The invertebrate fauna of the Hortobágy

Faunal history, faunal elements

It is proven by recent investigations that alkalization processes started at the end of the Ice Age and continued during the climatic phases after that in different degrees, as was stated by several researchers previously. This extensive grassland was primarily populated from local resources, i.e. patches of alkaline meadows formerly present in the area, from alkalizing clearings of steppe woods or the alkalizing borderlines of marshes with fluctuating water-level.

The unique, endemic animal and plant species and subspecies of the Hortobágy could not have been formed otherwise. Therefore the statement is false that the fauna and flora of the Hortobágy consist only of widely distributed species, and only their associations are unique. This statement was used for supporting the idea of the young Hortobágy.

Continental species tolerating low temperatures could have been already present in the loess grasslands with severe climate during later Ice Ages (Würm). The insect species are also members of the cold grassland fauna the larvae of which specialized on continental plant species tolerating low temperatures. There are endemic species of the Carpathian Basin or the Hortobágy among them, e.g. the moths Coleophora peisoniella and C. hungarica, Stenodes obliquana, Scrobipalpa semadensis and Holcophora statices; Noctuid Moths Narraga tessularia kasyi Geometrid Moths; Saragossa porosa kenderesiensis and Discestra dianthi hungarica.

The main period of the first occurrence of grassland species was the so-called Boreal phase (7000-5000 B.C.) during climatic fluctuations after the Ice Age. The majority of Pontic, Ponto-Kaspian or or Pontic-Pannon grassland animal and plant species could have occupied this area in this period. Several grasshoppers (e.g. Gampsocleis glabra, Tessellana vittata, Tettigonia caudata) and locusts (e.g. Epacromius tergestinus ponticus, E. coerulipes pannonicus, Celes variabilis, Dociostaurus brevicollis); Tenebrionida species and ground beetles (e.g. Carabus hungaricus with many subspecies, the Caterpillar-hunter Calosoma auropunctatum, Zabrus spinipes etc.) and Noctuid Moths (e.g. Euxoa Hastifera, Scotia crassa). A famous pontic species in the Hortobágy is the largest spider species in Hungary, the Russian Spider that lives in vertical holes and hunts rushing out from its lurking-place (thamnobiontism).

It is reasonable to discuss species separately that are distributed in the wooded steppe belt rather than in pontic steppes. These are often referred as "Subpontic" species. The insect fauna of the Hortobágy is also rich in wooded steppe species that mostly live in clearings of the two important relict alkaline oak-forest (Ohati- and Margitai-forest), e.g. the moth Gortyna borelii lunata feeding on the storing roots of Peucedanum officinale similar to the head of celery, and the larvae of Shark Moths (e.g. Cucullia tanaceti and C. asteris) feeding on Aster species (Aster punctatus, A. linosyris).

The subpontic-southern continental type is represented by some important forest-living insect species of the wooded steppes of the Great Plain. A species like this is the Scarce Fritillaryprotected by the Convention of Bern that unfortunately got extinct from the considerable part of Europe. Its caterpillar feeds on Fraxinus angustifolia ssp. pannonica in this region and requires the presence of bushy fringes and a loose network of clearings of gallery forests in the lowlands and oak-woods in the wooded steppe.

Southern (Mediterranean-Ponto-Mediterranean) species have occupied this area because of the postgalcial warming up of the region. Most of the are the inhabitants wooded areas. Therefore the areas of the Hortobágy richest in plant and animal species of distribution like this are relict oak-forests in the western part of it.

Several insect species of our thermophilous oak-forests also belongs to this biogeographical group. Many of them live in oak, e.g. some Kitten Moth species: Peridea anceps, Harpya milhauseri, Exaereta ulmi, Drymonia querna, Marumba quercus, Lunar Double-stripe Lunar Duoble-stripe and some representatives of less known Noctuid Moths, e.g. Dryobotodes protea, Dichonia convergens, Agrochola laevis etc.

There are very few Mediterranean-sub-Mediterranean species among grassland ones as opposed to those living in sandy grasslands. The Long-headed Grasshopper occurs only in sandy patches in the borderline of the Hortobágy (near Egyek-Telekháza and Tiszaigar). However the thamnobiont Preying Mantid Praying Mantid is more common on burial mounds, in loess meadows with tall grass and openings of forests.

Habitat types and their fauna

Floodland areas alongside the borderline of the Hortobágy

The fauna of highly variable habitats and their complex is also very variable. One can meet several colourful, protected butterfly species that live in very small numbers anywhere else in the Great Plain, e.g. Camberwell Beauty, Large Tortoiseshell Butterfly, and Lesser Purple Emperor as well, a form of which with two generations can be found in gallery forests. Several Snout Beetles, Leaf Beetles and Longhorn Beetles (e.g. Agapcinthia villosoviridescens), as well as diurnal butterflies (e.g. Red Admiral, Peacock Butterfly, Map Butterfly) live on nettle

(Urtica sp.). Cavities in trees and other local pools provide suitable habitats for thousands of mosquito larvae. Therefore it is not surprising that visitors are run over by unbearable amounts of haematophagous mosquitos in the summertime.

Unfortunately natural gallery forests are thinning away today. Although these are not really species-rich, provide an attractive scenery in all seasons. One can observe an abounding insect life here from spring to autumn. The Musk Beetle and the rare, threatened Osmoderma eremita live in old, hollow willow trees. The larvae of the protected Lesser Purple Emperor andCamberwell Beauty (Nymphalis antiopa) feed on willows and poplars.

Wetlands, marshes and wet meadows in the Hortobágy

The living communities of the wetlands of the Hortobágy are well adapted to water types providing home for them. Natural, extensive open-water wetlands can mostly be found in the larger marshes of the southern part of the Hortobágy. These are basicly semistatic with large-scale seasonal and multiannual water level fluctuations. Since these cease to be a wetland after silted up, their complete desiccation would decrease the number and area of breeding and migrating sites for birds, so their water level is artificially controlled by filling them up from time to time. Thus the area of wetland habitats covered by variable aquatic weed associations is considerable.

Alkaline marshes provide reproducing opportunities for many insect species. The larvae of Non-biting Midges (Chironomidae) grow in the mud. Masses of flying off insects eddy above marshes like dust. However the Mosquitos (Culicidae) are also form an important insect group. There are hardly any shallow wetlands or temporary pools in the puszta without thousands of mosquitos developing in them. The largest one is the buffish-brown Mansonia richardii, however Vexatious Mosquitos and Flood-water Mosquitos occur in much larger numbers. Larvae of Leaf Beetles (Donacia, Plateumaris) and Brown China-Mark butterflies live on marshland vegetation. The larvae of the dragonflies called Four-spotted Libellula and Norfolk Aeschna grow in marshy wetlands. The commonest dragonflies in shallow marshes are the Sympetrums; the marshy meadows of the Great Plain is characterised by the Sympetrum depressiusculum. The Sympetrum pedemontanum és S. danae are rarer species. The Lestes macrostigma live in shallow, ephemer wetlands; the Red-eyed Damselfly stick to large open water bodies.

Leaf-footed Crustaceans (Branchinecta ferox, B. orientalis), Shell-covered Crustaceans (Ilyocypris tuberculata, Limnicythere sanctipatricii), and larvae of Mayflies (Cloeon dipterum and Common Mayfly). occur in large masses in wetlands. Wheel Animalcules provide food for them also, among which the Brachionus plicatilis and Lecane ichthyoura are typically connected to alkaline wetlands.

Besides dragonfly larvae important predatory insect species in wetlands are the Wheel Animalcules and Water Beetles, e.g. Green Water-Boatman and Common Water-Boatman, or theWater Scorpion that stings painfully with its strong haustellum. The Water Stick-Insect is waiting for its prey from its lurking place stretching its respiratory siphuncle to the water-level. Smaller species, like Sigara species dive deeper hunting for their prey.

Several butterfly or orthopterous species reproduce in marshy meadows. It is important to mention the protected Gossamer-winged Butterfly, some Clearwing species (Chamaesphecia hungarica and Ch. palustris) of unique appearance, as well as some Noctuid Moth species (Mythimna sp., Buff Moths Photedes sp., Chortodes sp., Apamea sp., Bulrush Winscot and other Phragmitiphila species). The most characteristic orthopterous species are the Large Marsh Grasshopper, Parapleurus alliaceus as well as Cone-heads: Long-winged Cone-head and Short-winged Cone-head.

Alkaline meadows, alkaline grazing-lands

The best-known and most recent type of landscape of the Hortobágy is the extensive, grazing land : alkaline grassland (puszta) according to generally accepted opinions. However it would be a good thing to put it more carefully and better defined when taking into account the alkalization processes in the late Pleistocene and the presence of meadows in the climatic phases after the Ice Age. The short-grassed grazing land is undoubtedly of anthropogene origin and quite recent. It is also a fact that the alkaline meadows of the Hortobágy are unique, typical for this landscape, native communities, well definable plant associations which are not especially species-rich but can be characterised by the presence of peculiar floral and faunal elements with some endemic species among them.

Alkaline grasslands provide special habitats for animals as well. The number of species that could have been adapted to its extreme conditions is relatively low. The duration of the presence of shallow pools, extreme thermal conditions, the almost continous presence of often stormy winds, the high frequency of heavy showers, repeated droughts and the vegetation consisting of often only small patches of micro-mosaics of a very peculiar species composition poses a difficult challenge for the fauna. All species react on these extremities in different ways. For some species open areas with unlimited horizon is the most important factor, while for some of them the borderline of an alkaline bench means the end of the world.

Several tiny insect species live on a single or a few individuals of a sole plant species, e.g. members of the Case Bearers (Coleophoridae) and Gelechiid Moths (Gelechiidae) families specializing on Sagebrush Wormwood. The

caterpillars of only a couple of millimeters length weave sacs of tiny plant parts growing and pupating in it. Even the inpennate female live in this sac for its whole life consisting of only a couple of days, since it does not feed at all. Males are attracted by the feromon of the female putting its abdomen to the opening of the sac. After copulation the female lays eggs and soon dies like it happens to males shortly after copulating. Therefore the tiny sacs can be found on alimentary plants in the whole breeding season, although the copulating period of these moths lasts only for a couple of days. It is not surprising then that endemic species form among insect species distributed in a very small area and connected to unique habitats (e.g. Coleophora hungariae, C. klimeschiella, C. magyarica). Several moth species specializing on a single alimentary plant species can be found in other genera* as well (e.g. some endemic Noctuid Moth subspecies: Saragossa porosa kenderesiensis living onSagebrush Wormwood and the Nutmeg Moth (Discestra dianthi ssp. hungarica) living on Annual Gypsophila and the endemic Geometrid Moth Narraga tessularia kasyi living also on Sagebrush Wormwood in large numbers). This specialization can also be found among Leaf Beetles, Snout Beetles, True Bugs and Aphids.

*Table 1. Plant-specializing larvae of moths living in plant associatiations of alkaline soils

Family		Species or subspecies	Alimentary plant(s)
		peisoniella KASY	Artemisia santonicum
		hungarica GOZMÁNY	Camphorosma annua
		salicorniae HEIN. et WCK.	Salicornia europaea et herbacea
		longicornella CONST.	Aster tripolium pannonicus
Coleophoridae	Coleophora	linosyridis M. HERING	Aster punctatus, A. linosyris
		halophilella ZIMMERM	Aster tripolium pannonicus
		silenella H.-SCH.	Silene otites
		dianthi H.-SCH.	Dianthus sp., Gypsophila sp.
		taenipenella H.-SCH.	Juncus gerardii
	Apodia	bifractella DGL.	Inula sp.
Gelechiidae		plantaginella ST.	Plantago maritima
	Scrobipalpa	salinella salicorniae E. H.	Salicornia europaea
		nitentella FUCHS	Salicornia europaea et herbacea
	Stenodes	woliniana SCHLEICH.	Artemisia santonicum
		obliquana EVERSM.	Artemisia santonicum
Phaloniidae	Phalonidia	vectisana WESTW	Plantago maritima
		affinitana ZELL.	Aster spp.
	Holcophora	statices	
	Gortyna	borelii lunata BKH.	Peucedanum officinale
Noctuidae	Discestra spp.	dianthi hungarica WAGN.	Gypsophila muralis, Dianthus spp.
	Saragossa	porosa kenderesiensis KOV.	Artemisia santonicum, A. pontica
Geometridae	Narraga	tessularia kasyi POVOLNY et MOUCHA	Artemisia santonicum

The orthopterous species (Orthoptera) are much less sensitive for the presence of small patches of vegetation. City dwellers are often surprised by abounding masses of grasshoppers when arriving at the Hortobágy who are not used to large flocks of insects causing the grass rustle. Dozens of grasshoppers fly up and land after a couple of meters of flight at every step. It is not at all accidental that the first Hungarian zoocoenological study was carried out by BARNABÁS NAGY in 1944-47 investigating grasshoppers of the Hortobágy. It is characteristic for the species composition that while phytocol and chortobiont (living inside vegetation) species are very numerous in closed alkaline meadows connected to special microclimatic conditions, geophilous and geobiont species are abundant in dry alkaline areas with large patches of barren alkaline soil replacing them in these habitats. These animals warm up by sunbathing on barren soil which is required for their activities. These can generally fly very well, therefore they can move between habitats which is typical for opportunistic species. Their hind wings are often bright, e.g. it is light blue with black bordering in the Blue-winged Grasshopper, it is pink in the Italian GrasshopperItalian Locust, pale green with black bordering in the locust Oedaleus decorus, while the hind wings of the locust Celes variabilis is bright red or dark blue with black tip. Some species change their habitats during the day according to their heat requirements, e.g. the locust Aiolopus thalassinus of tropical origin that shifts to hot barren alkaline areas in late summer by day, and moves to wet meadows with tall grass keeping much warmth at night thus surviving decreasing temperature. On the other hand the locust Epacromius tergestinus ponticus requires transitional habitats (Artemisio-Festucetum - Puccinellietum - Alopecuretum) which sometimes can be found in large numbers in some years especially in the southern pusztas (e.g. Zám). The orthopterous species of the Hortobágy are characterised by the temporary overpopulation of large areas. Species of the Chorthippus genus abound in large numbers in closed alkaline meadows; their density can be as high as 20-30 per m2. The locust Dociostaurus brevicollis is very numerous in alkaline meadows with Sagebrush

Wormwood and temporarily wet barren alkaline associations. Dociostaurus maroccanus is closely related to but bigger than the former species and appeared in extremely large masses in some years in the first decade of the XXth century in the Hortobágy accompanied by birds feeding on them. Nowadays it is rarely to be found in the Hortobágy. The locust Omocestus petraeus is dominating on barren alkaline soil. It is a large mistake to think of locusts as damaging animals in the alkaline meadows. It is true, that considerable amount of plant biomass is eaten by them when overpopulating. Therefore it is not accidental that a special locust-killing machine pulled by a horse was developed by Jablnowsky in the Hortobágy in the beginninig of the XXth century. On the other hand locusts are necessary for the normal metabolism of meadows and other types of grasslands, since they help decomposing cellulose-rich plant parts decomposing otherwise slowly by the activitiy of cellulose-decomposing bacteria living in their intestines. Thus humification is also facilitated, since not only undigestible plant parts get back to the soil inside the droppings of locusts but large masses of cellulose-decomposing bacteria continuing their job in the soil.

Predatory locusts and those which feed on both types of nutrients are rather connected to taller, more closed stands of meadow vegetation. The locust Platycleis affinis occur also in alkaline meadows of better quality together with the locust Tessellana vittata, however both of them are more typical for loess vegetation. The grasshopper Gampsocleis glabra is a steppe-living species distributed from Southern-Europe to the Mongolian grasslands. Their presence in the alkaline grasslands is connected to taller plants.

The beetle Epicauta rufidorsum feeds mostly on locust eggs which occurs in large numbers when locusts overpopulate.

The flightless Lamiinae Longhorns feeding on grass roots live in alkaline meadows of better quality. In warm late spring-early summer days one can meet up to four species of them (Dorcadion scopolii, D. pedestre, D. aethiops, D. fulvum) in the grazing lands of the Hortobágy. The Telini Fly (Mylabris pannonica) is an endemic beetle in the alkaline grasslands of the Carpathian Basin. The Caterpillar-hunter is a large-sized predatory beetle which is predominantly nocturnal. Besides there are several Ground Beetle species of different size in the alkaline meadows of the Hortobágy. The necessity of further entomological studies is indicated by the fact that a new species (Poecilus kekesiensis) was found in the Puccinellietum meadows with heavily fluctuating water-cover near the borderlines of marshes.

Another important predatory arthropodal group in the alkaline meadows is formed by spiders. One can meet them from snow melt to late autumn, especially Wolf Spiders (Lycosidae) which do not prepare cobwebs but hunt in the grass. Young spiders "fly off" travelling on gossamer threads covering grasses in the puszta. One of the most famous species of them is the Russian Spiderthat spends the whole daylight-time in a vertical hole in the earth lined by spider-threads and starts hunting at dawn or at night. This spider which is the largest in Hungary provides an interesting and attractive sight when the female let the young spiders walk connected to them by thin spider-threads which otherwise sit on her back. The most striking ones among the cobweb-making spiders are the black-and-yellow spiders Argiope fasciata, A. bruennichi that catch their prey building a relatively large cobweb fastened to taller stalks of grass.

The remnants of loess grasslands

Unfortunately the loess meadows in the Hortobágy are too small and isolated to let a completely unique, independent fauna and flora evolve in them. Their insect species are characterised by ones connected to closed meadows with tall grasses, e.g. Gampsocleis glabra, Platycleis affinis, and Tessellana vittata. The Preying Mantid Praying Mantid is common on burial mounds. The Tabby Cledobia moldavica, the Tiger Moth Endrosa kuhlweini and many Noctuid Moth species (Agrotís crassa, Euxoa hastifera) are eastern, steppe-living species.

The fauna of the burial mounds is peculiar, however not species-rich. Predatory grasshoppers live in the tall grass: Tessellana vittata and Platycleis affinis are characteristic here. The Painted Lady, the Peacock Butterfly and the Small Tortoiseshell can regularly be seen feeding on thistles. The caterpillars of the latter two species feed on nettle (Urtica sp.)

The most numerous butterfly species of the loess-patches are the Meadow Brown, the Small Heath and the Silver-studded Blue butterflies. The Feathered Flunkey and the moth Endrosa kuhlweini swarm in warm morning hours.

The tall-grassed loess meadows are characterised by the presence of large numbers of grasshoppers and locusts. The chirring of the male of the grasshopper Gampsocleis glabra sitting on tall weeds and thistles can be heard at large distances. It is a typical steppe-living species: it is distributed from the West-Mongolian grasslands to the western borderline of the Great Hungarian Plain. The grasshoppers Platycleis affinis and Tesselana vittata are also predatory species. The number of predatory grasshoppers in the loess meadows is always relatively high, since these habitats provide many Plant Bugs and Homopterans as prey items. The density of graminivorous locusts can be as high as 15-20/ m2 at the same time, of which the locust species belonging to the Stenobothrus and Chorthippus genera are the commonest ones.

The forests of the Hortobágy

The remnants of the native oak-forests of the Hortobágy belong to the alkaline oak-forest association (Festuco pseudovinae-Quercetum roboris).

Their fauna is very species-rich compared to their small size and isolatedness. Of course a special circumstance plays an important role in it, i.e. the alkaline oak-forests are differently structured than those in the forested areas of Central Europe. It is because this type of habitat is the mosaic-like system of intertwining communities thus the coexistence of species of different origin and ecological needs become possible. The number of species living in the foliage of the oak-forest is also considerable. The Gipsy Moth (Lymantria dispar) often appears in large numbers, eating all leaves from oaks in some parts of the Ohati-forest. The female lays its eggs covered by the hair of its abdomen in large balls on the bark of the trees. After a short-term larval stage the moths swarm out in mid-summer (late July, early August). The males search for flightless paunchy females sitting on the bark of the trees with a specially rolling flight by day. Finding the female is facilitated by organs of senses of incredible sensitivity situated on the feather-like antennae of the males sensing the feromons given out by females.The other foliage-eating species that occurs in large numbers is the Pea-green Oak Curl. Its way of life is totally different. The small caterpillars hatch from overwintering eggs before frondescence, then work into the buds and make a web on rolled up leaves after frondescense and finally pupate in it. The whole process of its development is incredibly fast, since the moths fly out in late May-early June the lifetime of which is only a couple of days. Besides there are around 300 different moth species develop exclusively on oak or in oak species as well. The most numerous species are the Leaf-Rollers (Tortricidae), the Geometrid Moths (Geometridae) and the Noctuid Moths (Noctuidae). Considerable numbers of Geometrid Moths imagos of which swarm late in the autumn (late October-early November) or early spring (late February-early April). The foliage-eating activities of their caterpillars is significant from frondescence to late May. Their overpopulating occurs generally in ten years periods. Catocala-species are large sized moths with striking, bright hind wings. Several members of Noctuid Moths swarm in late autumn, the full-grown moths overwinter and reproduce only early in the spring (e.g. Chestnuts - Conistra-species), while the lifetime of full-grown moths of other species is only a couple of weeks in the autumn (e.g. Sallow Moths of the Cirrhia, Agrochola, Griposia, genera or the Dryobotodes eremiata). The Drab moths are also represented by several species (e.g. Northern Drab). The number of species connected to oak-trees which are now rare or sporadical in the Great Plain (e.g. Lobster Prominent, a Kitten Moth Harpya milhauseri, Exaereta ulmi, Dichonia convergens, Dusky Brocade etc. among Noctuid Moths).

The caterpillars of many foliage-eating moth species is an important food item for lots of predatory beetles (e.g. Calosoma inquisitor, Xylodrepa quadripunctata) and parasitic Ichneumons (Ichneumonidae: Ophioninae) as well as Parasite Flies (Tachinidae) species. Many gall-fly species specialize on oaks. Different generations develop their characteristic galls in different parts of the oak-tree. The Andricus hungaricus is exclusively connected to Peduncalatus Oak developing enormous bud galls. It is especially common on single old trees in grazing-lands or those in the fringe of forests. The dense thickets of woods provide suitable habitats for large numbers of insects. First of all species like this are some ground beetle species connected to humid microclimatic conditions (e.g. Field Ground Beetle, Carabus cancellatus tibiscinus etc.), several Buprestid Beetle species (Anthaxia nitidula, Chryso-bothris affinis, Agrilus pannonicus, Agrilus obscuricoflis), Leaf Beetles, Longhorn Beetles and Snout Beetles.

Fallen out trees rot at the same place in parts of the woods with no human interference (e.g. in the core area of the Margitai-forest Biosphere Reserve). Many arthropodes develop in them that do not find suitable habitats in stands of wood managed by the forestry thus becoming scarcer and scarcer in Europe. Several protected Longhorn Beetle species occur in old, dying oak-trees of thinning out stands of oak-forests, e.g. Great Capricorn Beetle, the rare Trichoferus pallidus living in Longhorn Beetle-holes, the (Purpuricenus kaehlerí) with black-wings and red spots on it , the brownish, flat-bodied Walnut Longhorn Beetle etc. Many beetle species feed on the poring sap of trees: Longhorn Beetles, Stag Beetles, Buprestid Beetles. The most striking species among Buprestid Beetles is the large Potosia aeruginosa.

In the clearings of woods live the protected thamnobiont Preying Mantid Praying Mantid, theSwallowtail living on large umbellated species, the Gortyna borelii lunata specializing on Peucedanum officinale, several Shark Moth (Cucullia) species and Proserpinus proserpina. Since these clearings are highly variegated with medium humidity mesophilous or even wet meadow species may reproduce in them which do not occur at all in the Great Plain or occurs at most in the borderline of it, e.g. the large flightless grasshopper Polysarcus denticauda, Mecostethus grossus and Chrysochraon dispar locusts or the Small Pearl-bordered Fritillary. Large dragonfly species hunting in these habitats can be observed in large numbers during the summer (e.g.Emperor Dragonfly, Anax parthenope, Anaciaeschna isosceles, Aeschna affinis, etc.).

All insect species characteristic for alkaline grasslands can be found in patches of Artemisietum associations.

The soil as habitat

The soil fauna of the Hortobágy is less known. However several worm species (Nematodes, Ringed Worms) can be mentioned here. Two ecologically interesting earthworm species Brandling Worm and Allolobophora jassyemsis are strongly connected to alkaline soils (pH 8,5 - 9,5). Besides Spring-tails are represented by around 60, while Beetle Mites important in the soil life belonging to Chelicerates are represented by 100 species. All of them are important food items of beetle larvae, primarily of those of ground beetles.

Different ant species build their hills partly or comletely in alkaline soils of better quality or in loess soils (Red Myrmicine Ants, Harvester Ants, Tetramorium, Black Ants and Formica species).