Studies on population trends of *Vespa spp*. predacious on Honeybee colonies in Pakistan

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Abstract

This study was carried out at five locations Islamabad, Haripur, Khour, Chakwal and Karak to measure the relative abundance of *Vespa* species in dry rain-fed and moist sub-humid ecology during 2004. Five species of hornets; *Vespa orientalis (*L.*), Vespa velutina pruthii (*smith*), Vespa tropica hometyde (*L.*) and Vespa basalis (*smith*)* and *Vespula vulgaris* (L) were found attacking honeybee colonies in different ecological areas. It was noted that *V.vulgaris* was restricted in temperate zones. Studies revealed that *Vespa orientalis* is present in all locations, whereas other four species *V. velutina pruthii, V. basalis* and *V. tropica hometyde* and *V.vulgaris* are restricted to relatively moist sub-humid and temperate ecology. The peak population of *V. orientalis* was fairly high in dry rain-fed areas compared to wet ecology. All species of hornets attained high population on the onset of monsoon rainy season in their respective habitats and high peaks in population were observed during September to October. The predation by *V. orientalis and V. velutina pruthii* continued till first fortnight of November; however a few adults of *V. orientalis, V. velutina pruthii and V. basalis* were noted during first week of December at the hive entrances. No adults of *V. tropica* and *V.vulgaris* were seen during December in their nesting sites. *V. basalis and V. velutina pruthii were* found active in their nesting sites after December. No adults of any species were found active after the month of January.

Introduction

Wasp and hornets are common enemies of the honeybees and they are widely distributed throughout the world. Records of various *Vespa* spp. predations in world are of the opinion that wasps intercept honeybees at hive entrances and cause losses. Wildman (1770) reported that honeybees have no enemies more dreaded than wasp, who are not content with plundering

them but likewise they devour them. Studies on *Vespa* species preying on honeybees were carried out by various scientists; Sonan(1927), Vecht(1957), Matsuura and Sakagami(1973), Singh(1962), Bromley(1948), Choi(1974), Wafa(1956), Blake(1966), Burgett and Akratanakul(1982) in Formosa(Taiwan), Indonesia, Japan, India, Germany, USA, South Korea, Egypt and Thailand. Predation by *Vespa* species on commercial apiaries is generally a seasonal problem. Four species of hornets: *V. orientalis, V. tropica hometyde, V. basalis* and *V. velutina pruthii* were found attacking honeybee colonies during monsoon. Hawking of *V. pruthii* in hive bees; *A. cerana* colonies generally causes the bees to abscond and similar behavior is reported from weak colonies of *A. mellifera.*

Other than honeybee predation, wasps sometimes attain pest status during monsoon and cause nuisance due to its stinging behavior, disease carrying organisms, contaminate human food and causes economic losses to beekeepers and some time fruit growers. Sometimes fatal reactions take place. Parrish H.M (1963) reported analysis of 460 fatalities from venomous animal in USA results half of the deaths were due to hymenopterans stings, 30% to snakes, 14% spiders, 6% other animals Hymenopterans 54% were due to bee stings, 44% wasps and hornets and 2% others. There are about 400,000 honeybee colonies in the country. Beekeepers move their colonies in different ecological areas for nectar and pollen harvest. Wasp population increases from May onwards and attain pest status during dearth period. Various studies were carried out to reduce the incidence of hornets; for instance, Ahmad et al. (1985) in Pakistan used a mite; *Pyemotes ventricosus* predacious on hornets, mass multiplied them on larvae of *Sitotroga cerealalla* as Bio-control agent resulting 42-100% brood infestation during August-September. Matsuura (1973) reported that 30 hornets killed 25,000 bees in three hours; an average of one bee per hornet every 14 seconds. Walton, G.M & Ried, G. M (1976) during a survey reported

total destruction of 3,900 bee hives during 1974-75 in New Zealand. Various studies with reference to bee defenses against hornets were carried out; Matsuura (1985), Choi (1987), Ishay et al (1967), Butler (1974) and Seeley (1982). Indu-Varshneya et al (2009) studied the seasonal incidents of predatory wasps in *A. mellifera* colonies and reported three species of wasps; *V. tropica, V. orientalis* and *Polistis hebraeus* invading hive entrances and explained correlation of wasp with number of bee frames, temperature and humidity. He also reported population increase during early rainy season and decline in late rainy season. Villemant,-C (2008) reported *A. cerana* defends itself against *Vespa velutina*: observations in the forset massif of Bi Doup, Vietnam (Hym.) Chhuneja; et al (2008); The population dynamics of *Vespa orientalis* in *Apis mellifera* apiary in the Punjab, India, during the 2004-06 monsoon and post monsoon periods revealed its peak invasion during August and September while peak activity was at noon compared to in the morning and the evening. There was significant positive correlation between the mean daily wasp population and mean minimum temperature, mean daily temperature and mean relative humidity. Hypothesis of the wasp density relative to the number of colonies in the apiary is also postulated. Tan,-K; et al (2007) reported that the relative success of native *A. cerana* over European *A. mellifera* in thwarting predation by the wasp *V. velutina* is interpreted as the result of co-evolution between the Asian wasp and honeybee, respectively. Li-JianJun; et al (2008) This article examines the association between the visiting/attack rates of *Vespa velutina* hornets and the growth rate of honey bee colonies (*Apis cerana*), using data from a study conducted in Wuding county (Yunnan Province, China) during July-October 2005. The aim was to identify the defence strategies that are utilized by honey bees in response to hornets' threat. Papachristoforou,-A; et al (2008) explained High frequency sounds produced by Cyprian honeybees *Apis mellifera cypria* when confronting their predator, the Oriental hornet *Vespa*

orientalis. These results provide a detailed description of the sounds generated by *A. mellifera cypria* when defending their nest against hornets and they could be used for future research to better understand the biological function of the acoustic behavior in honeybee colony defense. Swamy,-B-C-H (2008) recorded a total of 25 species of insect enemies on four species of honey bees. Among the insect enemies, greater wax moth Galleria mellonella, ants Camponotus compressus and Oecophylla smaragdina, yellow banded wasp Vespa tropica were predominant, observed in a large scale and caused higher infestation to all the 4 species of honey bees. Papachristoforou,-A; et al (2007) studied the ability of Cyprian honey bees (*Apis mellifera cypria*) to kill its major enemy, the Oriental hornet (*Vespa orientalis*), by asphyxia balling (mobbing and smothering to death) was studied. Field and laboratory experiments were conducted to investigate if the honey bees could kill the hornet by blocking its respiration. The results indicated that honey bees raise the ball temperature to 44 degrees Centigrade, and affect the respiratory system by directly blocking abdominal pumping. Sugahara,-M (2005) studied Ecology of feral colony of the Japanese honeybee; habitation in city area and behavior characteristic. Absconding by *Vespa mandarinia japonica* may be observed under natural conditions. Tan-Ken; et al (2004) studied Defence response of *A. cerana* to *Vespa*. The bees from the tropical area of low elevation were more sensitive to wasp infestation than the bees from the temperate area of high elevation. Matsuura,-M (2004) studied Biology and control of social wasps and bees in urban environments. Niche differences in nest site characteristics exist between *Vespa simillima* and *V. ducalis*. An intra-specific comparison of nest site characteristics between urban and natural areas is possible for *V. simillima*. Aerial nests are associated with buildings and other man-made structures in open or concealed places. *V. analis* nests only in free spaces above ground and hangs its nest in twigs from the eaves of buildings. *V. ducalis*

builds its nest in various covered places above ground, preferring relatively spacious sites, including spaces under floors, attics, insides of wooden walls, as well as subterranean cavities. The adaptive foraging strategies of vespine species are also described, as well as some specific differences in the mode of food collection, colony size at peak, male patrolling, mating site and mass hibernation in urban areas. Watanabe,-H(2003) listed larvae and pupae of honey bees and even those of wasps (*Vespa* spp. and *Vespula* spp.) are commonly sold and eaten. Besides, various edible insects like larvae of bamboo caterpillar, weaver ant and, adult of dung beetle, etc. are also sold. Khater,-A-M; et al (2001) studied the seasonal activity of oriental wasp, *Vespa orientalis L.* populations attacking honeybee colonies. A significant positive correlation was found between daily activity and mean temperature during the daytime. Kshirsagar (1971) gave detail of wasp trap design. Walton and Reid (1976) used insecticides for wasp control.

Material and Method

Study was conducted to measure the seasonal abundance of *Vespa* spp. attacking honeybees at two different ecologies; dry rain-fed and moist sub-humid. The study sites were selected with consultation of progressive beekeepers. Population was studied by capturing and killing individual hornets foraging at apiary with stick measuring 3' lengths, 1" diameter fitted with piece of tyre flapper 4x5". Two observers were at each apiary site for killing, counting and separation of species according to performa during foraging period of hornets at 5 different localities. Data was recorded during peak foraging hours of bees i.e. 0600-1100 hrs and 1600-1800 hrs (Table 1, 2 and 3).

Results and Discussion

As a result of this study it was noted that only one species of hornet i.e. *V. orientalis* was restricted to plains and dry rain fed area, where as all 4 species were in abundance in hilly areas

and relatively moist and humid ecology. And population of *Vespa* species was three times more in hilly areas compared to dry rain fed areas Fig. 1

Observation was recorded throughout the day and species counted. Monthly population given in Table 1, 2 , and 3. It was observed that activity started during May and ended by December. All four species of hornets foraged on honeybees at Islamabad and Haripur with maximum population during August and October. Data also indicate that *V. velutina* and *V. oirentalis* are more frequent foragers of honeybee colonies at Islamabad and Haripur. In salt rage Area (Chakwal, Khour and Karak) only one species of hornets i.e. *V. orentalis* was found attacking honeybee colonies similar behavior was also recorded in these areas.

Results and Discussion

The results showed that four species of *Vespa* genus viz., *Vespa orientalis*, *Vespa velutina* *Vespa tropica*, and *Vespa basalis* attacked honey bees "*Apis mellifera*" at Islamabad. The activity of *Vespa orientalis* started in May with population 2.25/ day. The population of this wasp species was high in August i-e 13.12 /day and the activity of this species started declining and was lowest at 0.83/ day in December. The *Vespa velutina* was also observed in May with 0.9 /day and the highest population of this species was observed in August, September and October. This species seem to be the most serious predator at Islamabad, which causes damage to honeybee colonies if not controlled. The *Vespa tropica* population was observed in July and was seized in November. The highest population i.e. 6.5 per day was observed during October. The *Vespa basalis* started preying on honeybees during September and remained active up to December. The peak population was obsersved in October and November i.e. 4.5/ day. The cumulative population of these four species showed that their activity starts in May and population is high in

June to November. It is imperative for beekeepers to take necessary control measures to protect bees from these *Vespa* predators to save honey bee population.

At Haripur district of Khyber Pakhtunkhwa province the species of *Vespa* genus viz., *Vespa orientalis, Vespa velutina Vespa tropica,* and *Vespa basalis* were observed

The most active species predating on hive bee is *Vespa orientalis* the activity of this predator was observed during May. The population was high during July- August i.e. 10/ day per catch. The population declined in October and November there was no activity in December. The *Vespa velutina* started activity in May. The peak population was observed in September followed by October. This species is active for six months from June to November at this location. The *Vespa tropica* population also started activity in May and remained low in June. The population was also minimum during July and August; however it was 5.8/day catch in September. There was no activity during November and December at this location. The *Vespa basalis* species was also observed at this location. However its population started in August and prevailed up to November ranging population from0.25-3/ day. The cumulative population of this species showed that they are present from May to December however, they increase to dangerous level during June to October.

At three locations of Salt range (Table 3) the population of *Vespa orientalis* was recorded throughout active season of *Vespa* species from April to November. There is steady increase in population of *Vespa orientalis,* and highest number / day / catch was recorded during September. There was no population of *Vespa orientalis* in December. Similarly at Khore and Chakwal only one species i.e. *Vespa orientalis* was recorded and its population started in April 9/day/ catch and peak population was recorded in September, whereas at karak (Khyber PakhtunKhwa) the activity of *Vespa orientalis* started in May and peak population was recorded in September. The activity of this species seized in December at all three locations.

Table 1: Population of *Vespa* species attacking honeybee colonies *Apis mellifera* L. based on average per day catch at Islamabad.

Period	Species							
	V. orientalis		*V. velutina*		*V. tropica*		*V. basalis*	
	Range	Average	Range	Average	Range	Average	Range	Average
May	0-5	2.25	0-3	0.96	-	-	-	-
June	1-15	7.1	2-13	5.1	-	-	-	-
July	3-17	11.19	3-20	7.1	1-3	0.48	-	-
August	4-24	13.12	5-30	15.2	0-5	2.51	-	-
September	3-16	7.86	3-35	16.22	1-11	4.3	0-5	2.25
October	2-15	6.32	3-30	14.19	1-15	6.52	2-15	5.3
November	1-11	4.93	2-15	6.5	0-2	0.5	1-11	4.1
December	0-2	0.83	0-2	0.5	-	-	0-2	0.51

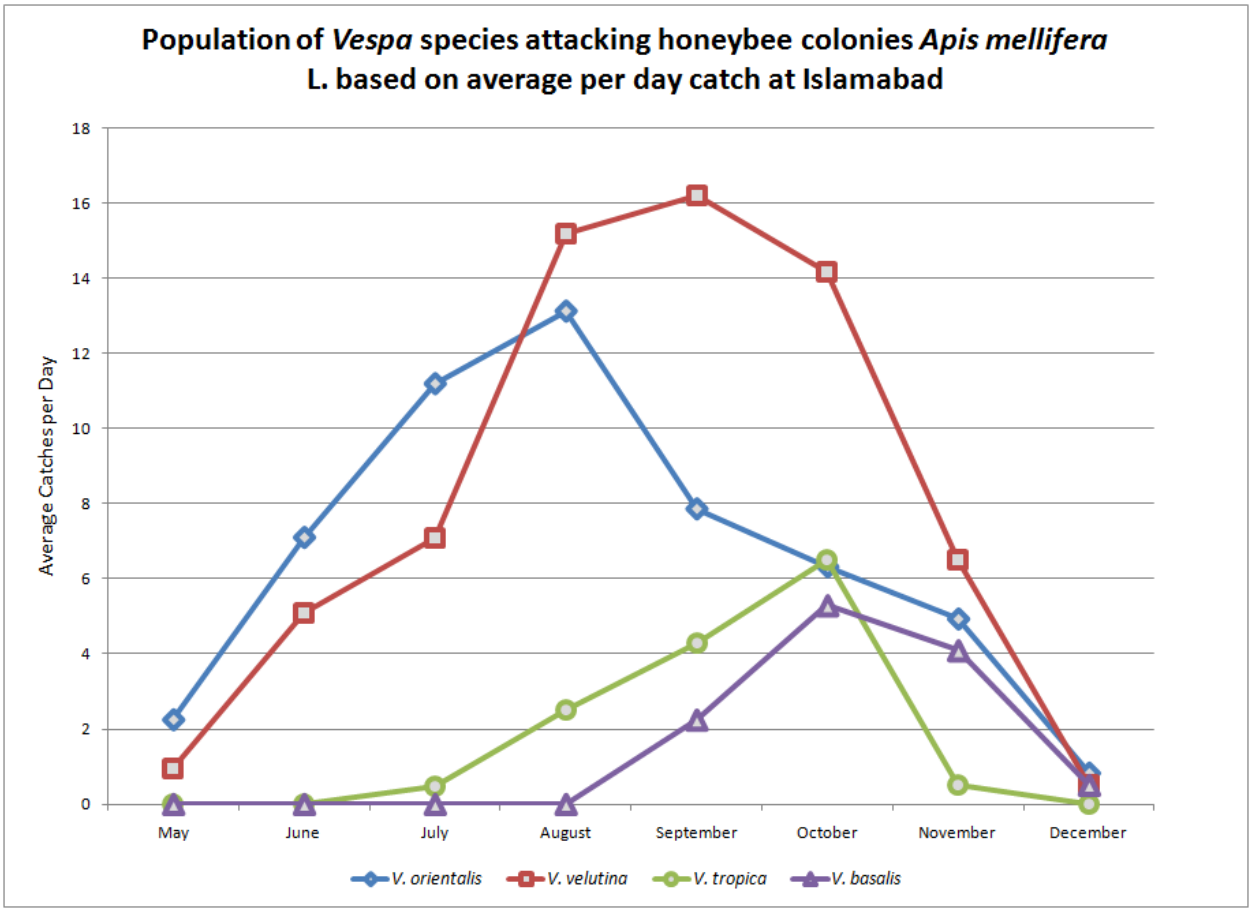


Table 2: Population of *Vespa* species attacking honeybee colonies *Apis mellifera* L. based on average per day catch at Haripur.

Period	Species							
	V. orientalis		*V. velutina*		*V. tropica*		*V. basalis*	
	Range	Average	Range	Average	Range	Average	Range	Average
May	0-3	0.96	0-2	0.51	0-1	0.25	-	-
June	1-14	6.83	2-15	5.8	0-3	0.8	-	-
July	2-16	10.87	3-19	8.51	0-5	2.6	-	-
August	3-22	11.4	6-32	14.96	2-7	3.5	0-5	2.16
September	2-14	5.96	6-37	16.33	2-15	5.8	2-11	3
October	0-6	2.83	3-30	13.9	0-5	1.6	0-7	2.5
November	0-6	0.4	0-15	5.5	-	-	0-2	0.25
December	-	-	0-1	0.38	-	-	-	-

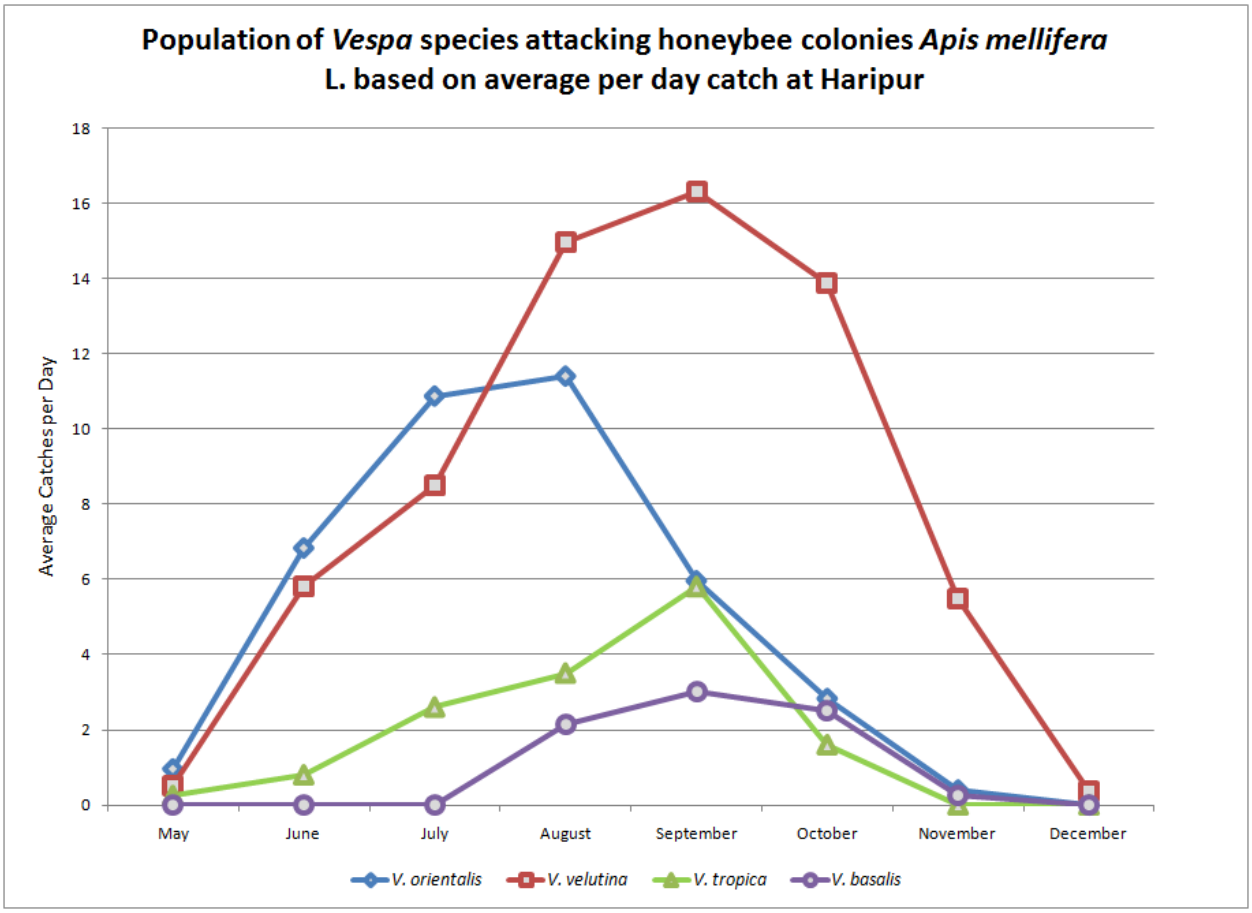
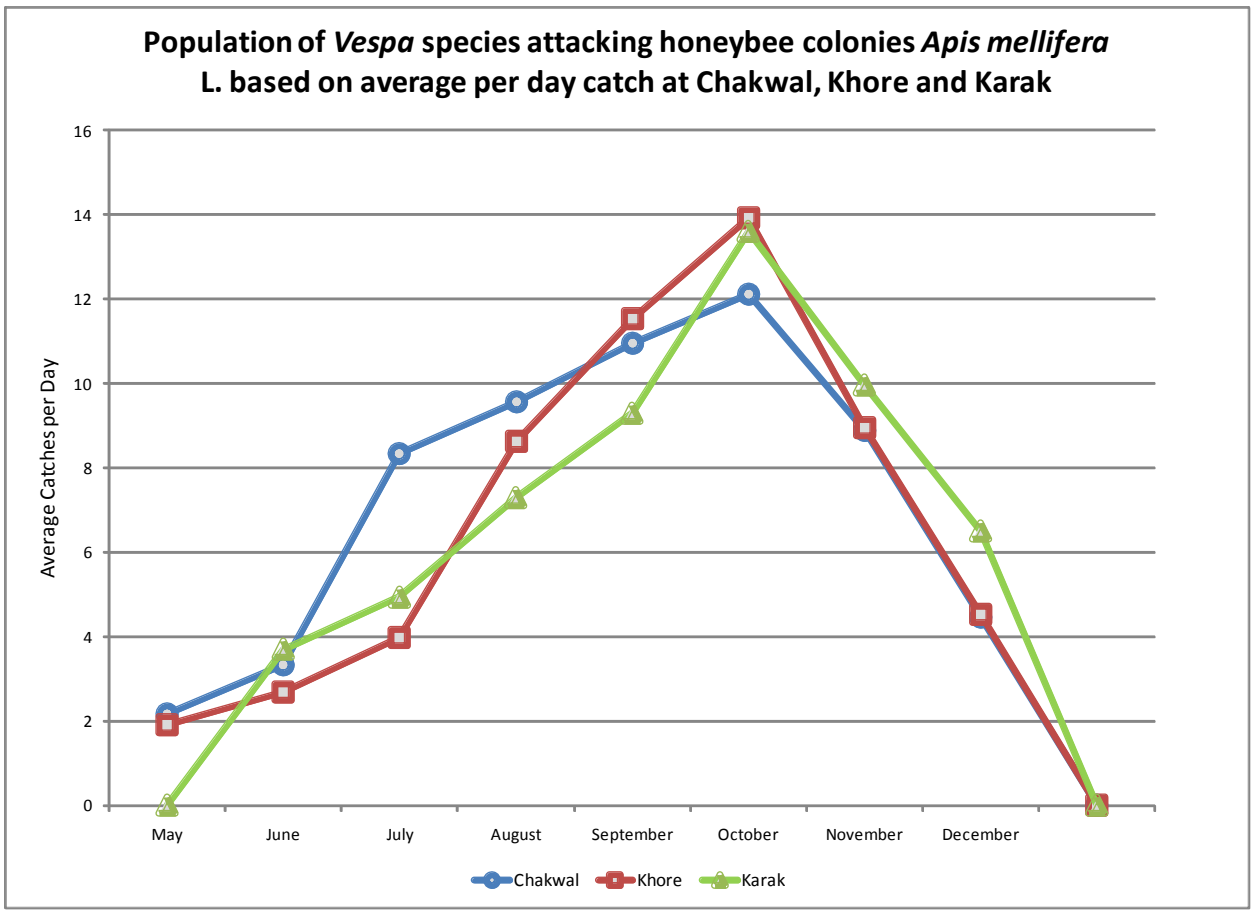


Table 3: Population of *Vespa* species attacking honeybee colonies *Apis mellifera* L. based on average per day catch at Chakwal, Khore and Karak.

Period	Species					
	Chakwal		Khore		Karak	
	Range	Average	Range	Average	Range	Average
April	0-3	2.16	0-3	1.9	-	-
May	0-5	3.32	0-6	2.67	0-7	3.7
June	3-12	8.33	1-8	3.96	2-10	4.93
July	3-17	9.58	2-18	8.64	3-14	7.29
August	3-18	10.96	3-22	11.54	3-20	9.29
September	3-21	12.12	4-25	13.93	4-29	13.6
October	4-13	8.87	3-17	8.96	4-18	9.96
November	0-8	4.46	0-10	4.53	0-15	6.5
December	-	-	-	-	-	-



Control:

Various methods of killing the hornets exist in present study. Capturing and killing individuals' hornets foraging in the vicinity of the apiary. This approach has proven quite effective; largely because the period of most intense hornet attack is relatively short that is 2-3 months. It has been seen that the real damage inflicted to honeybee colonies by hornets attack occur during the occupation and slaughter process. Killing the hornets in early stage of predation has resulted in disrupting the hunting phase and prevented the predation progress from reaching the more destructive phase. Destruction of the hornets thus prevented, or at the least minimized the damage. Mass destruction of hornet nests in the vicinity of apiaries during November –December is also one option for control. As a final and more general; recommendation for protective action against hornets attack is narrowing the hive entrance in this way final invasion of the hive can generally be avoided. Study is still in progress for effective bait trapping and mass destruction of hornet nests for lowering down the incidence.

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