
Insects in a Changing World: From Past to Future (An Essay)

Kukaiņi mainīgajā pasaulē: skatījums no pagātnes nākotnē (eseja)

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Author (entomologist) in this essay speaks of unique and diverse world of insects. The multitude of the species of insects ensures biodiversity on our planet. In order to avoid homogenisation of the ecosystems, society should understand that its existence in the most profound essence does not depend on technologies but on natural resources. Human history is closely connected with understanding of the insect world. Author emphasizes that the Bible (and especially the Old Testament) is the best example of mutual understanding between natural processes and a man. Using examples from the Old Testament different species of insects are discussed (lice, mosquitoes, sand flies, fleas, bees, a.o.) in close connection with the culture of society and human existence.

Key words: entomology, Old Testament, insect species, lice, mosquitoes, sand flies, fleas, bees, biological diversity, natural resources

If we look on the diversity of world species, we can easily come to conclusion that insects are ruling the world. Why such an assumption? Because if we are looking at number of species, then it is found that number of insects are comprising more than 1 000 000 species; some estimated number up to 100 000 000 species. The estimation is based on counting of insects on a single tree species in the tropical forest. Man arrived much later and had to accept the world of insects.

Human history is closely connected with understanding of the world of insects. Since ancient times humans have observed the life of insects in order to use the possible benefits produced by insects. Benefits might be quite different – from getting honey or food up to avoiding the insects transferring diseases. At the same time insects might be very harmful to humans as vectors of deadly diseases, and that is something worth to know about.

Looking through the history of humankind we can found innumerable evidences of the presence of insects in the history. For example, the Old Testament, which is closely linked to the depiction of natural events, reveals diversity of animals and

insects, testifying to the good understanding of animal diversity. On the other hand, New Testament concentrates on a human being, neglecting animal importance in human life.

As an entomologist I have analyzed evidences of insects in the Holy Bible. Among many evidences I have found some very important to my mind. In certain cases insects have had a crucial role in the survival of people who have developed religion of future. The Old Testament says: “And they did so; for Aaron stretched out his hand with his rod, and smote the dust of the earth, and it became lice in man, and in beast; all the dust of the land became lice throughout all the land of Egypt” (Exodus 8:17). How this statement can be explained from perspective of modern knowledge?

Aaron, brother of Moses, had passed through Egypt. This country is known to harbour different diseases that can affect humans. The attackers of Aaron had to be diminished nearly instantly thus giving the possibility for a rescue. That is why the question raises – what was the reason of Aaron being induced by “smote the dust of the earth”? There are many assumptions depending on translation (e.g., Latvian and English). One of them, these had been lice, mosquitoes, sand flies and even fleas. I do firmly believe that Aaron had known some definite species of insects. Unfortunately, the translators of the Old Testament did not.

Next, I should analyze the biology of the suspected insects. First of all, the lice. These insects are well known as human blood-suckers and usually follow after humans in critical situations, these being poverty and starvation, ethnical and military conflicts. The lice had won even the brave military leader named Napoleon! Is it possible at all? Yes, and very simply. The lice are vectors (transmitters) of some deadly bacterial diseases as louse born typhus *Rickettsia prowazekii* and trench fever rickettsia *Rochalimaea quinta*, which usually has outbreaks during the long-lasting military conflicts. But lice do not have any connection with the soil (ground). These insects are specialized parasites on the human body. And if any of Aaron’s followers had this louse then all of them would be infected with the deadly bacteria. The development of these bacterial diseases is rather slow and usually takes few weeks. Thus the lice falls off of the list of suspected insects of the caused trouble.

Mosquitoes follow the lice. At a first glance it seems that mosquitoes cannot be an important cause of infection in a desert. Meanwhile, oases are important key points for distribution of mosquitoes. A yellow fever mosquito *Aedes aegypti* is the most famous among mosquitoes transferring deadly diseases for humans. This insect could transfer not only the yellow fever but also other dengue of viral infection as well as some more infections. *Aedes aegypti* is widely distributed in the world, albeit firstly described from Egypt. The species is responsible for thousands of human deaths around the world. For instance, during the digging of the Panama channel about 95% of builders were hospitalized due to the tropical fevers transmitted by this mosquito. This mosquito species nowadays are supplemented by several species introduced from Asia, namely, *Aedes albopictus*, *Aedes japonicus* and some other similar species. They constitute a new threat to Europeans as in total these species can transfer 22 viral diseases for animals and humans. Due to the climate change fastened by human consumption, these species are heading north and I expect to see them even in Northern Europe soon.

If we return to Egypt, we could easily find that the mosquitos are distributed along the Nile River and only sporadically distributed in the desert. Consequently, mosquitoes were not assisting Aaron to destroy the attackers.

Now it is our turn to analyze the contribution of sand flies. The name “sand flies” well coincide with the “Aaron stretched out his hand with his rod, and smote the dust of the earth, and it became lice in man and in beast”. The sand flies (families *Psychodidae* and *Phlebotomidae*) really have behaviour of feeding from animal blood while the larvae are developed in the animal and human droppings. The blood-sucking sand flies are concentrated in the tropical regions, leaving temperate regions for unmanaged territory. Sand flies could be the vector of bacteria *Bartonella bacilliformis* or Carrion’s disease, viral sand fly fever or three days fever, and of unicellular animal parasites (different species of the genus *Leishmania*). But the bacteria do not cause human deaths, fever usually lasts for three days and leishmaniasis develops into disease in several months. Thus the sand flies did not assist for the goal of Aaron.

Fleas are the next pretenders to the solution of escape of Aaron. Do fleas can affect the development of humankind at all? Definitely yes, as these small insects could be a vector of the deadliest infection in the human history – the plague *Yersinia pestis*! The plague is easily transferred from small rodents to a human by fleas and is causing bubonic plague. This disease kills about two thirds of infected humans within four days. That is the desired effect of Aaron! Humans infected by bubonic plague later can contaminate other people very quickly by direct contacts. The larvae of fleas develop in the soil (ground) and are fed from droppings of animals in the household with the remnants of animal or human skin. After the mature larvae pupate, they are waiting for some initial signal to break the pupa and become adult blood-sucking fleas. The signal for emerging of adults is soil vibration! Vibration means that any person or animal vibrates the soil (ground) by his/its feet. At these conditions fleas rapidly pupate and mature in a few days. The emerging fleas are very hungry and could bite infected rodent and later infect the human. It is well known that parasite affects the nervous system of host by changing the behaviour of the latter. In this case bacteria press the flea to suck the blood very shortly and change the host as soon as possible. This is the way in which plague is distributed rapidly. And I suspect these fleas are the main reason for the death of the attackers of Aaron. Actually, this should serve as an evidence of good knowledge of the biology of fleas.

Fleas causing transmission of the plague still favour its circulation among the rodents. Rodents are the natural nidus of the plague. In case of any disturbance in a human society – military conflicts, starvation, floods and de-domestication – this could be a reason for inflammation of the plague.

Well, the next citation goes: “And the house of Israel called the name thereof mannah: and it was like coriander seed, white; and the taste of it was like wafers made with honey” (Exodus 16:31). The question is – what is mannah? The suspected animals are scale insects. The scale insects suck plant (*Tamarix* spp. bushes) juice, extract proteins and expel drops of water containing high concentration of sugars. Drops of sugars in hot climate after reaching the soil and plants finally form “sugar dew” – a sort of concentrate of sugars. The sugars are an important source of energy that is particularly required for long-time travelers. Scale insect *Trabutina mannipara* could be the responsible insect for the rescue of Aaron. This insect lives on *Tamarix* plants characteristic to deserts, and the plant has high diversity – about 50-60 species.

What happens in our days? Scale insects are not providing humans with the beneficial “mannah”. It is quite the opposite, they become more and more dangerous pests to different plants, starting from such plants as vine grape – one of the crucially important plants in the ancient world – to plants growing on our windowsill.

The process is mainly due to the introduction of insects to new territories. The introduction of insects to new territories is facilitated by wide exchange of plants coming from different environments.

Let us examine one conspicuous example. The horse-chestnut leaf miner moth *Cameraria ochridella* is an excellent example. The tiny moth has lived for a long time in natural habitats north of Balkan Mountings where horse chestnut tree *Aesculus hippocastanum* has its natural range of distribution. The moth fly was described as a new species quite recently, as late as in 1986. Due to its beauty and modesty chestnut-tree is widely distributed in Europe. And in a short time, since 1984 (even before the description!) the species gradually occupied the whole Europe and invaded the horse-chestnut trees there. However, in this case scientists reacted just like after the first introduction. After the invasion of horse-chestnut tree leaf miner scientists finely paid significant attention to this species in searching for methods to reduce the damage of this insect. The question, why it has happened? – is of relevance here. Most probably the climate change is a reason for distribution of Mediterranean species to the North. But there has been no firm proof for that.

In the meantime the story about insects continues. “Even these of them ye may eat; the locust after his kind, and the bald locust after his kind, and the beetle after his kind, and the grasshopper after his kind” (Leviticus 11:22). It is known that educated people of the ancient world distinguished locust species, particularly those with significant impact on human life – migrating locusts. The two main species – migratory locust *Locusta migratoria* and the desert locust *Schistocerca gregaria* – are well-known as devastators of plants. Their migration ability is closely connected with density of population of these insects; the higher density, the higher is their ability to migrate. Additionally, the locusts are herbivores and facultative cannibals eating their siblings. Anyone who moves too slowly in wrong direction was consumed by its siblings. Migrations and migration directions was more or less predictable and that was assumed even in the ancient times. What’s left after devastation of vegetation? Obviously, people should feed on locusts! Locusts are nutritious because of high content of proteins in their bodies. After invasion of locusts local people were asked to catch locusts, to dry them and use as food. It was a good advice written in the Bible (cited above).

Today desert locusts still regularly migrate in the arid areas, although migrating locusts are expanding their distribution area. Since 2007 the migrating locust in summers was regularly observed up to the Northern Europe. Again it raises a question – why so and is it an occasional event? The answer might be simple – it happen due to the climate warming in Europe; meanwhile, no scientific proofs are available at the moment. Speaking ironically, Europeans should to be ready to follow the predictions of the Bible in their menus and cuisines and to have locusts in their dinner.

Let us open the most familiar chapter from the knowledge of insects in the ancient world! The bees! If we consider that Eve offered an apple to Adam, then we should assume that the bees have pollinated the apple tree before. The bees are the most important pollinators of apple-trees. Consequently the bees have followed humans since their creation. Both in the Bible and in every other culture we can trace numerous evidences of bees’ products (honey, wax). The common honeybee is distributed worldwide. However, the bees have different “races” which are adapted to particular local conditions – climate and plants to pollinate. Nothing has been said about diversity of bees – local “races” in the Bible.

Honey has been a major source of sugars for ancient people. The sugar means an inflow of energy in the body for passing “short-term” problems. That is why the honey-bees were so important in the past. Even now the freshly harvested honey is the best product that anyone should have for a satisfaction.

People of any particular region find the most important local “races” of bees in their surroundings. These bees are adapted to local climatic conditions and to pollination of local plants. Meanwhile, the world is changing and the bees have to follow these changes as well. For instance, in Latvia the local bee has diminished drastically in numbers because of invention of hybrids and more productive bees from other regions of Europe; consequently, the genetic diversity of bees has been reduced. Another striking example illustrates consequences of introduction of an African bee to South America. African bees are very hardworking and they collect much more honey than the local bees that led to their introduction. Both introduced and local bees made hybrids, which resulted in establishment of hybrid “killer-bees”. These bees are very aggressive against people and hardly comply with living in hives.

What can we expect in the near future? Most probably mankind will keep its focus on welfare, thus the nature will serve just as a provider of goods and comfort. Ordinary people cannot understand the real threat to biodiversity, although it provides us with food, species, recreation and ecosystem functions – thus maintaining balance in nature. The most affected ecosystems are in the tropics that are inhabited by high diversity of plants and animals. Every change in equilibrium of nature strikingly affects both humans and their environment.

Scientists are well informed about the main threats to nature: they are caused by over-consumption of natural resources, changes of natural habitats, and introduction of species outside their natural range. The worst future scenarios predict homogenisation of ecosystems and reduced differences in regions with similar ecological conditions. Then there will be no difference, whether anyone lives in Canada, Europe or Japan.

Due to these threats to biodiversity scientists work hard to conserve local and regional diversity by establishing particularly protected territories and preparing the lists of protected species. Sharp increase of number and area of protected territories is observed in both Europe and other continents. However, simple analysis of locations of these territories gives an impression that they are located mostly in inhabited regions. For instance, the protected territories in Latvia are located along the borders of regions with the worst network of roads, in seemingly unfertile areas and in the bogs.

What are lessons we learn from the past? First and foremost, we should know local insects to a good level of expertise, as well their ecology, and evaluate services provided by them. This knowledge could enable prediction of the future events – outbreaks of some species, possible damage to people and household or possible benefits to both humans and natural processes.

And finally, significant improvement in nature conservation can be achieved only if people would understand how important it is to conserve biological diversity and to reduce consumption of natural resources. Personally I am very skeptic about this issue and I expect further serious degradation of nature until the limit when people will be forced to think about conservation. Then everybody will realize that we don't depend on technologies but rather on natural resources, and will be forced to return to the roots – the Bible which is the best example of mutual understanding between processes in nature and a man.

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Kopsavilkums

Autors (entomologs) esejā runā par unikālo un dažādo kukaiņu pasauli. Kukaiņu sugu dažādība nodrošina bioloģisko daudzveidību uz mūsu planētas. Lai izvairītos no ekosistēmu homogenizācijas, sabiedrībai būtu nepieciešams izprast, ka tās pastāvēšana visdziļākajā būtībā nebalstās uz tehnoloģijām, bet gan uz dabas resursiem. Cilvēces vēsture ir cieši saistīta ar kukaiņu pasaules izpratni. Autors uzsver, ka Bībele (it īpaši Vecā Derība) ir piemērs savstarpējai cilvēka un dabas procesu izpratnei. Esejā minētajos Vecās Derības piemēros ir aplūkotas dažādas kukaiņu sugas (utis, odi, smilšu mušas, blusas, bites u.c.) ciešā saistībā ar sabiedrības kultūras un cilvēkeksistences tradīcijām.

Atslēgas vārdi: entomoloģija, Vecā Derība, kukaiņi (utis, odi, smilšu mušas, blusas, bites), bioloģiskā daudzveidība, dabas resursi



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