

## Ecological studies of some insects associated with Bedouin settlements in St Katherine Protectorate, South Sinai, Egypt.

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### Abstract

Two wadi systems in the southwestern part of the St Katherine Protectorate were surveyed for one year to record the seasonal abundance and food preference of the most common troublesome household pests in Bedouin villages, the oriental hornet *Vespa orientalis* and cockroaches (Blattodea). There was no significant difference between wadis in wasp and cockroach abundance, even though they differ in altitude, Bedouin density and type of tourism impact. The wasp was abundant from April to November, peaking during August, and disappearing between December and March. Cockroaches were very abundant in houses, peaking in August, and reaching a minimum in winter. The abundance of *Vespa orientalis* has important implications for wild bees, and the huge numbers of cockroaches have health implications for Bedouin.

**Keywords:** *Vespa orientalis*, *Blattella germanica*, *Periplaneta americana*, seasonal abundance, wadi systems

### Introduction

The year of 1983 was a turning point in the scope of ecological studies in Egypt because of the declaration of twenty-five Protected Areas, of total area 11000 km<sup>2</sup>, representing the main ecosystems of the country: South Sinai contains five of these Protected Areas (Shaltout 2001). Although at 61000 km<sup>2</sup> the Sinai Peninsula represents one-sixth of the area of Egypt, little attention has been given to its ecology and biodiversity. The mountainous terrain, harshness of its environment and its recent political history discourage visitors and scientific research.

The Bedouin population in South Sinai is divided into eight tribes. Within the limits of the declared Protected Areas, they retain their traditional rights and continue to occupy their settlements. Bedouin knowledge of their environment is extensive, but tends not to be transferred between generations now because of the loss of traditional lifestyles in the face of modern life. Because of this, the aim of much recent research is to document this lore before it is lost. Whilst there is considerable scientific work concerning the fauna and flora of Sinai and its conservation, less attention is directed to entomological research. This is especially true for the interaction between insects and Bedouin life including their animals and surrounding plants.

A comprehensive study of the rich entomofauna of St Katherine Protectorate would be an extremely voluminous work. The detailed Bedouin knowledge of the wadi systems and mountains can provide key information that can help. Here, a preliminary questionnaire was conducted in five localities in South Sinai Protectorates with different Bedouin families, about the harmful insects that cause problems to them by infesting their houses, animals, cultivated and wild plants, and consequently affect their health and economy. From the results of this questionnaire, two wadis (Mandar and Um-Adawi) were selected on the basis of their dense and permanent Bedouin communities, and two common and destructive insects chosen because they represent the greatest irritants to the Bedouin, the oriental hornet *Vespa orientalis* and the common domestic cockroach (*Blattella germanica* and *Periplaneta americana*).

*Vespa orientalis* (Linnaeus 1771) is a common and widespread species of hornet found throughout southeastern Europe, north Africa and southwestern Asia (Archer 1998). Like all hornets, it is a social insect with colonies made up of a queen, workers and immature stages cared for by the workers (Akre 1982). It has a smooth sting that can be used multiple times; the sting is very painful, and people can die when stung many times at once (Olkowski

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1991). Some people suffer from a strong allergic reaction to inflammatory substances in the venom, which in severe cases may cause a sudden drop in blood pressure and loss of consciousness (Hoffman 1993). As scavengers on dead and decaying matter as well as fruit and human food, *Vespa* can cause fruit spoilage and also transmits a number of serious diseases. It can cause problems to honeybees by attacking their hives, feeding on flower nectar and transmitting diseases from one infected hive to another. Bedouin consider these wasps one of their worst pests because they suffer from the painful stings, their dried preserved food in the roofs of their houses is attacked, and fresh food stolen or spoiled.

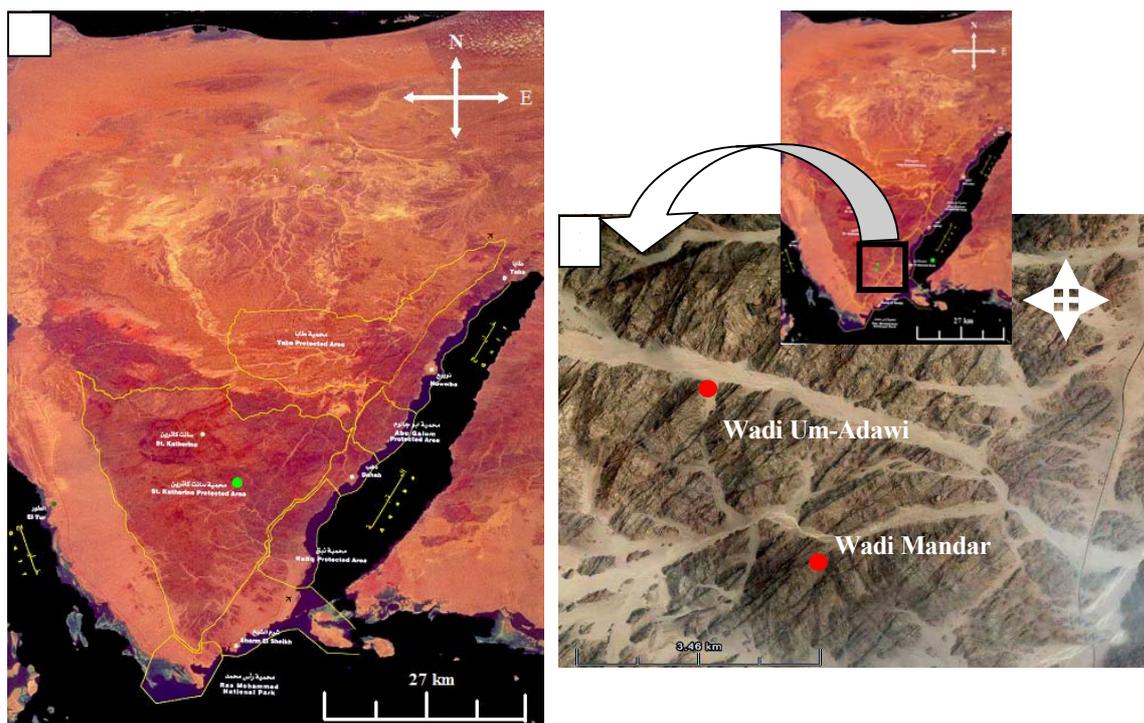
Domestic cockroaches are among the least desirable intruders in human life. They are perhaps the most common troublesome household pest in Sinai, and the Bedouin suffer from huge numbers in the houses. Cockroaches can cause irritation, allergy, food contamination and destruction of foodstocks; they are capable of transmitting many pathogens, including bacteria, viruses, fungi, protozoa and pathogenic helminths that threaten human health, and act as potential disease-transmission agents in hospitals (Lee 1997). Additionally, there is evidence that substances such as tryptophan secreted by cockroaches and found in their faeces are involved in severe allergic symptoms (Brenner 1995). Inhalants and allergens produced by cockroaches have received much attention with the increase in household allergy and asthma problems (Kang & Chang 1985).

## Materials & Methods

The study was carried out over 15 months from July 2002 to June 2003. The samples and data collection took place in Wadi Mandar and Wadi Um-Adawi in St Katherine Protectorate (Figure 1). Each locality was visited every month for three days. In each wadi, a hand-held GPS receiver (Trimble Ensign, Trimble Navigation Europe, Hampshire, UK) was used to record the position of different sites in the wadi. Daily maximum and minimum temperature and relative humidity were measured using digital thermohygrometer. The flora found in the wadis was recorded and a sample of each plant species collected and mounted to be identified; the numbers, areas and types of plants of cultivated areas of Bedouin gardens were recorded. Preliminary identification of the plants was made in the field using Täckholm (1974), with more critical identifications made later using the herbarium of Suez Canal University.

Collection of wasps used a cone trap, the most effective type of trap for collecting *Vespa* (Olkowski 1991). The trap is made of wood and aluminum screening, with a cone of the same material at the base to allow the wasps to enter but not escape. A bait pan is placed beneath the bottom of the cone in such a way that the top edge of the bait pan is above the bottom edge of the cone, to collect all wasps coming to feed on the bait. Traps were distributed randomly at four sites along each wadi (total number of traps = 8) and left for two consecutive days hanging near a water tank between Bedouin houses. These locations were selected due to the aggregation of wasps in these areas as a result of their need for water as well as food. The most attractive bait (molasses) selected from a food preference experiment (see below) was used. Trapped individuals were collected in plastic containers and kept in an icebox during the remaining fieldwork. They were then counted and transferred to a deep freezer overnight.

During three weeks in June 2002, three different types of baits were tried for their ability to attract wasps; these baits were fresh fish, fermented fruit and molasses, selected according to previous studies (Spurr 1995, 1996). The experiment was designed so that nine cone traps were placed in the same area, three for each bait-type, and the number of trapped wasps recorded every day for 21 days.



**Figure 1:** A- Satellite map of the Protectorates of South Sinai showing St Katherine Protectorate. B- Satellite Map of the two studied localities in St Katherine Protectorate (Wadi Mandar and Wadi Um-Adawi).

Cockroaches were surveyed using sticky traps, which can be easily constructed and are most convenient to use (Moore 1983). In Thailand (Tawatsin *et al.* 2001), sticky traps were the most effective trap used in a nationwide cockroach survey. The efficacy of sticky traps relies mainly on the bait that strongly attracts cockroaches, and also on the sticky substance that prevents their escape. One advantage is that this trap never creates any insecticide-related problems. The traps were made from a wide-mouthed jar, with a wide band of petroleum jelly smeared around the inside of the container just below the neck to prevent escape.

The traps were distributed in four randomly chosen houses in each wadi; each house contained four traps, two in the kitchen and two in the bathroom (these are the areas of high infestation according to the results of the preliminary questionnaire). Thus the total number of traps was 32, an optimal number estimated from the preliminary survey according to the extent of cockroach infestation. Traps were hidden in the ground so that their tops were at ground level to darken the inside of the traps, to maximise the catch. A suitable bait was placed inside each trap, chosen from the results of the food preference experiment (see below), where it was found that wet bread with sugar was the most appealing. Traps were left for two consecutive nights each month. The catch was preserved in 70% ethanol.

Both baited and unbaited sticky traps can be used in cockroach surveys (Cochran 1982): although unbaited traps will catch cockroaches, baits make them work better. Cockroach baits consist of an attractant food such as fresh fruit (apple or banana), dry sugar, and wet bread with sugar (Christensen 1991). In the first three weeks of June 2002, these different types of attractive baits were trialled by placing bait at the bottom of the trap. Twelve traps were used in this experiment, four for each type of bait. The data were analyzed using analysis of variance, and were expressed as means  $\pm$  one standard error (Zar 1984).

Table 1, shows the average temperature and relative humidity in both sites during the period from July 2002 until June 2003. The flora found at the two localities were: *Acacia tortilis* (Leguminosae), *Achillea fragrantissima* (Compositae), *Alkanna orientalis* (Boraginaceae), *Artemisia inculca* (Compositae), *Asclepias sinaica* (Asclepiadaceae),

*Citrullus colocynthis* (Cucurbitaceae), *Mentha lavandulacea* (Labiatae), *Peganum harmala* (Zygophyllaceae), *Stachys aegyptiaca* (Labiatae), *Tamarix nilotica* (Tamaricaceae), *Teucrium polium* (Labiatae), *Trichodesma africanum* (Boraginaceae), *Verbascum sinaiticum* (Scrophulariaceae), *Zilla spinosa* (Cruciferae), *Zizyphus spina-christi* (Rhamnaceae), and *Zygophyllum simplex* (Zygophyllaceae). Cultivated areas and gardens beside Bedouin houses contained some palm trees and various fruit and vegetable trees which are regularly irrigated.

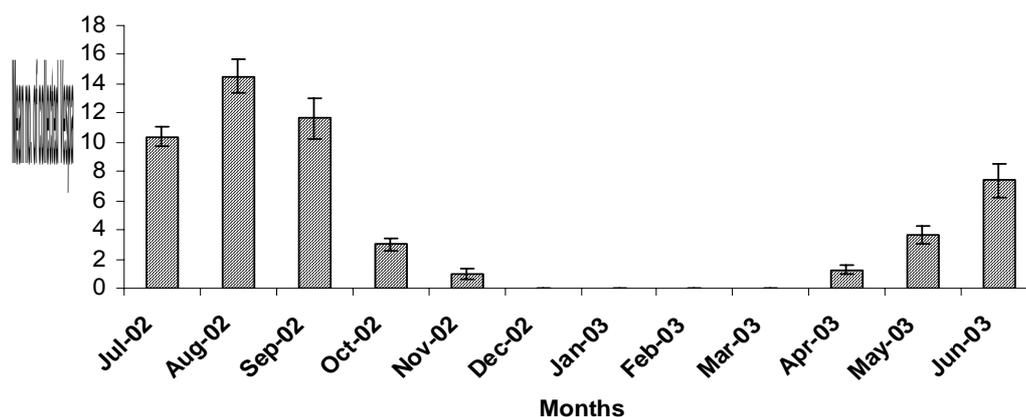
**Table 1:** Average temperature and relative humidity in both localities recorded during the period from July 2002 until June 2003.

Months	Average temperature	Average relative humidity
From July to September 2002	38	30%
From October to December 2002	35	40%
From January to March 2003	24	50%
From April to June 2003	32	40%

## Results

A total of 449 individual *Vespa orientalis* wasps were collected, 204 from Wadi Mandar and 245 from Wadi Um-Adawi. Wasps were commonest in summer, and absent in winter (Fig 2). The average temperature when wasps were active was approximately 33 °C, and they did not appear at temperatures below 16 °C. They were abundant from April to November (average temperature 38 - 23 °C). From the results of the food preference experiment, molasses was chosen to be the bait of choice for regular trapping, because it attracted the majority of insects (Fig 3).

A two-way Anova showed that there was a significant difference between the two localities in the number of collected *Vespa* ( $F_{1,72} = 4.46$ ,  $p = 0.038$ ). There were highly significant differences in the number of collected *Vespa* among months ( $F_{11,72} = 53.03$ ,  $p < 0.001$ ). There was no interaction between months and localities ( $F_{11,72} = 0.4$ ,  $p = 0.952$ ).



**Figure 2:** Mean number of *Vespa orientalis* collected from both Wadis during the period of study.

The total number of individuals collected of the two species of cockroach was 1051, 504 from Wadi Mandar and 547 from Wadi Um-Adawi. As with wasps, they peaked in summer (August), and were at a low point during winter, although unlike wasps they were present during winter (December to February: Fig 4). Cockroaches were present in high

numbers in the two wadis. From the results of the food-preference experiment, wet bread with sugar was more appealing to cockroaches (Fig 5).

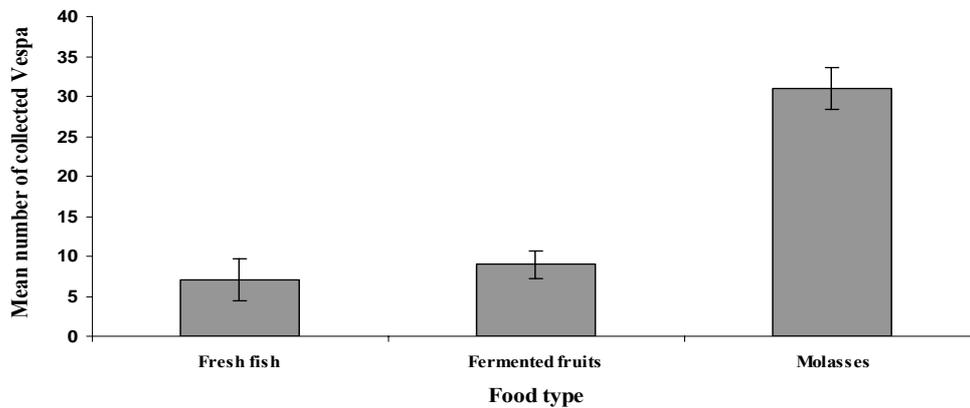


Figure 3: Mean number of *Vespa* collected by each bait used in the food preference experiment .

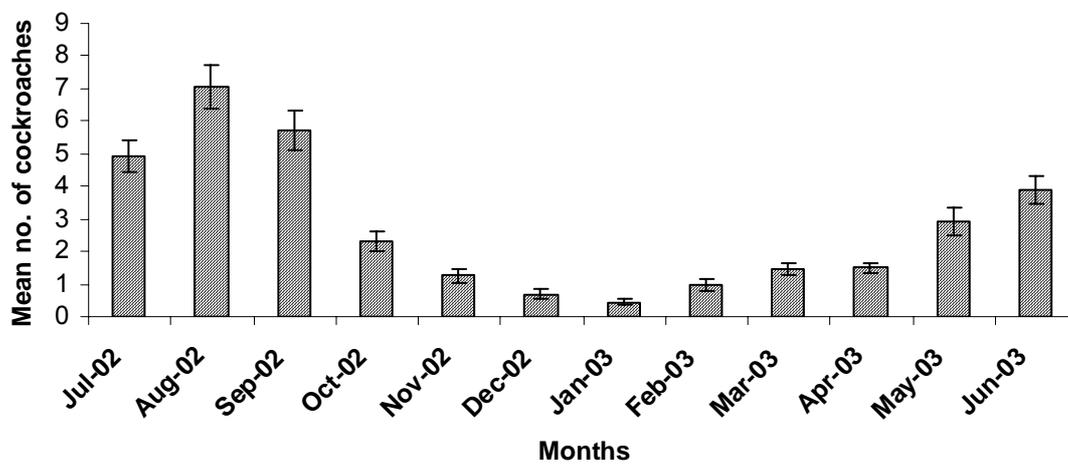


Figure 4: Mean number of cockroaches collected from both wadis during the period of study.

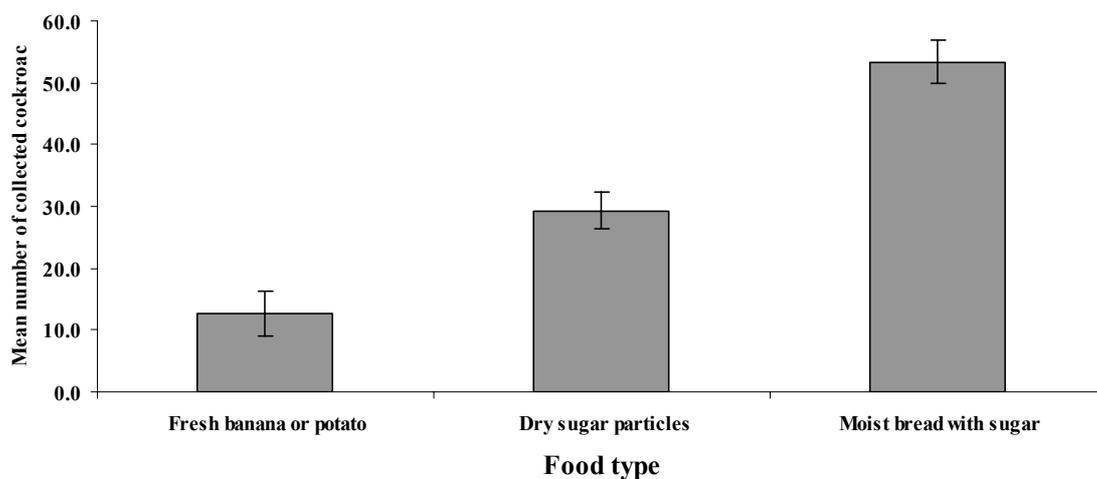


Figure 5: Mean number of cockroaches collected by each bait used in the food preference experiment.

A three-way Anova showed no significant difference between the two localities in the number of cockroaches, but clear differences among months of study and ‘habitat’ (ie trap location,

kitchen or bathroom) together with some interesting interactions between month and locality, and month and habitat (Table 2).

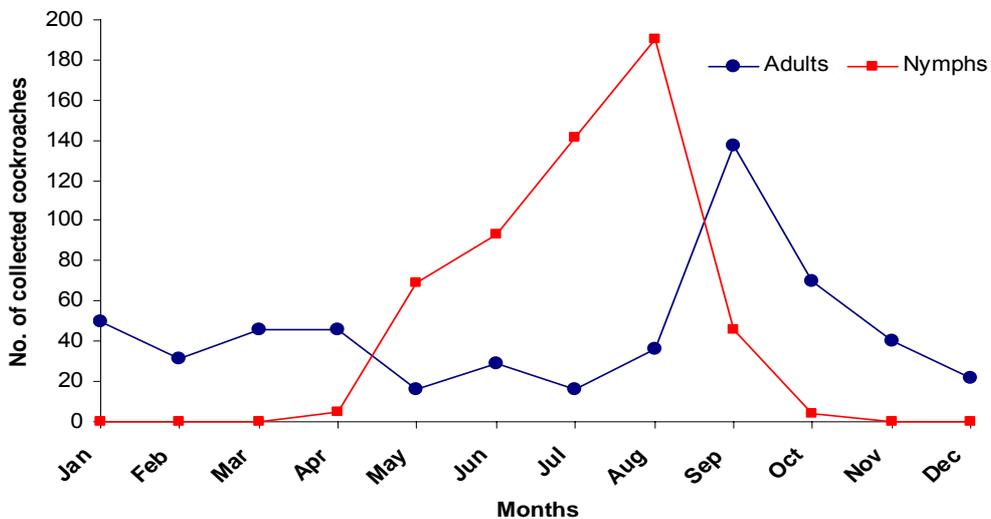
**Table 2:** Three-way Anova of the number of cockroaches collected with respect to the factors of month, locality and habitat.

Factors	df	F	P-value
month	11	62.34	<0.001
locality	1	6.54	0.12
habitat	1	191.37	<0.001
month * locality	11	2.28	<0.05
month * habitat	11	12.32	<0.001
locality * habitat	1	1.39	0.24
month * locality * habitat	11	0.36	0.97
Error	144		

More than twice as many cockroaches were trapped in kitchens than in bathrooms (Figure 6).



**Figure 6:** Mean number of cockroaches recorded during the study period in kitchens and bathrooms.



**Figure 7:** Total number of adult and nymph cockroaches collected during the period of study.

Separating the nymphs from the adults showed that immature cockroaches emerged from April until October, dominating the catch from May to September, and peaking in August. Adults started to reduce in abundance after September, and from November to March only adult cockroaches were found (Fig 7).

## Discussion

Wasps and cockroaches are clearly most abundant during the warmer months of the year. Weather characteristics are well known to play an important role in determining insect activity: each species has a preferred range of climatic conditions for activity (Ghazoul & Willmer 1994).

The absence of wasps in spring and autumn may be connected with their main avian natural enemy, the European bee-eater *Merops apiaster*, which passes across Sinai during its migration twice per year, in April and November, and causes a decline in the number of wasps during these months (Porter 2000). However, it is more probably connected with the life cycle. Archer (1998) explained the colonial life cycle of *Vespa orientalis* in Egypt, reporting that the queens can emerge during a period of warm weather in early spring, but the main emergence is during the middle of spring. The first workers emerge in early to mid-summer. The building of *Vespa* cells starts from early autumn with the emergence of sexuals in mid-autumn until early winter. After mating and laying eggs, activity decreases and their appearance outside the nest disappears completely as the period of rearing the larval stages begins: the larvae enter the sealed-brood stage after 15 days and the adults die off, leaving the larvae to produce a new generation the following spring.

Carbohydrates are often the target of wasp foraging, and include flower nectar, honey, and sugar obtained from human food. Protein sources include a wide range of arthropods caught alive, dead animals, and human food such as fresh meat or fish scavenged by adult wasps and fed to growing larvae (Spurr 1994). The food preference experiment showed that molasses was the most desired bait, while fresh fish and fermented fruits were less attractive. It may be that *Vespa* is attracted to liquid solutions more than viscous substances such as jams, honey, or fermented fruits baits (Spradbery 1973), but in fact molasses have been reported previously as being a highly attractive bait (to the German wasp *Vespula germanica*: Thomas 1960). In contrast, Goodwin & Ten-Houten (1991) reported that molasses acts as a repellent to honeybees. Molasses could therefore be good to use as a poison bait to control these harmful wasps, but it is important to determine the bait preferences of non-target beneficial species such as honeybees before attempting a poison-baiting operation (Spurr 1995). Spurr (1995) showed that protein-based baits such as raw fish and raw meat are less attractive to wasps than carbohydrate-based baits.

Cockroaches showed a continuous presence through the whole year, as elsewhere (Cornwell 1976). The nymphs of the German and American cockroaches emerge and are most active from April, and continue to molt and grow until September: they reach their highest abundance in July, when the parental generation begins to die off. Mature adults from the nymphs become dominant during August to November, and through November to March only adult cockroaches are found (Ogg & Gold 1993). The low level of cleanliness due to lack of water, the presence of lots of garbage near the houses, coupled with a lack of knowledge of methods of deterrence and control lead to a high cockroach infestations in both wadis.

Moist bread with sugar was the most appealing bait for cockroaches, perhaps because it can be considered as an integrated meal, rich in protein and carbohydrate. Although fresh fruit has been reported previously as being excellent bait for American cockroaches (Peairs 1998), this bait was less attractive to cockroaches in this experiment. The greater attractiveness of bread here may be due to the high temperatures that cause fruit to rot and

decompose very quickly: cockroaches prefer fresh unfermented fruit (Frishman 1994), and hence fruit bait must be changed frequently to be kept effective.

This study highlights some of the many problems and questions that need answers concerning Bedouin communities and their associated pests, in the interesting and very important area of South Sinai. More effort is needed to address these many unanswered questions. The Protected Area needs much more promotion of its conservation message through continuous management programs, ensuring the involvement of the Bedouin community so as to ensure better health and reduction of the poverty in this harsh environment.

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## U الملخص العربي U

دراسات بيئية على بعض الحشرات المرتبطة بالتجمعات البدوية في محمية سانت كاترين ، جنوب سيناء، مصر.

غادة محمد عبد الغنى – سامى محمد زلط – أحمد حسن أبوغالية – فايز محمد صميده  
قسم علم الحيوان – كلية العلوم – جامعة قناة السويس – الاسماعيلية - مصر

في هذا البحث تم التركيز على دراسة التواجد الشهري والموسمي لكل من زنبور البلح "فسبا أرينتاليس"، والأنواع المختلفة من الصراصير (رتبة: بلاتوديا) وذلك في الفترة من يوليو 2002 إلى يونيو 2003. لوحظ عدم وجود اختلاف معنوي بين الوديان محل الدراسة ( في أعداد الزنابير والصراصير المجمعّة، بالرغم من اختلافهما في الارتفاع عن مستوى سطح البحر، وأعداد البذ التي تقطن المكان وكثافة السياحة بهما (وادي مندر أكثر ارتفاعاً ويقطنه أعداد أكبر من البدو وتزيد فيه أعداد السباح الزائرين). وجد الزنبور بوفرة من أبريل إلى نوفمبر (حيث كانت درجة الحرارة المتوسطة تتراوح من 28 الى 30 درجة مئوية) و وصل لأعلى قمته أثناء أغسطس وإختفى في الفترة من ديسمبر إلى مارس. وعلى الجانب الآخر، مثلت الصراصير تشبهاً حقيقياً في مكان الدراسة حيث تواجدت طوال العام وتفاوتت درجة تواجدها من قمة النشاط في أغسطس إلى أدنى مستوى للنشاط في ديسمبر ، يناير و فبراير، ثم أظهرت تواجداً معتدلاً أثناء الشهور الباقية من السنة. أظهرت تجربة استخدام انواع غذائية مختلفة أن عسل المولاس هو أفضل الاغذية لجذب زنابير البلح حيث جذب ما لا يقل عن 64% من الزنابير يليه الفواكه المتحللة والتي جذبت 22% ثم اقلهم السمك الطازج بنسبة 14%. أما بالنسبة للصراصير فإن العيش المبلل بالسكر اثبت فعالة معقولة حيث جذب 56% من الصراصير، ثم السكر الجاف والذي جذب 31% ثم اقلهم الفاكهة والبطاطس الطازجة بنسبة 13%. ومن نتائج الدراسة يتضح ان تلك الحشرات تمثل تهديدا على حياة البدو نظرا لانتشارها بالمنطقة بالإضافة إلى تواجدها بأعداد ليست بقليلة وعلى مدار العام. أيضا وضح ان عسل المولاس يمكن الاستفادة منه بصورة كبيرة في التخلص من زنبور البلح باستخدام تقنية مناسبة للتخلص من الزنبور بعد جمعه، وكذلك اثبت الخبز المبلل بالسكر فعاليته في التخلص على أكثر من نصف الصراصير المنتشرة بالمنطقة. وأخيراً تلقى الدراسة الضوء على خطورة عدم النظافة في المنطقة نظراً لندرة المياه بالإضافة إلى إنتشار القمامة داخل منازل البدو وتواجد الشقوق الكبيرة داخل جدران المنازل، بالإضافة إلى غياب الوعي التام عن خطورة تلك الحشرات ودورة حياتها وكيفية مقاومتها والتخلص منها بصورة بيئية آمنة، مما يستلزم تبنى خطة وعى بيئي وصحي لتوعية بدو المنطقة.