



SAND DUNES OF THE DANUBE REGION

*Splinters of sand
in agricultural land*



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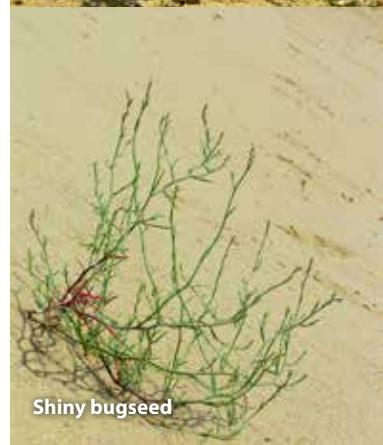
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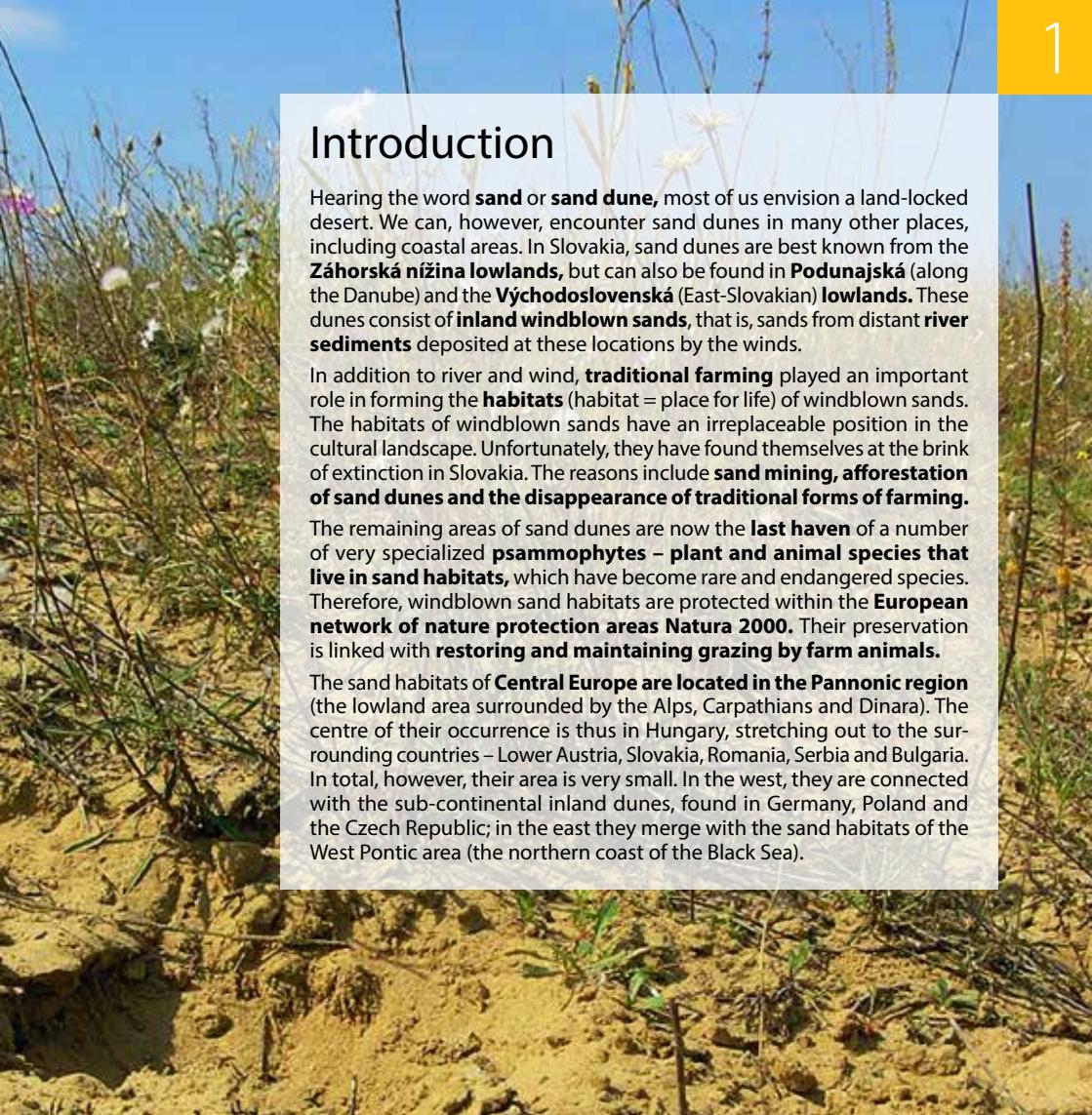
Introduction

Hearing the word **sand** or **sand dune**, most of us envision a land-locked desert. We can, however, encounter sand dunes in many other places, including coastal areas. In Slovakia, sand dunes are best known from the **Záhorská nížina lowlands**, but can also be found in **Podunajská** (along the Danube) and the **Východoslovenská** (East-Slovakian) **lowlands**. These dunes consist of **inland windblown sands**, that is, sands from distant **river sediments** deposited at these locations by the winds.

In addition to river and wind, **traditional farming** played an important role in forming the **habitats** (habitat = place for life) of windblown sands. The habitats of windblown sands have an irreplaceable position in the cultural landscape. Unfortunately, they have found themselves at the brink of extinction in Slovakia. The reasons include **sand mining, afforestation of sand dunes and the disappearance of traditional forms of farming**.

The remaining areas of sand dunes are now the **last haven** of a number of very specialized **psammophytes – plant and animal species that live in sand habitats**, which have become rare and endangered species. Therefore, windblown sand habitats are protected within the **European network of nature protection areas Natura 2000**. Their preservation is linked with **restoring and maintaining grazing by farm animals**.

The sand habitats of **Central Europe are located in the Pannonic region** (the lowland area surrounded by the Alps, Carpathians and Dinara). The centre of their occurrence is thus in Hungary, stretching out to the surrounding countries – Lower Austria, Slovakia, Romania, Serbia and Bulgaria. In total, however, their area is very small. In the west, they are connected with the sub-continental inland dunes, found in Germany, Poland and the Czech Republic; in the east they merge with the sand habitats of the West Pontic area (the northern coast of the Black Sea).



Marcelovské piesky sand area



Sand plantain



Chotínske piesky sand area

Not all sands are the same

What are windblown sands?

The creation of **inland windblown sands** is linked with the dry and cold times of the **early Quaternary Period**. **Large rivers freely meandered through plains**, constantly moving their beds. In the meanders of the largest rivers – in the lower parts of the Morava, Danube and Tisza rivers – **sand sediments accumulated**, which were then **blown away by the wind** from the original river beds and deposited in the lowlands. In the course of their transport through landscapes with thin or no vegetation, the sand grains were eroded, becoming smaller and rounded, thus creating what we call today **the windblown sands**. These sands most frequently formed sand dunes of various heights; for example, in the area along the Danube River they are about 2 to 3 meters high.

Based on the character of the river sediments, the **windblown sands** can be **siliceous** (acid and low in nutrients) – typical for the Záhorie region, or **calcareous** (alkaline and richer in nutrients) – like **the sands of the Danube region**.

On exposed sand, the conditions are similar to desert – hot, dry, lacking nutrients, and with the sand ever moving. In many ways, these conditions for life are extreme. Since water permeates through sand very easily, it **dries very quickly**. The surface layer of sand relies mainly **on precipitation only** because underground water does not reach the surface via capillary action. Therefore, **soil dew** plays a significant role in maintaining moisture in the sands' surface layer. It is created through water vapour condensation on the sand surface, when the temperature drops below the so-called *dew point*. **The temperature differences between day and night, as well as between the sand surface and the subsurface layer are significant**. For example, just a distance of 10 – 20 cm between the surface and the subsurface layers can cause a difference in temperature amounting to 20 – 40 °C. In addition, there is always **a lack of humus** here because decayed organic material is blown away or covered in sand.



Extremist psammophytes

Plants of windblown sands and their adaptations

The plants able to live on sand had to adapt to extreme life conditions, mainly drought, summer heat and repeated covering by sand. These plants are called **psammophytes – plants preferring sand for life**. To avoid excessive water loss, they have small vents under the skin level of their leaves, can reduce the area of their leaves by rolling them into blades, are often thickly haired, and frequently grow in tufts or create "pillows" which capture condensation moisture. They survive adverse periods in the form of seeds (yearlings). They have large root systems, which stabilise the plants in the loose substrate and also enable them to gain moisture from greater depths. In addition, psammophyte plants can withstand **constant covering by sand**, and when mechanically damaged, **they can quickly regenerate** and **shoot out new roots** from axillary buds.



Species withstanding the most extreme conditions are called **pioneer species**; Bassia laniflora, European knotweed (*Polygonum arenarium*) or Puncturevine (*Tribulus terrestris*) are examples of such species. They are called pioneers because they are first to **settle at places with exposed sand**. They reinforce the loose sand with their roots, and the dead plants add organic matter to the sand, thus preparing conditions for other species to grow and, in fact, giving life to moving sand areas. As the sand area gradually grows in, the pioneer species retreat, pushed away by grasses and stronger plant competitors. Pioneer species **require constant deterioration of the surface**, for example by grazing, which creates new areas of exposed sand.



Bassia laniflora



Puncturevine



Dianthus serotinus



Sand saffron



Sandy iris



When the pioneer species are gone, **other psammophyte species** begin to grow on windblown sands, thus continually covering these sand areas. Such species include the endangered *Dianthus serotinus*, the endemic grass **Red fescue** (*Festuca vaginata*), the critically endangered **Federgras** (*Stipa bostrythenica*), and the quite abundant *Potentilla arenaria*. **Baby's breath** (*Gypsophila paniculata*), belonging to the group of so-called **steppe runners**, has a very interesting way of expanding its seeds. When the seeds are ripe, part of the plant breaks off and the wind rolls it on the ground a great distance, thus allowing the seeds to be released and spread.

In good conditions, shrubs and trees maintain their growth on windblown sands, thus creating **forest steppe**. In Slovakia, some unique stands of **white poplar** and **common juniper** can be found **only in the area of Čenkov (SE of the Danube plain)**.

* Do you know what an endemic species is?

An **endemic species** is one that grows in a certain area and does not occur elsewhere. A **Pannonian endemic species** is a species geographically limited to the Pannonian (Carpathian) region. Among the psammophytes, the Pannonian endemic species include, for example, *Dianthus serotinus*, sand saffron (*Colchicum arenarium*) and sandy iris (*Iris arenaria*).



Federgras

Potentilla arenaria

Baby's breath

The psammophyte species: **sand saffron** (*Colchicum arenarium*), **dyer's bugloss** (*Alkanna tinctoria*), **sandy iris** (*Iris arenaria*), and **sea grape** (*Ephedra distachya*) are critically endangered species in Slovakia and **they grow only in the area of Čenkovský forest**, which is the northern edge of their general occurrence. Also, **sand saffron** and **sandy iris** are among the species protected under the EU Habitats Directive, and the critically endangered *Achillea ochroleuca* can be found only in the **Chotínske piesky sand area**.

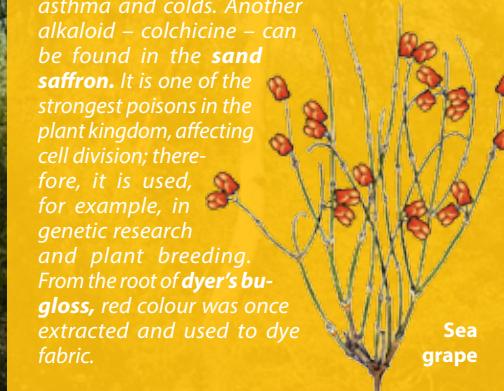
Two habitats protected under the EU Habitats Directive can be found on the windblown sands along the Danube River: **xeric sand calcareous grasslands** (6120*), representing pioneer vegetation growing on exposed sand, and **pannonic sand steppes** (6260*), richer in species, with prevailing psammophyte grasses and sedges, as well as mosses and lichens, covering the sand abundantly.

* Do you know what a biotope or habitat is?

A **biotope** (from Greek bios – life, topos – place), or more commonly in English, a **habitat**, is the set of all factors (both organic and inorganic), which cooperate in creating an environment for the life of a species. Simply said, it is a space for life, or environment for life.

* Do you know what is interesting about them?

The **sea grape** is a dioecious (either male or female) semi-shrub with interesting red berries. The entire plant contains ephedrine, an alkaloid used as a stimulant for the human heart, activity and attention. It is also added to medicines to treat asthma and colds. Another alkaloid – colchicine – can be found in the **sand saffron**. It is one of the strongest poisons in the plant kingdom, affecting cell division; therefore, it is used, for example, in genetic research and plant breeding. From the root of **dyer's bugloss**, red colour was once extracted and used to dye fabric.



Sea grape



Dyer's bugloss



Achillea ochroleuca

* Did you know that...?
The nosed grasshopper is
the largest grasshopper
in Slovakia.



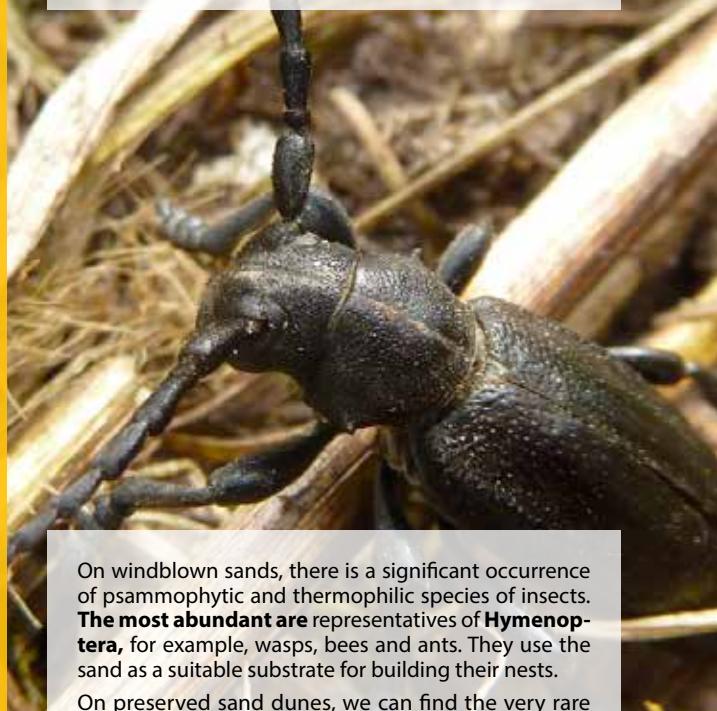
* Did you know that the antlion larva has a noteworthy way of hunting?

The predatory antlion larva uses a sand trap to hunt its prey. It makes a funnel hole in the sand and then waits, buried at the bottom, for its prey. If ants or other small insects walk across the edge of the funnel, they slip into it. The larva also often throws sand high up, thus trying to "shoot down" the escaping prey. The falling and slipping sand pushes the prey to the bottom of the hole. There, the larva captures it with its pincer-like mouthparts. First, it injects poison and then digestive juices into its prey. Finally, the antlion larva sucks it dry, throwing away the unneeded parts of the prey's body.



Rare and inconspicuous Invertebrates of windblown sands

Unlike with plants, there are only a few animal species bound exclusively to the habitats of windblown sands. Most of the animal species found in areas of windblown sands can live in several types of habitats having similar features, for example, dry and warm, with low grass vegetation. On sand dunes, you can also see some forest animal species which are able to find enough food there.



On windblown sands, there is a significant occurrence of psammophytic and thermophilic species of insects. The most abundant are representatives of **Hymenoptera**, for example, wasps, bees and ants. They use the sand as a suitable substrate for building their nests.

On preserved sand dunes, we can find the very rare **nosed grasshopper** (*Acrida ungarica*). This psammophytic species has its northern-most occurrence in Slovakia, and its reproduction is strictly bound to calcareous windblown sands and grasslands on sands. When vegetation covers the sands, this species loses its habitat.

The unusual nocturnal hunter called the **antlion** (*Myrmeleon formicarius*) prefers to live on dry sand soils. In daylight, it hides in the vegetation; at dusk, it sets off to hunt aphids and other small insects. Adult *Myrmeleon formicarius* can be seen from May to August.

Spiders are typical inhabitants of windblown sand areas, and there we can find representatives of some of our most endangered spider species. Among them is the rare **wolf spider** species *Alopecosa psammophila*. The female wolf spider carries a cocoon (a sack with eggs) on the bottom of its belly. When the baby spiders hatch, the mother carries them on its back as a small backpack. In the extremely dry and hot places, we can occasionally have a glimpse of a beautiful **ladybird spider** (*Eresus cinnaberinus*). Its conspicuous colouring perfectly protects the male because its red back with four black dots makes it look like a ladybird, thus cautioning the birds: Leave me alone; I am not edible! The female is all black and bigger than the male. It is rarely seen because it leaves its shelter only when searching for food.



Among beetles, *Carabus hungaricus*, a species protected under the EU Habitats Directive, can sometimes be seen on windblown sands of the Danube region. In most of its area of occurrence, it is considered an extinct or critically endangered species. It is a predatory species, feeding mainly on small insects, snails and various worms, thus preventing their overpopulation in the soil.

In summer, the nectar of plants of windblown sands attracts a number of colourful butterflies. One of them is a thermophilic species, the **southern festoon** (*Zerynthia polyxena*), the caterpillars of which are also very colourful and conspicuous. It is a perfect specialist because the only food plant for its caterpillars is the **European birthwort**. The caterpillars enjoy warming up in the sun; therefore, they are easy to spot on the birthwort. The southern festoon is probably our “most exotic” butterfly. That is because its wings are definitely just as colourful as those of many tropical species.

* Did you know that ladybird spiders live in burrows?

The ladybird spider lives in an underground burrow lined with spider-web. It can be up to 10 cm deep and has a spider-web roof for catching prey



Carabus hungaricus

* Do you know why the festoon is endangered?

The festoon is not a great flier and usually stays near one place. If it has enough plants to feed on, it can gradually spread into new nearby localities. If the birthwort disappears from an area, the festoon is not able to migrate longer distances and its local population becomes extinct



* Did you know that the spadefoot's tadpole is bigger than the adult individual?

The tadpoles of the spadefoot are true giants among the tadpoles of our toads – they grow as long as 12 – 18 cm, which means they are bigger than the adult spadefoot.



* Did you know that the bee-eater is a great builder?

The bee-eaters can skilfully dig a 1 – 2 meter deep tunnel in an upright wall, widening it into a nest burrow at its end. Here, the nestlings are safe until they can fly.



* Do you know how the European honey buzzard is protected from the wasp sting?

The sensitive part between the eyes and the beak is covered by scale-like feathering and its nostrils are narrow slots.



Concealed and mysterious

Vertebrates of windblown sands

In a dry environment, only a perfectly adapted amphibian can survive – **such is the common spadefoot toad** (*Pelobates fuscus*). It buries itself one meter deep in the sand, thus escaping the drought and high temperatures on the surface.

The warm sand substrate offers good living conditions for the thermophilic **European green lizard** (*Lacerta viridis*), our largest and most beautifully coloured lizard. It is one of the few lizards of Slovakia that climbs trees. It is predatory and, using a quick and surprising attack, hunts larger insects and sometimes even other kinds of lizards, young birds and small rodents. It winters in holes in the ground, rock crevices or tree cavities.

Above sandstone and loess walls as well as in sand quarries, our vision may be attracted to the most colourful bird of Europe – **the European bee-eater** (*Merops apiaster*). Due to its colours, it is reminiscent of exotic parrots. As the name suggests, bee-eaters feed on Hymenoptera (including bees), hunting them ably in the course of their acrobatic flying or in sorties from an open perch.

Sand dunes are an ideal hunting place for many feathered predators which look for their prey in the open landscape. One of them is **the European honey buzzard** (*Pernis apivorus*). The main part of its food consists of wasps and their larvae. Using its legs and beak, it can dig up wasp nests hidden as deep as 40 cm in the sand.

The extreme conditions of the windblown sands are perfectly used to its own benefit by **the red fox** (*Vulpes vulpes*), which excavates its den in the soft substrate. One area of windblown sands near the village of Nesvady is even named Ličie diery (Fox hollows) due to the presence of fox burrows there.

At dusk and at night, bats fly from nearby forests and settlements to look for food in the open areas of the sand dunes, being mainly attracted by large insects. The most common of these bats is **the common noctule** (*Nyctalus noctula*). Its colonies of male bats have been found, for example, in growths of silver poplar in the Čenskovská forest steppe.

* Did you know that...?

...vigilance and canniness, as well as a great level of adaptability are reasons why foxes are among the most successful predators?



European green lizard

Will they survive?

Endangered habitats of windblown sands

If we measured the total area of windblown sands in the Slovak part of the Danube region and compared it with the total area of this region, we would very quickly find that the area of these habitats is negligibly small. Their **significance in biodiversity conservation, however, is enormous**. Since they are small and isolated areas surrounded by intensively used farmlands, the sands are threatened by many negative impacts.

For the windblown sand habitats, the **spreading of invasive and weed species** represents the most serious danger. They spread mainly from the surrounding arable land. In addition, invasive wood species were **often actually planted** on windblown sands. Typical examples are **the black locust** (*Robinia pseudoacacia*) and **the tree of heaven** (*Ailanthus altissima*).

The **black locust** (originally from Northern America) and the **tree of heaven** (originally from China) are non-indigenous species introduced to our territory in about the 17th century. These, now domesticated, **invasive woody species** aggressively invade the habitats **of the windblown sands** and gradually **push out the original species**. In the past, these invasive species were even planted on sand dunes to prevent wind erosion of the sand soil.

The spread of weeds and invasive species is primarily related to the **end of the traditional use** of windblown sands (mainly grazing). In the past, livestock such as sheep, cows and horses grazed on windblown sands. That grazing suppressed the stronger plant competitors, primarily tall grasses and weeds, and exposed places were created where the rare and competitively weaker psammophytes, mainly annual plants, could take root. Without grazing, **decaying biomass accumulates** on the sand dunes; the sand **becomes enriched with humus** and the psammophytes retreat.

Sand is a high demand commodity in the construction business. Therefore, **sand mining** is an extremely serious threat. Many windblown sand habitats have been totally destroyed and, even today, mining (e.g., on the sand dune *Bašov kopeček/hill*, near the nature reserve Mašan, and on the Marcelovské piesky sand area) continues to reduce the already small area of the sand dunes.

The general public often perceives windblown sands as non-fertile, uninteresting areas. As a result, the sands often become sites of **illegal disposal of domestic, agricultural or construction waste**.

* Do you know what invasive species are?

*They are non-indigenous species transported to Slovakia mostly as decorative or melliferous (from which bees can make honey) plants, which began to spread quickly from parks and gardens to open nature. They thrive best on sites which are somewhat disturbed, gaining a dominant position there. If they spread massively, they change the character of habitats and endanger populations of our original species. The following plant species are spreading to the windblown sands: Canada goldenrod (*Solidago canadensis*), tall goldenrod (*Solidago gigantea*) and common milkweed (*Asclepias syriaca*).*



Illegal waste disposal site



Sand mining



There is still a chance

Conservation of windblown sand habitats

Even previous generations realised that the windblown sands of the Danube region deserve our attention and conservation efforts. For example, the most famous area of windblown sands in the Danube region, the Čenkovská steppe, has been protected since 1951. Gradually, other territories became protected and, after Slovakia entered the European Union, most of our windblown sand environments were included in the **European network of protected areas, Natura 2000, as special areas of conservation**

The Natura 2000 network does not create open-air museums, i.e., areas where most activities are prohibited; quite the opposite, it allows for an **active approach to and regular care of** precious habitats. Many of the Danube region's windblown sand habitats have recently found themselves at the brink of destruction. Therefore, the **Restoration of endemic Pannonic halophytic and psammophytic habitats in southern Slovakia project** was implemented in 2011, **financially supported by the European Commission's programme Life+**. Its goal is the ecological restoration (restoration of the quality and functions of natural habitats) of selected windblown sand sites along the Danube river (the Marcelovské sands, Chotínske sands, Nesvadské sands and Čenkov), resulting in the return of traditional ways of farming in cooperation with local people.

For the restoration and well-being of primarily the **pioneer species of wind-blown sands**, which are among the most endangered, **the soil surface needs to be disturbed and exposed sand areas created**. In the past, this was assured by livestock grazing and treading through a site. Therefore, in order to recreate these habitats and preserve these endangered species, **extensive grazing needs to be resumed**. In the conditions of the windblown sands, **sheep, goats, horses and mangalicas** (a breed of pigs able to endure very cold weather) are the most suitable livestock for this purpose. To enable the resumption of grazing, the **grazing areas must be prepared** beforehand by removal of volunteer trees, mowing of areas covered by weeds and invasive plants, and mulching.



Marcelovské piesky sands – overgrown sand dunes

After removal of voluntary woods



Grazing restoration – prerequisite for the conservation of rare windblown sand habitats

Within the project, **voluntary plants** of black locust have been **removed** from the Natura 2000 special areas of conservation (total area of 4.3 ha) – the Marcelovské, Chotínske and Nesvadské sands (in the Liščie diery area). In the Mašan area of the Marcelovské sands, the invasive *wood small-reed* grass was **mown** in an area of 1.2 ha, and an area of 1.5 ha was **mulched**. In the Chotínske sands, an area of 1.4 ha was mown and the biomass was removed.

In the Nesvadské and Marcelovské sands, **soil walls were removed** over a total area of 1.3 ha. They formed a barrier to wind, thus preventing the movement of sand and the spread of psammophytic species.



Nesvadské piesky sands – soil wall



After the removal of the soil wall

If you wish to learn more about our windblown sand habitats, we recommend the following materials:

- Chrenková, M., Královičová, A. Svet viatych pieskov pre mladých objaviteľov/The World of Windblown Sands for Young Discoverers. DAPHNE – Institute of Applied Ecology, Bratislava, 2015. 50 p.
- Šefferová Stanová, V., Valachovič, M., Šíbl, J., Janák, M. Manažmentový model pre viate piesky/Management Model for Windblown Sands. DAPHNE – Institute of Applied Ecology and Botanical Institute of the Slovak Academy of Science, Bratislava. 26 p. URL: http://www.daphne.sk/sites/daphne.sk/files/uploads/MM06_piesky.pdf
- Web page focused on windblown sands and halophytic habitats of the Danube river region: www.perlypodunajska.sk

Special areas of conservation in the Danube Region with habitats of windblown sands

Name and code of SAC*	Area in ha	Cadastre	The most significant rare plant species	Characteristics of the windblown sand habitat
SKUEV0067 Čenkov	123,9	Mužla	The only site of sea grape, dyer's bugloss, sandy iris and sand saffron species, but also with federgras – <i>Stipa borysthenica</i> , <i>Syrenia cana</i> , <i>Minuartia glauca</i>	The largest preserved complex of Pannonic windblown sand habitats in Slovakia. The Pannonic poplar-juniper habitat of Čenkov is the only site of its kind in Slovakia.
SKUEV0100 Chotínske piesky sands	7,13	Chotín	Bassia laniflora, European knotweed, <i>Achillea ochroleuca</i> – the only site of its occurrence in Slovakia	Small area of rare Pannonic windblown sand habitats.
SKUEV0065 Marcelovské piesky sands	43,89	Marcelová, Krátke Kesy, Radvaň nad Dunajom	Bassia laniflora, Shiny bugseed, European knotweed, <i>Syrenia cana</i>	One of a few preserved windblown sand sites in the Podunajská nížina plain; it consists of three parts – the Marcelovské sands, Mašan and Bašov.
SKUEV0098 Nesvadské piesky sands	17,09	Nesvady	Bassia laniflora, European knotweed, <i>Achillea ochroleuca</i> , <i>Silene borysthenica</i> , federgras – <i>Stipa borysthenica</i> , <i>Syrenia cana</i>	The location of rare windblown sand habitats; it consists of two parts: Duna pri Kalvárii (Dune by the Calvary) and Liščie diery (Fox Hollows).

*SAC – Special Area of Conservation of the Natura 2000 network

Special areas of conservation in the Danube Region with habitats of windblown sands



Nitra



Nesvadské piesky sands



Nesvadské piesky sands



Chotínske piesky sands

Komárno



Marcelovské
piesky sands



Čenkov

Štúrovo



Chotínske piesky sands



Marcelovské piesky sands



Čenkov