

## A review of the scorpion predators and the introduction of *Scarites Subterraneus*, as a new predatory of them in Iran

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### ABSTRACT

The report discusses a predatory beetle feeds on scorpions, trapped under the rocks in the holes of scorpions' habitat around the suburbs of Kashan in the north of Esfahan province and Ize in the east of Khuzestan province in Iran. Furthermore to the fact, a sample was investigated in the laboratory of environmental health department, keeping in the special container of animate insects. The prominent characteristic of this species was its so sturdy and strong elytron difficult to be pierced, even with specific pin used in entomology, to generate inanimate samples for the collection. In a series of laboratory experiments on the beetle, a variety of animate scorpions were placed in the same container used to keep the beetle and observed that the Beetle attacked the Scorpions and fed on them. Armor-like elytron, cursorial legs and strengthful mandibles were the main characteristics of them. Such a strong mandible enables the beetle to rend the skin and the meat of the human hand. . It was observed that it can be considered as a capable predator of scorpions since it lives only on the same habitat of these scorpions. Using the morphological parameters, this beetle was diagnosed as *Scarites subterraneus* species.

**Key words :** Big-headed, ground beetle, predators, scorpion, *Scarites subterraneus*.

### INTRODUCTION

Inconveniences caused by most arthropods to human and the other creatures had always been a matter of considerable concern for entomologists. Sting and bite are some of the major problems caused by arthropods (Dehghani, 2011) Scorpions are found in most parts of the world, especially in the Middle East. (Shehab and Lindsell, 2011) Scorpions can be pointed as the main pests of Iran's health. (Hodge, 1999). There are some dangerous species in Iran. (Karatas and Gharkheloo, 2013) Every year a large number of people in Iran encounter the sting of scorpions, in some cases it can be fatal (Rafizadeh *et al.*, 2013; Dehghani and Fathi, 2012). In the scientific resources of the bygone era 'Kharfastaran' included all annoying animals or insects, therefore the act of killing or Kharfastar destruction) has been very common in ancient Iran (Dehghani and Arani, 2015). In "the law of Avicenna", using appropriate coverage

or using special and natural materials was expressed to remove pests. Also observing the health principles of the sanitation and conservation of water and pest control was pointed as many past corpus (Dehghani and Valaei, 2010; Dehghani, 2011). Currently the most common method used to control the health pests is chemical materials called pesticide that because of the cheap and simple function was formed quickly a commercial shape and available in market. Pesticides are different in chemical structure and causes chronic and long-lasting effects on environment (Dehghani, 2010). Abundant use of chemical pesticides is the cause of the phenomenon of resistance in pests over last 70 years. The indiscriminate and excessive use of pesticides compounds increasingly led to the development of resistance in different populations of healthy pests, disease-carrying insects and incidence of resistant arthropods to different pesticides. (Dehghani *et al.*, 2012). Nowadays the humans inevitably deal with 70000 different types of toxins in their surrounding environment and the number of them increase every year which toxins are the major part of them. Considering the increasing role of pesticides in agriculture and health in order to

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eliminate various pests, it is the matter of concern that their destructive effects in the nature cause deformities and many problems for the health of people and domestic animals live there, so there is a growing need for using appropriate control methods and programs to decrease the deleterious disadvantages of pesticides at the very least (Howarth, 1991). According to what mentioned before, one of the most convenient methods of sustainable environmental is to apply biological methods of pest control that carried out by various factors such as bacteria, fungi, nematodes and predators (Janisiewicz and Korsten, 2002; Harley and Forno, 1992). Regarding the received reports of the diseases and mortality cases caused by arthropods and other poisonous animals each year in Iran, there is an emergency for control methods. Since the use of chemical control methods has harmful effects on the environment and on human health, the present study reviews the related articles and introduces one of the scorpion's predators found in their habitat in Khuzestan and Esfahan provinces in Iran.

### **Predators**

Predators are the group of animals that use other animals as food. Many species of fish, amphibians, birds, reptiles and arthropods are considered as predators in health and agricultural pests (Saloniemi, 1993). Predators are the most important group of organisms for biological control of pests. Predators are found almost everywhere. For example, spiders hunt the stirring pests, but some of them also feed on insect eggs. Some species of spiders hunt only during the night. Other species spinning a web, feed on whatever falls into the trap over the day and night (Snyder and Ives, 2001; Greathead and Greathead, 1992; Riechert and Lockley, 1984). There are a large number of predators among Carabidae family beetles. Many adult beetles prefer the eggs of a pest (21-19). Most predators, no matter be a mature or immature one, attack insects. Other predators such as bugs can hunt and feed on scorpions. In order to complete their growth, predators stay, as a group or individual, on, inside or near the host (Araujo Lira, 2016).

### **Scorpion's predators**

Scorpions are attractive prey. Large body, abundance, lack of proper defense, predictability of their defense and the amount of nourishment can be pointed as effective factors of them to be hunted. At least 142 vertebrate and 26 invertebrate feed on them.

Scorpions provide the great amount of the predator's diet. Many creatures such as arthropods, centipedes, black widow spiders, predator beetles and solpugids, the harvester ants, and vertebrates such as foxes, grasshopper-eating mice, hedgehogs and birds such as great horned owl, insectivorous birds and lots of other vertebrates feed on scorpions (Williams, 1987). Lizards are considered as major predators (Simmonds, 1958). A large number of arthropods such as Carabidae beetles, centipedes, spiders, lizards and proboscis mice are observed near the scorpions while capturing and collecting them in Khuzestan province in Southwest of Iran. Carabidae beetle are considered as the most capable predators of pests which have been reported from the different areas of Iran (Samin *et al.*, 2011; Sadeghi, 2010; Paik *et al.*, 2006).

### **Vertebrate predators**

Vertebrates such as owl, Grasshopper-eating mice, lizards, crows and poultry hunt and feed on Scorpions. Reports and observations also suggest that domestic chicken is one of the best predator of Scorpions. Pecking scorpions and holding them, these birds move their beak quickly up and down with high frequency or hit it against the ground and in this way prevent them to do any reaction, therefore they eat the fragmented body entirely (Dehghani, 2006). Raising of these birds, especially in the rural places can be useful and reduce the scorpions' population in residential and rural places. In spite of nocturnal activity of scorpions, the chickens feed mostly during the day, but the nightly lighting system of rural homes in the early evening helps the birds to continue their activities and feed on insects and other arthropods such as scorpions. It has been observed that these birds have a tendency to hunt rather than feed seeds at night. Allowing chickens to be free in the daylight can help them to hunt the scorpions which have not yet returned to their habitat (Buckner, 1966). Insectivorous mammals are composed of three family whose members includes small animals with a long and very sensitive muzzle. They have mouth structure and many special sharp teeth. Some species of this family live on the earth and some in the water and some live in both environment. These animals in order to escape from the enemy, feeding and avoiding from heat and light endeavor in the night (Dickman, 1988).

### **Hedgehogs**

The hedgehog family that has been frequently in Iran, are considered as capable predators of arthropods such as scorpions. Despite the small

size of these animals and have a quick interaction, not only from the bites of snakes and scorpions sting are safe but easily feed and hunt them. This animal is in most parts of Iran. It is very useful as a vertebrate's predator. This mammal can be found frequently in the Kashan area and around Kashan University of medical sciences, especially in the spring and summer nights while nightly activities. *Hemiechinus hypomelas* or Iranian hedgehog lives in most part of Iran (Dehghani, 2011; Dehghani, 2006)

### Shrews or insectivorous mammals

The Shrews are mammals and biologically similar to mice. These animals most of the time of day are hidden in the porches as a nest dugout under the ground and hunt at night. This is mainly insectivorous animal, very agile and fast. This is seen rarely by human. These animals are shrews with very strong sense of smell. These animals in proportion of their nervous stimulations and their instinct for prey have a large appetite and eat insects and other arthropods up to two times more than its own weight. This animal is able to produce high-frequency sounds that is kind of simple sonar. Susiana Shrew or *Crosidura Susiana* in the city of Kashan in Esfahan province and villages of Ize in the Khuzestan province in the natural habitats of species of Scorpion has been observed by the authors. These predators are fed with the scorpions too (Dehghani, 2011; Dehghani, 2006).

### The predator Lizards

Similar to the other reptiles, lizards are cold-blooded creatures in various sizes. Lizards can be found everywhere in Iran. They can be observed abundantly in the hot land, desert, forest and wet areas in the North, the shores of the Caspian Sea, the Persian Gulf and the Oman Sea, heights of Alborz and Zagros Mountains. Lizards live in the residential areas are almost insectivorous, and depending on the physique and the size of their body feed on arthropods and sometimes on rodents. Some lizards that are observed on the walls of houses, usually look for the arthropods such as spiders, solpugids, and insects gather around the light bulbs to hunt them (Mikaili and Shayegh, 2011). Regarding to feeding on pests, lizards are privileged with high ecological value. So they can be considered as one of the natural controlling factors in arthropods' population. In conclusion, ecologically they have a high value in the energy pyramid. If Humans remove lizards from the cycle of nature, as a matter of fact they would delete one of the main factors of natural control (Dehghani, 2011). Leopard spotted Gecko which scientifically

named *Eublepharis angramainyu* is one of the most abundant species of these animals in the central and southwestern regions of Iran. This animal can easily penetrate into the house and the rooms and feed on the arthropods. This animal's oviposition takes place along the walls and the edge of carpets. The eggs of this animal is about 1 centimeter in diameter (Figs. 1-3). This useful and harmless predator which live in dwellings feeds on the newborn and average scorpions (Ahmadzadeh *et al.*, 2008).

### Invertebrate predators

Solpugids belong to the group of invertebrates and considered as capable predators. This arthropod can be also observed in the scorpion's habitat, but some of them are considered as pests. These arthropods are aggressive predators who hit easily their chelicer against scorpions and feed on them (Dor and Hénaut, 2011). Spiders are also a group of arthropods which are almost Hunter and feed on the

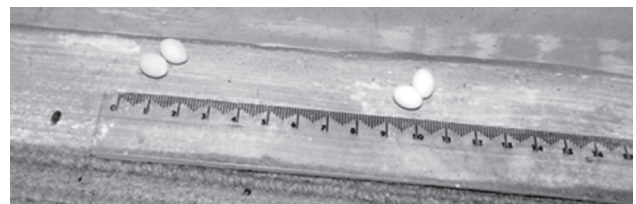


Fig. 1. Eggs of spotted leopard Gecko in living room in Kashan (prepared by R. Dehghani)

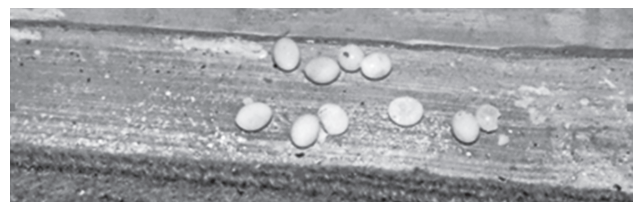


Fig. 2. Eggs hatched of spotted leopard Gecko in living room in Kashan (prepared by R. Dehghani)

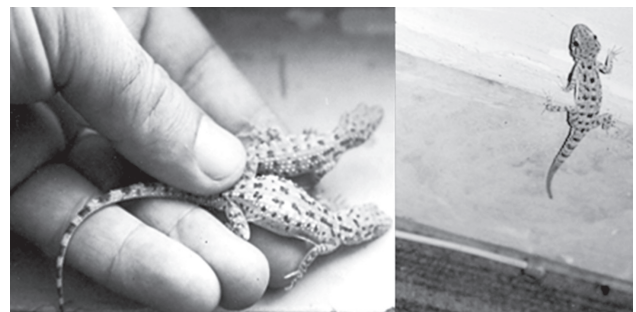


Fig. 3. Adults of spotted leopard Gecko in living room in Kashan (prepared by R. Dehghani)

other arthropods (Hodge, 1999; Polis *et al.*, 1989). Predator beetles of the Carabidae family are one of the beneficial arthropods in the field of biological control which was trapped in the scorpion's habitats in Khuzestan and Esfahan province (Dehghani, 2006).

### Scarites Subterraneus Beetle

This beetle has shiny black color and up to 35 mm length, the structure of its mouth is comprised of long and cutter mandible of the Prognate type (Fig. 4). This insect has cursorial legs. This beetle uses the pair of first legs to dig the ground. The dorsal and ventral surfaces of this beetle covered with firm chitinous layer and has longitudinal rows on elytra. (Figures 5 and 6 show the ventral and dorsal surface of the beetle).

Laboratory observations proved that this insect easily attack scorpions that weigh 2 or 3 times more than its own weight and feeds on them. *Odontobuthus doriae* scorpions with approximately 7 to 8 cm length and *Mesobuthus eupeus* scorpions with 5 cm length are hunted and fed by this beetle (Fig. 7).

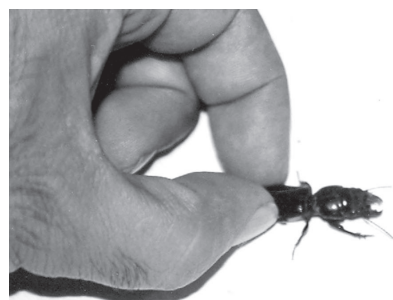


Fig. 4. The picture of *Scarites subterraneus* beetle (prepared by R. Dehghani)

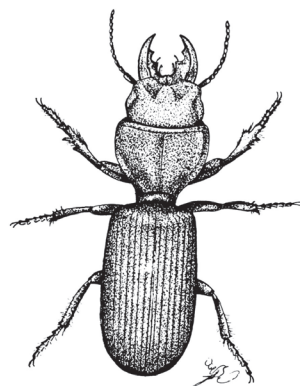


Fig. 5. Dorsal surface of *Scarites subterraneus* (painted by Ali Erfan)

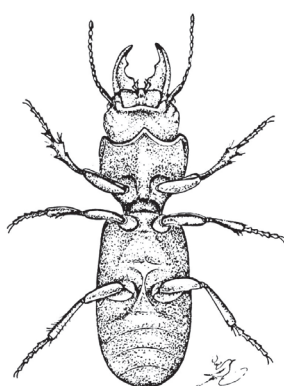


Fig. 6. The ventral surface of *Scarites subterraneus* (painted by Ali Erfan)



Fig. 7. Predator beetle, *Scarites subterraneus* after feeding of *M.eupeus* scorpion (prepared by R. Dehghani)

The use of these insects can be effective to control Scorpions. It would be more efficient to support and identify natural enemies rather than using toxins in terms of both economy and environment pollution. Public education about useful and harmful animals can bring about changes in the attitude of the people and results in worthwhile impact on the culture of rural and urban community particularly in the areas in which there are plenty of scorpions.

### DISCUSSION

Domestic and urban health pests such as scorpions is reported frequently in the tropical regions of Iran. Scorpions live in rural areas more than in urban areas (Dehghani *et al.*, 2013). Currently toxins are used more than the other control methods for health and agricultural pests (Dehghani *et al.*, 2012). Pesticides consumption not only removes soil microorganisms and the remains of it is left on nutritious materials, but also causes destruction of the natural ecosystems and disconnection of the food chain, weakness of the immune system or irregularities in some outcomes exchanged among most microorganisms and threatens the health of consumers and farmers. Pesticides are simply entered into the country and then are utilized (Dehghani *et al.*, 2012; Dehghani *et al.*, 2011). Some different laboratory experiments and epidemiological studies in several last decades have confirmed the relationship between pesticides and the appearance of diseases such as allergies, food poisoning and cancers including lymph, pancreas, breast, colon, ovary, prostate and thyroid in humans. (Eddleston *et al.*, 2002; Windham *et al.*, 2005). In 1990 the USA National Toxicology project announced that 24 types of 51 known pesticides which are the agent of cancer in laboratory animals, are still in use. Eight of twenty

six pesticide types which are also confirmed by the international cancer research agency as the sufficient evidence to cause cancer up to 1997, but unfortunately these pesticides are still demanded by the farmers for agricultural products. Most people on the basis of their daily diet pattern take considerable amounts of residues of pesticides and other toxins that may cause major problems for consumers of these products in the long term (Hussain, 2012). So nowadays, there should be more attention on biological control as one of the most important methods for pest control in the world because it is cheaper than pesticides and does not require to repeat regularly and in many cases it costs less than the annual cost of insecticides. On the other hand, unlike the insecticides, these methods do not have any deleterious effect on the environment and is considered as a way of improving the quality of the environment, moreover, there is not any proof to show that applying biological methods increases the pests' resistance against insecticides (Dehghani, 2011; Waterhouse, 1998). Therefore, identification of new predators against health and agricultural pests of any region can have a significant effect to removing them in the ecosystem of that region, moreover using the technical facilities and training specialists can establish the biological control system in order to invest and breed the predators, so in addition to increase their efficiency in common or emergency situations, it would be possible to translocate a huge amount of predators reproduced through laboratory experiments to anywhere they are needed. However, in tropical areas of Iran such as Khuzestan province and some parts of Esfahan Province like Kashan that deal with the problem of poisonous animals such as scorpions, identification of predators and parasitoids can reduce the harmful effects of these pests (Dehghani and Fathi, 2012; Dehghani, 2006; Dehghani, 1992). In Iran, particularly in the south and southwest regions, scorpions are the major health pests, so it is essential to prevent them to approach residential places. The Improvement of people's living conditions and rebuilding the ruined areas can be efficient to prevent the increasing population of health pests such as scorpions. (Dehghani, 2011).

The present study introduced a new and valuable species of scorpions' predator belonging to hard elytra found in the province of Esfahan and Khuzestan in Iran. Regarding to have a common habitat with scorpions, this predator could have an important role in decreasing their population. Studies on The efficiency of these predators in the reduction of the scorpions' population in different weather conditions can be recommended for further research.

## ACKNOWLEDGEMENTS

This study was conducted in the faculty of health at the Kashan University of medical sciences. Hereby we thank and appreciate the respectable head of the Public Health faculty. Beautiful painting of *Scarites subterraneus* Beetle was provided and plotted by Mr. Ali Erfan, responsible for audio-visual of Kashan University of Medical Sciences, therefore we appreciate him.

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(Received : April 3, 2016; Accepted : July 5, 2016)