence, their findings had decisive consequences for apiculture, especially for the evolution of drone accumulation in congregation areas.

European bee-eaters (*Merops apiaster*) are migratory, diurnal birds that spend most of their time foraging for food. They have a broad distribution covering much of Europe and Africa with range estimates up to 11,000,000 square km. These migratory birds can be found as far north as Finland and range as far south as South Africa, extending east into some Asiatic countries as well. Most commonly, European bee-eaters usually breed and nest in southern Europe, then migrate south during autumn and winter [16], [17]. They may cause significant damage to a hive if they prey upon the queen [18], meanwhile, [19] listed European bee-eaters as a species of least concern by

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IUCN. Although their numbers have been declining over the past decade, the population (480,000 to 1,000,000 breeding individuals) is still well above any level of threat. [20], [21] found that European bee-eater (*M. apiaster*) has been documented to live up to 5.9 years in the wild, and [22], [23] stated that mixed colonies of European bee-eaters and blue-cheeked bee-eaters can be found foraging together without competition because of minimal diet overlap.

Green bee-eater (*Meropa orientalis*) feed on flying insects and can sometimes be nuisance to beekeepers [24], their preferred prey was mostly beetles followed by hymenopterans, but Orthopterans appear to be avoided [25], they are sometimes known to take crabs [26]. Like most other birds, they regurgitate the hard parts of their prey as pellets [27], an endoparasitic nematodes (*Torquatoides balanocephala*) that live in the gizzard has been found [28].

Different methods were used to protect honey bee (*A. mellifera*) colonies against predation by *Merops* sp. These methods included scaring the birds by drum beating and stone pelting loud noises, scarecrows scaring the birds, including various sound-producing devices and recorded, amplified distress calls made by an injured bee-eater; shooting the birds, poisoning, killing some of them and using net made from nylon [8], [12], [29], [30]. [31] applied three control measures to protect honey bee (*Apis mellifera*) colonies against predation by *Merops orientalis*. These included (A) scaring the birds by drum beating and stone pelting, (B) killing some of them and (C) keeping the colonies in poplar (*Populus deltoides*) plantations. The latter practice was found to be the most effective, and measures at A and B were completely ineffective.

The aim of the presence study was to identify the species of bee-eating birds attack honey bee colonies in the Central Region of Saudi Arabia. It also aimed to monitor the bee-eater for recording their appearance in the apiaries in the considered locations, and the time when they spend in the area. It was planned to evaluate the efficiency of the direction of bird-trapping nets for trapping the bee-eaters to protect honey bees from their attack.

2 MATERIALS AND METHODS

Experiment was carried out during 2009 and 2010 in two apiaries belong to Agricultural Extension Department, Ministry of Agriculture, Kingdom of Saudi Arabia. The honey bee colonies in each apiary are placed in permanent chute (tenet) made from steel columns and its ceiling made from isolated sheets, to keep honey bee colonies from very high air temperature during summer season. Each apiary was about 75 meters in length and 7 meters in width. The number of honey bee colonies in each apiary was 120 colonies of indigenous bees (*A. mellifera jemenitica* Ruttner). Each colony was about seven frames covered with adult bees and about three frames of brood. The distance between the two apiaries was about 600 m.

2.1 Preparation and Setting the Bird-Trapping Nets In The Apiaries

Sixteen bird-trapping nets made from black nylon, each one gauge 15 meters in length and 2 meters in width were used for survey, monitoring, trapping the bee-eating birds and for evaluation the direction of nets for trapping them. Eight bird-trapping nets were used in each apiary; they were placed and distributed in each apiary in five directions as follows:

1. Two were placed in front of the apiary (East direction).
2. Two were placed behind the apiary (West direction).
3. One was placed in left side of the apiary (North direction).
4. One was placed in right side of the apiary (South direction).
5. Two were placed above the apiary (above the chute).

The bird-trapping nets were left in the apiary for trapping bee-eating birds for two years, and they were renewed when damaged. Birds caught were removed from the nets continually as soon as they trapped; they were collected, counted and tabled two times/ day, in the morning (9 am) and in the evening (5 pm) during the presence of the bee-eating birds in the apiaries.

2.2 Species of Bee-Eating Birds Attack Honey Bee Colonies In The Considered Area

The bee-eating birds caught in the bird-trapping nets were described and identified depending on the following characteristics: the shape of the body; length and weight of the bird; the shape of the beak; colours of the feathers; the face, chin, throat, chest, flanks and belly, the shape and colour of eyes, mandible, crown, nape, tail, legs, and the shape of the feet, length of wing [32], [33], [21], [34], [35], [36].

2.3 Survey And Monitoring The Bee-Eating Birds In The Considered Area

Survey and monitoring the bee-eating birds during four seasons (spring, summer, autumn and winter seasons) for two years were studied by recording their first appearance and their numbers were found in the bird-trapping nets, as well as their last date they were found in the nets.

2.4 Efficiency of Direction of Bird-Trapping Nets In Trapping The Bee-Eating Birds

The efficiency of the directions of bird-trapping nets in trapping the bee-eating birds was evaluated by counting the birds caught in each net in five directions for two apiaries two times/day (9 am and 5 pm) through the experiment periods, which was extended for two years.

2.5 Experimental Design And Analysis

All data were analysed using SAS PROC GLM ver. 9.1.3 [37]. ANOVA tests were performed to get P-values, and Least Significant Difference (LSD) tests (α:0.05) were performed for means separation.

3 RESULTS

3.1 Definition The Species of Bee-Eating Birds Attack Honey Bee Colonies In The Considered Area

The survey results showed that there were three migratory species of bee-eating birds belong to Genus: Merops; Family: Meropidae found in the investigated locations, which were:

1- European bee-eater (*Merops apiaster* Linnaeus 1758).
2- Olive bee-eater (*Merops superciliosus* Linnaeus 1766).
3- Green bee-eater (*Meropa orientalis* Latham 1802).

3.2 Survey And Monitoring The Bee-Eating Birds In The Considered Area

The two years survey and monitoring on bee-eating birds attack honey bee colonies in the apiaries showed that the bee-eating birds appeared in the bird-trapping nets in the apiaries in the considered area during spring and autumn seasons. In spring, they were found first trapped in the fourth week of March of the year 2009 (March 28, 2009), but in the year 2010 they were appeared in the first week of April (April 02, 2010). Meanwhile, the last day they were found in the bird-trapping nets was in the first week of May of the year 2009 (May 01, 2009) and in the third week of April of the year 2010 (April 20, 2010). In autumn season, they were appeared in the apiaries in the fourth week of September of the year 2009 (September 23, 2009), but they were appeared in the second week of October of the year 2010 (October 11, 2010). In addition, the last day they were appeared in bird-trapping nets in autumn season was on November 04, 2009 and November 01, 2010.

The survey and monitoring results also summarized that the bee-eating birds spent in the apiaries in the investigated area 35 and 19 days in spring, 2009 and 2010, respectively. Meanwhile, they spent 43 and 21 days in autumn, 2009 and 2010, respectively. It also concluded that non bee-eating birds were caught during summer and winter seasons.

3.3 Efficiency of Direction of Bird-Trapping Nets In Trapping The Bee-Eating Birds

The mean numbers of bee-eating birds trapped in bee-eating birds placed in different directions in two apiaries during spring and autumn seasons through experiment period extended two years is summarized in Table (1 and 2).

3.3.1 Mean Numbers of Trapped Bee-Eating Birds In Bird-Trapping Nets During Spring Season In The First And Second Inspection Apiaries

3.3.1.1 First Inspection Apiary

Table (1) showed that in spring, 2009 during the first inspection period (9 am) the bird-trapping nets placed in east direction and above the apiary significantly trapped a higher number of bee-eaters (1.730 and 2.000 bee-eater/day), respectively, followed by nets placed in north and south directions (1.135 and 1.243 bee-eater/day). Meanwhile, the bird-trapping nets placed in west direction significantly caught fewer number of bee-eaters (i.e. 0.838 bee-eater/day) (F= 1.55, df= 7, P= 0.1899). In spring, 2010 the bird-trapping nets placed above the apiary significantly caught a higher number of bee-eaters (2.571 bee-eater/day), followed by east direction (1.857 bee-eater/day). Meanwhile, the bird-trapping nets placed in west, north and south directions significantly trapped fewer number of bee-eaters (0.952, 0.952 and 1.095 bee-eater/day), respectively (F= 9.96, df= 7, P= <0.0001) (Table 1).

At the second inspection period (5 pm) the bird-trapping nets placed above the apiary significantly caught a higher number of bee-eaters (1.676 bee-eater/day), followed by east direction (1.216 bee-eater/day), meanwhile, the nets placed in west, north and south directions significantly trapped fewer number of bee-eaters (0.541, 0.757 and 0.730 bee-eater/day), respectively during spring 2009 (F= 10.85, df= 7, P= <0.0001). In spring 2010 (5 pm), the nets placed in east direction and above the apiary significantly trapped a higher number of bee-eaters (1.952 and 1.467 bee-eater/day), followed by those placed in north and south directions (0.952 and 0.952 bee-eater/day), meanwhile, nets placed in west direction significantly trapped fewer number of bee-eaters (0.714 bee-eater/day) (F= 7.06, df= 7, P= <0.0001) (Table 1).

3.3.1.2 Second Inspection Apiary

Data in Table (2) showed that in spring 2009 at 9 am the bird-trapping nets placed in the east direction and above the apiary significantly trapped a higher number of bee-eaters (1.568 and 1.973 bee-eater/day), meanwhile, the nets placed in west, north and south directions significantly trapped fewer number of bee-eaters (i.e. 0.784, 1.027 and 1.135 bee-eater/day), respectively, (F= 9.31, df= 7, P= <0.0001). In spring 2010 at 9 am the nets placed above the apiary significantly trapped a higher number of bee-eaters (2.286 bee-eater/day), followed by the east direction (1.667 bee-eater/day), meanwhile, the nets placed in west, north and south directions significantly trapped fewer number of bee-eaters (0.667, 0.810 and 0.857 bee-eater/day), respectively (F= 16.53, df= 7, P= <0.0001).

At the second inspection period (5 pm) bird-trapping nets placed above the apiary significantly trapped a higher number of bee-eaters (1.541and 1.714 bee-eater/day) during spring 2009 and 2010, respectively,

followed by the nets placed in east direction (1.135 and 1.333 bee-eater/day) during spring 2009 and 2010 respectively. Meanwhile, the bird-trapping nets placed in west, north and south directions significantly trapped fewer number of bee-eaters (0.486, 0.676, and 0.649 bee-eater/day), respectively, during spring 2009 (F= 13.68, df= 7, P= <0.0001), and (0.524, 0667 and 0.714 bee-eater/day) for west, north and south directions, , respectively, during spring 2010 (F= 14.71, df= 7, P= <0.0001) (Table 2).

3.3.2 Mean Numbers of Bee-Eaters Trapped In Bird-Trapping Nets During Autumn Season In The First And Second Inspection Apiaries

3.3.2.1 First Inspection Apiary

In autumn 2009 at 9 am the bird-trapping nets placed in east direction and above the apiary significantly trapped a higher number of bee-eaters (1.822 and 2.000 bee-eater/day), respectively without significant difference between them, followed by those placed in west, north and south directions (0.689, 1.022 and 0.800 bee-eater/day), respectively (F= 7.57, df= 7, P= <0.0001) (Table 1). In Autumn 2010 at 9 am the bird-trapping nets placed above the apiary and in the east direction significantly trapped a higher number of bee-eaters (1.583 and 1.125 bee-eater/day) without significant differences between them, followed by those placed in west and north directions (0.833 and 0.667 bee-eater/day). Meanwhile, the bird-trapping nets placed in south direction significantly trapped fewer number of bee-eaters (0.583 bee-eater/day) (F= 4.79, df= 7, P= 0.0013) (Table 1).

In autumn (2009) at the second inspection period (5 pm) the bird-trapping nets placed in east direction and above the apiary significantly trapped a higher number of bee-eaters (1.333 and 1.444 bee-eater/day), respectively, followed by nets placed in west, north and south directions (0.533, 0.644 and 0.511 bee-eater/day), respectively (F= 9.23, df= 7, P= <0.0001). Meanwhile, in the year (2010) the bird-trapping nets, which placed above the apiary significantly caught a higher number of bee-eaters (1.708 bee-eater/day), followed by east direction (1.375 bee-eater/day) and west direction (0.875 bee-eater/day). Meanwhile, the bird-trapping nets placed in north and south directions significantly caught fewer number of bee-eaters (i.e. 0.458 and 0.417 bee-eater/day) (F= 11.23, df= 7, P= <0.0001) (Table 1).

3.3.2.2 Second Inspection Apiary

In autumn, 2009 at 9 am, the bird-trapping nets placed above the apiary and in the east direction significantly trapped a higher number of bee-eaters (i.e. 1.800 and 1.489 bee-eater/day), respectively without significant difference between them, followed by those which placed in west, north and south directions (0.578, 0.889 and 0.689 bee-eater/day), respectively (F= 11.27, df= 7, P= <0.0001) (Table 2). In autumn, 2010 the bird-trapping nets placed above the apiary and in the east side of the apiary significantly trapped a higher number of bee-eaters (1.333 and 1.00 bee-eater/day), respectively, without significant difference between them, followed by the nets placed in west direction (0.625 bee-eater/day). Meanwhile, the bird-trapping nets placed in north and south directions significantly trapped fewer number of bee-eaters (0.583 and 0.583 bee-eater/day), respectively (F= 5.25, df= 7, P= 0.0006) (Table 2).

At the second inspection period (5 pm), the bird-trapping nets placed in east direction and above the apiary significantly trapped a higher number of bee-eaters (1.222 and 1.333 bee-eater/day) and (0.985 and 1.250 bee-eater/day), during autumn 2009 and 2010, respectively, followed by those placed in west, north and south directions (0.444, 0578 and 0.467 bee-eater/day), respectively, during autumn 2009 (F= 10.84, df= 7, P= <0.0001), and (0.583, 0.458 and 0.500 bee-eater/day), respectively during autumn 2010 (F= 7.84, df= 7, P= <0.0001) (Table 2).

Regardless the direction of bird-trapping nets, no significant differences were found in numbers of caught bee-eaters during the first inspection period (9 am) and the second inspection periods (5 pm) (Table 1 and 2).

4 DISCUSSION

The survey and monitoring results showed that there were three migratory species of bee-eaters belong to Genus: Merops; Familty: Meropidae, were found in the considered location, which were (European bee-eater (*Merops apiaster* Linnaeus 1758), Olive bee-eater (*Merops superciliosus* Linnaeus 1766) and Green bee-eater (*Merops orientalis* Latham 1802)). The presence findings were found in agreement with data obtained by [38] who found that European bee-eater (*M. apiaster*) in Saudi Arabia and [29] who found Blue-cheeked bee-eater (*M. superciliosus*) and European bee-eater (*M. apiaster*) in Saudi Arabia.

In the current study no bee-eating birds were found in the bird-trapping nets during summer and winter seasons, which mean no sedentary subspecies in the area. This findings was found in agreement with data obtained by [39] who stated that being a migratory species, the bee eaters may prey on bees in an apiary for a period of time and then move on the another locality. On the other hand, this part of study do not support the findings of [40] who found two sedentary subspecies of the little Green bee –eater (*M. orientalis*) and *M. orientalis najdanus* in the desert central Arabian plateau.

In the presence study the bee-eaters were found in the aperies in the investigated location in spring and autumn seasons, in spring their first appearance was in the last week of March and last time they were recorded was in the first week of May. Meanwhile, in autumn season, they

appeared in the last week of September up to the first week of November. These findings agree with data obtained by [41] who found that Green bird eater *M. orientalis* Latham and king crow *Dicrurus ater* Nerm. rendered period from February to March unsuitable for multiplication. Although, [13] stated that the birds *M. orientalis*, began to prey on foraging honey bees at an apiary in the third/fourth weeks of July in India and they congregated in large numbers near an apiary during the dearth period and were seen near the foraging sites of the bees in the flowering period. Meanwhile, [8] stated that bee-eaters (*M. apiaster*) migrate to Central Anatolia during the second week of May.

Bird-trapping nets were used in the present study to evaluate the direction of the nets for trapping the bee-eaters. The obtained results showed that the bird-trapping nets placed in the east side of the apiary and above the apiary significantly trapped a higher number of bee-eating birds; meanwhile, the nets in other directions caught fewer numbers of bee-eaters.

Therefore, it is conclude that there are three migratory species of bee-eating birds belong to (Merops: Meropidae) found in the considered apiaries in the central region of Saudi Arabia, which were (European bee-eater (*M. apiaster* Linnaeus 1758); Olive bee-eater (*M. superciliosus* Linnaeus 1766) and Green bee-eater (*M. orientalis* Latham 1802)). They were appeared in the considered apiaries in the area during the spring season from the last week of March up to the first week of May, and in autumn season from the last week of September to the first week of November. The data also showed that the direction of the bird-trapping nets significantly affected the number of trapped bee-eaters, where the bird-trapping nets placed in east side of the apiary and above the apiary significantly trapped a higher number of bee-eaters than other directions.

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TABLE 1

Mean number of bee-eaters trapped (±SE) two times/day (9 am and 5 pm) in the bird-trapping nets placed in five directions (east, west, north, south and above the apiary) in first apiary, during spring and autumn seasons (2009 and 2010).

Season	N	Number of bee-eaters caught at 9 am and 5 pm in bird-trapping nets set in different directions														Total	Mean
		9 am							5 pm								
		East	West	North	South	above	Total	Mean	East	West	North	South	above	Total	Mean		
Spring (2009)	8	1.730	0.838	1.135	1.243	2.000	6.946	1.562	1.216	0.541	0.757	0.730	1.676	4.919	0.984	11.865	5.932
March 28, 2009		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.19a	0.126c	0.165b	0.771b	0.219a	0.763	0.255	0.141b	0.100c	0.137c	0.127c	0.182a	0.585	0.117	1.276	0.638
May 01, 2009		(64)	(31)	(42)	(46)	(74)	(257)	(57.80)	(45)	(20)	(28)	(27)	(62)	(182)	(36.4)	(439)	(219)
L.S.D. at 0.05				0.261							0.389						
Spring (2010)	8	1.857	0.952	0.952	1.095	2.571	7.429	1.486	1.476	0.714	0.952	0.952	1.952	6.048	1.210	13.476	6.738
April 02, 2010		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0270b	0.146c	0.146c	0.194c	0.320a	0.919	0.184	0.178ab	0.140c	0.201bc	0.176bc	0.234a	0.803	0.161	1.476	0.738
April 20, 2010		(39)	(20)	(20)	(23)	(54)	(156)	(31)	(31)	(15)	(20)	(20)	(41)	(127)	(25.40)	(283)	(141.5)
L.S.D. at 0.05				0.635							0.528						
Autumn (2009)	8	1.822	0.689	1.022	0.800	2.000	6.333	1.267	1.333	0.533	0.644	0.511	1.444	4.467	0.893	10.80	5.400
September 23, 2009		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.357a	0.100b	0.160b	0.133b	0.244a	0.781	0.156	0.234a	0.088b	0.115b	0.088b	0.173a	0.596	0.119	1.199	0.599
November 04, 2009		(82)	(31)	(46)	(36)	(90)	(285)	(57)	(60)	(24)	(29)	(23)	(65)	(201)	(40.20)	(486)	(243)
L.S.D. at 0.05				0.611							0.419						
Autumn (2010)	8	1.125	0.833	0.667	0.583	1.583	4.792	0.958	1.375	0.875	0.458	0.417	1.708	4.833	0.967	9.625	4.813
October 11, 2010		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.193ab	0.187bc	0.155bc	0.158c	0.225a	0.742	0.148	0.224b	0.125c	0.104d	0.103d	0.237a	0.661	0.132	1.319	0.659
November 01, 2010		(27)	(20)	(16)	(14)	(38)	(115)	(23)	(33)	(21)	(11)	(10)	(41)	(116)	(23.2)	(231)	(115.5)
L.S.D. at 0.05				0.520							0.250						

Values between brackets are total numbers of bee-eater caught during maintained period.

TABLE 2

Mean numbers of bee-eaters trapped (±SE) two times/day (9 am and 5 pm) in the bird-trapping nets placed in five directions (east, west, north, south and above the apiary) in second apiary, during spring and autumn seasons (2009 and 2010).

Season	N	Number of bee-eaters caught at 9 am and 5 pm in bird-trapping nets set in different directions														Total	Mean
		9 am							5 pm								
		East	West	North	South	above	Total	Mean	East	West	North	South	above	Total	Mean		
Spring (2009)	8	1.568	0.784	1.027	1.135	1.973	6.486	1.297	1.135	0.486	0.676	0.649	1.541	4.486	0.897	10.973	5.486
March 28,2009		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.167a	0.117b	0.131b	0.151b	0.196a	0.649	0.130	0.111b	0.083c	0.123c	0.104c	0.153a	0.465	0.093	1.070	0.535
May 01, 2009		(58)	(29)	(38)	(42)	(73)	(240)	(48)	(42)	(18)	(25)	(24)	(57)	(166)	(33.20)	(406)	(203)
L.S.D. at 0.05				0.432							0.327						
Spring (2010)	8	1.667	0.667	0.810	0.857	2.286	6.286	1.257	1.333	0.524	0.667	0.714	1.714	4.952	0.990	11.238	5.619
April 02, 2010		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.199b	0.105c	0.112c	0.143c	0.250a	0.684	0.137	0.144b	0.112c	0.105c	0.101c	0.184a	0.545	0.109	1.129	0.565
April 20, 2010		(35)	(14)	(17)	(18)	(48)	(132)	(26.4)	(28)	(11)	(14)	(15)	(36)	(104)	(20.8)	(236)	(118)
L.S.D. at 0.05				0.480							0.373						
Autumn (2009)	8	1.489	0.578	0.889	0.689	1.800	5.444	1.089	1.222	0.444	0.578	0.467	1.333	4.044	0.809	9.489	4.744
September 23, 2009		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.255a	0.087b	0.116b	0.100b	0.170a	0.556	0.111	0.208a	0.075b	0.087b	0.075b	0.156a	0.496	0.099	0.885	0.443
November 04, 2009		(67)	(26)	(40)	(31)	(81)	(245)	(49)	(55)	(20)	(26)	(21)	(60)	(182)	(36.4)	(427)	(213.5)
L.S.D. at 0.05				0.441							0.366						
Autumn (2010)	8	1.000	0.625	0.583	0.583	1.333	4.125	0.825	0.958	0.583	0.458	0.500	1.250	3.750	0.750	7.875	3.938
October 11, 2010		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
to		0.135ab	0.132bc	0.119c	0.158c	0.177a	0.546	0.109	0.112a	0.103b	0.104b	0.104b	0.173a	0.422	0.084	0.833	0.416
November 01, 2010		(24)	(15)	(14)	(14)	(32)	(99)	(19.8)	(23)	(14)	(11)	(12)	(30)	(90)	(18)	(189)	(94.5)
L.S.D. at 0.05				0.408							0.343						

Values between brackets are total numbers of bee-eater caught during maintained period.