

12. BIOLOGY AND ECOLOGY OF VENOMOUS ANIMALS IN ISRAEL

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The variety of climatic conditions in the land of Israel ranging from 1,000 meter high hills rich in rainfall to dry deserts and the Dead Sea valley situated deep below the sea level provides different biotops for a very wide spectrum of animal life. In addition this tiny plot of land situated in the meeting point of Asia, Africa and Europe serves as a passageway for many migrating animals and birds. Nevertheless the zoogeographical analysis of the animal population of the land of Israel shows quite a high percentage of endemic species. Some of them are venomous.

The knowledge about the venomous animals of the land of Israel originates from the passages of the Old Testament in which references were made to venomous snakes, scorpions and spiders either describing the fatal results of their bites or as a warning.

Over the ages, information about the appearance and the way of life of these creatures and the methods of treatment of poisonous bites was accumulated in Talmudic and Jewish Medieval Literature. However these references were as a rule commentaries to the passages of the Bible without adding any new knowledge.

Although some of the dangerous creatures mentioned in the Bible became through the world wide use of the Bible, fabulous and mystical beings, nevertheless in zoologists living in and visiting the land of Israel succeed in identifying at least some of them.

This report deals only with terrestrial venomous creatures particularly with snakes, scorpions and spiders.

I. SNAKES:

Of seven poisonous snakes in Israel only one is of importance; this is the Palestine viper, *Vipera xanthina palestinae*. The others, *Echis colorata*, *Pseudocerastes fieldi*, *Aspis cerastes*, *Aspis vipera* as well as the Black cobra, *Walterinnesia aegyptia*, and Ein Gedi mole viper, *Atractaspis eingaddensis*, are comparatively rare and live only in remote and scarcely-populated areas of the Negev — the southern part of the land of Israel.

The Palestine viper which is the Biblical "Zerfa" is translated in the King James version as Basilisc. It is the most common Israeli poisonous snake, the distribution of which is connected with the Mediterranean zoogeographical regions of Israel. It seems that the highest concentration of this snake is in the coastal plain of Sharon where the most intensive agricultural cultivation is taking place with consequent abundance of rural rodents on which this viper preys. Its

maximal length is 120 cm. This viper is frequent also around the fish ponds where it feeds on fish. This snake lives in burrows of rodents, and is as a rule nocturnal. However, in winter it can be met during the warm days when basking in the sun. It is sluggish in movements and does not strike as a rule when not provoked. Many cases are reported about these snakes being found and held in the hands by ignorant adults and children who were not bitten by the snake, as they treated it gently. However this snake is responsible for more than 99% of all ophidian bites in Israel. The Palestine viper is oviparous and, the hatching of the eggs takes slightly more than a month and a half at the temperature of the coastal plain. The young vipers have already developed a venomous apparatus and are able to kill their prey.

The second snake in order of importance is the saw-scaled sand viper, *Echis colorata*. It is smaller than the Palestine viper, not exceeding 40-50 cm. Its basic color varies from yellow to reddish rose with distinct oval markings in darker frames. It is found in and around the Dead Sea and along the Jordan and Arava valley, reaching the eastern slopes of the Judean and the Gilboa hills bordering the Jezreel valley. This snake inhabits stony areas with very scarce vegetation, being found under stones. As a rule, it does not live in burrows. It is very quick in its reactions, striking often instantly when approached and is therefore popularly believed more dangerous than the Palestine viper, although the comparison of the lethal dose of this snake venom with that of the Palestine viper shows that the venom of the Palestine viper is almost twice as strong as that of *Echis*. It preys on small rodents, reptiles, occasionally on young desert birds. Its diet consists also of some insects. It is oviparous, the development of eggs takes at 31°C, 43 days.

The *Pseudocerastes fieldi* vipers are yellowish-grey in colour. On each side of the body there is a row of light brown rhomboid blotches and the ventral side of it is pure white. The length of the body ranges between 60 to 90 cm and the weight of a well fed adult specimen may reach 500 gm. All specimens of this viper have "horns" consisting of small scales above the eyes and are easily recognized by the black tip of their tails.

Pseudocerastes vipers live in areas of the sandy soil with stretches of hard ground and a certain amount of vegetation. It seems that they prefer spacious hiding places under stones and rodents' burrows. These vipers are found quite often among vegetation during daylight although they live on small rodents, birds and lizards. It seems that they feed also on already dead animals and birds. In Israel, this snake is found in Jordan, Sinai, the central part of the Neger with the main population in the Nahel Ramon and northern Arabia.

Copulation has been observed in May and June. The number of eggs in a clutch ranges between 14 to 21. As the eggs are laid in more advanced stages than in *Echis colorata* and *Vipera xanthina palestina*, they develop relatively rapidly hatching in 30-31 days at 31°C. The duration of development until the adult stage is not yet known.

The venom of *Pseudocerastes* is quite a strong one and among the Israeli venomous snakes, it is second only to that of the black cobra *Walterinnesia*. There are no authentic reports regarding the influence of this snake's bite upon human beings.

The horned sand viper, *Aspis cerastes* is smaller than *Pseudocerastes*, being 50-70 cm long and 400 gms in weight. Its colour is yellow with brown

and grey markings. The specimens found in Israel are hornless in contrast to the horned ones found in North Africa, the Arab peninsula, Iraq, Sinai and Jordan.

It is found in sandy areas of the Arava valley. This snake burrows itself into the sand by sidewise movements of its ribs so that only its head and the nostrils remain above the surface. Sometimes the whole body is hidden in the sand. It seems that in this position it is ambushing its prey. However its permanent abode is usually the rodents' holes in which it exhibits the same burrowing habit.

The horned viper feeds on mice and lizards. It is oviparous. The female lays up to 20 eggs which hatch after more than two months in summer. The period of development until maturity lasts 1½ year for males and 2½ for females.

The venom of the horned viper seems to be quite strong. However, no authentic records of casualties have yet been reported in this land.

The *Aspis vipera* is the smallest of the sand vipers, reaching 30 cm in length and 50 gm in weight. It is the plumpest of all the venomous snakes of Israel. Its colour is similar to that of the horned viper, being yellowish with brown spots. It is possible to distinguish between males and females of this species by the black tip of the tail of the latter.

The distribution of the *Aspis vipera* is similar to that of the horned viper. In Israel, it has been found only in the sandy areas bordering Sinai, being sympatric with the horned viper.

This viper seems to be very well adapted to life in sand. Its ability to burrow itself in the sand is very well developed. When alarmed, instead of running away it burrows deeper into the sand. Like the horned viper, it digs itself vertically into the sand.

No authentic reports on bites in human beings have so far been published.

The black cobra (*Walterinnesia aegyptia*) is the only Elapid snake found in Israel. It is quite widely distributed in the south of Israel without reference of any type of soil or vegetation. It ranges from Egypt to Iran in the desert and steppe areas. As a rule its length doesn't exceed one meter. Its color is shiny black. This fact causes some trouble when the necessity arises to distinguish between the venomous black cobra and the harmless black colubrid snake (*Coluber jugularis*) in the border areas of their distribution. As a rule the black cobra does not appear farther north than a few miles north of the city of Beer-sheva, whereas *Coluber jugularis* does not occur to the south of this town. The other useful difference is in the body length — that of the black coluber is more than one meter.

The black cobra is a nocturnal animal and is a subterranean dweller, whose ability to burrow can easily be detected by the form of its head and the smoothness of its scales. Its sight is very poor and it locates its foods by smell only. It preys on a variety of creatures such as frogs, toads, mice, small birds and various reptiles. It also eats dead animals and even those already decomposing. It likes to drink water and it is found many times in humid places near or within settlements.

There are no authentic reports regarding reproduction in this snake. However, many papers have been devoted to the properties of its venom.

There are some lethal accidents attributed to Cobra bites in Sinai and Egypt but there have been no casualties in Israel, although several cases of bites were reported.

The Ein-Gedi Mole-Viper was discovered only in 1944 in the oasis of Ein-Gedi, situated on the western shore of the Dead Sea. It belongs to the Mole-Vipers of the genus *Atractaspis* living in several regions of tropical Africa. *Atractaspis engaddensis* has since been reported from other places in the Negev and in the Sinai peninsula.

It is a typical burrowing snake with a small head, without any marked constriction between the head and the body. Its color ranges from black to brown, the eyes being very small and the sight extremely poor.

The effect of the venom on human being and animals is neurotoxic. However, certain hemorrhagic effects exvasations have also been observed in autopsies of laboratory animals killed by this snake. No exact chemical and toxicological data regarding this venom have yet been published.

The relative toxicity of venom of 5 Israeli snakes is presented in the table I. The comparison was carried out by injecting dissolved venom subcutaneously into white mice 14-16 gr in weight. A similar investigation carried out with fresh pooled venom of the same snake gave similar results. However the differences in the strength of venom do not reflect the degree of potential danger of these snakes as the main factor in this respect would be the probability of human beings meeting with bearers of the different venoms. In this respect the Palestine Viper is important being responsible for almost all cases of ophidian bites in the population in Israel.

II. SCORPIONS:

In comparison to snakes, the scorpions are considered less dangerous. However, it appears that in Israel as well as in Mexico and in Algeria the number of casualties caused by scorpions is at least equal to the number of deaths caused by snakes. The lack of knowledge about the potential danger of the bite of a scorpion quite often causes delay in treatment and leads to lethal consequences.

There are some 12 species and subspecies of scorpions already described from Israel. Stings of at least two of which may cause death.

It is interesting to mention that the use of the poisonous sting by scorpions is not necessary connected with their feeding. As a rule a scorpion does not start using its sting when hunting. It does it only when the prey is too big and it cannot be crushed with pedipalps enabling sucking and feeding on it. Therefore the scorpion stings only when treaded on or otherwise seriously disturbed. Similarly to snakes there is a wide range of differences in the strength of scorpion's venoms with regard to their potential danger to human beings, ranging from almost harmless species to those whose sting might be fatal. The amount of venom injected at each sting varies considerably and its influence fluctuates according to the part of the body stung, to the proximity of the spot of sting to nerves or blood vessels, and many other conditions. Many other factors influencing the effect of the sting depend on the scorpion. Among these, secondary

only to the specific qualities of its venom is the fact that according to observations based on thousands of specimens, the pointed tip of the sting is frequently broken, thus enabling its bearer to sting the soft-skinned prey but rendering such a sting completely harmless to human beings.

The most dangerous of the scorpions of Israel is the common yellow scorpion *Leiurus quinquestriatus* H. et E. It is quite widely distributed, ranging from North Africa through the Arab peninsula and the countries of the Levant to Turkey and Persia. In Israel it is the most common species of scorpion, ranging throughout the country with the exception of the coastal plain where it is replaced by the black scorpion *Buthotus judaicus* E. Sim. In the Mediterranean part of the Judea and the Gallilee, both species appear to be sympatric. In the hilly region appears as a rule the biggest scorpion of the Near East *Nebo hierochonticus* E. Sim. which reaches 16 cm length. Two species of the genus *Prionurus crassicauda* Ol. and *bicolor* H. et E., are found in isolated groups mostly in the hills. In the Neger, the southern part of Israel, there they occur together with *Leiurus quinquestriatus*, the small black desert scorpion *Orthochirus Innesi* F. Sim. as well as with endemic *Buthus occitanus. Mardochei* var. *Israelis* Shulov et Amitai which is found only in few isolated localities.

Although as a result of intensive collection we now have considerable knowledge about the distribution of scorpions in Israel it would nevertheless be difficult to describe exactly the ecological habitats of each of the species mentioned above, especially in localities where as many as four species are found. It may be stated in general, that *Leiurus quinquestriatus* inhabits dry stony calcareous ground, often preferring the southern and eastern slopes of the hills. The Judean scorpion is found under stones in the Mediterranean region to the west of the watershed of the Jordan and Mediterranean water systems. Sometimes it is also found under the bark of trees. *Orthochirus Innesi* is found under small stones on light soils. The burrows of some of the scorpions are highly characteristic and can be easily identified especially those of *Scorpio maurus palmatus* Seurat and *Scorpio maurus fuscus* H. et E. as well as the typical entrance under a stone to the burrow of *Nebo hierochonticus* E. Sim.

All the scorpions of this country appear to be nocturnal, their activity being directed by a biological clock. Only sporadically, a scorpion may be found during the day apparently disturbed from its abode. They seem to be active through the whole year with the exception perhaps of the coldest days of the winter in the hill region. During the hottest part of the summer they burrow deep into their retreats or remain under large stones and in the crevices of rocks. The copulation of three species of scorpions observed in our laboratory almost simultaneously with the observations made in Germany, South Africa, Brazil, and Uruguay show quite an elaborate process of transfer of the spermatophore previously formed within a comparatively short period within the body of the male. The maturation of the eggs before oviposition within one body of the scorpion as described by Pavlovsky as early as 1923, revealed the possibility both of viviparity and ovoviviparity in various groups of scorpions. According to our observations the period of development of local scorpions ranged between 6-7 years with the exception of the small *Orthochirus* where this period may be much shorter. The period of reproduction and appearance of the young scorpions on the back of their mothers is July-August. The experiments carried out in our laboratory showed quite a wide range of toxicity of various local scorpions. The results are presented in the table.

III. SPIDERS:

Unlike definite indications regarding potential danger of snake and scorpion bites is no direct reference of this kind in the Bible regarding the spiders. Only one problematic passage about the anger of an unidentifiable creature named Achshuv may bear some relation to spider venom.

It is remarkable that in such a tiny country as Israel three different species of *Latrodectus* spiders have been found, as well as a few specimens of *Latrodectus mactans* possibly recently introduced. The Karakurt palaearctic species of *Latrodectus tredecimguttatus* is found all over the country, reaching in several localities of the northern Negev and Arad, a density of almost one adult female spider per square meter. As a rule its retreat is situated under medium size stones from which a corridor-like shiny threads reveal the presence of a live spider. It preys mostly on beetles of the family TENEBRIONIDAE. Other insects as grass-hoppers, crickets and bugs are also found. It is worth mentioning the small **SOLIFUGA** and small and medium size scorpions that are also found in its snares. In spring these spiders are found together with numerous cocoons containing each up to 500 eggs or already hatched spiderlings. The cycle of development of the female spider depends on the supply of food and extends from one to two years. The development of a male spider is much shorter and takes a couple of months only. Despite its abundance, there are only a few records of this spider's bites and among them only one with a scientifically proved lethal result.

The second *Latrodectus* spider originally recorded from this country and later also from the Arab peninsula is *Latrodectus pallidus*. This spider was found in quite dense population in several localities in the valley of Jesreel south of the city of Beer-Sheva and along the coastal plain.

It feeds mainly on ants and for this purpose it builds its snare in a peculiar way, with threads extending as a rule between two or three shrubs at the height of 40-60 cm. This thread bridges over the path of the ants, and the spider catches them by descending on a thread from above, seizing its victim and lifting it through the bridge into its abode. The spider's retreat consists of a peculiar, very elaborate structure at the highest point of which is a small thumb like structure in which the spider sits awaiting its prey or digesting. The venom of this *Latrodectus* species is comparatively weak, although it may cause death to white mice as well as to field mice. Occasionally insects other than ants can be found in its snare.

Latrodectus revivensis is another species which up to present has been described only from the land of Israel. Its general appearance resembles that of the *Latrodectus tredecimguttatus* and it can be distinguished from it by the form of the hairs covering its abdomen and on close observation, by the general hue of the body which ranges from dull black to heavy brown with exceptionally occurring light coloured specimens. The markings and the colour of the young spiders are completely different from these of the other *Latrodectus* species. The adult male retains its peculiar markings, but the adult female loses all juvenile designs and becomes dark as described above. The snares of *Latrodectus revivensis* are similar to a certain extent to these of *Latrodectus pallidus* but the retreat is much shorter and broader and the whole snare is situated obliquely in contrast to the almost vertical position of the snare of *Latrodectus pallidus*. Its height is 35-40 cm above the ground. The food of *Latrodectus revivensis* is

similar to that of the *Latrodectus tredecimguttatus* and all investigations carried out with dry and fresh venom of both species indicate that they are similar if not equal. No study both of *pallidus* and *revivensis* venom has yet been carried out.

Recently several specimens of *Latrodectus mactans* have been found along the coastal plain and it is suggested that they have been introduced by immigrants from the American continents.

Several cases of bite with quite severe symptoms have been reported as a result of the bite of the common house spider *Loxosceles rufescens* found frequently in houses, cellars and caves. Investigations carried out on the white mice showed symptoms of neurotoxic envenomation, which seem to be similar to those described for the bite of some spiders of *Loxosceles* genus described in South America but not showing any kind of histopathological effects as described for there.

Sporadic observations carried out on a specimen of *Hogna narbonnensis* lycosid spider showed a low degree of venom neurotoxic influence but clear histolytic and vasolytic effects around the location of bite.

Although it seems quite amazing that such a small land as Israel, harbours so many venomous creatures, it must however, be kept in mind that in addition to its geographical position as a meeting point of three continents the intensive zoological research carried out here by scientists both driven by an interest in the creatures mentioned in the Bible as well as fostered by secular scientific interest made the land of Israel one of the most studied countries of the entire globe.

BIBLIOGRAPHY

1. Mendelssohn, H. — On the biology of the venomous snakes of Israel I. *Israel J. of Zoology*, 12:143-170, 1963.
2. Mendelssohn, H. — On the biology of the venomous snakes of Israel II. *Israel J. of Zoology*, 14:185-212, 1965.
3. Shulov, A., Weissman, A. & Ginsburg, H. — Observations on the lyophilized venom of the Egyptian Black Snake *Walterinnesia aegyptia*. *Harefuah*, 55:54-57, 1958.
4. Shulov, A. & Weissmann — Notes on the life habits and potency of the venom of the three *Latrodectus* spider species of Israel. *Ecology*, 40:515-518, 1959.
5. Shulov, A., Flesh, D., Gerichter, Ch., Eshkol, Z. & Shillinger — The anti-scorpion serum prepared by use of fresh venom and the assesment of its efficacy against scorpion stings. *Fifth International Meeting for Biological Standardization, Jerusalem*, pp. 489-492, 1959.
6. Shulov, A. & Amitai, P. A. — Key to Israeli Scorpions. *Tera veavez*, 5, 1960.
7. Swaroop, S. & Grab, B. — Snake bite mortality in the world. *Bull. Org. mond. Santé*, 10:35-76, 1954.

