

ZAMĚŘENO NA PŘÍRODU

MILITARY LIFE FOR NATURE

Restoration of steppe habitats in Načeratický kopec Special Area of Conservation



**Case study of the Military LIFE for Nature project
implemented between 2016–2022**

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INTRODUCTION

Military areas are comparable in importance to the most valuable Czech protected areas; mainly due to the occurrence of nowadays rare non-forest habitats, such as dry grasslands, heathlands, wetlands or even sand dunes. These habitats have been preserved here due to the absence of urbanization and industrial agriculture, as well as due to the army activities. The activities of soldiers in the field unintentionally simulated natural processes for many decades – the so-called disturbances, which otherwise disappeared from the cultural landscape. Disturbances generally disrupt the established state of the ecosystem, prevent the gradual overgrowth of the landscape and thus ensure the constant restoration of non-forest habitats. Infantry, heavy vehicles, and exploding ammunition shaped the landscape just like herds of large ungulates, natural landslides, windthrows, and fires once did.

The aim of the Military LIFE for Nature project was to provide management of five biologically extremely valuable sites in the Czech Republic, which were formed in the past by military training: Načeratický kopec near Znojmo, Pánov near Hodonín, Blšanský chlum and Mašovická střelnice together with Havranické vřesoviště. For this purpose, four management methods were selected, which are being introduced in the Czech nature conservation: heavy and military equipment activity, motocross, free grazing of sheep and goats and grazing of „wild“ horses. The advantage of these approaches is, on the one hand, that they make it possible to create much-needed heterogeneity in the environment. On the other hand, they can also be effective in large areas, such as military areas, often at relatively low financial costs, especially with the involvement of local communities. The project also sought to raise public awareness of the natural significance of abandoned military areas and the involvement of local people in the management of these sites.

Načeratický kopec is not only a significant feature of the south-eastern edge of Znojmo, but also one of the most important areas in terms of nature conservation in South Moravia. Here we can admire large steppe meadows with typical species of plants and animals, such as greater pasque flower, dwarf everlast, spiked speedwell, feather grasses, and more than 230 species of beetles. From the 1950s to the 1990s, there was a training ground for heavy military equipment, especially tanks. Their movement effectively eliminated self-seeding woody plants and aggressive herbs, thus preserving space for rare steppe species. After the army left, however, the area gradually began to overgrow with trees (especially roses, hawthorns and invasive acacia) and expansive grasses, and valuable steppes and the species associated with them began to disappear. Their rescue required the removal of self-seeding acacia and the reduction of bushes. Subsequently, it was necessary to prevent further overgrowth. It was made possible for the heavy tank equipment and the traditional free grazing of a mixed flock of sheep and goats to return to the site. These new conservation activities were combined with the ongoing activities of the local motocross club and were used to raise awareness during the annual Open Steppe Day on Načeratický kopec.

The Military LIFE for Nature project was launched in September 2016 with a five-and-a-half-year implementation period. Its main researcher was the professional conservation organization Beleco, z.s., in close cooperation with partners: the organization Česká krajina (which provided grazing of wild horses in Mašovice and Havraníky), the company Wetland s.r.o. (which carried out restoration management in Pánov) and the Ministry of the Environment.

This document was created at the very end of the project and is intended to serve as a case study in order to record and share important information about the initial state, course and results of conservation management on Načeratický kopec. Emphasis is placed on retrospective evaluation of measures and transfer of experience gained, which can be used in the conservation of similar areas in the future. We thank the European Union's LIFE programme and the Ministry of the Environment of the Czech Republic for their support of the entire project and the publication of this case study.

CHARACTERISTICS OF THE AREA

■ Historical development

Before the establishment of the military training ground, Načeratický kopec was part of a common agricultural landscape. We learn the first facts about its use only from historical maps of the 19th century, which prove the mostly open character of the whole area. The nature of vegetation and the presence of some plant species typical of pastures (e.g. greater pasque flower) also indirectly testify to the grazing use. Historical maps also document the use of part of the hill as an orchard. Remains of old fruit (especially cherry) orchards have been preserved to this day; in addition, individual old or wild fruit trees are very common here. It is possible that some parts of the hill were used as vineyards in some periods; the occurrence of individual old vines could indicate this (Slavík 2014). Aerial survey images from the 1940s already show the bare pasture nature of the hill, especially in the eastern half with agricultural enclaves (see map 1; for the comparison with the current situation, see map 2).

The dating of the beginnings of military training on Načeratický kopec is not entirely clear and probably dates back to the 19th century (Slavík 2014). In any case, the presence of a shooting range is documented from 1938. Since the 1950s, the 24th Infantry Regiment, which was stationed in Znojmo, with the exception of World War II, since 1920. Mainly for engineering and infantry training it used only the northern and central part, in which there were many roads and a large number of trenches. In 1958, it was replaced by the 9th Motorized Rifle Regiment, included in the 4th Panzer Division, which was stationed here until 1992. The key to the development of the area was the rearmament to the IFV (infantry fighting vehicle) in 1978. The area served only as a training ground for driving and tactical training. A shooting range for all infantry weapons, IFV and tanks was established near the village of Mašovice (see the case study Mašovická střelnice and Havranické vřesoviště). As part of the training, there were four to five tanks, about ten IFV, five armoured personnel carriers and several lorries. The area was interwoven with a dense network of variously disturbed roads, with the largest concentration in the central and western part. Military activity at the training ground practically ended in 1992, when the 9th Motorized Rifle Regiment was replaced by the 9th Infantry Regiment during the transformation of the army. From 1994, only the 6th Reconnaissance Battalion was based here. In 1997, the barracks complex was completely abandoned and a year later the entire area was transferred to the city of Znojmo free of charge as surplus state property (Slavík 2014). In addition to training activities, the army also operated a pigsty here, which was abolished in the early 1990s and subsequently demolished (Slavík 2014).

Shortly after the army left the area, it was considered to declare it a specially protected area. In 1995, the NCA CR (under a different name then) conducted a detailed botanical survey of the site. However, the SPA was not declared. Only after 2000, in connection with the preparation of documents and data collection for the planned Natura 2000 system, there was a renewal of a more intensive conservation interest in the site. In 2005, Načeratický kopec was declared a Special Area of Conservation and in 2013 a Nature Monument. Preserved communities of narrow-leaved and acidophilous dry grasslands and shrubs have been identified as a conservation objective. Despite state protection, however, the site continued to face issues typical of many abandoned military areas – overgrowth and degradation of valuable grassland and herbaceous communities, illegal dumping of various waste and illegal activities of bikers, which increased in intensity over time.

■ Natural conditions

Načeratický kopec is a so-called island mountain, which is a remnant of the Tertiary weathering of the granite massif. Only poorly developed ranker soils with unique vegetation of silicate xerophytic grasslands are created on the granite base, which protrudes to the surface in many places. The diversity of the area is in the depressions and

at the foot of the slopes complemented by preserved locations of Miocene marine sediments with basophilous vegetation. In a detailed view, the whole hill represents a system of ten knolls separated by shallow valleys with very gentle slopes. The whole area of interest has an area of 127 hectares and is located at an altitude of about 230-290 m above sea level.

According to the phytogeographical division of the Czech Republic, Načeratický kopec is located in the area of thermophytic. The potential natural vegetation would consist mainly of acidophilous oak groves, with cow-wheat oak-hornbeam forest in the northern and southern parts of the site. In some isolated places of extreme habitats, the forest could be replaced by natural non-forest vegetation (Slavík 2014). Today, it is represented by mostly acidophilous vegetation of ephemerals and succulents on exposed bedrock and artificial outcrops. The dominant type of vegetation is acidophilous and narrow-leaved dry grasslands with xerophytic shrubs with dwarf cherry and dog rose. Notable are the small fragments of in the past large cherry orchards in the north-western part of the area.

We will not find military buildings and panel roads here, otherwise characteristic of most training grounds. The only observable trace of military activity are unpaved roads created by heavy machinery concentrated especially in the central and northern part of the site. In steeper places, the rocky base was fragmented by subsequent erosion. Stone mining took place to a limited extent, probably only for local purposes. The resulting small quarries contribute to the already high diversity of habitats.

■ Species important from the conservation point of view

Due to its size and preservation, Načeratický kopec is a very important steppe enclave of South Moravia and is one of the most important areas of its kind in the Czech Republic. The steppe vegetation here has a very long history – according to available data, parts of the site with shallow soils have never been cultivated and have been used as pasture for centuries. The key to maintaining the character of the site is the all-season free grazing of flocks of sheep and goats directed by shepherds and herding dogs in combination with local more intense disturbances provided by off-road motorcycle rides.

The vegetation of Načeratický kopec consists mainly of different types of dry grasslands with dominant fescue – Volga fescue (*Festuca valesiaca*), blue fescue (*Festuca pallens*), fescue sp. (*Festuca rupicola*), and hairy feather grass (*Stipa capillata*) spreading at places. As for the important species of dry grasslands, there are three species of Gagea on Načeratický kopec in the spring – early star-of-Bethlehem (*Gagea bohemica*), Gagea sp. (*G. pusilla*), a hairy star-of-Bethlehem (*G. villosa*), greater pasque flower (*Pulsatilla grandis*), and pygmy iris (*Iris pumila*). Among other endangered species, there are numerous populations of dwarf everlast (*Helichrysum arenarium*), night-scented stock (*Hesperis tristis*) a biennial hollyhock (*Alcea biennis*). There are large populations of other species of sparse grasslands, such as rush skeletonweed (*Chondrilla juncea*), Spanish catchfly (*Silene otites*), and purple mullein (*Verbascum phoeniceum*). An important element of the Načeratický kopec vegetation are endangered field weeds, which appear in places with more intense disturbances. The most valuable species are European heliotrope (*Heliotropium europaeum*), giant needleleaf (*Polycnemum majus*), field woundwort (*Stachys arvensis*), and a very strong population of black henbane (*Hyoscyamus niger*).

The entomological significance of Načeratický kopec is very high with the occurrence of important species in each studied group. The most researched groups are butterflies and beetles. There are species-rich communities of taxa of diurnal butterflies and burnet moths associated with steppe habitats and dry meadows with 25 species included in the Red List. The most endangered species are spotted fritillary (*Melitaea didyma*), safflower skipper (*Pyrgus carthami*), and burnet moth species (*Zygaena punctum*). The most important nocturnal species of Macrolepidoptera group include Baltic grayling (*Chelis maculosa*), and chaste pellicle (*Watsonarctia casta*).

An extremely important species among the beetles is the weevil species *Pachycerus segnis*, which has its only known site in the Czech Republic here. Its occurrence is closely linked to motocross activities, which influence the optimal condition of its nutrient plants, and thus support a number of other important species, such as *Bruchidius cinerascens*, *Chrysolina limbata*, *Psylliodes hyoscyamin*, *Rhabdorrhynchus echii*, and *Rhinusa rara*. A well-researched group are jewel beetles (*Buprestidae*) with several extremely rare species (*Agrilus antiquus croaticus*, *Paracylindromorphus subuliformis*, *Sphenoptera substriata*).

Among vertebrates, birds are the most important group. Barred warbler (*Sylvia nisoria*) has a supra-regionally important population here, but other species of xerothermic open landscape also nest here, such as hoopoe (*Upupa epops*), corn bunting (*Emberiza calandra*), wryneck (*Jynx torquilla*), and woodlark (*Lullula arborea*).

Table 1 shows the selection of conservation-important species found at the site since 2010 (see Table attachments). It includes only species listed in the CR (critically endangered) and EN (endangered) categories of the relevant red lists and specially protected species included in the CR (critically endangered) category.

■ Important stakeholders

Landowners:

- The town of Znojmo – dominant landowner in the project site

Specially protected area administration:

- Regional Office of the South Moravian Region, detached workplace Znojmo – execution of the state administration of nature conservation – Ing. Milan Král

Managing entities:

- Ing. Petr Kosmák, Nový Dvůr – LPIS land block user, sheep and goat grazing

Interest groups:

- Motocross Club, Oblekovice
- Nový Šaldorf-Oblekovice Hunting Association

Local expert consultants:

- Mgr. Miroslav Bažant, University of South Bohemia in České Budějovice, ornithologist performing long-term monitoring of the population of barred warbler and other bird species on Načeratický kopec
- Ing. Robert Stejskal, Ph.D., Podyjí National Park Administration, officer for scientific management of forest and non-forest ecosystems
- Ing. Martin Škorpík, Podyjí National Park Administration, Head of the Department of Special Nature Protection and Strategic Planning, entomologist

INITIAL STATE

With the end of military activity, the disturbances that maintained conditions in favour of diverse herbaceous communities disappeared, and the shrubs began to expand, often in combination with stands of invasive false acacia (*Robinia pseudoacacia*). At the same time, the fast-spreading grasses wood small-reed (*Calamagrostis epigejos*), and false oat-grass (*Arrhenatherum elatius*) began to gain ground. In 2015, when the Military LIFE for Nature project was established, the area of Načeratický kopec had been abandoned by the army for almost 20 years and without any conceptual prospects for future use. The status of Nature Monument and Special Area of Conservation guaranteed the primary role of nature conservation; however, there was insufficient funding to manage valuable habitats in such a large area. The main problem was overgrowth by woody plants, which led to the constant reduction of valuable steppe areas.

The degradation of valuable steppe grasslands was at least partially reduced by the grazing of a mixed flock of sheep and goats, which returned to the hill to a limited extent in 2006. Each year, different parts of the area were grazed, while those that showed higher degradation of grasslands, especially by false oat-grass, were grazed repeatedly and more intensively (Slavík 2014). However, due to the size of the site and the limited financial resources, the grazing reached only a fraction of the desired annual extent and thus could not have a significant effect on the overall overgrowth. Since 2012, an organic farmer, Petr Kosmák, has been herding a relatively large flock of sheep and goats in the traditional way of free grazing without fences. At the time of his arrival, however, a large part of the valuable grasslands had already succumbed to overgrowth to such an extent that they were not available for grazing at all.

At the beginning of the Military LIFE for Nature project, Načeratický kopec was already largely overgrown with self-seeding shrubs and uninterrupted acacia stands (see maps 3 and 4). In addition, the remnants of dry grasslands were significantly degraded by wood small-reed and false oat-grass. Wood small-reed was still relatively rare on the site; more continuous vegetation was concentrated mainly in several places in the central and southern part of the area (see map 5). False oat-grass was abundant in the lower elevations. The interstitial vegetation of ephemeral plants and succulents occurred on the tops of hills and artificially exposed places. In several places there were illegal dumps of agricultural and construction waste, which contributed to the ruderalization of vegetation.

Another long-term problem was illegal vehicle activities. The installation of barriers on the access roads in 2009 reduced unwanted visits by ATVs and off-road vehicles, but they could not stop two-wheeled vehicles (Slavík 2014). Načeratický kopec was a well-known and popular location in the motorcycle community; they organized their activities in private via the Internet, they also organized unauthorized races there, all year round, regardless of the vegetation or breeding season of protected organisms. The intensity of vehicle movements reached such a level that it burdened not only the environment, but also the locals, who occasionally visited Načeratický kopec for walks, horseback riding, and other activities. It must be said that the vehicle activities have had a positive side effect on grassland communities. Similar to the activities of soldiers, they created disturbance pressure, thus restoring the microhabitats of the initial succession stages, and thus to a certain extent contributed to maintaining the species diversity of dry grasslands. However, the problem was in the spontaneity of vehicle movement, the riders' thoughtlessness towards the environment, and the absence of any regulation or supervision by experts or representatives of the regional environmental administration. The solution came in the form of the establishment of a motocross association (Znojmo Motocross Team), which negotiated with the city of Znojmo the conditions for legal motocross on a part of Načeratický kopec with regard to nature conservation. Thus, it was possible to contact the riders at the beginning of our project and establish cooperation with them.

PROJECT MEASURES

The aim of the Military LIFE for Nature project was to restore the area and quality of steppe habitats on Načeratický kopec to their original form (i.e., when the army was there), and thus ensure suitable conditions for survival and strengthening the populations of rare species associated with them. However, the aim was not to create one uniform type of habitat over the entire area of the site during the restoration. Instead, the aim was to create a mosaic of habitats and microhabitats at different stages of succession development – with exposed substrate, sparse to stratified grassland and sparse solitary shrubs. Such a combination of different habitats and micro-habitats generally allows the protection of a wider range of conservation-important species with different ecological requirements.

For this purpose, free grazing was combined with heavy machinery movements as the main tool for restoration. Before that, however, it was necessary to remove self-seeding shrubs and acacias at the most of the area. The reduction of woody plants took place in stages over several years, while the cleared areas were immediately added to the grazed area.

Free but intensive grazing subsequently ensured the reduction of regrowth and the gradual restoration of steppe communities. At the end of the project, these restored pastures will be integrated into the LPIS system (which will allow additional management to be financed from agricultural subsidies) and the grazing will move in the same more extensive way as in the rest of the area.

Because the reduction of woody plants required a really significant remediation intervention in the interest of steppe restoration, it was necessary to carry it out in the gentlest way possible and to balance it with the protection of species associated with xerothermic shrubs. This conflict of protection mainly affected birds; the most significant impact was expected in the highly endangered barred warbler, whose population reaches supra-regional significance on Načeratický kopec. Shrub clearing therefore followed a pre-developed design in consultation with an expert on the local population of this species. At the same time, the procedures for reducing woody plants were adapted to the requirements of shepherds who provided grazing in the organic farming regime: everything was done without the use of herbicides, via ways that were as environmentally friendly as possible, which posed a clear challenge with such a significant acacia invasion.

■ **Removal of shrubs and subsequent regrowth cutting**

The self-seeding woody plants were cut on the defined areas in two stages spread over two years: in the first stage of winter 2016/17 the management was carried out on 21 ha of the southern part of the hill, in the second stage of winter 2017/18 on 15 ha of the western part (see map 3). The woody plants were always removed by hand during the dormant period from the beginning of October to the end of March. Approximately 80% of woody plants were cleared on a total area of 36 ha; most of the wood mass consisted of rose (*Rosa* sp.) and hawthorn (*Crataegus* sp.). The cut material was removed from the site.

The number of removed woody plants and the final form of the remaining stands had to be determined in accordance with the ecological requirements of the protected bird species nesting in the shrubs. Priority was given primarily to nesting requirements of barred warbler, which is highly endangered in the Czech Republic. This species nests in tall shrubs, often preferring roses. Its habitat demands overlap with another conservation-important species – red backed shrike – with which it often nests in the immediate vicinity (even on Načeratický kopec). The past approach of keeping solitary shrubs in a roughly even arrangement did not work at the site because the remaining shrubs were not used by warblers (Bažant pers. comm.). Therefore, in cooperation with Miroslav Bažant, who has been studying the local population of this species for a long time, the design of the resulting shrub stands was designed to increase the structural heterogeneity of the affected areas and, and

at the same time, a suitable habitat is provided both for birds living in shrubs such as barred warbler and for steppe species. Woody plants were left in groups of round shape with a diameter of 10-30 m; especially compact groups with dominant trees in the middle and low and open shrubs at the edges were desirable. For the shrub species, patches of these clusters were formed with a predominance of woody stands, which was surrounded by open grassland habitats with only scattered individual shrubs (see Fig. 1). Such an appearance of open areas with solitary hawthorns and other woody plants is characteristic of pastures. In the nesting season of 2017, the influence of the chosen clearing method on nesting birds was monitored by a team of ornithologists led by Miroslav Bažant. The results of the monitoring confirmed the appropriateness of the measures, and therefore the second stage of shrub removal was carried out in the same way.

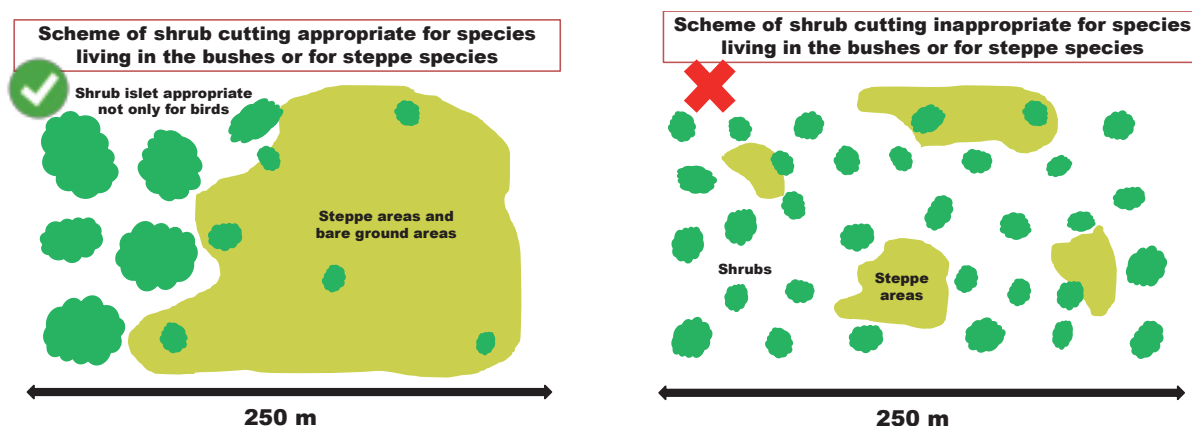


Fig. 1: A diagram showing the previously applied inappropriate method (left) and our applied method (right) of leaving woody plants on Načeratický kopec. (Created by Miroslav Bažant)

Regrowth on areas with cut shrubs was removed by mowing by brush cutter, always from the beginning of August to the end of March. This measure was carried out on each area three times in successive years. The first cutting was carried out as soon as possible after shrub clearing. The entire regrowth was removed. During the first regrowth removal, all material was removed from the site. The regrowth removed during the second and third intervention was left on the ground to rot.

In addition to three-phase clearing, the woody plant regrowth was exposed to the grazing of a mixed flock of sheep and goats during the grazing season. Nibbling the regrowth, especially by goats, reduced the vitality of the young shoots, thus increasing the overall efficiency of their removal.



Fig. 2: Removal of self-seeding shrubs, leaving solitary trees and fruit trees. (Photo: Beleco, 2017)

■ Acacia removal

False acacia formed compact stands on Načeratický kopec in groups of various sizes and ages distributed in different parts of the site. Most of these stands were removed (a total of 12 ha); only a few fragments (a total of 1.3 ha) were left as a source of shade for grazing animals (see Map 4). Initially, an experimental change of some of the acacia trees to Turkey oak stands was also considered, but this plan had to be abandoned due to the extreme droughts that hit the site for two years in a row during the project. The city of Znojmo, owner of the respective plots of land, took over the harvesting and removal of larger trees. Harvesting and removal of the remaining material was provided by an external contractor within the project.

During the preparatory phase in 2016, and subsequently throughout the project, the most suitable methods of acacia eradication with regard to minimizing root regrowth were consulted with experts who had theoretical and practical experience in this area. The issue was discussed with representatives of Podyjí National Park (Robert Stejskal, Petr Vančura), Silva Tarouca Research Institute for Landscape and Ornamental Horticulture, p.r.i. (Tomáš Vrška), the City of Prague (Jiří Rom), Daphne - Institute of Applied Ecology (Ján Šeffer), Czech Association of Nature Conservation Jaro Jaroměř (David Číp), and others. Two main methods were recommended: felling trees on a so-called high stump (about 130 cm) in modifications with or without herbicide application to the cut surface, and injecting concentrated herbicide into pre-drilled holes around the trunk circumference.



Fig. 3: Acacia felled leaving a high stump. (Photo: Beleco, 2018)

Due to the requirements of the agricultural entity on Načeratický kopec providing the grazing, which wanted to stay true to the principles of a chemical-free approach, a high stump felling method was chosen to remove the acacia. This method consists of felling trees between August and October, leaving a stump approximately 130 cm high; this significantly reduces the formation of root regrowth (which is a problem in the case of low stump felling).

After such an management, the acacias regrow at the top in the following growing season. In 2018 and 2019, from August to October, the top regrowth was therefore always removed several times a year, both by hand and by nibbling of grazing animals. After the death of the trees, the remaining stem was harvested to a low stump. In the middle part of the motocross track, the stumps were pulled out so that in the future it would be possible to extend the vehicle movement there.



Fig. 4: Starting regrowth of acacia felled leaving a high stump. (Photo: Beleco, 2018)

■ Restoration grazing

Restoration grazing with a mixed flock of sheep and goats started on the site in 2017 and continued for all five growing seasons until 2021. It took place without a fence (free grazing), under the supervision of a shepherd and herding dogs. It was concentrated in areas where shrubs and acacia had previously been removed. However, outside the project, grazing took place in the same (albeit more extensive) form on the long-maintained grassy parts of Načeratický kopec, which were already part of the LPIS. The hill thus represented a continuous grazing area for free grazing.

In total, restoration grazing was carried out on an area of 48 hectares (see map 6), while in the areas where acacia was removed, grazing was repeated in two consecutive years. Other areas were grazed only once in one year. Each year, the grazing lasted 100 days, and this period was divided into two sub-stages – the first part from April to the end of June lasted 60 days, the second part from the beginning of September to the end of November lasted 40 days. The herd of at least 100 individuals consisted of sheep with a smaller proportion of goats (at least 5 individuals).



*Fig. 5: Free restoration grazing
in a traditional way.
(Photo: M. Jedličková, 2020)*



*Fig. 6: In particular, goat
grazing significantly
contributed to the
suppression of shrub and
acacia regrowth
(Photo: M. Jedličková, 2020)*

■ Removal of wood small-reed

Wood small-reed was still relatively rare at the beginning of the measures. More continuous areas of wood small-reed were concentrated mainly in several places in the central and southern part of the area (see map 5). Wood small-reed does not tolerate long-term and regular disturbances. Therefore, to eliminate it, two methods of disturbance were used and tested – motorcycle riding and military vehicle movement. Some patches were removed by pulling the turf with a bulldozer. In some places, these measures were also supported by grazing.

In 2016, the Regional Office of the South Moravian Region allowed the construction of a motocross track in the central part of the site. During the construction of the track, one compact wood small-reed stand was removed, with the help of heavy machinery, and then motorcycle riding started here (marked in red on map 5). The measure was monitored in the following years, especially in terms of vitality of the wood small-reed stand at the original site and monitoring of new occurrences that could potentially arise at the site in connection with the movement of soil substrate (and the potential scattered wood small-reed populations with it) around the site.

Selected wood small-reed stands (marked in green on map 5) were disturbed by military vehicles in the spring of 2017 and subsequently grazed as part of restoration grazing. The remaining wood small-reed stands were grazed without combination with other management.



Fig. 7: Turf removal in order to remove expansive wood small-reed on the most affected areas. (Photo: Beleco, 2018)



Fig. 8: Disturbance of grassland degraded by wood small-reed using tracked vehicles. (Photo: Beleco, 2020)

■ **Military vehicle movements**

There are two similarly important reasons for military vehicle movements on the project site. Disruption of vegetation and soil surface contributes to the restoration of target habitats, especially interstitial ephemeral plants and succulents, while also suppressing unwanted wood small-reed. At the same time, vehicle movements are of great educational importance; they make it possible to provide information to the general public and stakeholders on the importance of disturbance for biodiversity.

Vehicle movement was implemented between 2017 and 2021 and every year they were connected with an event for the public as part of the Steppe Open Days. A diverse programme was prepared for the public in the form of various stands, aimed especially at families with children, informing them about the natural values of Načeratický kopec and the principle of protection of steppe habitats. Military vehicle movement was also used as an attraction for visitors. Tracked vehicles were used, specifically infantry fighting vehicles (IFV) and other tracked vehicles. During the five years of the project, a total of 120 hours were driven by these vehicles and an area of 5 hectares was treated. After only two years of repetition, a positive effect was evident on the populations of species associated with the exposed areas of the soil substrate and sparse grasslands.

The use of military vehicles on Načeratický kopec is limited by the areas that are included in the LPIS system, and influencing the appearance of these areas could lead to complications with the payment of subsidy funds to the agricultural entity that manages the site. Map 7 shows the extent of areas outside the LPIS register at the beginning of the project (2015), which were potentially suitable for military vehicle movement. In most of these areas, vehicle movements have also been used. However, after the end of the project, part of these areas (on which woody plants have been removed and steppe restored) will be included in the LPIS. Whether this happens at once or gradually, as a result there will be fewer areas suitable for vehicle movement. Therefore, the specific form of the movement was and will be determined in the future before each tank day separately with regard to the current availability of suitable areas.



Fig. 9: Military vehicle movement and its coordination. (Photo: Beleco, 2017)



Fig. 10: Military vehicles as an attraction for the public. (Photo: M. Jedličková, 2020)

MONITORING

Throughout the project, vegetation and entomological monitoring took place of the impacts of restoration measures on communities of interest and plant and animal species. The starting point for the evaluation is the data obtained in the first year of monitoring, which was completed in October 2017. Subsequently, monitoring was repeated every year, based to the methodology described below. The obtained data are currently being processed. The monitoring results will help both to optimize the implemented measures for the future, and contribute to general knowledge about the use of individual management measures.

■ Vegetation monitoring

Within vegetation monitoring, four mutually complementary methods of data collection were applied:

- 1. Monitoring of target habitats:** 3 transects 20 to 60 m long were fixed in the area and placed on the basis of subjective selection on a gradient from the optimal habitat to the degraded habitat. Based on the on-site calibration, an indication group of species was determined. In the regular network of squares 0.5 m x 0.5 m (n = 63), the presence or absence of species was determined and the status of the area was recorded as optimal or degraded. Every two years, the ratio of optimal and degraded areas was evaluated.
- 2. Phytocoenological images:** 18 images were fixed in the area. Each image was fixed in the corners with a metal mark. The cover of individual species was estimated on the Braun-Blanquet nine-member scale; the total cover, living vegetation cover, old grass cover and moss layer cover was recorded.
- 3. Vegetation maps:** vegetation maps were made in the first and last year of the project (2016 and 2021) in the form of an outline of habitat extension boundaries. Habitats were recorded in accordance with the updated Habitats Catalogue.
- 4. Monitoring of the greater pasque flower:** the centre of the population in the area was located using GPS, the border of occurrence was drawn on the map. Simultaneously, the number of individuals with a distinction between flowering and sterile was determined. Using GPS, 3 transects 20 to 60 m long were fixed in a regular network of squares 0.5 m x 0.5 m (n = 63) and the presence/absence of the species was determined.

■ Entomological monitoring

The model groups of monitoring were spiders (Araneae), true bugs (Heteroptera), butterflies and moths (Lepidoptera), and selected families of beetles (Coleoptera): ground beetles (Carabidae), weevils (Curculionidae), and Chrysomelidae. Data collection was ensured by a combination of methods: pit traps, sweep netting, light traps, and time-lapse images of diurnal butterflies.

A total of 12 pairs of pit traps were installed 10 m apart in selected parts of the area (see map 4). Pit traps were exposed three times during the growing season (first half of May, mid-June, August) for 10 days each time. The fixing medium was alcohol vinegar. At each of the pairs of traps, the surrounding vegetation was swept (always 100 times), a light trap for one night was installed here, and a time-lapse image was taken for the registration of diurnal butterflies. The collection of data on butterflies and moths (time-lapse image for the registration of diurnal butterflies and light traps) was installed also separately (without reference to other methods) in the second half of July.

RESULTS

Sheep and goat grazing have proven to be crucial to keeping the steppes in good condition. Thanks to large-scale grazing, the open areas of Načeratický kopec have gradually acquired the character of long-standing traditional pastures with edible forms of hawthorns and structurally diverse grass and herbaceous stands, where ungrazed areas alternate with intensively grazed places and bare soil. Restoration of overgrown steppe grasslands and their subsequent grazing have significantly supported the population of many conservation-important species, such as greater pasque flower (*Pulsatilla grandis*).

Intensive heavy machinery movement has proven to be particularly effective in suppressing shrub regrowth. Areas after cleared shrubs, which have been repeatedly disturbed by tanks, are successfully developing towards disturbed steppe grasslands with a typical occurrence of the hollyhock species *Alcea pallida*. Here, too, conservation-important species are already found, such as night-scented stock (*Hesperis tristis*).

As far as motocross is concerned, fauna monitoring has shown that a number of rare steppe species spread directly to individual terrain features, such as feather grasses, night-scented stock *Hesperis tristis*, bur forget-me-not (*Lappula squarrosa*), or broom-leaf toadflax (*Linaria genistifolia*). In addition, track edges and recently abandoned tracks are an important habitat for oligotrophic disturbed soil species, such as cudweeds, critically endangered knotted clover (*Trifolium striatum*) and, most importantly, one of the most important species here – critically endangered giant needleleaf (*Polycnemum majus*). It was found in 2020 on another micro-site in the north-western part of the area together with knotted clover (*Trifolium striatum*).

During the project, endangered species of butterflies were supported – Baltic grayling (*Chelis maculosa*) and chaste pellicle (*Watsonarctia casta*). In the first half of the project, only individuals were captured in the first half of the project (only in the climatically favourable year 2018 the abundance of chaste pellicle was exceptionally high); between 2020 and 2021, there was a significant increase in population, especially of Baltic grayling. This is a critically endangered species in the Czech Republic and Načeratický kopec is one of its few sites of occurrence. Both types are indicators of changes that occur at the site as part of the project. Similar population changes can be expected for other invertebrate species with similar habitat requirements.

	2017	2018	2019	2020	2021
Baltic grayling (<i>Chelis maculosa</i>)	5	2	3	29	42
Chaste pellicle (<i>Watsonarctia casta</i>)	6	39	3	28	15

The resulting range of individual measures

Measure	Result
Shrub removal	36 ha
Regrowth removal	36 ha
Acacia removal	12 ha
Restoration grazing	48 ha
Military equipment movement	120 hours of movement



Fig. 11: The resulting landscape character of Načeratický kopec – grazed steppes with unevenly distributed woody plants forming a heterogeneous habitat mosaic on a scale from exposed soil to mature stands. A motocross track is visible in the rear part on the right. (Photo: Beleco, 2021)



Fig 12: Among the predominant ruderal species, steppe species of interest, such as hairy feather grass (*Stipa capillata*) or broom-leaf toadflax (*Linaria genistifolia*), are clearly spreading among the artificially created terrain features of the motocross track. (Photo: Beleco, 2018)



Fig. 13: The critically endangered giant needleleaf (Polycnemum majus) is provided with optimal conditions by irregularly disturbed parts of motocross tracks on nutrient-poor skeletal soil. (Photo: Beleco, 2021)



Fig. 14: Free grazing of sheep and goats is very beneficial to the local population of greater pasque flower (*Pulsatilla grandis*). Comparison of the habitat in 2017 before management (removal of shrubs, grazing) and two years later. (Photo: Beleco, 2017 and 2019)



*Fig. 15: Areas after cleared shrubs, which are regularly and intensively disturbed by military equipment, cover with species-diverse grasslands formed by steppe and ruderal species. The abundant occurrence of biennial hollyhock (*Alcea biennis*), which is a typical species of disturbed steppes, is striking here. Even here, rarities such as night-scented stock (*Hesperis tristis*) can be found. (Photo: Beleco, 2019)*



*Fig. 16: Many areas previously overgrown with self-seeding shrubs are already acquiring the character of long-standing traditional pastures with edible forms of hawthorns and structurally diverse grass and herbaceous stands, where ungrazed areas alternate with intensively grazed places and bare soil. These places also attract rare species of birds – hoopoe (*Upupa epops*) and woodlark (*Lullula arborea*). (Photo: Beleco, 2021)*



*Fig. 17: The remaining enclaves of dense shrubs represent a suitable habitat for barred warbler (*Sylvia nisoria*), red-backed shrike (*Lanius collurio*), and other endangered bird species of xerothermic shrubs. (Photo: Beleco, 2019)*



Fig. 18: Flowery acidophilous steppe grasslands in the area of one of the historical pastures on Načeratický kopec. (Photo: Beleco, 2021)



Fig. 19: At the edges of the motocross tracks there are large areas of endangered vegetation species of disturbed areas with a predominance of annual species. Cudweeds (*Filago arvensis*, *F. minima*) predominate here. (Photo: Beleco, 2021)



*Fig. 20: The rarest plant species on Načeratický kopec is European heliotrope (*Heliotropium europaeum*) critically endangered and extremely rare in the Czech Republic. It occupies intensively disturbed places in the motocross area, including the actual tracks. (Photo: Beleco, 2019)*



*Fig. 21: On the ecotone between the intensely disturbed motocross track and the surrounding stratified steppe grasslands, some competitively weak species find suitable conditions requiring occasional disturbance of the soil surface. The most prominent member of this group is the highly endangered dwarf everlast (*Helichrysum arenarium*). (Photo: Beleco, 2019)*



*Fig. 22: The changes that took place on Načeratický kopec during the project significantly supported the critically endangered Baltic grayling (*Chelis maculosa*). (Photo: Beleco, 2017)*



*Fig. 23: The only known site of *Pachycerus segnis* in the Czech Republic is on Načeratický kopec. Its occurrence is supported by local motocross activities. (Photo: Beleco, 2021)*



Fig. 24: At the annual autumn Open Steppes Day, we introduced the general public to nature conservation at Načeratický kopec and the former military training grounds in general. (Photo: Beleco, M. Jedličková, 2020)



Fig. 25: Volunteers from near and far regions of the Czech Republic also took part in the restoration of steppe grasslands. (Photo: L. Dvořáková, 2020)

LONG-TERM SUSTAINABILITY

■ Basic approach:

- ▶ Maintaining the open character of the site will be ensured by grazing by a mixed flock of sheep and goats. They will continue to be free grazing, overseen by shepherds and dogs, running according to current conditions from early spring to late autumn.
- ▶ Motocross will take place in the central part of the site.
- ▶ If there is continued interest in events for the public with military equipment, it will be appropriate to direct these activities to places where it is desirable to suppress wood small-reed and regrowth after shrub clearing (in contrast, it is not desirable in places after acacia removal).
- ▶ It is necessary to combine both basic approaches in such a way that their influence complements each other synergistically and, at the same time, so that one method does not lead to the termination of the other.

■ Recommendation:

Grazing:

- ▶ The economic sustainability of grazing will be supported by the inclusion of most of the Načeratický kopec site in the LPIS land use system and a suitable subsidy title will be drawn there.
- ▶ The grazing load should be set in a way that ensures optimal vegetation pressure. Climatic conditions of the site are very variable year-on-year, with frequent episodes of severe to extreme drought. For this reason, it is necessary to react flexibly to current conditions. A rough guide is the number of grazing animals per year under normal weather conditions (without significant drought and, conversely, outside the above-average humid years) of at least 500 individuals.
- ▶ During the LIFE project, the false acacia stands were removed on about 12 ha. Regrowth on the acacia stumps is suppressed by repeated grazing, combined with the trimming of ungrazed regrowth. This management is repeated at least three times during each growing season. This management measure must be repeated until the acacia stumps die.
- ▶ It would be appropriate to supplement the grazing with other types of grazers, especially horses. The inclusion of horses would more effectively regulate areas with false oat-grass and other expansive grass species.
- ▶ It is desirable to intensively graze places with greater pasque flower every year in the autumn.
- ▶ If the intensity of grazing fails to ensure sufficient grazing pressure on the vegetation due to the low number of animals, it would be appropriate to direct the grazing to the parts with the original steppes (map 2) and to implement mowing in places with former fields.

Motocross:

- ▶ Motorcycle rides should be kept regulated for specific days of the week (2–3).
- ▶ Rides take place on stable tracks. It is desirable to change at least 10% of the tracks every year, and leave the abandoned parts without intervention for at least five years.
- ▶ An alternative to shifting the track is annual removal of the soil substrate by bulldozer on a line at least 50 m long (and at least 4 m wide), with the open part left without intervention.
- ▶ Do not build other obstacles, try to ride in open terrain as much as possible.
- ▶ Do not use track modification material from elsewhere.
- ▶ The administrator of the motocross area is obliged to monitor the track and its surroundings, including jumps and obstacles, for the presence of invasive tree species, especially false acacia and tree of heaven. If they are found, clearing will be done by a suitable method approved by the regional authority and shepherds.

Other activities:

- ▶ It is necessary to control the regrowth of the shrubs removed during project implementation and remove it mechanically.
- ▶ It is absolutely necessary to control the regrowth of acacias in areas with removed trees and to clear them in the established way (repeated grazing combined with trimming of ungrazed regrowth) until the stumps die.
- ▶ It is necessary to check the condition and possible regrowth in the vicinity of acacia stands, which were left at the site as a source of shade for grazing animals. In the case of spread of acacia into the surroundings, it is necessary to clear it.
- ▶ The most suitable solution would be the change of the leftover acacia stands to other deciduous stands (by planting suitable tree species, especially oaks) and the subsequent clearing of acacias. The alternative is to leave the rejuvenating trees (especially cherries) in suitable places in an area similar to the leftover acacia stands without intervention and to allow the creation of new stands of these trees. Then remove the acacia stands for prevention reasons.
- ▶ In the northern part of Šibeník hill, where the site is in contact with adjoining continuous acacia trees, it is necessary to control the return of acacia trees to the site.
- ▶ It is desirable to proceed to further reduction of shrubs, especially on sites with original steppes (see map 2).
- ▶ As part of the protection of birds associated with dense shrubs, especially barred warbler, it is appropriate to continuously replace some aging groups of shrubs with younger ones or to rejuvenate old shrubs by cutting. As shrubs age, they become significantly thinner, especially in the lower layers, and cease to be a suitable habitat for the respective bird species, which leads to a reduction in the number of nesting pairs.
- ▶ Occasional burning is appropriate on selected parts with native vegetation.
- ▶ Vehicles (motocross, military equipment, etc.) should sometimes also be directed to places with grazing so that the conditions of the valid subsidy titles are not disrupted.

SUMMARY

- ▶ Free all-season grazing is the most suitable basic way of management of Načeratický kopec Nature Monument.
- ▶ When managing grasslands on sites with a military history, it is appropriate to combine grazing with more intense disturbances caused by vehicle movements. Minor disturbances of the soil and vegetation by grazing are insufficient for some conservation-important species (especially some plants and invertebrates).
- ▶ The operation of different management activities, often with conflicting interests on one site, requires frequent communication between the parties involved and facilitation of dialogue with a person/entity respected by all involved.
- ▶ If some of the shrubs are left as a habitat for birds and other fauna during clearance, it is significantly more appropriate to keep groups of shrubs within tens to lower hundreds of square metres than individual isolated trees. The ideal appearance of the remaining areas is a high central area gradually decreasing in shrub height to the edges.
- ▶ Removal of acacia, tree of heaven, and other invasive woody plants is desirable by performing the more technically demanding method of injecting herbicide into pre-prepared holes. Removal by simple felling (whether on a low or high stump) without the use of a herbicide, followed by manual disposal of regrowth, is extremely laborious and time consuming. This method of disposal can be implemented only in cases with a strong interest in the exclusion of chemicals (e.g., in organic farming) and with a guarantee (commitment) of the user of the site to complete the removal.
- ▶ Grazing sheep and goats is a less suitable way of management of areas where expansive grasses such as false oat-grass have developed. Here, it would be desirable to apply the grazing of other types of grazers specialized in grasses, especially horses.

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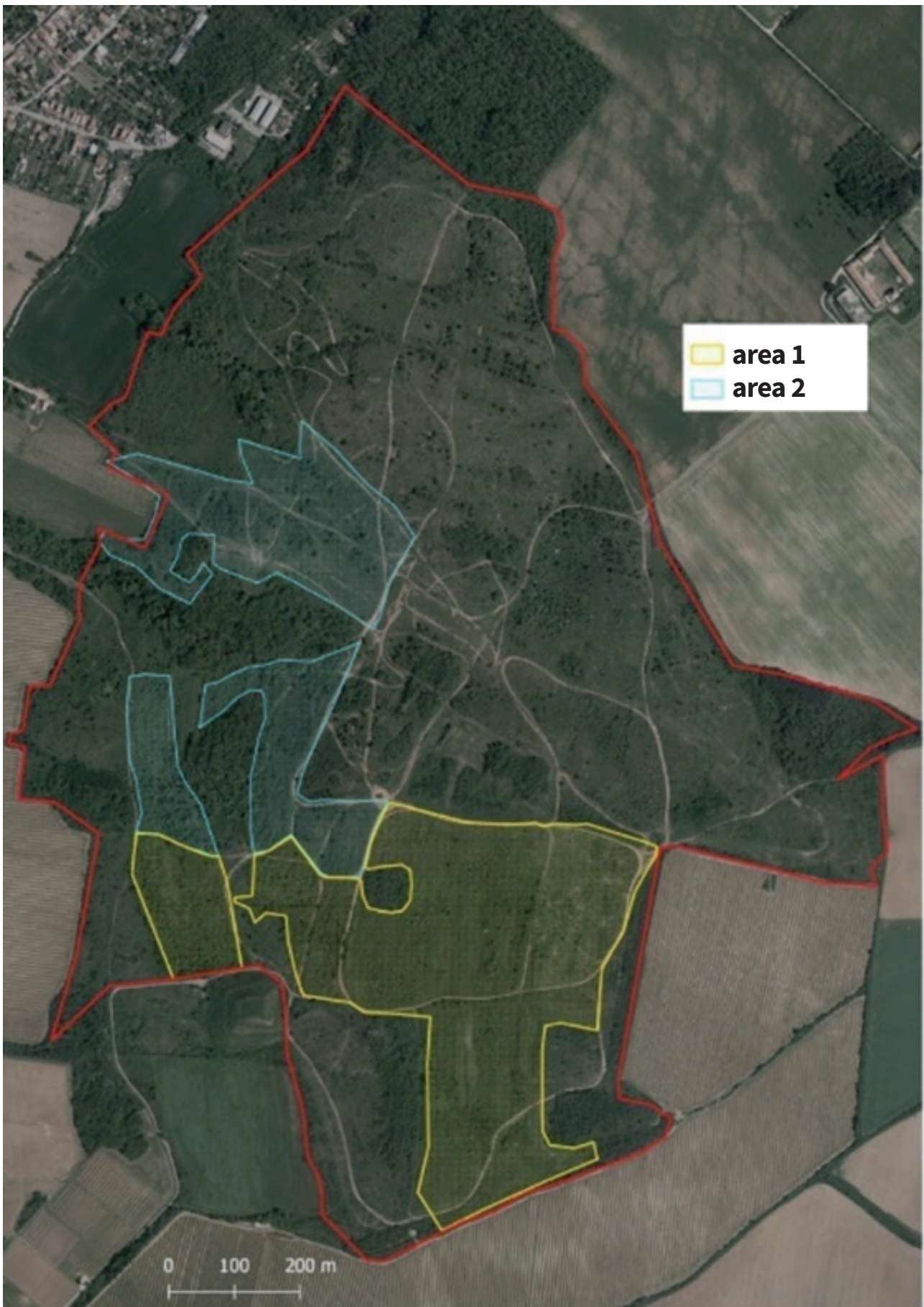
MAP ATTACHMENTS



Map 1: Aerial survey image of Načeratický kopec from 1938. The extent of the steppes is marked by a yellow line. The rest of the area consisted of fields and orchards. (Created by Beleco)



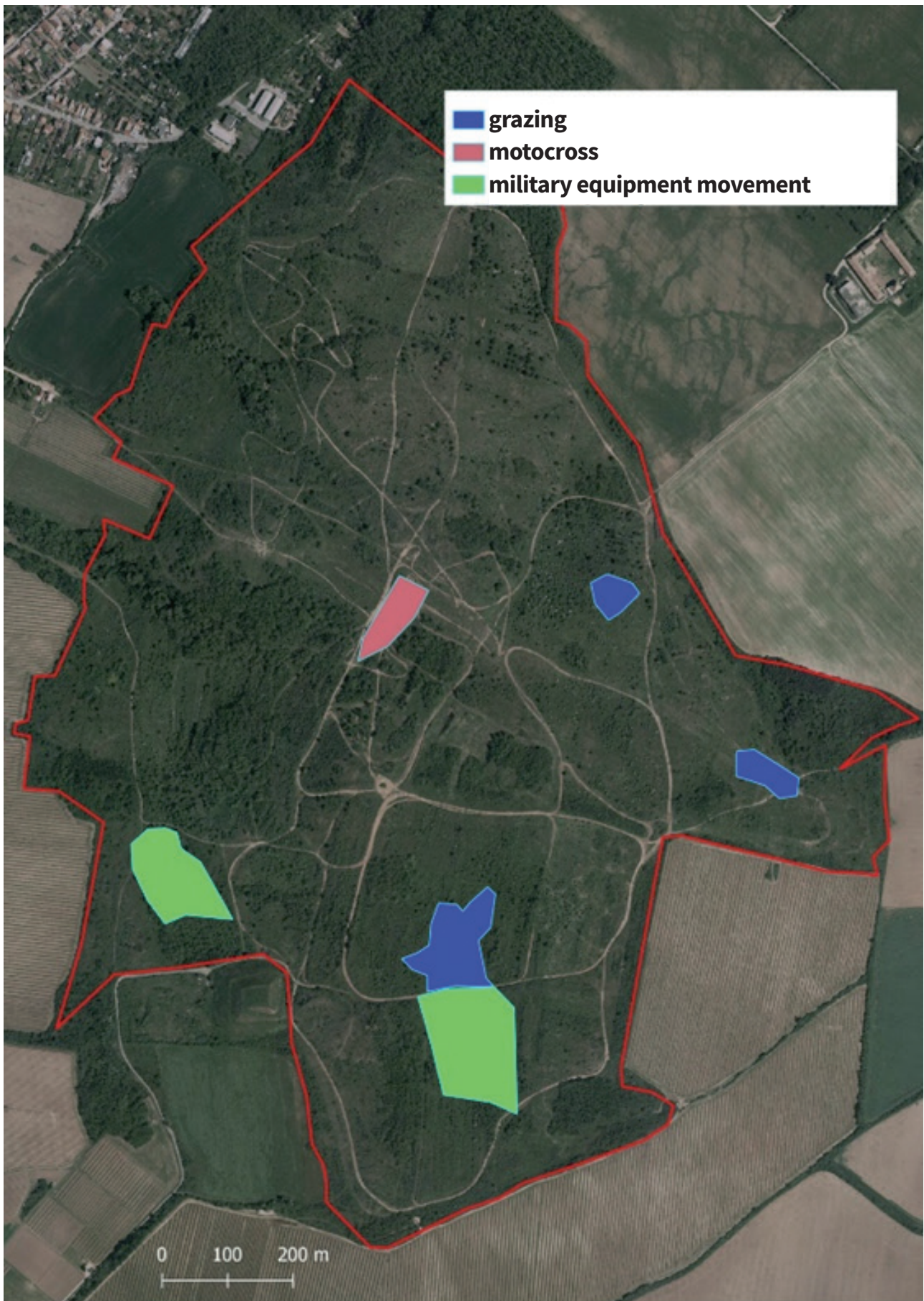
Map 2: Current aerial photograph of Načeratický kopec with the original extent of the steppes marked (as of 1938).
(Created by Beleco)



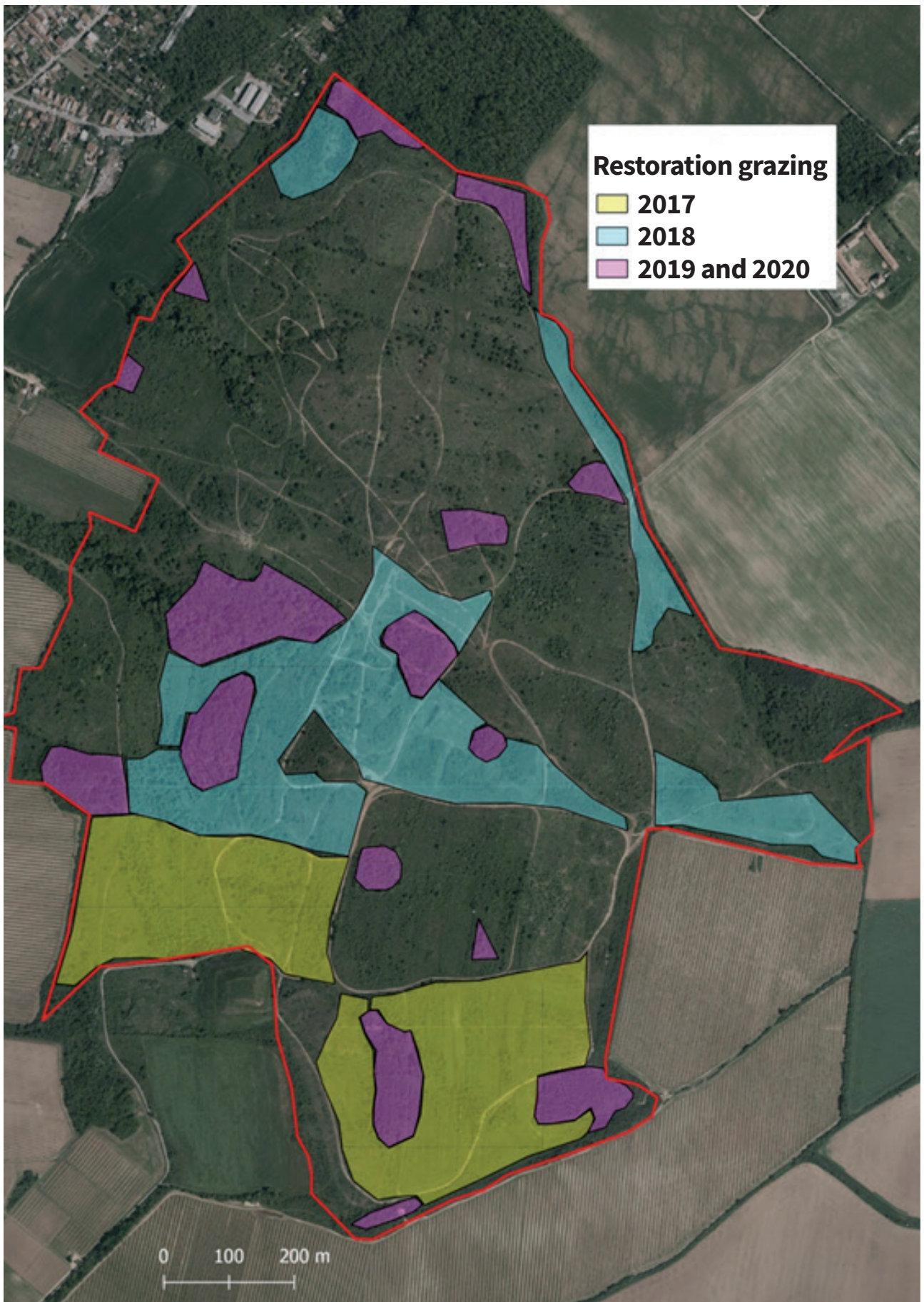
Map 3: Aerial image of Načeratický kopec (initial state) showing the extent of the reduction of self-seeding shrubs and the subsequent regrowth removal. The shrubs were removed to the planned extent: on area 1 in the dormant period 2016/2017, on area 2 in the same period 2017/2018. (Created by Beleco)



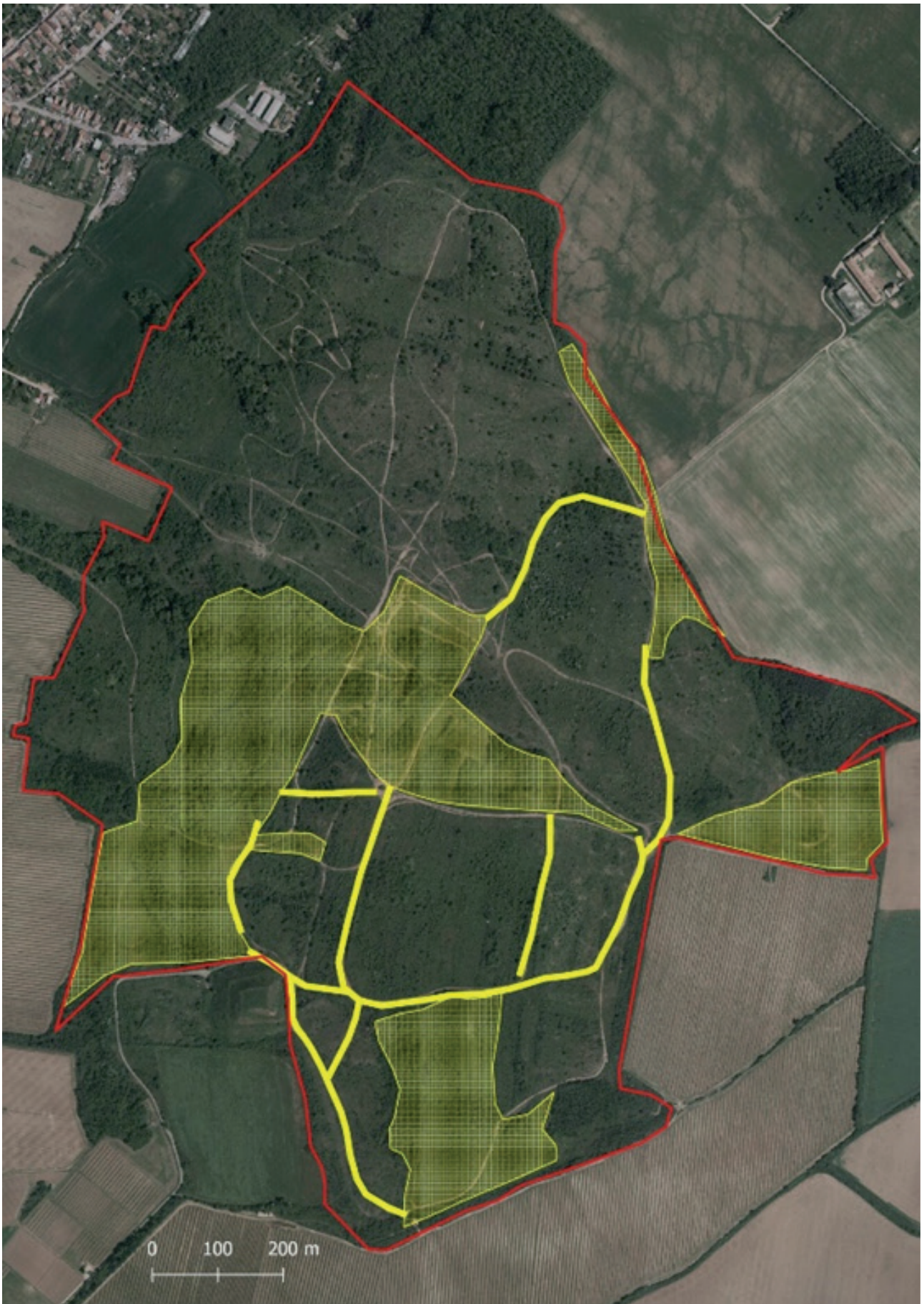
Map 4: Aerial image of Načeratický kopec, taken from the management plan created at the beginning of the project, showing the initial extent of the acacia stands and their intended management. The conversion to oak forest did not take place due to unfavourable climatic conditions; the relevant stands were also removed. (Created by Beleco)



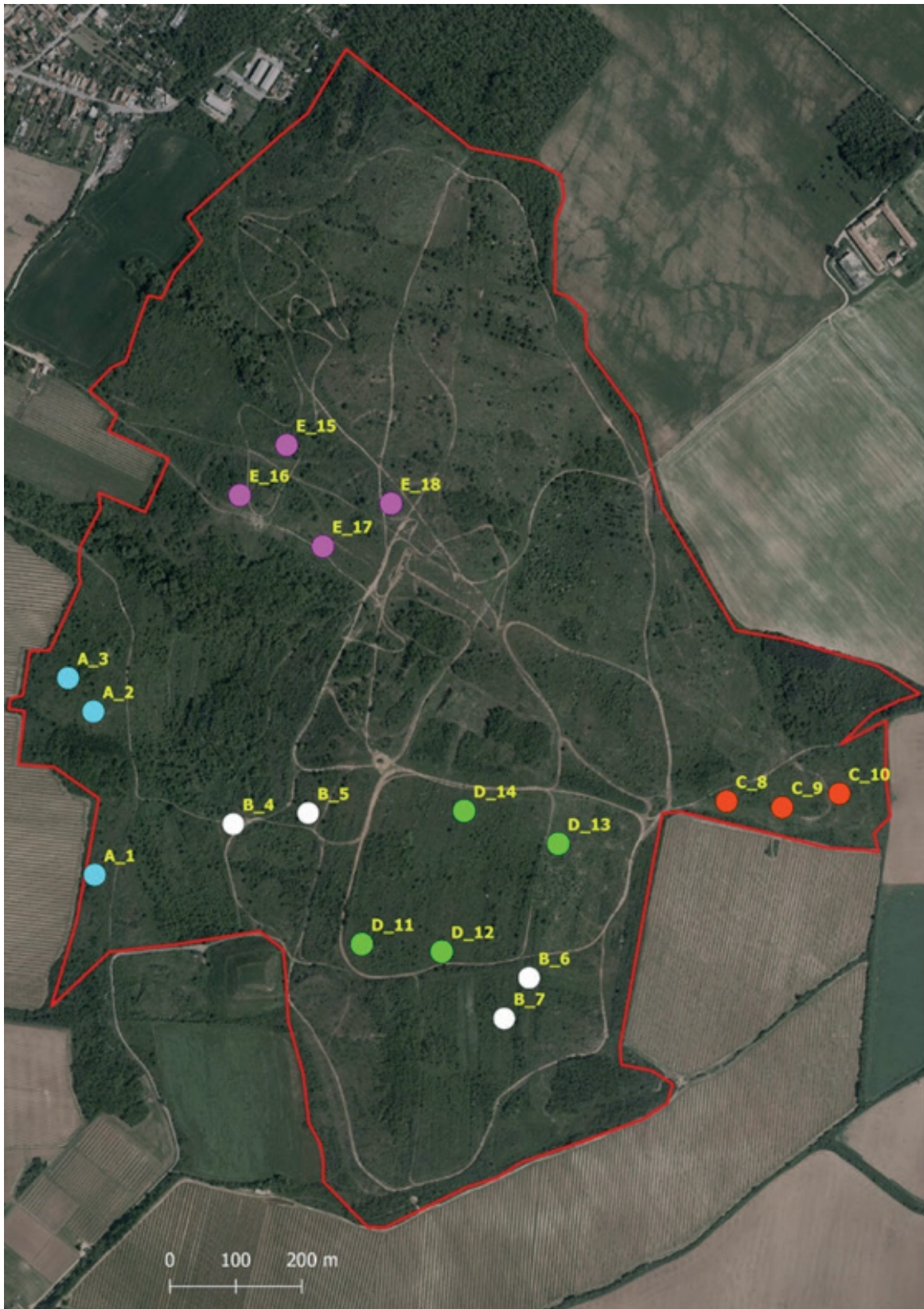
Map 5: Aerial image of Načeratický kopec (initial state) showing the approximate initial extent of continuous wood small-reed growth and its planned management. (Created by Beleco)



Map 6: Aerial image of Načeratický kopec (initial state) showing the extent of restoration grazing in individual years. (Created by Beleco)



Map 7. Aerial image of Načeratický kopec (initial state) showing areas suitable for military equipment movement. The movement took place in most areas. (Created by Beleco)



Map 8: Aerial view of Načeratický kopec with marked location of entomological traps during the whole project. Trap codes reflect different combinations of compared management measures in terms of their impact on invertebrate model groups: A - 0 year, grazing; B - without 0 year, removal of woody plants, grazing, military equipment movement; C - 0 year, grazing, military equipment movement; D - without 0 year, removal of woody plants, grazing; E - 0 year, removal of woody plants, grazing. (Created by Beleco)

TABLE ATTACHMENTS

Table 1: Selection of the most conservation-important species found on Načeratický kopec since 2010. Only species listed in the CR (critically endangered) and EN (endangered) categories of the relevant red lists (RD) and specially protected species (SPS) included in the KO (critically endangered according to Czech law) category are included.

Latin name	English name	Family	RD	SPS
Plants				
<i>Helichrysum arenarium</i>	dwarf everlast		EN	SO*
<i>Heliotropium europaeum</i>	European heliotrope		CR	
<i>Polycnemum arvense</i>			CR	
<i>Prunus fruticosa</i>	dwarf cherry		EN	
Mantises				
<i>Mantis religiosa</i>	European mantis		VU	KO
Net-winged insects				
<i>Mantispa styriaca</i>	Styrian praying lacewing			KO
Beetles				
<i>Agrilus antiquus croaticus</i>		Buprestidae	CR	
<i>Anthaxia candens</i>		Buprestidae	EN	
<i>Anthaxia chevrieri</i>		Buprestidae	EN	
<i>Anthaxia olympica</i>		Buprestidae	EN	
<i>Aphanisticus pusillus</i>		Buprestidae	EN	
<i>Bruchidius cinerascens</i>		Bruchidae	CR	
<i>Bruchidius varius</i>		Bruchidae	EN	
<i>Cheilotoma musciformis</i>		Chrysomelidae	CR	
<i>Chrysolina limbata</i>		Chrysomelidae	CR	
<i>Longitarsus echii</i>		Chrysomelidae	EN	
<i>Pachycerus segnis</i>		Curculionidae	CR	
<i>Paracylindromorphus subuliformis</i>		Buprestidae	CR	
<i>Protaetia ungarica</i>		Scarabaeidae	EN	
<i>Psylliodes hyoscyami</i>		Chrysomelidae	EN	
<i>Rhabdorrhynchus echii</i>		Curculionidae	EN	
<i>Rhinusa rara</i>		Curculionidae	EN	
<i>Sphenoptera substriata</i>		Buprestidae	CR	
Hymenoptera				
<i>Spinolia unicolor</i>	cuckoo wasp sp.	Chrysididae	EN	

Latin name	English name	Family	RD	SPS
Butterflies and moths				
<i>Dicallomera fascelina</i>	dark tussock	Erebidae	EN	
<i>Gastropacha quercifolia</i>	lappet	Lasiocampidae	EN	
<i>Chelis maculosa</i>	Baltic grayling	Erebidae	CR	SO*
<i>Lasiocampa trifolii</i>	grass eggar	Lasiocampidae	EN	
<i>Melitaea didyma</i>	spotted fritillary	Nymphalidae	CR	
<i>Pyrgus carthami</i>	safflower skipper	Hesperiidae	EN	
<i>Watsonarctia casta</i>	chaste pellicle	Erebidae	CR	SO*
<i>Zerynthia polyxena</i>	southern festoon	Papilionidae	NT*	KO
<i>Zygaena punctum</i>	burnet moth sp.	Zygaenidae	EN	
Birds				
<i>Dendrocopos syriacus</i>	Syrian woodpecker		EN	SO*
<i>Emberiza calandra</i>	corn bunting		VU*	KO
<i>Lullula arborea</i>	woodlark		EN	SO*
<i>Upupa epops</i>	hoopoe		EN	SO*

*VU = vulnerable, NT = near threatened, SO = very endangered according to Czech law

**Restoration of steppe habitats
in Načeratický kopec Special Area of Conservation
case study of the Military LIFE for Nature project**

*Obnova stepních biotopů na evropsky významné lokalitě
Načeratický kopec – případová studie projektu
Military LIFE for Nature*

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