

Action Plan for the

Bohemian Sand Pink

(Dianthus arenarius subsp. bohemicus (Novák) O. Schwarz)



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ACTION PLAN SUMMARY for *Dianthus arenarius* subsp. *bohemicus* (NOVÁK) O. SCHWARZ

Initial situation

Dianthus arenarius subsp. *bohemicus* (Novák) O. Schwarz – Bohemian Sand Pink is protected as a critically threatened species in the Czech Republic; the same degree of threatening is stated also in the Red List of Vascular Plants of the Czech Republic.

The Bohemian Sand Pink grows only in the Czech Republic. It is endemic to a small area near Roudnice nad Labem. Four other subspecies of the Sand Pink (*Dianthus arenarius*) occur in Northern Germany, Poland, southern Sweden and Finland, the Baltic countries, Belarus, and Ukraine (see Chapter 1.1.3).

Historically, only two habitats of occurrence were recorded, both in the Podřipská plain – National Nature Monument (NNM) Kleneč and near Vražkov, while the Vražkov habitat ceased to exist in the 1950's. The recent occurrence of the species in the Czech Republic is limited to one original habitat in NNM Kleneč and one artificially established habitat near Kyškovice.

1. NNM Kleneč – currently the only original habitat of the species in the Czech Republic; it is situated on a south-west facing sandy hillside some 250 m from the village of Kleneč (district of Litoměřice). Until the 1990's there were only some 200 clusters remaining, most of them old. After the performance of management measures on the habitat the number of individual growing plants has substantially increased since 1999, with successful dissemination of seeds and ecesis. In 2005 the total population included approximately 830 individual plants.
2. Kyškovice (proposed Nature Monument – NM - Na Kamenici) – There is only a single cluster growing on this habitat, which survived from artificial planting schemes carried out in 1987 by the group of Czech Union for Nature Conservation based in Roudnice nad Labem. The size of the cluster is approximately 30x30 cm while the total area of the habitat is 0.4 ha. The plant does not spread in this habitat.

The plant is a heliophilous species growing in the societies of open sand and sandy soil grasslands. An imperative condition for successful rooting of seedlings and their further development is a mild disturbance of the growth as the species is not able to withstand the competition of grasses and ruderal plant species on undisturbed habitats.

The main causes of threat to species are succession changes within the habitat due to changed use of the habitats, especially abandonment of the traditional management methods. As a result of these changes the historic habitat near Vražkov ceased to exist – in the 1940's a pine and locust-tree plantation was established there after the land was no longer used in the traditional way. After this interference to the original habitat the population became extinct for once. The changes caused by the abandonment of the

traditional management of the land are also the core of the current problem of the population at NNM Kleneč. The absence of proper management (especially grazing) causes the grassland to thicken, which dramatically limits the possibilities for natural reproduction of the plant population. This habitat is also under the negative influence of herbivorous insects, which prevent the correct development and maturing of the Sand Pink seeds.

Objectives of the Action Plan

Long-term objectives:

1. Establishing a long-term stable population of *Dianthus arenarius* subsp. *bohemicus* on the NNM Kleneč habitat with 400% larger area of the plants' occurrence than the condition documented in 2005. The newly established population must be capable of spontaneous reproduction in the long-term perspective, which shall be verified by checks performed in at least ten successive years.
2. Establishing a long-term stable population reserve of *Dianthus arenarius* subsp. *bohemicus* on the second site near Kyškovice; this population must also be capable of spontaneous reproduction in the long-term perspective, which shall be verified by checks performed in at least ten successive years.

Mid-term objectives:

For the period of the **first ten years** after the acceptance of the Action Plan the following objectives were set:

1. Establishment of stable population and suitable conditions for the existence of *Dianthus arenarius* subsp. *bohemicus* population on the site at NNM Kleneč.
2. Support of the species' introduction and stabilisation of the population on the reserve habitat near Kyškovice.
3. Proposal and performance of measures improving the habitat conditions on the reserve site near Kyškovice.
4. Study and research activities in order to broaden the knowledge of the biology and ecology of the species *Dianthus arenarius* subsp. *bohemicus* and its relative populations in Germany and Poland.

Main scope of measures

The main activities of the Action Plan will focus predominantly on the site of NNM Kleneč in order to create conditions suitable for the development of the species and its population. The aim of the planned measures will be to achieve such condition of the habitat that enables for a spontaneous dissemination of the species within the habitat and the growing of the local population of the Bohemian Sand Pink.

As the NNM Kleneč site is the last original habitat with the species' population, a back-up population will be established on the reserve site near Kyškovice, which has already proved as suitable for the introduction of the species. The aim of the planned measures on the Kyškovice site will be to create suitable conditions

enabling for a spontaneous dissemination of the species within the habitat and the survival of a sufficiently large back-up population of the species.

Repatriation to the site near Vražkov, where the species occurred in the past, was considered as well but after thorough assessment the site was found unsuitable for the performance of this measure. The grasslands between Kleneč and Vražkov, where the plant was once abundant, are now totally covered with locust-tree and pine growths, and the site would not be suitable for repatriation after felling either as a thick layer of humus and fallen leaves formed there over the past decades – such substrate would not suit the proper development and growth of the plant after repatriation.

The main management measure proposed under the Action Plan (RP) is extensive grazing of goats and sheep along with maintenance operations – cutting, removal of self-seeded trees and shrubs as well as expansive and non-indigenous plant species.

On the Kyškovice site the turf will be removed all at once in the places where sowing of the Sand Pink seeds is planned. The removal of the turf will be followed by other interventions in order to prevent the succession of unwanted plant and moss species (mechanical disturbance of the moss layer, removal of self-seeded trees and shrubs, etc.).

On the Kleneč site the turf will be removed also all at one time and in places selected during the soil survey. This shall provide for a sufficient size of the suitable areas for the growing of the species' seedlings, which shall lead to the natural reproduction and dissemination of the species within the site.

Regular monitoring is planned for both sites – NNM Kleneč and Kyškovice – to study the condition of the populations, phytocenological surveying of new and existing areas with Bohemian Sand Pink plants, monitoring of micro-climatic conditions on the sites and analysing of soil samples.

The research shall focus mainly on the study of reproduction, genetic and morphological variability of the species on the site, the study of the plant's relation with herbivores, influence and relation of ant colonies on the root system of the Sand Pink, monitoring and determination of the natural pollinators of the species, as well as on the surveying of individual soil strata.

The research programme shall also cover the protection of the habitats and enforcing of the protective regimen on the Kyškovice site as well as popularization of the species among the local people, which should also support the consequent enhanced protection of the sites.

1. INITIAL INFORMATION FOR THE IMPLEMENTATION OF THE ACTION PLAN

1.1 Taxonomy

1.1.1 Nomenclature

The first information about the species came probably from the Opitz “List of the Plants in the Flora of Bohemia” (“Seznam rostlin květeny české” – Opitz 1852, p. 75), where the author lists the Pink (*Dianthus plumarius*) along with another species named “pyrkovka obecná” (*Plumaria vulgaris*) but without any description, localization, and herbarium evidence. In 1896 an amateur botanist Karel Polák published an article in the journal of natural sciences *Vesmír*, reporting the finding of a new species of Czech flora. It was a Pink that was found on a rolling hillside near Roudnice nad Labem and brought by the students of the local school of economy to high school professor Valentin Weinzettel in June 1896. Weinzettel informed prof. Čelakovský about the finding, and Čelakovský determined the taxon as *Dianthus plumarius* L. (Čelakovský 1897). This name was later accepted by other authors (Domin 1904, Polívka 1912).

In 1915 the site was visited by prof. F. A. Novák, who applied the geographic-morphological method and excluded the Pink at Kleneč from the relatives of *Dianthus plumarius* L. and listed it to the cluster of species around *Dianthus arenarius* L. and *Dianthus serotinus* W. et K. as an endemic variety of *D. arenarius* var. *bohemicus*. Professor Novák continued to pursue the issue of taxonomy further (Novák 1916, 1921, 1922). In his monograph (Novák 1927 a, b) he studied both groups of Pinks in detail, determining several varieties under *Dianthus arenarius*. In 1949 the *bohemicus* variety was promoted to a subspecies.

Soják (Soják 1980) described the same plant as an autonomous species *Dianthus novakii*. Kovanda (1984) considers this proposal as overestimation and confirms the plant's position under the *Dianthus arenarius* L. group, however pointing out the similarity of subsp. *bohemicus* in some features to subsp. *pseudoserotinus* and subsp. *borussicus*.

- *Plumaria vulgaris* OPITZ Sezn. Rostl. Květ. české, 1852
 - *Dianthus arenarius* L. var. *bohemicus* NOVÁK Věstn. Král. Čes. Společ. Nauk, cl. math.-natur., 1915/8: 23, 1915
 - *Dianthus x novakii* (GRAEBNER) NOVÁK Věstn. Král. Čes. Společ. Nauk, cl. math.-natur., 1927/9: 47, 1927
 - *Dianthus arenarius* L. subsp. *bohemicus* (NOVÁK) O. SCHWARTZ Mitt. Thüring. Bot. Ges. 1: 99, 1949
- Dianthus novakii* SOJÁK Čas. Nár. Muz., ser. natur., 148: 77, 1980

Species names in other languages:

English:	Bohemian Sand Pink
German:	Tschechische Sandnelke

1.1.2 Description

Perennial, densely clustering greyish green plants with strong primary root and creeping branched rootstock.

Perennial, densely clustering ash-green plants with strong primary root and creeping branched rhizome. Stem straight, (5–)8–12(–15) cm tall, bearing 1-3 flowers, rounded, bald, with 2–7(–9) stem segments and indistinctive nodes. Leaves linear, tapering to pointed or obtuse-pointed, 1-2 mm wide. Sheaths 1-2 mm long. Flowers fragrant, simple flowerhead with one or max. 3 flowers. Subcalyx bracts obovately lanceolate to ovate, ± acute to tapering. Tubular calyx, sometimes slightly narrowed from base to top, (24–)25–28(–30) mm long, green or with violet hue. Triangular dentation, acute to acuminate, 4 mm long, with webbed, softly ciliate edge. The blade of the petals is ovate to orbicular, cuneated and narrowing towards the base, up to ½ and more deeply lacinated in narrow, also lacinated (4–8 mm long) sections. The corolla is 13–15 mm long, white, often greenish and hirsute at the base. The capsule is ± by ¼ longer than the calyx. The seeds are 2.3–2.7 mm long, black.

1.1.3 Variability

The issue of the Sand Pinks was studied by Novák in his monograph (1927). He differentiated four vicarising intraspecies units on the level of variety. This differentiation was confirmed by other authors (Tutin 1964; Meusel et Mühlberg 1971–1978) and varieties were reconsidered to subspecies with their number increasing to five. Currently there are five subspecies of the *Dianthus arenarius* species. The nominate subspecies Hegi (syn. *D. a. sub. suecicus*) occurs in Southern Sweden, subspecies *borussicus* (Vierh.) Kleopow occurs within a larger area of Northern to North-Eastern Europe reaching up to Central Volga region. The subspecies *bohemicus* (Novák) O. Schwarz occurs near Kleneč in the Czech Republic, subsp. *pseudoserotinus* (Blocki) Tutin can be found in Western Ukraine, and subsp. *pseudosquarrosus* (Novák) Kleopow (syn. *D. a. sub. glaucus*) occurs in Belarus and Ukraine. Adopted from Abtová (1992), who refers to Novák (1927a, b).

Some plants from NNM Kleneč have red marks on the base of their petals (Toman 1986; confirmed by own field study). These plants will be studied in order to find out whether this is a genetic deviation or whether the variability occurs simply upon the difference in the ecological conditions (e.g. type of substrate).

Some parts of the population (some clusters) have pink flowers; Novák (1915a) presumes this to

be due to cross-breeding between *D. arenarius* subsp. *bohemicus* a *D. carthusianorum* (*D. × novakii*). Válová (1988) also states that some clones cultivated on a medium from seed had pure white flowers, others had their petals in a pinkish hue. It has not yet been resolved whether the pink-flowering individuals and the ones with red marks on the base of the petals result just from a morphological variability due to substrate type or whether they are crossbreds.

1.1.4 Karyology

2n = 60 – determined upon material collected at the NNM Kleneč site (Kovanda 1984; sec. Měsíček et Jarolímová 1992)

1.1.5 Hybridisation

The possibility of cross-breeding with the charterhous pink (*Dianthus carthusianorum*), which occurs at the NNM Kleneč site together with the Bohemian Sand Pink, was first suggested by Novák (1915b). He titles the crossbreds of both species as *Dianthus subcarthusianorum × arenarius* var. *bohemicus*. Novák states that in many of the crossbreds the features of the parent *D. carthusianorum* demonstrate only faintly, especially in the pinkish colour of the corolla. The intermediary type combining the features from both parents is much rarer.

In literature (Kubát, Šimr et Šťastný 1970; Chvapil 1998) this crossbred is also titled as Lucas Pink (*Dianthus lucae*). The petals are reputedly pink marked with several dark lines and the flower is lightly fragrant. The author does not mention the origin of this name, no resource is cited either. Graebner (sec. Novák 1927a) titles this crossbred as *Dianthus novakii*.

The issue of Hybridisation and taxonomic value of the crossbreds will be studied under genetic variability (see Chapter 3.4.3).

1.2 Distribution

1.2.1 Overall distribution

The Bohemian Sand Pink grows only in the Czech Republic. It is endemic to a small area near Roudnice nad Labem. Four other subspecies of the Sand Pink (*Dianthus arenarius*) occur in Northern Germany, Poland, southern Sweden and Finland, the Baltic countries, Belarus, and Ukraine (see Chapter 1.1.3).

1.2.2 Distribution in the Czech Republic

1.2.2.1 Historic distribution

The occurrence of the Bohemian Sand Pink was historically documented on two sites only within the Czech Republic. Besides the current site at NNM Kleneč it also occurred on the slopes running towards the village of Vražkov (phytogeographic district Podřipská Plain). According to literary resources (Polák 1896) it grew abundantly in large clusters whereas at the Kleneč site the occurrence was sparse in individual clusters growing on the dry and sandy hillock. Due to the establishment of intensive locust-tree and pine plantations before World War II the Vražkov habitat changed so much that after 1945 the Pink was practically absent there. A few of the last plants were spotted in 1955 (Kubát, Šimr et Šťastný 1970). After the war the Pink was replanted by Mr. Sádlo in his sandpit situated close to the original site on the Kleneč slopes (Novák 1949); it grew well in the sandpit, but only until 1980 when it was last spotted there (Kubát 1986). During the habitat checking in 1985 and 1986 no live specimen was found.

1.2.2.2 Recent distribution

The Bohemian Sand Pink currently grows only on one site near Kleneč by Roudnice nad Labem in the phytogeographic district Podřipská Plain. The site is protected as National Nature Monument Kleneč. The above-sea elevation of the site ranges between 200 and 220 m above sea level. The site is shaped as a south-west facing exposed sandy hillside with subsoil of Mesozoic sediments of the Czech Chalk Plain (clays, marls), which are covered by Quarternary gravel sands of the river Labe, forming a terrace along the Čepel brook and elevated to the surface in these areas. The Bohemian Sand Pink grows in loosened grasslands here. The size of the population ranges in hundreds of clusters.

In 1987 the members of the group 37/01 of Czech Union for Nature Conservation based in Roudnice nad Labem (Mgr. Chvapil) planted five plants, cultivated from seed and originating from NNM Kleneč, on a slope near Kyškovice, where they still grow in a single cluster. For transposed drawing of the sites see Annexes No. 1 and 2.

Kleneč

Phytogeographical district: 7b. Podřipská plain
Region: Ústecký
District: Litoměřice
Estate: Kleneč
Conservation status: National Nature Monument
Localisation: 14°16`E, 50°26`N
Quadrant: 5651b
Elevation: 200 –220 m above sea level

Kyškovice

Phytogeographical district: 5b. Roudnické písky
Region: Ústecký
District: Litoměřice
Estate: Kyškovice
Conservation status: proposed Nature Monument Na Kamenici
Localisation: 14°27`E, 50°44`N
Quadrant: 5551d
Elevation: 160 m above sea level

1.2.2.3 Trends in distribution

At the time of the finding of the new Pink species in the 19th century there used to be a larger population near the former Průša's Mill by Vražkov. According to literature (Polák 1896) it grew there in luscious clusters, whereas on the Kleneč site it was rather sparse. Due to the management and planting of trees (locust-tree, pine) the last year when the species was spotted there was 1955 (Šťastný 1970). At Kleneč, the last approximately 200 clusters, most of them old, survived to the 1990's. Up to then no new seedlings were recorded on the site and the population was growing old. Since the clearing intervention in 1999 the seeds had the chance to propagate more quickly, successful ecesis was recorded and the number of specimens increased to 830 (situation in 2005).

1.3 Biology and ecology of the species

The biology of the species and its propagation was studied by Toman (1972, 1986) under an extensive survey that he carried out on the site at NNM Kleneč. Since 1995, professionals from ANCLP CR (office Ústí n. L.) have studied the ecobiology of the species and the influence of management on its population.

1.3.1 Life cycle, phenology, life form, and strategy

The Bohemian Sand Pink is a perennial plant. The germination of seeds takes place during 3 – 4 weeks after dissemination, usually when the first heavier rains come. After germination, the primary leaves remain for approximately 6 weeks before falling off.

The first leaves appear after 8 – 10 days and the formation of further leaves follows shortly. At the age of five weeks the plant has eight developed leaves with new rosettes appearing at the base of the petiole. The fast initial development enables the plant to generate a sufficient volume of resources before the end of the dormance period; in autumn the young plants already have three internodes and they are capable of active growth even during mild winter. In the following year the plant already starts forming clusters with each flower-bearing stalk having 1 – 2 flowers. The flowering period starts in the third week of May until the end of July when the last flowers fade. The flowering optimum (when most of the population is in bloom) is during the first half of June. Reflorescence comes from the second half of August and lasts until the end of October. In this case the ovary does not have enough time to ripen and no seeds are formed. The plant is an S-strategy hemicryptophyte.

1.3.2 Generative reproduction

The plant reproduces both generatively and vegetatively. Generative reproduction is provided by diaspores (seeds). The plant is anemochoric. Flowers are monoclinal, alogamic with entomogamy. Flowers are fragrant, the nectary at the base of the receptacle secretes sweet nectar. The main pollinators are hymenopterous insects including wasps, syrphians, some beetles, and also butterflies. The spider *Misumena vatia* hunts small insects inside the flowers of the Pink, which more or less protects the plant from predators (Vysoký 1996). The ovary ripens in mid July. When fully ripe, the capsule opens with four valves on the top and the dry corolla falls off. The seeds remain relatively long inside the dry capsules. There are approximately 25 – 30 seeds (up to 40 in some years). Capsules cored by phytophages are empty or contain only a few seeds.

1.3.3 Biology of germination and ecesis

The seeds of the Pink disperse by anemochory (boleochory) only in strong wind conditions as they have no flying mechanism to spread under normal weather. Another way of their dissemination may be kinochory (touch of animals or humans) or spontaneous disintegration of the capsule. In the second case the seeds remain close to the mother plant.

During the first interventions on the site and at the time when the monitoring of the taxon's biology have begun (Toman 1986) it was very rare to find any seedlings. No seedlings were detected during the 1990's despite the fact that under laboratory conditions the germinative capacity of the seeds was almost 90% (Kovanda 1986; Bělohoubek – own study). In moist conditions the seeds germinate over 24 hours, if they are covered by a thin layer of sand the first plants start appearing in 3 days.

1.3.4 Vegetative reproduction

Under vegetative reproduction the plant, aged several weeks, creates new rosettes at the base of the petiole. Adult specimen (cluster) represents a genetically identical clone. The disintegration of old clusters to several smaller clonal individuals was not recorded. Experiments with the planting of stem cuttings, as well as spring cultivation of divided clusters, did not yield positive results so far.

1.3.5 Ecological requirements

The species is closely bound to the rough gravel sand base where the volume of skeleton and rough sand in the rhizosphere exceeds 65% and the soil pH on the site ranges between 4.2 – 4.8. The soils are low in humus, its total content ranges between 0.7 – 3%. Cultivation experiments have shown that these factors (content of humus, pH) are not primary for a successful development of the plant. The heliophyte, which prefers mostly habitats with direct exposure to sunlight, can also stand the conditions of a light shade. Thanks to its strong taproot the plant withstands the drying out of the rhizosphere on the sunny spots. In the surface layers of the soil the daily temperature fluctuations range in tens of degrees even if the temperature just below the surface is relatively stable due to the bad temperature conductivity of sand. The main limiting factor, however, is drought - due to the low ability of the sands to accumulate water and further enhanced by the position of our sandy soils, which are mostly found in lowlands where precipitation is scarce.

1.3.6 Biotic factors

Disease, mycorrhizas or allelopathy are not known and are not mentioned in literature either. Intra-species relations of the plant versus phytophage are described in greater detail in Chapter 1.4.

1.3.7 Link to communities

On the site at NNM Kleneč the Bohemian Sand Pink occurs in the society of open sandy grasslands, alliance *Corynephorion canescentis* Klika 1931 in the association *Festuco psammophilae* - *Koelerietum glaucae* Klika 1931. The society covers low loose grasslands on sandy soils, usually with the dominance of the grey-hair-grass (*Corynephorus canescens*). Acidophilous species of the sub-Atlantic distribution (e.g. *Calluna vulgaris*, *Corynephorus canescens* and *Spergula morisonii*) are often combined with the diagnostically significant group of the sub-continental species. There are also some less habitat-specific xerophilous plants, usually again with the continental tendency for distribution (*Artemisia campestris*, *Festuca rupicola*, *Carex praecox*). The moss layer with the occurrence of acrocarpic mosses (e.g. *Ceratodon purpureus* and *Tortula muralis*) and bushy lichens of the *Cladonia* genus usually range under 25% in the degree of cover. Due to succession, most of the growths are currently impacted by the presence of grasses such as *Elytrigia*

repens and *Poa angustifolia* or partially ruderalised by synanthropic species, e.g. *Berteroa incana*, *Chenopodium album* and *Lolium perenne*.

In the past the society occupied open sandy areas originating upon the total degradation of sandy grazing meadows or forests; these habitats reflected the traditional management of the cultural landscape (until World War II). During the 20th century these habitats have completely disappeared and the society has survived only on small substitute habitats such as pine forest edges, sandy railway embankments, broad field and forest roads, sandpits, and military shooting ranges.

1.4 Causes of threat to species

- collecting or digging out of live plants

This negative phenomenon was common mainly at the end of the 19th and in the beginning of the 20th century when the species was not protected by law and neither was the habitat. This actually legal and massive collection ended after the declaration of the reserve in 1934. A large part of the population, however, was destroyed, this time illegally, in the 1970's (1977, 1978) by vandals (Toman 1986). Currently no mechanical destruction of the plants was recorded.

- succession changes of the habitat due to change or absence of management

The absence of traditional grazing of sheep and goats led to the necessity to remove the growing biomass on the habitats and there was also no factor causing the breaking up of the compact turf. The excess increase of biomass and competitive advantaging of nitrophilous species was supported also by higher content of nitrogen in the soil, which came from heavy industrial immissions. Moreover, the nearby slopes from Kleneč to Vražkov were purposely planted with locust-tree, which spreads very quickly, reaching to the NNM Kleneč site – this is a constant threat due to the abundance of seeds on the site.

- activity of herbivores

Since 1986 the attack of phytophages on the Pink flowers has been regularly recorded. Holes with 1.3 – 3.8 mm diameter were found on the ripening capsules. Such capsules contain no seeds or only a few remaining ones. Collecting of insects was performed in 1986, focusing specifically on adult insects and larvae occurring on the Pink. The material was passed to the Institute of Zoology at Komenský University in Bratislava, Slovakia, for determination. After the determination the most likely predator seemed to be one weevil species - *Hypera arator* from the *Curculionidae* family. The same was found by Vilímová (1990). Weevils of this species and in all life phases were found on the plants, inside flowers and flower buds. Only in years when the infestation of the Bohemian Sand Pink was at its strongest the holes were found also on the charterhous pink. Under strong infestation the

production of seeds drops to a minimum (years 1986, 1987, 1995, 2003).

This opinion was opposed by Vysoký (1997), who did not find the *Hypera arator* weevil over two seasons of insect surveying at NNM Kleneč although the flowers were damaged again. The newly found fact (Vysoký 1997) is that the root system is damaged by ants (*Formica rufibarbis*), who build their underground colonies directly under the Pink clusters. These plants tend to dry out quickly and die. Once dead, the plant is abandoned by the entire ant colony that moves on to another one. According to the author's opinion the relation between the ants and the Pink is more dangerous than the phytophage eating the seeds as there is an irreversible damage to entire clusters.

- change of soil conditions

The Bohemian Sand Pink is closely tied to the sand or gravel sand base. The mechanical composition of the substrate is one of the most important ecological factors for a successful development of the species. Over the years the habitat has been grown over by self-seeding trees (shrubs), and the gravel sand was covered by a layer of humus generating from the leaves fallen of these woody species and partially also from the field runoff. These conditions allow the competitive stronger grasses to take over the Pink habitats, causing stagnation and gradual decline of the Pink population.

1.5 Status of protection

1.5.1 Status of protection at international level

Under the Directive of the Council 92/43/EEC On the protection of natural habitats, wildlife, and wild plants the Bohemian Sand Pink is listed among species requiring special local protection (Annex II) as well as species requiring strict protection within the entire territory of the EC member country (Annex IV).

In the IUCN Red List (Walter et Gillett 1997) it is listed under the Vulnerable category (VU).

1.5.2. Status of protection in the Czech Republic

In accordance with the provision of § 48 of Act No. 114/1992 Coll., On nature and landscape conservation, as amended, the species is listed among specifically protected plant species under the Critically Threatened category (Annex No. II of Reg. MŽP No. 395/1992 Coll.).

In the Black and Red List of vascular plants of the Czech Republic (Procházka 2001), which is not a legislative document, it is listed as Critically Threatened (C1).

1.6 Existing measures for protection of the species

1.6.1 Non-specific protection of the species in the Czech Republic

The sandy slopes near Kleneč and Vražkov, where the Bohemian Sand Pink occurs, were declared

Nature Reserve in 1934 by the Society for Beautification and Conservation of the Homeland in Roudnice nad Labem. The declaration was strongly promoted by F. A. Novák. After World War II the Kleneč site was listed as “protected habitat” according to the decree of the Ministry of Education, Sciences, and Arts from August 14, 1951, with the total area of 0.1834 ha. Later on, the protected habitat was extended (upon Decree No. 9860/76 of the Ministry of Culture of the Czechoslovak Republic dated 01.10.1976) to a site with total area of 5.3467 ha. Currently the site is protected as a “National Nature Monument” (NNM) according to Act No. 114/1992 Coll., On nature and landscape conservation from 19.02.1992. The key document for the care of the NNM is the Conservation Plan – currently the new conservation plan (for period 2008 – 2015) is before completion and will be presented to the Ministry of Environment for approval.

The site (entire NNM) is also listed among the Sites of Community Importance (SCI) under Natura 2000. The site is also listed as an Important Plant Area (IPA) in the Czech Republic; this status is not backed by any legislative document.

1.6.2 Specific protection of the species in the Czech Republic

Protection measures on the site

Upon the results of surveys carried out by the Pedagogical Faculty in Ústí nad Labem in the period of 1968–1973 (Toman 1968, 1970, 1972) that focused on the creation of optimal ecological conditions for the existence of the Bohemian Sand Pink a proposal for the first intervention measures of the Kleneč protected area was drawn up (Toman 1972), which presumed the performance of the measures between years 1969 and 1990.

In the 1970's the protected habitat was under the care of the former TIS – Nature and Landscape Conservation Society from Roudnice nad Labem and the members of voluntary community of the State Nature Conservation of Litoměřice district authority. Besides clearing operations (removal of unwanted self-seeded trees and shrubs as locust-tree, ash, dog rose) the members of the organisation took care of the protected area signposts including the installation of panels with the national emblem and information about the site. During vegetation period they also performed guarding service on the site. From 1991 the Agency for Nature Conservation and Landscape Protection (ANCLP) of the Czech Republic in Ústí nad Labem established a steering group in order to take care of the NNM Kleneč site.

There is virtually no evidence about the interventions performed before 1990. The basic data about the time and extent of the operations are missing. The interventions were performed on an uncoordinated basis according to the judgment of the individual conservationists and members of the Nature Conservation Society (ČSOP). The performed interventions were not evaluated regularly. Due to this it is now impossible to properly assess the effect of the individual measures on the stabilisation of the Bohemian Sand Pink population. However, it is evident that despite all the clearing activities performed the population was steadily declining.

a) Removal of self-seeding trees (shrubs)

Between 1969 and 1976 the regional centre of SÚPPOP Ústí nad Labem performed clearing interventions that covered the removal of locust-tree and cherry trees by felling and cutting out without follow-up chemical treatment.

In the 1980's a new agent was launched against the spreading of locust-tree – arboricide Spolana EC 50, which was used diluted with petroleum in 1:10 ratio and applied by brushing on the stumps of the felled trees. In the second half of the 1980's this practice was continued with new agent Roundup.

Currently the self-seeding trees (shrubs) (locust-tree, dog rose, hawthorn, etc.) are cleared every year by cutting out followed by chemical treatment using Roundup Biactiv or Garlon 4E.

Assessment: The interventions performed during the 1970's without follow-up chemical treatment of the stumps proved to be ineffective, as especially the locust-trees rejuvenated very quickly and the intervention was thus pointless. From the 1980's the cutting was followed by chemical treatment and has been almost 100% effective. These interventions lead to the increase in the vitality of the Bohemian Sand Pink clusters - the clusters have grown bigger due to more sunlight available for their development.

b) Breaking-up of the compact turf

Between 1969 and 1976 the regional centre of SÚPPOP Ústí nad Labem performed interventions in order to break up the compact turf. The breaking up was carried out by ploughing a 10-metre wide strip to the depth of 8 cm (in 1967) and 20 cm in 1970 in order to exchange the fine-grain materials for coarse-grain ones that suit the development of the protected societies.

In the 1980's the compact turf was removed by spraying the herbicide Dicotex on smaller parts of the area.

In 1997 a compact grass patch was mechanically broken up in the shape of continuous parallel stripes in order to produce a loose habitat for the society of the *Koelerion glaucae* alliance.

In 1999 an area of 30x40 metres in the upper part of the NNM Kleneč site near the gravel terrace and close to the Pink clusters the upper turf layer was removed using agricultural machinery. The intervention was performed by a private enterprise. The intervention was proposed rather intuitively, without properly prepared and approved project.

Assessment: The ploughing of the turf in 1967 and 1970 proved to be unsuitable as the area began to quickly grow over by tall grasses.

Removal of the turf using Dicotex herbicide was only partially successful and did not yield a long-term effect.

After the interventions in 1997 and 1999 came a positive turn in the development of the Bohemian Sand Pink population. The seeds dispersed rather quickly, ecesis was successful and the number of

specimens in the population increased from 200 to 830 (situation in 2005). However, the patches treated in this way are very susceptible to the colonisation by expansive plant species and are also quickly taken up by mosses.

c) Removal of competitive expansive plant species

In 1983 the Roundup herbicide was experimentally applied around two clusters in order to remove the competitive herb and grass components of vegetation.

Since 1989 the expansive grass species (*Arrhenatherum elatius*, *Calamagrostis epigeios*) are removed every year by regular cutting and the individual clusters are weeded by hand. Currently no chemical agents are used to eliminate the expansive species.

Assessment: The use of chemical agents to eliminate the development of expansive plants has proved to be of little effect in the long-term perspective. On the other hand, the annual cutting of the expansive species and hand-weeding has a positive influence on the population of the Pink.

d) Firing of the dead growth

In February 1991 an experiment with the firing of dead grass and other growth was performed for the first time. It was applied to areas growing over with *Calamagrostis epigeios* and *Arrhenatherum elatius*.

Assessment: The experimental firing as a management method aimed at the suppression of *Calamagrostis epigeios* and *Arrhenatherum elatius* was not very successful as the vegetation was damp and did not burn very well. This experiment was not repeated later even if the conditions improved.

e) Establishment of area for regular monitoring of the population

In the area where the Pink plants were most abundant a basic square network was established in 1988. The size of the entire area is 60x40 metres and it is divided into smaller patches of 10x10 metres. This allowed for the monitoring of the exact situation of the individual clusters, the composition of the plant cover in the quadrants and accurate location for the performance of maintenance operations.

Assessment: The quadrant network is still used for the monitoring of populations.

f) Plantings at NNM Kleneč and by Kyškovice

In 1988 and 1994 the above mentioned quadrant network was used as a reference grid to choose suitable spots for the planting of new Pink specimens (propagated in vitro at UJEP), the planting and development of the plants was properly documented.

Assessment: Due to the financial costs of the in vitro method relative to the number of plants actually taking root on the site (20 - 26%) this method was assessed as not very efficient.

Cultivation and gene bank

The own biology of the species was studied by Toman (1972), who cultivated the Pink at a greenhouse of the Pedagogical Faculty in Ústí nad Labem, and performed unsuccessful experiments in vegetative propagation from stem cuttings.

In the 1980's the State Institute for Nature Conservation asked several professional organisations (Botanical Institute of Czech Academy of Sciences in Průhonice, Technical Services of Teplice, Regional Geographic Museum in Liberec, Nature Conservation Group in Roudnice n. L., Institute of Experimental Botany of the Czech Academy of Sciences) to propagate the Bohemian Sand Pink from collected seeds. This project was not co-ordinated and documented properly and yielded no expected results.

However, the Institute of Experimental Botany of the Czech Academy of Sciences Prague agreed to propagate Pink clusters *ex situ* and these were planted at NNM Kleneč in 1989 and 1990.

In 1992 – 1995 there was an experiment with propagating the Pink my means of the meristem cultures *in vitro* the Department of the Pedagogical Faculty in Ústí nad Labem. The propagated plants were planted at NNM Kleneč in the mentioned period.

Between 1996 and 1998 the species was cultivated under a partial research project of “Propagation of threatened species by means of tissue culture” at the Department of Cell Biology and Genetics of Palacký University in Olomouc. The results of this project are listed hereunder; at the moment, the Bohemian Sand Pink is not grown at the Botanical Garden Olomouc.

Overview of institutions and individuals formerly involved in the cultivation and rescue propagation of the Bohemian Sand Pink:

- ***Technical Services Teplice***

In 1982 the Ministry of Environment of the Czechoslovak Republic granted an Exception No. 2633/82 to enable the collecting of the Pink seeds. Upon this exception approximately 30 seeds were collected on the site in the same year and handed over of the Technical Services. In 1983 two clusters were successfully cultivated, which were then transferred to outdoor bed. In 1984 they died due to mechanical disturbance. In 1984 more seeds were collected, and in 1986 only two plants survived in the pot. After the gardener, who was in charge of the experiment, went on a maternity leave the co-operation of ANCLP CR with this institution ceased.

- ***Institute of Experimental Botany of the Czech Academy of Sciences, Prague***

The first seeds were collected in 1985 and cultivated in a clay pot with garden soil inside a greenhouse. In mid July 1986 one cluster containing approximately 10 – 15 specimens with approximately 25 cm in diameter was planted outside. In august two flowers bloomed but produced no seeds. In October the cluster was dug up and moved to a hot bed for the winter. In spring 1987 it was

propagated vegetatively and further cultivated in the open hotbed. The next flowering was abundant but production of seeds was low as the plants were disturbed by insects. In 1988 – 1989 the vegetative propagation in the hotbed continued with the sowing of the produced seeds. In 1990 the total of 41 produced clusters were planted at NNM Kleneč, but only 16 of these survived through to September of the same year.

- ***Institute of Ornamental Horticulture Průhonice***

Part of the material from the Institute of Experimental Botany was passed also to Ing. J. Dostál in Průhonice. Apex and node cuttings were transferred into *in vitro* culture and cultivated on Murashige and Skoog solid media with agar and about 1 – 3% sacharose without growth stimulators. Acclimatization to *ex vitro* conditions was tested and the plants were moved to greenhouse.

The documentation of these operations is very brief and almost all the information got lost over the years or is incomplete – therefore the information is missing on when and with what results the experiments took place.

- ***Botanical Institute of Czech Academy of Sciences in Průhonice***

The Institute (BÚ ČSAV) cultivated a stock of plants to be planted on the reserve site near the original growth at Kleneč. In 1978 an experiment was performed with 200 seeds sown near the individual clusters on the site at NNM Kleneč, but check-ups in the following year did not detect any increase in the number of specimens (Kovanda 1986). In 1985 several specimens were planted on a site near the village of Uhy (district of Kladno). The site was destroyed in the following year when a gas pipe was dug there, the habitat declined and the plants died.

- ***Regional Geographical Museum in Liberec***

In 1986, 20 seeds were handed over to Dr. Studnička to perform experimental cultivation from meristem cultures on artificial substrates. The results of the experiment are not known.

- ***37/01 ZO ČSOP in Roudnice nad Labem***

In 1985 the district conservationist of the State Nature Conservation authority collected several seeds at NNM Kleneč and sowed them in a cool seed-bed (probably in his own garden). In 1986 he had 6 pots with plants, in 1987 he planted them on the sandy slope near Kyškovice. Some of these plants are still present on the site in the form of a single compact cluster.

- ***Pedagogical Faculty of Jan Evangelist Purkyně University in Ústí nad Labem***

Since 1991 under a co-operation with PedF UJEP Ústí n. L. the enhancement of the population at NNM Kleneč was performed using specimens cultivated by means of meristem cultures. In 1992 those cultures of the Pink were derived in which tissue culture propagation method was successful. The entire cycle was performed: initial material – tissue culture – proliferation – rooting – transfer to soil – flowering – production of seeds. The gene bank for this species was maintained in tissue

culture and methodology was drawn up to monitor the genetic stability of the regenerated plants. The success rate of the planted specimens ranged around 26%. The project ended in 1994.

- ***Faculty of Natural Sciences, Palacký University in Olomouc***

In 1998 the ANCLP CR ran a project titled “Active help to threatened species of selected plants and animals” under which a partial project was performed – “Propagation of threatened species by means of tissue cultures”, in which the Faculty of Natural Sciences UP Olomouc was participating. The research project focused on long-term keeping of the gene bank of selected plant species *in vitro* including the Bohemian Sand Pink, the transfer of plant clones into soil in order to be planted on the natural site, and monitoring of specimens planted at the University Botanical Garden in Olomouc. The cultivated clones were derived from the node segments and seeds collected on the site at NNM Kleneč. During 1998 the transfer of 246 plants from culture to non-sterile soil conditions was performed; in spring 1999 and 2000 these plants were planted on the natural site. In 1998 four clusters of the Bohemian Sand Pink were grown at the Botanical Garden – these came from tissue cultures, flowered, and produced seeds. Currently the Bohemian Sand Pink is not grown at the Botanical Garden any more (Válová in lit. 2005).

2. OBJECTIVES OF THE ACTION PLAN

The main objective of the Action Plan is the sustaining of the Bohemian Sand Pink (*Dianthus arenarius* subsp. *Bohemicus*) as a wild growing species in the Czech Republic. This objective should be met by the achievement of the following:

Long-term objectives:

1. Establishing a long-term stable population of *Dianthus arenarius* subsp. *bohemicus* on the NNM Kleneč habitat with 400% larger area of the plants' occurrence than the condition documented in 2005. The newly established population must be capable of spontaneous reproduction in the long-term perspective, which shall be verified by checks carried out in at least ten successive years.
2. Establishing a long-term stable population reserve of *Dianthus arenarius* subsp. *bohemicus* on the second site near Kyškovice; this population must also be capable of spontaneous reproduction in the long-term perspective, which shall be verified by checks carried out in at least ten successive years.

Mid-term objectives:

For the period of the **first ten years** after the acceptance of the Action Plan the following objectives were set:

1. Establishment of stable population and suitable conditions for the existence of *Dianthus arenarius* subsp. *bohemicus* population on the site at NNM Kleneč.
2. Support of the species' introduction and stabilisation of the population on the reserve habitat near Kyškovice.
3. Proposal and performance of measures improving the habitat conditions on the reserve site near Kyškovice.
4. Study and research activities in order to broaden the knowledge of the biology and ecology of the species *Dianthus arenarius* subsp. *bohemicus* and its relative populations in Germany and Poland.

3. SCHEDULE OF MEASURES UNDER THE ACTION PLAN

3.1 Biotope management

3.1.1 Extensive grazing

Motivation

Extensive grazing (ideally goats or combination of goats and sheep) is a traditional and also the most suitable type of habitat management for the Bohemian Sand Pink. Currently the habitats are not grazed. All the other methods of management are secondary. Grazing allows for selective and continuous removal of biomass, disturbance of the solid turf and thus also for the creation of open patches where germination and rooting of the Bohemian Sand Pink seedlings can take place.

Content of the measure

The extensive grazing of a combined herd will be performed on the grassy areas outside the forest. Before the grazing begins the area must be fenced – mobile fencing needs to be installed to prevent the animals getting outside the areas of interest. The suitable degree of the grazing intensity as well as the ideal number of animals in the herd have not been tested yet but we will be following the experiences with grazing on similar types of habitat at other sites.

If the grazing cannot be established on the site, substitute management will be performed by means of manual cutting of the grass (cutting) followed by the breaking-up of the turf (see Measure 3.1.4). To break up the turf, garden tools will be used with the possibility of alternative methods such as the application of horses, which are available near NNM Kleneč – during walk or light canter their hooves could break-up the turf as needed. The suitable degree of intensity as well as the ideal number of animals has not been tested yet but we will be following the experiences from experimental performance of the measure on small patches. The performance of this type of turf breaking-up as a substitute solution for the grazing will be regular during the entire course of the Action Plan. The establishment of extensive grazing on the selected areas at NNM Kleneč will be proposed after the implementation of Measure 3.1.3 (mechanical removal of turf).

Grazing on the Kyškovice site will be performed on a very limited area of 0.4 ha, which will be fenced-off by a mobile electric fence. The size and character of the area enables for the movement and grazing of just a few animals.

3.1.2 Cutting

Motivation

Substitute method of biotope management at the time when grazing cannot be performed, and also a complementary measure to grazing in the less or temporarily ungrazed areas.

Measure contents

Once in every year regular manual cutting of the dry grasslands shall be performed, covering also the areas where trees and shrubs have been cut (see Chapter 3.1.6). On the site at NNM Kleneč the cutting shall be performed in two phases. On areas where the Bohemian Sand Pink is not present the term of cutting is recommended to take place in mid June, areas with Bohemian Sand Pink and St. Bernard's Lily (*Anthericum liliago*) shall be cut from the end of June (after ripening of seeds). In the close vicinity of the Pink the cutting will be performed individually under the supervision of ANCLP professional.

On the site near Kyškovice the term of cutting will be set from the end of July until the seeds of the Pink and purple mullein (*Verbascum phoeniceum*) ripen.

3.1.3 Mechanical removal of turf in selected areas

Motivation

On the site at NNM Kleneč there is currently only one suitable area to sustain the existence and expansion of the species. It is necessary to prepare suitable conditions for the potential expansion of the Bohemian Sand Pink on new areas within NNM Kleneč as well as for the arrangement of the habitat for sowing seeds on the substitute site by Kyškovice. The solution could be the removal of the humus layer down to the gravel sand base. The surfaces exposed in this way would provide good conditions for the germination of new plants of the Bohemian Sand Pink.

Measure contents

During the period of dormancy the areas at NNM Kleneč, selected upon pedological survey (see Chapter 3.6.1) will be treated by the removal of the upper humus layer by means of heavy agricultural machinery. In places where the Sand Pink occurs this will be always done manually – using garden tools.

On the site at Kyškovice the upper humus layer will be performed on the entire area of the site but in three phases as there are also other plants of interest – besides the Bohemian Sand Pink it is the purple mullein: if the humus were to be removed all at once its population would be totally destroyed. The measure will be therefore performed gradually over three years while every year the humus layer will be removed on one third of the area only. The measure will be executed by means of heavy machinery.

The removal of the humus layer is in fact a one-shot measure; it will be performed only once on each site during this phase of the Action Plan.

3.1.4 Maintenance of areas where the humus layer was removed

Motivation

The areas where the humus layer was removed are prone to fast succession during which the area quickly overgrows with species bearing the greatest potential for expansion. In order to achieve the required phytocoenose on the area it is necessary to regulate the succession development.

Measure contents

On areas where the humus layer was removed the following measures will be applied to prevent succession:

- mechanical disturbance of the moss layer: the key method will be natural mechanical disruption by the hooves of grazing animals (sheep, goats, horses); if this is not provided, additional mechanical disturbance will be done manually using garden tools.
- removal of fallen pine needles: this problem will be substantially resolved through the gradual removal of the self-seeded pine growth or by removing the lower branches of old trees. Before the trees are cut, the needles will be regularly raked and removed from the area. The raking of the pine needles will be done also under the large pine tree in the central part of NNM Kleneč, which is not to be removed.

Both types of interventions will be performed only at NNM Kleneč. The implementation will take place annually if required, specifically on the area where the turf was removed in 1999. All the new areas with turf to be removed under the performance of this Action Plan will be treated in the same way.

On the Kyškovice site only the mechanical disturbance of the moss layer will be performed.

3.1.5 Removal of competitive expansive plants

Motivation

One part of NNM Kleneč is overgrown with the wood small-reed, which is starting to spread from the forest edges to the Pink habitats. Its compact growths eliminate the less competitive species and cause the pauperization of the herbaceous layer. The regular cutting of the wood small-reed at NNM Kleneč did not stop its expansion therefore its elimination by means of manual pulling of entire clumps is necessary.

A similar problem, although not so serious, is the expansion of the tall oatgrass.

Measure contents

On the site at NNM Kleneč the manual pulling of tall oatgrass clumps will be performed on the total area of 500 m². It is presumed that after this intervention the tall oatgrass will reappear on the area. This intervention will be repeated every five years as necessary.

The tall oatgrass is relatively easy to eliminate by annual cutting and its growths will be reasonably

limited also by the planned removal of turf (see Chapter 3.1.3) therefore no other special measures are planned.

No special measures to eliminate expansive plants will be performed on the site near Kyškovice. To prevent the expansion of these plants the measures described in Chapters 3.1.1 and 3.1.2 will be sufficient.

3.1.6 Removal of self-seeding trees (shrubs)

Motivation

In the vicinity of the areas with the Bohemian Sand Pink there already are mature growths of self-seeding plants (locust-tree), which produce large amount of seeds enabling for easy spreading of this species to the areas of interest. Moreover, the leaves (locust-tree) and the needles (pine) inhibit the germination and growth of the Bohemian Sand Pink, which is a heliophilous and competitively weak species.

Measure contents

The felling of the locust-trees at NNM Kleneč and their replacement by suitable native trees (oak). Continuous removal of other self-seeding shrubs (dog rose, hawthorn) from both sites.

3.2 Species management

3.2.1 Sowing seeds

Motivation

The aim of the Action Plan is to set up, on both sites of *Dianthus arenarius* subsp. *bohemicus*, species population that would be stable in the long-term perspective. On the newly established site of *Dianthus arenarius* subsp. *bohemicus* by Kyškovice currently grows only one cluster of this plant. Development of the population at NNM Kleneč also needs supporting. This is why the populations by Kyškovice and at NNM Kleneč will be supported by sowing of the species' seeds.

Measure contents

The sowing will be performed on both sites – by Kyškovice and NNM Kleneč. The condition of the performance is the implementation of Measure 3.1.3 (Mechanical removal of turf in selected areas). The seeds will be collected in proportional amount (approximately 1,000 seeds from 10 marked plants for each of the sites) after the ripening of the capsules at NNM Kleneč (in June). The collected capsules will be opened and number of seeds will be calculated. In the same season the defined number of seeds will be loosely scattered on the previously prepared cultivated areas of 3x3 metres size (with turf scraped off down to the gravel sand base).

As the turf removal measure (see Chapter 3.1.3) at the Kyškovice site will take place in three

phases, in spring of the following year the sowing will be performed on the prepared areas, always after the removal of the turf. In each of the phases the turf will be removed from one third of the site, which will be then treated in order to enable the sowing of the seeds on three areas of 3x3 metres.

At NNM Kleneč the sowing will be performed only once in the spring following the year after the implementation of Measure 3.1.3.

During ten successive years the rate of seedlings' ecesis will be monitored every year as well as the further development of the plants (see Chapter 3.4.1). If, after the first sowing, more than 50% of the seedlings are established successfully, the measure shall not be repeated. In case that the success rate of seedlings' establishment in the second year after sowing will be under 50% the measure will be repeated in the same fashion, and the cultivated areas will be sowed again. This method has already been experimentally tested (Bělohoubek 2006) and so far it represents the most efficient and cheapest method of species introduction in new habitats (see Chapter 1.6.2).

3.2.2 Preservation of the plants in a gene bank

Motivation

Preservation of genetic variability of the populations and conservation of the plant material for the purpose of potential sowing and planting.

Measure contents

The seeds will be collected at NNM Kleneč and permanently deposited in the seed bank at the Institute of Plant Production Prague – Ruzyně. The seeds will be collected from ripe capsules at the end of July through early August. The implementation of the measure is planned twice in this phase (years 2008 and 2010).

There is no experience with the long-term storage of seeds of this species, the method of efficient storing will need to be tested first.

3.3 Monitoring

3.3.1 Monitoring of the population at NNM Kleneč

Motivation

Detailed monitoring of the Bohemian Sand Pink population aims to monitor the annual changes in the populations' abundance as well as the distribution of the plants within the site at NNM Kleneč. The resulting information will serve as basis for the performance of other measures under the Action Plan (see Chapters 3.1, 3.2).

Measure contents

On the newly treated areas (see Chapter 3.1.3) new monitoring patches of 2x2 m will be

established in order to monitor the succession and development of the Pink population. The main monitored parameters will include the number of new seedlings, number of mature plants, their mutual ratio, number of flowering/non-flowering specimens and stems, number of developed capsules, number of capsules affected by the weevil (see Annex No. 5). The monitoring on the newly established areas will take place every year in five successive years after the end of the site treatment works and later in three-year periods depending on the results of the final report on the five-year monitoring.

The monitoring of existing areas at NNM Kleneč will be performed in three-year period as the turf there has already been removed in the past.

3.3.2 Monitoring of the population by Kyškovice

Motivation

Detailed monitoring of the Bohemian Sand Pink population aims to monitor the annual changes in the populations' abundance as well as the distribution of the plants within the Kyškovice site. The resulting information will serve as basis for the performance of other measures under the Action Plan (see Chapters 3.1, 3.2).

Measure contents

New monitoring patches of 2x2 m will be established on the newly treated areas in order to monitor the succession and development of the Pink population. The same parameters will be monitored as on the NNM Kleneč site. The monitoring on the newly established areas will take place every year in five successive years after the end of the site treatment works and later in three-year periods depending on the results of the final report on the five-year monitoring.

3.3.3 Phytosociological relevés of areas after turf removal

Motivation

The plant societies and their dynamics have a great influence on the population of the Bohemian Sand Pink therefore it is important to collect data on the development of the vegetation on the newly exposed gravel sand areas (see Measures in Chapter 3.1.3) at NNM Kleneč and by Kyškovice.

Measure contents

The newly established monitoring patches of 2x2 m (established under the implementation of Measures 3.3.1, 3.3.2) on the sites at NNM Kleneč and by Kyškovice the standard phytosociological relevés will be performed with the recording of exact number of the Bohemian Sand Pink. The surveying will be performed on the sites of the existing growth containing the species of interest where more 2x2 m monitoring areas will be set up for this purpose. This will enable for the concurrent monitoring of the development of vegetation on treated and untreated areas containing the

Pink. The phytosociological relevés will be repeated on the same sites in three-year intervals (between May and June).

3.3.4 Monitoring of microclimatic values on the sites

Motivation

The year-round monitoring of climatic characteristics directly on the site will provide for the possibility of correlating these characteristics with the development of the population and understanding of the occurring changes and fluctuations.

Measure contents

On the NNM Kleneč site, later also on the site near Kyškovice, equipment will be installed for year-round monitoring of climate characteristics data (air temperature, air humidity, precipitation amount, atmospheric pressure, direction and speed of wind).

3.3.5 Analysis of soil samples

Motivation

Regular monitoring of soil characteristics and their correlation with the development of the population will allow for the understanding of trends in the population development on the NNM Kleneč site. It is also important to know the soil characteristics from this species' habitat in order to successfully establish the new population at the Kyškovice site.

Measure contents

The analysis of soil samples will be carried using samples taken on the sites at NNM Kleneč and by Kyškovice. The following parameters will be studied - pH, N org., C org., P, K, Mg, Ca, humus content. The results will be evaluated upon the requirements of the species. The soil analyses will be repeated every five years.

3.4 Research

3.4.1 Study of the means of reproduction and reproduction ecology

Motivation

Insufficient knowledge of the phases of the life cycle, which belong to the key factors of survival and expansion of the Bohemian Sand Pink populations.

Measure contents

The Sowing seeds on the newly established site by Kyškovice will be annually monitored and

evaluated upon the success of the sowing. The sowed patches of 1x1 m will be marked and their detailed topography (micro maps) will be drawn. The following parameters will be monitored and evaluated:

- number of plants
- production of seeds
- germination capacity of seeds
- rooting capacity of seedlings on the site

3.4.2 Study of the species' variability relative to substrate

Motivation

Thorough knowledge of the species' life cycle and its environmental requirements (the limiting factors) is necessary for the selection of suitable management, selection of new areas for the species' spreading, and especially for the establishment of a new population. For these purposes the result of the study (Toman, 1986) will be experimentally verified and potentially disproved; this study suggests that all the European subspecies of the Sand Pink are all a single species that only reacts by its morphology to the type of substrate.

Measure contents

The relation of the taxon to the soil substrate will be studied upon its physical and chemical composition as well as the structure including biometrics and phenology of the species. On four patches with different substrate (gravel sand, marl, black soil, loess) the Pink seeds will be sown (collected at NNM Kleneč) and plants will be cultivated. The germination and ecesis of the seedlings will be monitored, adult specimens will be studied in terms of dissemination, biometrics, phenology, and architecture of the root system.

3.4.3 Study of genetic variability of the Bohemian Sand Pink population

Motivation

As the issue of genetic variability of our population of the Bohemian Sand Pink has not yet been sufficiently resolved, which applies also to the populations of the Sand Pink growing elsewhere in Europe, the Action Plan shall include also the study of genetic variability of our population compared to the populations of all the five subspecies of the Sand Pink (*Dianthus arenarius*) as it still was not disproved that they all could be a single taxon that only reacts to different types of substrate, varying the morphology (Toman 1986).

The Hybridisation and taxonomic value of the *Dianthus arenarius* crossbreds will be also studied against other species from the *Dianthus* genus as it is still unclear whether the specimens with the pinkish colour of the flowers from NNM Kleneč are hybrids of *Dianthus arenarius* and *Dianthus carthusianorum* or if this phenomenon is only a morphological variability under single species.

Similarly, the taxonomic classification of the Sand Pink specimens from NNM Kleneč that bear flowers with red marks on the base of the petals.

Measure contents

Genetic analysis of the variability of population at NNM Kleneč will be carried out, followed with analyses of foreign European populations of *Dianthus arenarius*. The genetic variability analyses will be compared and the result will be a study that should explain the taxonomic classification of *Dianthus arenarius* subsp. *bohemicus* and all its five subspecies currently distinguished.

The conclusion of the study should explain also the issue of Hybridisation and taxonomic classification of potential hybrids on the NNM Kleneč site.

3.4.4 Study of the plant versus phytophage relation

Motivation

It was found that the plant ovaries are damaged by larvae of the *Hypera arator* weevil. The aim of the activity is to find out whether this factor causes a serious disturbance to the population and which measures could be used for mitigation.

Measure contents

Entomological survey will be requested in order to study the relation of the plant versus the phytophage at NNM Kleneč with the aim to resolve the issue of the ovaries destruction and insufficient generation of seeds at certain periods. (The survey has already been requested in 2007 from RNDr. Jiří Skuhrovec, Ph.D. and shall continue in the following years).

3.4.5 Study of influence and dependence of ant colonies on the root system of the Pink

Motivation

The ant colonies occur in close proximity of the plant clusters. The purpose of the activity is to find out how these colonies influence the prosperity of the plants and what measures could be adopted.

Measure contents

Survey will be requested in order to study the influence and dependence of ant colonies on the root system of the Pink.

3.4.6 Monitoring and determination of natural pollinators of the Bohemian Sand Pink

Motivation

The study of presence and monitoring of abundance of the natural pollinators is important for the determination of potential natural reproduction of the taxon.

Measure contents

Monitoring and determination of the natural pollinators of the Bohemian Sand Pink will be performed at NNM Kleneč. Upon the results, measures aimed at the protection of their habitats will be adopted.

3.4.7 Entomological survey at NNM Kleneč

Motivation

The entomological survey at NNM Kleneč will be performed prior to the removal of the turf layer (see Chapter 3.1.3). This habitat may host rare insect species and the turf removal performed at an inappropriate time may threaten them.

Measure contents

In the season before the performance of Measure 3.1.3 (removal of turf) an extensive entomological survey will be performed at NNM Kleneč, which shall focus on epigeic groups of insects and arachnoids. The following groups will be surveyed: spiders (*Araneae*), bugs (*Heteroptera*), beetles from the *Carabidae* and *Curculionidae* families, and hymenopterous insects (*Hymenoptera*).

Upon the results of the survey and experts' recommendation it will be decided about the period when the Measure 3.1.3 will be carried out or about the implementation of the measures in general.

3.5 Education and promotion

3.5.1 Publicity of the results of the Action Plan

Motivation

Due to its unique character the site at NNM Kleneč has already been continuously presented in media and press (Živé srdce Evropy, Botanicky významná území, Evropsky významné lokality, website of ANCLP CR, etc.). The village of Kleneč uses the symbol of the Pink flower on its community emblem. There is an information board at the site, which is currently under reconstruction. The publicity of the Action Plan results will therefore continue to be carried out by means of expert and popular articles.

Measure contents

The results of the Action Plan will be published in expert (Příroda) as well as public journals (Ochrana přírody, Živa apod.). In case of successful performance of the genetic analyses of the population and the comparison of our population of *Dianthus arenarius* with foreign populations, the results will be published in international scientific journals. An information leaflet will be also issued providing details about the species and the Action Plan to the broad public in order to increase the general knowledge about the condition of the species' population in our country and about the priorities and objectives of the Action Plan.

3.5.2 Cultivation in botanic gardens

Motivation

As this species occurs only on two sites in the Czech Republic it is not widely known among the public. Proper protection from negative human impacts on its populations in our nature, which includes also the potential limitation of visitors coming to see the plants in their habitat, will represent a key factor that shall influence the future survival of the Bohemian Sand Pink in our nature. It is therefore desirable that the broadest public gets the opportunity to learn about the species elsewhere than just on the site of the species occurrence.

Measure contents

In order to present this species to the public in botanic gardens, selected gardens will receive seeds collected at NNM Kleneč (approximately 200 seeds for each botanic garden) where follow-up cultivation of the species will be ensured along with its suitable presentation in publicly accessible show beds.

3.6 Other measures

3.6.1 Pedological survey focusing on the stratigraphy of the individual layers

Motivation

This survey will allow for the selection of the best places where the management intervention (removal of turf layer, Chapter 3.1.3) will be performed.

Measure contents

Detailed pedological survey concentrated on the stratigraphy of the individual layers will be requested. With the use of probes, 3D model of the site will be created showing appropriate places where the turf may be removed down to the gravel base. The survey will be carried out on the NNM Kleneč site.

No pedological survey is planned for the Kyškovice site.

3.6.2 Provision of conservation regime for the Kyškovice site

Motivation

The site by Kyškovice, which is suitable for the establishing of a new Pink habitat, consists of a long and narrow slope between two fields. The land is owned by the Kyškovice community. Currently there is no territorial protection.

Measure contents

Proposal of the listing of the Kyškovice site as a conservation area in the category of Nature Monument.

4. ACTION PLAN IMPLEMENTATION TABLE

TABLE 4: IMPLEMENTATION TABLE OF THE ACTION PLAN FOR THE BOHEMIAN SAND PINK

Number and type of measure	Priority	Time of performance	Frequency	Relation to other measures	Note
3.1 Biotope management					
3.1.1 Extensive grazing	1	continuously during the entire project	every year	will be followed by Measure 3.1.2	cutting (3.1.2) is also substitute measure for grazing
3.1.2 Cutting	1	continuously during the entire project	every year (once per year)	accompanying measure to Measure 3.1.1	
3.1.3 Mechanical removal of turf in selected areas	1	continuously during the entire project	once per one Action Plan phase	upon the performance of Measure 3.6.1	
3.1.4 Maintenance of areas after removal of turf and breaking-up of solid turf	1	continuously during the entire project	every year as required	upon the performance of Measure 3.1.3	
3.1.5 Removal of competitive plants	1	continuously during the entire project	measure to be repeated every five years		
3.1.6 Removal of self-seeding trees (shrubs)	1	continuously during the entire project	repeated measure		
3.2 Species management					
3.2.1 Sowing seeds	1	from 2010	repeated measure	upon the performance of Measure 3.1.3	
3.2.2 Preservation of plants in gene bank	2	2008, 2010	twice per one Action Plan phase		
3.3 Monitoring					
3.3.1 Monitoring of population at NNM Kleneč	1	continuously during the entire project	every year in 5 consecutive years after performance of Measure 3.1.3 and then once in 3 years	upon the performance of Measure 3.1.3	
3.3.2 Monitoring of the population at Kyškovice	1	continuously during the entire project	every year in 5 consecutive years after performance of Measure 3.1.3 and then once in 3 years	upon the performance of Measure 3.1.3 and 3.2.1	
3.3.3 Phytosociological relevés of the	2	continuously during the	repeated measure, every	upon the performance of	

areas with newly established populations		entire project	three years	Measure 3.1.3	
3.3.4 Monitoring of microclimate values	2	continuously during the entire project	repeated measure		will be performed continuously during the entire project and all-year-round after the installation of the devices
3.3.5 Analysis of soil samples	2	continuously during the entire project	repeated measure, every five years		
3.4 Research					
3.4.1 Study of the means of reproduction and reproduction ecology	1	2008-2017	unrepeated measure		
3.4.2 Study of ecobiological characteristics of the taxon	1	2008-2018	unrepeated measure	upon the performance of Measure 3.1.3	
3.4.3 Study of genetic variability	2	2008-2012	unrepeated measure		
3.4.4 Study of the relation plant x phytophage	2	2008-2009	unrepeated measure		
3.4.5 Study of influence and dependence of ant colonies on the root system of the Pink	2	2008-2009	unrepeated measure		
3.4.6 Monitoring and determination of natural pollinators	3	2008-2010	unrepeated measure		
3.4.7 Entomological survey at NNM Kleneč	1	2008	unrepeated measure	upon the performance of Measure 3.1.3	
3.5 Education and promotion					
3.5.1 Publicity of the Action Plan results	3	continuously during the entire project	repeated measure		
3.5.2 Cultivation in botanic gardens	2	continuously during the entire project	unrepeated measure		
3.6 Other measures					
3.6.1 Pedological survey focusing on stratigraphy of individual layers	1	2008	unrepeated measure		
3.6.2 Provision of conservation regime for the Kyškovice site	2	2008-2010	unrepeated measure		proposal to be sent to KÚÚK

Note: Individual measures and the schedule of activities are proposed upon the experience gained during the implementation of rescue works in years 1999 – 2007. The numbers of the measures correspond with the numbering in Chapter 3, priority 1 – highest, priority 2 – medium, priority 3 – lowest.

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6. ANNEXES

Annex 1: Orthophotograph map of the National Nature Monument Kleneč with the marked occurrence of plant specimens of *Dianthus arenarius* subsp. *bohemicus* L.

Annex 2: Orthophotograph map of the Na kamenici hillside by Kyškovice with the marked occurrence of *Dianthus arenarius* subsp. *bohemicus* L.

Annex 3: Questionnaires for the monitoring of *Dianthus arenarius* subsp. *bohemicus* L.

Annex 4: Methodology of the monitoring of European species of interest - Bohemian Sand Pink *Dianthus arenarius* subsp. *bohemicus* L.

Annex 1: Orthophotograph map of the National Nature Monument Kleneč with the marked occurrence of plant specimens of *Dianthus arenarius* subsp. *bohemicus* L.



Annex 2: Orthophotograph map of the Na kamenici hillside by Kyškovice with the marked occurrence of *Dianthus arenarius* subsp. *bohemicus* L.



ANNEX 3-1: ANCLP CR QUESTIONNAIRE FOR THE MAPPING AND MONITORING OF THREATENED PLANT SPECIES, 2000

NATURA 2000

SPECIES	Dianthus arenarius subsp. bohemicus
SITE	Kleneč
DISTRICT	Litoměřice
LAND REGISTRY AREA	Kleneč
QUADRATE NETWORK MAPPING	5651 b
COORDINATES	14 °15'26'' e.l., 50°23'20'' n.l.
NUMBER OF MAP 1:10 000 (or other scales)	02-43-25, 12-21-05
CONSERVATION CATEGORY AND NAME	national nature monument
PHYTOCHORION	7b. Podřipská plain
DESCRIPTION OF THE SITE	xerothermic hillside 0.4 km ESE from the village
ELEVATION (minim., maxim)	220 m above sea level
SLOPE ORIENTATION, INCLINATION	0-15°
CHARACTER OF VEGETATION (physiotypes, forestry typology, phytocoenology),	cons. Koelerion glaucae
POPULATION AREA	1 ha
NUMBER OF SPECIMENS/CLUSTERS	approx. 200 clusters
VITALITY (good, average, bad)	good
DEVELOPMENT TREND (good, average, bad)	stable population
NEGATIVE IMPACTS	overgrowing with self-seeding plants, thick layer of humus
RECENT MANAGEMENT	removal of self-seeding plants, cutting, removal of humus layer down to gravel base
PROPOSED MANAGEMENT	continued regular cutting and removal of self-seeding plants, monitoring of the population development on the exposed areas, change of the species composition in the forests, total elimination of locust-tree
AUTHOR OF FIRST FINDING, DATE	Opitz 1852; refindinged by Weinzettl in 1896
VERIFICATION OF THE SITE, DATE	Čelakovský 1897
RECORDED BY, DATE	J. Bělohoubek 20.09.2000
HABITAT CODE (NATURA 2000)	
NAME OF HABITAT	
PROPOSAL FOR LISTING UNDER NATURA 2000 NETWORK	
from the perspective of species habitats Annex. II of Directive No. 92/43/EEC	YES
from the perspective of habitats Annex I = Directive No. 92/43/EEC	YES

ANNEX 3-2: ANCLP CR QUESTIONNAIRE FOR THE MAPPING AND MONITORING OF THREATENED PLANT SPECIES, 2003

NATURA 2000

SPECIES	Dianthus arenarius subsp. bohemicus
SITE	Kleneč
DISTRICT	Litoměřice
LAND REGISTRY AREA	Kleneč
QUADRATE NETWORK MAPPING	5651 b
COORDINATES	14 °15'26'' e.l., 50°23'20'' n.l.
NUMBER OF MAP 1:10 000 (or other scales)	02-43-25, 12-21-05
CONSERVATION CATEGORY AND NAME	national nature monument
PHYTOCHORION	7b. Podřipská plain
DESCRIPTION OF THE SITE	xerothermic hillside 0.4 km ESE from the village
ELEVATION (minim., maxim)	220 m above sea level
SLOPE ORIENTATION, INCLINATION	0-15°
CHARACTER OF VEGETATION (physiotypes, forestry typology, phytocoenology),	cons. Koelerion glaucae
POPULATION AREA	1 ha
NUMBER OF SPECIMENS/CLUSTERS	approx. 200 clusters
VITALITY (good, average, bad)	good
DEVELOPMENT TREND (good, average, bad)	stable population
NEGATIVE IMPACTS	overgrowing with self-seeding plants, thick layer of humus
RECENT MANAGEMENT	removal of self-seeding plants, cutting, removal of humus layer down to gravel base
PROPOSED MANAGEMENT	continued regular cutting and removal of self-seeding plants, monitoring of the population development on the exposed areas, change of the species composition in the forests, total elimination of locust-tree
AUTHOR OF FIRST FINDING, DATE	Opitz 1852; refound by Weinzettl in 1896
VERIFICATION OF THE SITE, DATE	Čelakovský 1897
RECORDED BY, DATE	J.Bělohoubek 20.09.2000
HABITAT CODE (NATURA 2000)	
NAME OF HABITAT	
PROPOSAL FOR LISTING UNDER NATURA 2000 NETWORK from the perspective of species habitats Annex. II of Directive No. 92/43/EEC	YES
from the perspective of habitats Annex I = Directive No. 92/43/EEC	YES

ANNEX 3-3: ANCLP CR QUESTIONNAIRE FOR MAPPING AND MONITORING OF THREATENED PLANT SPECIES, 2005

SPECIESL NAME (Latin)	Dianthus arenarius subsp. bohemicus
SPECIESL NAME (Czech/English)	Hvozdík písečný český / Bohemian Sand Pink
SITE (name – abbreviated for database)	Kleneč
EXACT LOCATION (community, field 300 m NW of the village spot height, etc.)	0.4 km ESE from the village
DESCRIPTION OF THE SITE LOCATION (in case of caves or proximity of prominent landmark – tree, boulder, etc.)	Xerothermic hillside with western orientation between the village Kleneč and the hill Říp
ACCURACY OF MAP MARK, AERIAL PHOTO (good, average, bad)	good
REGION	Ústecký
DISTRICT	Litoměřice
CATEGORY OF CONSERVATION AND NAME	NNM Kleneč
COORDINATES (only if known)	14 °15'26'' e.l., 50°23'20'' n.l.
NUMBER OF MAP 1:10 000	02-43-25
MONITORING AREA	YES
ELEVATION (minim., maxim)	220 m above sea
SLOPE ORIENTATION, INCLINATION	western orientation (flat on top); 0-20°
MAGNITUDE OF POPULATION (state number expressing total number of specimens)	834
UNIT OF POPULATION SIZE (specimens, clusters, clumps, etc)	clusters
AREA OF POPULATION (m2, ha, fill especially in case when determining exact number is not possible)	
QUALITY OF MAGNITUDE DATA [good (exact number), average (qual. estimate), bad (rough estimate)]	good
PARTIAL NUMBERS (number of flowering or fertile plants, their share of the total population – where number of adult plants or seedlings cannot be determined, state share of clusters and specimens, etc.)	% ratio of flowering / non-flowering clusters in the population 46/54
FERTILITY (sterile, fertile, unknown)	fertile
VITALITY OF PLANTS (good, average, bad, unknown)	good
PHENOPHASE (sprouting, foliage, flowering, ripening of fruit, seed maturation, dry plants)	
DAMAGE, DISTURBANCE (% of damaged plants, e.g. by insects, animals grazing, diseases)	buds damaged by insects
SOCIABILITY (1- continuous cover, 2 – groups or clusters, 3 – individual)	2
TYPE/ VITALITY OF POPULATION (invasive, stable, senile – if can be determined)	± stable (slowly expanding in the recent years)
TREND OF THE POPULATION'S DEVELOPMENT (stable, increasing, decreasing, fluctuating, unknown)	increasing

MAIN INFLUENCES ON THE POPULATION (present and past – state period, numeric according to Amendment E and verbal)	141 – abandonment of grazing 162 – artificial afforestation 251 – excessive collecting of rare species
THREATS AND IMPACTS (future, numeric according to Amendment E and verbal)	102 – cutting (+) 952 – eutrophization (-) 972 – competition (-) 979 – damage by animals (-)
HABITAT (code and name of habitat)	T5.2 Open sandy grasslands with <i>Corynephorus canescens</i> T5.3 <i>Festuca</i> sand grasslands
DEGREE OF HABITAT CONSERVATION (good average, bad, unknown)	good
PHYTOCOENOLOGY (state at least alliance where possible)	Corynephorion canescentis Klika 1931 Plantagini-Festucion ovinae Passarge 1964
OTHER NOTABLE SPECIES: Anthericum liliago, Jasione montana, Thymus serpyllum, Corynephorus canescens	
RECENT MANAGEMENT ON THE SITE (type and period): Removal of self-seeding trees (shrubs) (locust-tree, ash, dog rose), cutting of grass, removal of humus layer down to the gravel base.	
PROPOSED MANAGEMENT ON THE SITE: Continued removal of self-seeding trees (shrubs) and continued cutting (or grazing) of the grasses. Removal of humus layer down to the gravel base on the adjacent area. Change of species composition in the surrounding forests. Replacement of the locust-tree groves by indigenous species – oak, pine.	
RECENT SPECIES MANAGEMENT (type and period – fill only those interventions that related directly to the species population – population enhancement, collecting of seeds and their cultivation <i>ex situ</i> , protective cages over plants, etc.): Removal of the moss layer around the individual specimens, removal of humus layer down to the gravel base	
PROPOSED SPECIES MANAGEMENT: Setting up of the Action Plan. The basic management lies in the revitalisation of the habitat, which shall enable for spontaneous spreading of the species. In the first phase this spreading can be enhanced by loose sowing on the exposed areas. In the following phases maintenance is required by means of light disturbance of the gravel area to prevent overgrowing with undesired plants and depositing of humus.	
AUTHOR OF THE FIRST FINDING, DATE (only if known)	Opitz 1852; refound by Weinzettl in 1896 Verified by Čelakovský 1897
VERIFIED BY, DATE	J. Bělohoubek, 2005
RECORDED BY, DATE	J. Bělohoubek, 28.06.2005

NOTE (literature reference, photo, specification of data, credibility, etc.)	Literature references are stated in the species mapping methodology and in the species Action Plan.
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ATTACHMENT: Map 1:10 000, aerial photo

ANNEX 3-4: ANCLP CR QUESTIONNAIRE FOR THE MAPPING AND MONITORING OF THREATENED PLANT SPECIES, 2000

NATURA 2000

SPECIES	Dianthus arenarius subsp. bohemicus
SITE	Kleneč
DISTRICT	Litoměřice
LAND REGISTRY AREA	Kyškovice
QUADRATE NETWORK MAPPING	5551 d
COORDINATES	14 °16'37'' e.l. 50°26'27'' n.l.
NUMBER OF MAP 1:10 000 (or other scales)	02-43-20
CONSERVATION CATEGORY AND NAME	-
PHYTOCHORION	7b. Podřipská plain
DESCRIPTION OF THE SITE	xerothermic hillside 1.,12 km NE from the village
ELEVATION (minim., maxim)	164 m above sea level
SLOPE ORIENTATION, INCLINATION	10°
CHARACTER OF VEGETATION (physiotypes, forestry typology, phytocoenology),	cons. Koelerion glaucae (fragments)
POPULATION AREA	0,5 ha
NUMBER OF SPECIMENS/CLUSTERS	1 cluster
VITALITY (good, average, bad)	good
DEVELOPMENT TREND (good, average, bad)	stable population
NEGATIVE IMPACTS	accumulation of dead growth and humus on the site
RECENT MANAGEMENT	cutting of grass in 2000
PROPOSED MANAGEMENT	continued recent management, removal of part of the humus layer, enhancement of population
AUTHOR OF FIRST FINDING, DATE	artificial planting in the 1990's
VERIFICATION OF THE SITE, DATE	J.Bělohoubek 11.06.1999
RECORDED BY, DATE	J.Bělohoubek 20.09.2000
HABITAT CODE (NATURA 2000)	
NÁZEV BIOTOPU NAME OF HABITAT	
PROPOSAL FOR LISTING UNDER NATURA 2000 NETWORK from the perspective of species habitats Annex. II of Directive No. 92/43/EEC	YES
from the perspective of habitats Annex I = Directive No. 92/43/EEC	NO

ANNEX 3-5 ANCLP CR QUESTIONNAIRE FOR THE MAPPING AND MONITORING OF THREATENED PLANT SPECIES, 2003

NATURA 2000

SPECIES	Dianthus arenarius subsp. bohemicus
SITE	Kleneč
DISTRICT	Litoměřice
LAND REGISTRY AREA	Kyškovice
QUADRATE NETWORK MAPPING	5551 d
COORDINATES	14 °16'37'' v.d., 50°26'27'' s.š.
NUMBER OF MAP 1:10 000 (or other scales)	02-43-20
CONSERVATION CATEGORY AND NAME	-
PHYTOCHORION	7b. Podřipská plain
DESCRIPTION OF THE SITE	xerothermic hillside 1.,12 km NE from the village
ELEVATION (minim., maxim)	164 m above sea level
SLOPE ORIENTATION, INCLINATION	10°
CHARACTER OF VEGETATION (physiotypes, forestry typology, phytocoenology),	cons. Koelerion glaucae (fragments)
POPULATION AREA	0,5 ha
NUMBER OF SPECIMENS/CLUSTERS	1 cluster
VITALITY (good, average, bad)	good
DEVELOPMENT TREND (good, average, bad)	stable population
NEGATIVE IMPACTS	accumulation of dead growth and humus on the site
RECENT MANAGEMENT	cutting of grass in 2000
PROPOSED MANAGEMENT	continued recent management, removal of part of the humus layer, enhancement of population
AUTHOR OF FIRST FINDING, DATE	artificial planting in the 1990's
VERIFICATION OF THE SITE, DATE	J.Bělohoubek 11.06.1999
RECORDED BY, DATE	J.Bělohoubek 20.09.2000
HABITAT CODE (NATURA 2000)	
NÁZEV BIOTOPU NAME OF HABITAT	
PROPOSAL FOR LISTING UNDER NATURA 2000 NETWORK from the perspective of species habitats Annex. II of Directive No. 92/43/EEC	YES
from the perspective of habitats Annex I = Directive No. 92/43/EEC	NO

Annex 4: Methodology of the monitoring of European species of interest - Bohemian Sand Pink
Dianthus arenarius subsp. *bohemicus* L.



**AGENCY FOR NATURE CONSERVATION AND LANDSCAPE
PROTECTION OF THE CZECH REPUBLIC**
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VaV/610/4/01

Monitoring of specially protected plant and
animal species and types of natural habitats
of interest under EC legislation

II.H.13

Methodology of monitoring Species of European interest

Bohemian Sand Pink *(Dianthus arenarius* subsp. *bohemicus)*

author: **Jiří Bělohoubek**

2005

1. General data about the species' threatening

Legislative protection (Regulation 395/92 Coll.): critically threatened

The Red List (HOLUB & PROCHÁZKA 2000): C1 – critically threatened

IUCN Red list of Threatened Plants (WALTER & GILLET 1997): Vulnerable

Directive on Habitats 92/43/EC: Annex 2, species of priority

2. Total area

The Sand Pink is a continental Eastern European species, its subspecies Bohemian Sand Pink grows only in the Czech Republic.

3. Distribution in the Czech Republic

From the two original habitats (Vražkov, Kleneč) only one remained – by the village of Kleneč near Roudnice nad Labem, in the phytogeographical district Roudnické písky (Roudnice Sands) in the National Nature Monument Kleneč. The above sea elevation is 195-210 m above sea level. The site is shaped as a south-west facing exposed sandy slope with subsoil of Mesozoic sediments of the Czech Chalk Plain (clays, marls), which are covered by Quarternary gravel sands of the river Labe, forming a terrace along the Čepel brook and elevated to the surface in these places. The Bohemian Sand Pink grows in loosened grasslands here. The size of the population ranges in hundreds of clusters.

In 1987 the members of the group 37/01 of Czech Union for Nature Conservation based in Roudnice nad Labem (Mgr. Chvapil) planted five plants, cultivated from seed and originating from NNM Kleneč, on a slope near Kyškovice, where they still grow in a single cluster.

4. Biology and ecology of the species

Perennial plant. The flowering period starts in the third week of May and lasts until the end of July when the last flowers fade. The flowering optimum when most of the population is in bloom is during the first half of June. Reflorescence comes from the second half of August and lasts until the end of October. In this case the ovary does not have enough time to ripen and no seeds are formed. Flowers are monoclinal, alogamic with entomogamy. Flowers are fragrant, the nectary at the base of the receptacle secretes sweet nectar. The main pollinators are hymenopterous insects including wasps, syrphians, some beetles, and also butterflies. The plant propagates both generatively and vegetatively. Generative reproduction is provided by diaspores (seeds) that provide the transport of the genes farther away from the mother plant. The ovary ripens in mid July. The seeds of the Pink disperse by anemochory (boleochory) only in strong wind conditions as they have no flying mechanism to spread under normal weather. Another way of their dissemination may be kinochory (touch of animals or humans) or spontaneous disintegration of the capsule. In the second case the seeds remain close to the mother plant. Under vegetative reproduction the plant, aged several weeks, creates new rosettes at the base of the petiole. Adult specimen (cluster) represents a genetically identical clone. The disintegration of old

clusters to several smaller clonal individuals was not recorded. Experiments with the planting of stem cuttings, as well as spring cultivation of divided clusters, did not yield positive results so far.

The species is closely bound to the rough gravel sand base where the volume of skeleton and rough sand in the rhizosphere exceeds 65% and the soil pH on the site ranges between 4.2 – 4.8. The soils are low in humus, its total content ranges between 0.7 – 3%. Cultivation experiments have shown that these factors (content of humus, pH) are not primary for a successful development of the plant. The heliophyte, which prefers mostly habitats with direct exposure to sunlight, can also stand the conditions of a light shade. Thanks to its strong taproot the plant withstands the drying out of the rhizosphere on the sunny spots. In the surface layers of the soil the daily temperature fluctuations range in tens of degrees even if the temperature just below the surface is relatively stable due to the bad temperature conductivity of sand. The main limiting factor, however, is drought - due to the low ability of the sands to accumulate water and further enhanced by the position of our sandy soils, which are mostly found in lowlands where precipitation is scarce.

On the site at NNM Kleneč the Bohemian Sand Pink occurs in the society of open sandy grasslands, alliance *Corynephorion canescentis* Klika 1931 in the association *Festuco psammophilae - Koelerietum glaucae* Klika 1931. The society covers low loose grasslands on sandy soils, usually with the dominance of the grey-hair-grass (*Corynephorus canescens*). These combine diagnostically significant group of sub-continental species, mainly Sarmatian and Sarmatian-boreal, somewhat more basiphilous psammophytes.

5. Summary of current state of knowledge and monitoring

5.1. Czech Republic

The first information about the species comes probably from the Opitz “List of the Plants in the Flora of Bohemia” (“Seznam rostlin květeny české” – Opitz 1852, p. 75), where the author lists the Pink (*Dianthus plumarius*) along with another species named “pyrkovka obecná” (*Plumaria vulgaris*) but without any description, localization, and herbarium evidence. In 1896 an amateur botanist Karel Polák published an article in the journal of natural sciences *Vesmír*, reporting the finding of a new species of Czech flora. It was a Pink that was found on a rolling slope near Roudnice nad Labem and brought by the students of the local school of economy to high school professor Valentin Weinzettel in June 1896. Weinzettel informed prof. Čelakovský about the finding, and Čelakovský determined the taxon as *Dianthus plumarius* L. (Čelakovský 1987). This name was later accepted by other authors (Domin 1904, Polívka 1912).

In 1915 the site was visited by prof. F. A. Novák, who applied the geographic-morphological method and excluded the Pink at Kleneč from the relatives of *Dianthus plumarius* L. and listed it to the cluster of species around *Dianthus arenarius* L. and *Dianthus serotinus* W. et K. as an endemic variety of *D.*

arenarius var. *bohemicus*. Professor Novák continued to pursue the issue of taxonomy further (Novák 1916, 1921, 1922). In his monograph (Novák 1927 a, b) he studied both groups of Pinks in detail, determining several varieties under *Dianthus arenarius*. In 1949 was the *bohemicus* variety promoted to subspecies.

Soják (Soják 1980) described the same plant as an autonomous species *Dianthus novakii*. Kovanda (1984) considers this proposal as overestimation and confirms the plant's position under the *Dianthus arenarius* L. group, however pointing out the similarity of subsp. *bohemicus* in some features to subsp. *psudoserotinus* and subsp. *borussicus*.

The biology of the species and its reproduction was studied by Toman (1972, 1986) under an extensive survey that he carried out on the site at NNM Kleneč.

Since 1995, professionals from ANCLP CR (regional office at Ústí n. L.) have studied the ecobiology of the species and the influence of management on its population. The first management interventions on the site were performed between 1967 and 1976. Since the 1980's the conservationists strived to eliminate the locust-tree growths by chemical means, but with significant effect. Active management of the site (cutting, cutting of sprouts, removal of competitive grasses) takes place regularly since 1987, since 1993 the evaluation of influences of these interventions on the population has been documented.

Since 1991 under co-operation with PedF UJEP Ústí n. L. the enhancement of the population at NNM Kleneč was performed using specimens cultivated by means of meristem cultures. In 1998 the ANCLP CR ran a project titled "Active help to threatened species of selected plants and animals" under which a partial project was performed – "Propagation of threatened species by means of tissue cultures", in which the Faculty of Natural Sciences UP Olomouc was participating. In the 1980's the state conservation bodies granted several expert organisations (Botanical Institute of Czech Academy of Sciences in Průhonice, Technical Services of Teplice, Regional Geographic Museum in Liberec, Nature Conservation Group in Roudnice n. L., Institute of Experimental Botany of the Czech Academy of Sciences, Botanic Garden Liberec) the approval to propagate the plant from collected seeds. This project was not properly co-ordinated or documented and yielded no expected results. The species is still grown at the Botanic Garden of the City of Prague. Since 1995 the ecobiology of the species and the influence of the management on its population have been studied continuously by ANCLP in Ústí nad Labem. In 1996 an entomological survey was carried out on the site, focusing on the issue of insect pests of the Bohemian Sand Pink. Detailed monitoring of the populations at NNM Kleneč and Kyškovice is performed since 2003 (J. Bělohoubek).

5.2. International occurrence

Endemic species of the Czech Republic – does not grow anywhere else.

6. Monitoring

6.1. Extensive monitoring (mapping)

6.1.1. Definition of the monitoring unit (specimen, cluster, ramet, polycormon, colony)

The basic monitored parameter is the number of specimens and the ratio of flowering and non-flowering specimens. In case of the Pink the individual clusters are considered specimens as they represent genetically identical clones. A cluster represents a clump of sprouts that grow from one place and create a coherent growth. In case of juvenile plants the specimens can be determined while growing densely close to each other. In later years the individual clones merge (grow into each other) and are monitored as a single cluster (clone).

6.1.2. Definition of site

For the purposes of monitoring site means the occurrence of one or more specimens of the species distant at least 500 metres from next closest occurrence. In case of this taxon there are only two natural habitats that are 6 km apart.

6.1.3. Selection of sites

The population of the Bohemian Sand Pink will be monitored on the sites Kleneč and Kyškovice.

6.1.4. Monitoring methods

The sites will be visited and the number of specimens occurring there will be determined. The accessibility of both sites is very good. The monitoring data is recorded in the ANCLP CR questionnaire, which is essential mainly to determine the total condition of the species population. As part of the field survey the sites will be marked in large scale orthophotographic maps.

6.1.5. Frequency and period of the monitoring

Considering the performed management interventions and the strong dynamics of the population over the past few years it is necessary to perform the monitoring every year. The suitable time of year is the flowering period, i.e. second half of May until first half of June.

6.1.6. Alternative solutions

Biennial interval of monitoring could be used if necessary. However, the low time and personnel demand of the proposed method supports the annual frequency of the monitoring.

6.1.7. Personnel requirements

Due to the small number and size of both the sites the field data can be collected over one day, processing of data shall also take one day only. Will be performed by J. Bělohoubek.

6.1.8. Material background

GPS, digital camera, maps, orthophotographic maps, questionnaires. The marking and counting of the clusters can be done using approximately 1,000 plain pointed skewer sticks (approximate cost CZK 100).

6.2. Intensive monitoring

6.2.1. Definition of monitoring unit (specimen, cluster, ramet, polycormon, colony)

The basic monitored parameter is the number of clusters and their position within the habitat.

6.2.2. Selection of sites

The same sites as stated under Item 6.1.2. were selected to perform intensive monitoring.

6.2.3. Monitoring methods

The basic criterion is the monitoring of the number of clusters and their size changes on selected areas. Seven monitoring areas have been set up for the purposes of the monitoring. One micro-mapping area (1x1 m) is established on the Kyškovice site and will be used in order to monitor the ecesis and development of seedlings. Six areas 2x2 m will be established on the Kleneč site; three of these will be placed in areas where turf was removed, and three on the original untreated surface. Over three years, these patches will be used to map the distribution of all the plants. Two of these patches – one on the area with removed turf and one on original surface will contain smaller 1x1 m patches to perform detailed monitoring of the development of individual clusters and generative reproduction including the ecesis of the seedlings. All will be photographed (the individual micro-populations) using the same gauge. Digital photography will be used with follow-up image analysis and processing using Adobe Photoshop and Corel.

6.2.4. Frequency and period of the monitoring

The monitoring will take place in three-year intervals. One of the suitable terms to identify the clusters is May and June when the plant is in blossom. The monitoring can be performed also later if required (July-August) as the clusters are easy to spot on the open gravel base. The advantage of monitoring in the latter period is also the fact that the cut vegetation enables for easier installation of the monitoring grid and the flowers of the Pink are not damaged.

6.2.5. Alternative solutions

No alternative solutions.

6.2.6. Personnel requirements

To ensure the continuity and organisation of the work it is recommended to continue using the current model when extensive and intensive monitoring is performed and processed by a single person. Field data collection shall take two days, 3 days are needed for the processing.

6.2.7. Material background

Monitoring already takes place from 2003 and the basic equipment has already been purchased. However, the necessity may occur to create new signage for some areas or repair the monitoring network. As the overground marking of the monitoring areas gets damaged during cutting it is necessary to install metal rods set deep in the ground. In such case the follow-up detection will need to be done using manual metal detector (CZK 600 – 3,000 according to type of machine). For permanent marking of old clusters

several metal tags need to be installed and numbered. A new digital camera is also needed.

6.3. Auxiliary monitoring

6.3.1. Selection of sites

The same sites as stated under Item 6.1.2. were selected to perform auxiliary monitoring.

6.3.2. Monitoring methods

Monitoring of vegetation is proposed as the main measure. At Kleneč and Kyškovice two monitoring areas of 2x2 m will be set up. To evaluate the success of the management intervention (exposure of the gravel layer) and to monitor the succession one of these patches will be placed on the scraped area and the other one on the original surface. The relatively small size of the vegetation monitoring patch issues from the need to maintain a comparable size both in Kyškovice and at Kleneč where it is not possible to set up a larger area of 16 square metres in the original growth. Documentation shall record all the performed management interventions on both sides including their photographing as well as the recording of all potential negative impacts detected. Further recommendations for auxiliary monitoring, surveying, and study are addressed in the Action Plan for this taxon (BĚLOHOUBEK 2005).

6.3.3. Frequency and period of the monitoring

The monitoring of vegetation will be performed in three-year interval. The suitable period is the flowering season – end of may to early June. With respect to the auxiliary vegetation monitoring it is necessary to perform the monitoring activities prior to the performance of other management interventions (cutting). Vegetation monitoring can be done parallel with the intensive monitoring of the species.

6.3.4. Personnel requirements

Same proposal as for the main monitoring.

6.3.5. Material background

Same as with intensive monitoring.

7. Risks

The proposed monitoring method was partially tested in years 1999 – 2001, and fully in 2003 – 2004. The current proposal already contains the amendment of methods that were specified during the application of the methodology. One of the main advantages is the very good accessibility of the sites (for mapping), which can actually represent a disadvantage for the plants (easy access of potential destructors). In 2005 the proposal of Action Plan for the Bohemian Sand Pink was written that includes the proposal of a number of measures aimed at the stabilising and expansion of the taxon on both sites. Some of these measures may collide with the existence of the monitoring areas over several years. This relates mainly to the monitoring of the plants and vegetation on the original (i.e. overgrowing) surfaces which are planned to be treated.

8. International co-operation

Not necessary for this species. There is a possibility to apply a method used for similar species on open disturbed sites, sandy habitats etc. with similar biology.

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