Concept of Seedings According to the Natural Area: An Example of the Munich Plain

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1 Introduction

Questions of restoration have gained increasing importance in the field of nature conservation due to continuing interferences into nature and landscape. The knowledge gained from restoration ecology research, implementation projects and the techniques developed in this context offer the opportunity today to newly create initial stages of oligotrophic grassland, extensively maintained meadows and marginal vegetation communities (e.g. Molder 1997, Pfadenhauer et al. 2000, Anderlik-Wesinger 2002, Pfadenhauer & Kiehl 2003, Kirmer & Tischew 2006). However, scientific monitoring has also shown that species communities that have developed over centuries or millennia cannot be redeveloped within a short time. Although restoration measures always create only the initial stages, these can actually contain a large number of the nature conservation's target species (Quinger 2002, Kiehl & Wagner 2006, Kiehl & Pfadenhauer 2007). In this way restoration ecology provides additional justification for the preservation of natural or near-natural biotopes. The reestablishment of oligotrophic grassland by applying plant clippings containing diaspores has meanwhile been widely accepted among nature conservationists (Tränkle 2002, Pfadenhauer & Miller 2000, Kirmer 2004, Braun 2006, Kiehl et al. 2006). Due to the sheer volume of plant material and transportation costs, the use of plant clippings is usually restricted to the immediate vicinity of the “donor sites”. This reduces the risk of a bastardization of the flora caused by possible hay dissemination outside the region of origin. If plant clipping cannot be used threshed grain, seeds or plants must be applied (Kirmer & Tischew 2006). These materials can be transported with relative ease over long distances to other areas where the respective plant tribes or races do not originally occur. Nature conservationists view this with skepticism. (Zahlheimer 2000, Zahlheimer & Schuhwerk 2006, Klingenstein & Eberhard 2003, Nickel 2003).

At present, business with seeds from wild plants is expanding rapidly in Germany. This brings new challenges for nature conservation. On one hand it is necessary to develop practical approaches to the use of threshed grain, seeds and plants of wild species. On the other hand, developing a legal framework must be kept in view (Hacker & Hiller 2003, Kirmer & Tischew 2006). In the context of the propagation and trade of wild plants current discussion also includes certification and control systems within private law. Some certification systems, such as that of the “Verband deutscher Wildsamen- und Wildpflanzenproduzenten e.V.” (Association of German Producers of Wild Seeds and Wild Plants), are already being partially implemented.

Using the example of the natural area “Munich Plain” (for the delineation of the natural areas refer to Meynen et al. 1962) this study aims to present a seeding concept using seeds from the natural area. The wide-reaching and continuous construction projects involved in the conurbation of Munich and the resulting interference in nature and landscape have led to, and are still leading to, a large amount of compensation measures for restoring damaged sites. Due to the large demand the establishment of dry grassland can only partly be covered by the transfer of plant clippings from original oligotrophic grasslands (such as the 'Garchinger Heide'). These conditions have led to a strong demand for seeds of autochthonous origin.

2 Legal Framework

National and international laws and programmes for the protection of the biological diversity (i.e. diversity within species) set high standards for the use of seeds and threshed grain for restoration measures. This leads to the necessity to use only autochthonous seeds in the open landscape. Table 1 provides an overview of important legal regulations.

Table 1: Legal framework condition

Legal regulation	**Core Statement / Key Message**
Environmental Programme of the United Nations (Rio Convention 3 June 1992)	Preservation of the biological diversity. According to section 2 the biological diversity comprises the diversity within the species (genetic diversity) and between the species (species diversity) as well the diversity of the ecosystems. Establishment of a global network of protection areas.
Habitats Directive of the European Union (RL 92/43/EWG 21 May 1992)	On European level the protection network Natura 2000 is to contribute to the global network. For this purpose the Habitats Directive was issued with the aim “to promote the preservation of the biological diversity, however also considering the economic, social, cultural and regional requirements.”
Federal Law on Nature Conservation (BNatSchG, §§ 1 and 2 (1), 10, 20, 41 (2); 25 March 2002)	The Federal Law on Nature Conservation regulates the implementation of these aims on national level. Beside the protection and development of biotopes of wild living animal and plant species it also requires “the resettlement of animals and plants of displaced species in suitable biotopes within their natural area of distribution” (§ 20 (1) 3). § 41 (2) refers to the responsibility of the federal states to avoid danger of a bastardisation of the flora caused by the colonisation and dispersal of plants of species foreign to the natural area.
Bavarian Law on Nature Conservation (BayNatSchG, 23 December 2005)	Main aims and principles are given in the §§ 1 and 2 of the Federal Law on Nature Conservation. “The biological diversity has to be maintained and developed." (Art.1 (2) 1 BayNatSchG). "The habitats of wild living plants and animals are to be protected" (Art.1 (2) 5). "The exchange between different populations of animals and plants according to their specific needs is to be facilitated by establishing systems of biotope networks" (Art1 (2) 6).

To implement the objectives listed in the legislation on nature conservation the Federal State of Bavaria has created a specialised programme which is binding for public authorities; the "Bayerisches Arten- und Biotopschutzprogramm" (Bavarian Programme for the Protection of Species and Biotopes) (Bayerisches Landesamt für Umwelt o. J.). This has been supplemented by the "Landschaftspflegekonzept Bayern" (Landscape Management Concept of Bavaria), providing recommendations and suggestions for the maintenance and development of the most important biotope types (Bayerische Akademie für Naturschutz und Landschaftspflege 2002).

In the middle of the 19th century oligotrophic grasslands on limestone had been widely dispersed in the Munich Plain, comprising several ten-thousands of hectares (Sendtner 1954). In 2001 their most valuable remnants, together with hay meadows and 'tan-forests' were designated as “Heideflächen und Lohwälder nördlich von München” (calcareous grasslands and tan-forests north of Munich) according to the Habitats Directive.

Their designation has made them part of the European biotope network NATURA 2000.

The Habitats Directive (RL 92/43/EWG des RATES v. 21. Mai 1992) not only requires the designation of protection areas but also demands “the provision of supplementary measures to regulate the resettlement of certain native animal and plant species (p. 3). Natural habitats of common interest according to Section 1c and Appendix I in the natural area ‘Munich Plain’ are among others “near-natural calcareous grasslands and their stages of shrub encroachment” (*Festuco-Brometalia*) (prioritary habitats: "stands with special orchid species" as well as “calcareous fens”). In the context of the implementation of the Habitats Directive particular importance has been given to the establishment of a biotope network between the isolated remains of the formerly connected calcareous grasslands and the light forests. Supported by federal and state authorities the “Heideflächenverein Münchner Norden e.V.” has already succeeded in establishing a biotope network in the Munich gravel plane (Valentien & Burkhardt 1995, Pfadenhauer et al. 2000, Wiesinger et al. 2003). Further important contributions have been made by other institutions, e.g. local authorities or contractors, providing important contributions in the context of the Compensation Regulation and by visually integrating new construction works.

3 Existing seed concepts in the natural area

Together with the “Technische Universität München-Weihenstephan” the “Heideflächenverein” has carried out the governmentally supported project „Erprobungs- und Entwicklungsvorhaben zur Sicherung und Entwicklung der Heiden im Münchner Norden (E+E)“ (Development Project for the Protection and Development of Calcareous Grasslands North of Munich from 1992 to 2003 (Pfadenhauer et al. 2000, Pfadenhauer & Kiehl 2003). The procedures developed and optimised in this project (hay transfer, additional seed or planting of individual target species that were not transferred with the cuttings, locally propagated seeds or plants of autochthonous origin) have meanwhile also been applied on sites of other owners (e.g. municipalities, highway authorities, contractors).
Owing to the lack of available hay from suitable ”donor sites” there is a growing demand for autochthonous seed for the establishment of site-adapted plant communities. So far, seeds of about 90 species of vascular plants from local origin are available. Many contractors, however, are still using seed mixtures of undefined origin. These are problematic regarding the protection of the genetic diversity (cf. Kirmer & Tischew 2006). Often such mixtures contain cultivars from species that also occur naturally in the area. This approach has often been justified with specifications of the Commercial Seeds Act, but has been regarded critically from a nature conservation point of view. The use of seeds of non-native origin of species occurring in the natural area can lead to a bastardisation of the flora and possibly to the elimination of local eco-types (cf. Keller & Kollmann 1998, Klingenstein & Eberhard 2003, Bischoff & Müller-Schärer 2005, Zahlheimer & Schuhwerk 2006). Additionally, these species 'occupy' sites with potential for more valuable restorations. The later enrichment of these sites with species of autochthonous origin is hardly possible due to the competitiveness of commercial varieties.

The market already offers mixtures of native wild plants whose application has increased. The term 'native' however covers a variable range depending on the vendor. The application of mixtures of native wild plants in their existing form raises a series of questions for nature conservation:

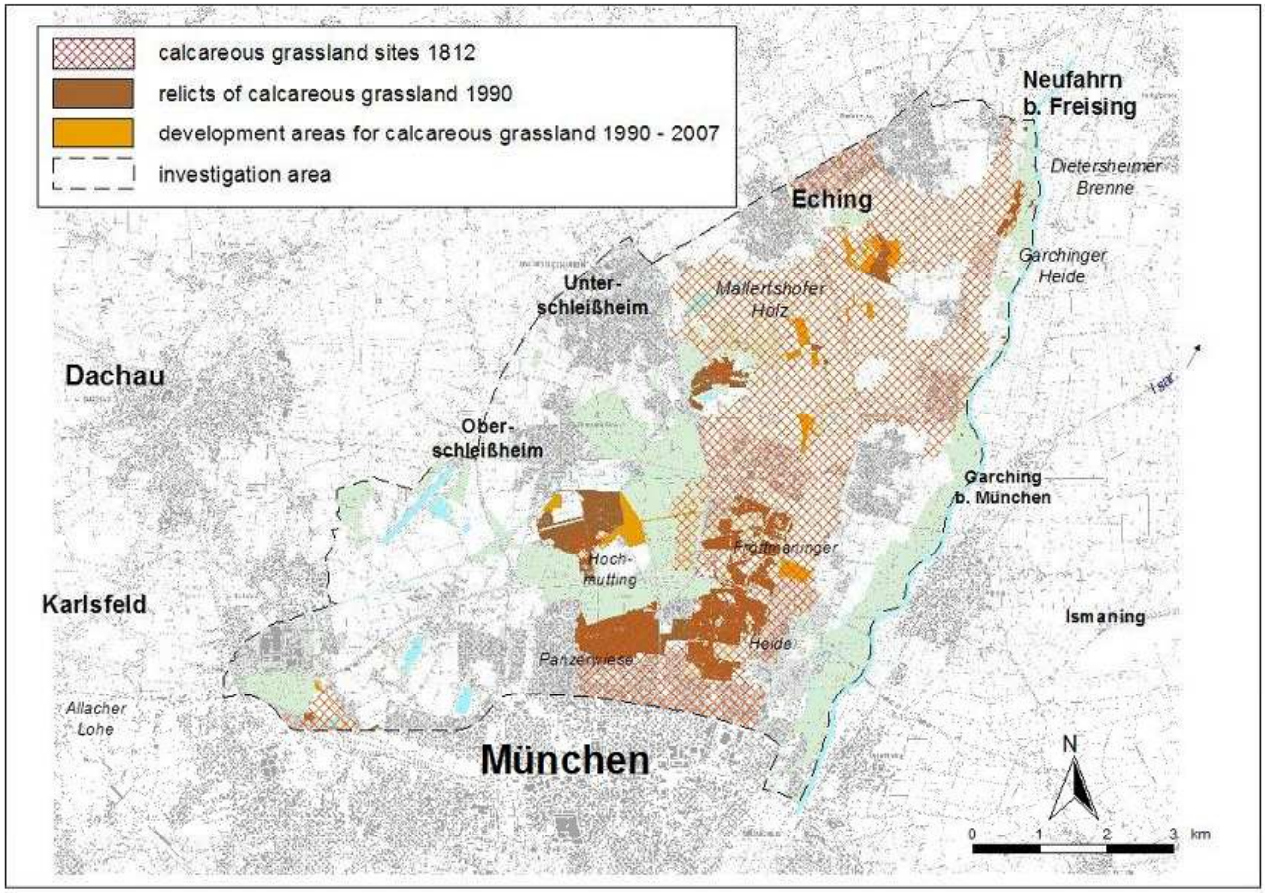
- Does the mixture contain seeds from species which are native in a larger reference area (e.g. Southern Germany) but not in the application area?
- Does the mixture contain seeds from non-native subspecies or races which could harm the existing, naturally developed genetic pool (loss of local adaptations)?
- Does the mixture contain contaminations, e.g. with species of expansive neophytes?

4 Concept for seedings originating from the natural area

Characterisation of the case study area

The 'Munich Plain' (Meynen et al. 1964) , also called 'Munich Gravel Plain' (Wettmann 1983), was developed during the last glacial period. This natural area stretches between the end moraine from the “Würm glacial stage” of the former glacier of the Isar River in the South and the Tertiary Hills in the North. The Munich Plain is the largest gravel cone of the Northern Alpine Foothills, developed its present form during the high glacial period. The surface is mostly generated by gravel from the Lower Terrace (Jerz 1993), along its northern edge extensive calcareous fens have developed. Parental material for soil formation is mostly gravel from the “Würm high glacial stage” and “Würm late glacial stage”, along the Northern edge soil developed also on peat with incorporated layers of chalk. Thin aeolian top layers are relatively frequent. Widespread soil units are Pararendzinas. Soil reaction is neutral to slightly alkaline (Fetzer et al. 1986). The area shows a slightly subcontinental climatic character with the peak of precipitation in summer.

Figure 1: Reduction of calcareous grassland in the Northern Munich Plain between 1812 and 1990, as well as development sites since 1990



Sources: Topographic Atlas of the Kingdom of Bavaria 1812-1815; Riedel & Haslach 2007

Up to the late 19th century the Munich Gravel Plain was characterised by far-reaching, grazed calcareous grasslands and light, grazed forests dominated by Scots pines. In the middle of the 19th century the oligotrophic grasslands covered several thousand hectares (Fig.1) Agriculture and the cultivation of meadows were mainly restricted to immediate vicinity of villages and individual

farms ('Schwaigen'). At that time there was a complete mosaic of vegetation types existing of grazed forests, thermophilic shrubbery, calcareous grasslands, cultivated fields with diverse wild vegetation, and bog pastures and forests. This mosaic has since been destroyed, and the remaining traces are fragmented and rather small (Pfadenhauer et al. 2000).

Conservation and restoration measures conducted in the Northern Munich Plain since 1990 aim to safeguard the isolated biotopes and realign their boundaries in order to maintain valuable species combinations and offer new habitats for the rare and endangered species. Additionally, establishing biotope networks aims to support the exchange of species. Due to the fact that about 150 years ago the vegetation complexes of the Munich Plain had formed a continuous floristic area, the following concept to seed autochthonous species refers to this natural boundary.

Suitable biotope types

A number of biotope types with regional to state-wide importance are characteristic to the Munich Plain Ecosystem and generally suited for restoration via sowing. Data from the 'Bayerisches Arten- und Biotopschutzprogramm', counties of Freising, Erding, Fürstenfeldbruck, Dachau, Erding and Munich, as well as from the 'Landschaftspflegekonzept Bayern' (Quinger et al. 1994) were analysed for the selection of the biotope types.

Restoration via seeding has been assessed as being generally possible for the following biotope types that are significant in the natural area (Table 2).

Table 2: Biotope types suitable for restoration in the Munich Plain

Biotope type	**Vegetation types**	**Site conditions**
Calcareous grassland on gravel	oligotrophic grassland on limestone, mainly species from the *Xerobromion* and from the *Sedo-Scleranthetea*	very nutrient-poor, very dry, very high skelet content, sunny
Calcareous grassland	calcareous semi-arid grassland, mainly species of the *Festuco-Brometea*	nutrient poor to moderately nutrient-poor, dry, high skelet content, sunny or light stands of fir treesSalvio
Meadows from the Salvio-Arrhenateretum	cultivated grassland, mainly species of the *Molinio-Arrhenateretea*	dry to moderately dry, comparatively nutritious, extensive cultivation (mowing twice per year)
Thermophilic forest margin	margin of zigzag clover and bloody cranebill, mainly species of the *Trifolio-Geranietea sanguinei*	nutrient-poor, dry, high skelet content, semi-shadow or forest margin
Ruderal vegetation	Sweet clover vegetation (*Dauco-Melilotion*)	nutrient-poor to moderately nutritious, disturbed site (e.g. roadsides, sites in commercial zones), sunny
wild flower communities of arable fields	Plant societies of fields of small bur-parsley (*Caucalidion*)	fields over pararendzina, no application of herbicides, no thermic weed control

Suitable species

The compilation of species lists for sowing mixtures referring to the natural area 'Munich Plain' should base on the following fundamentals:

I Publications on the vegetation of the natural area: Riemenschneider (1956), Hepp & Poelt (1979), Pfadenhauer & Liebermann (1986), Lippert (1989), Jeschke & Kiehl (2006), Röder et al. (2006), Will et al. (2005).

II Interviews of experts on vegetation science and on the floristic area.

III Inventories and programmes in the field of nature conservation (management and development plans, habitat mapping, “Bayerisches Arten- und Biotopschutzprogramm”, “Landschaftspflegekonzept”, etc.).

IV Publications on the establishment of oligotrophic grassland restorations in the natural area Munich Plain (Miller & Pfadenhauer 1997, Pfadenhauer & Miller 2000, Thormann et al. 2003, Kiehl et al. 2006, Kiehl & Pfadenhauer 2007)

Strictly protected species according to the “Bundesartenschutzverordnung” (Federal Regulation on the Protection of Species; according to § 10 (2) 5 and 10 of the Federal Law on Nature Conservation) as well as species which have become very rare in the natural area or are threatened with extinction should not be considered for the seed mixtures. Measures for their protection are reserved for governmental programmes (e.g. species support programmes) and to special measures of local nature conservation organisations (e.g. “Heideflächenverein”, “Dachauer Moos Verein” (Society of the protection of the 'Dachauer Moos', Land Care Groups).

Examples for seedings originating from the natural area

The following descriptions exemplify the site characteristics and typical species for three biotope types of the Munich Plain: Calcareous grassland on gravel (arid grassland), calcareous grassland (semi-arid grassland) and ruderal vegetation. The sowing can be conducted with the usual agricultural techniques for grassland sowing. This also applies to the soil cultivation and seedbed preparation. The maintenance measures during the year of sowing and subsequent years can also be carried out with agricultural machines. Further recommendations can be found in Pfadenhauer & Kiehl (2003) as well as in Kirmer & Tischew (2006).

Sowing calcareous grassland on gravel (arid grassland of the Munich Plain)

Site conditions
Very nutrient-poor, very dry and sunny, extremely skeletal soil. Pararendzina over gravel of the Lower Terrace, raw soil with hardly any A_h profile.

Suitable recipient sites
Only on gravel-dominated sites. Also on sites with removed topsoil. Not on filled sites, unless filled with gravel from the natural area (Quartery gravel). The long-term preservation requires the occasional removal of tree and shrub seedlings.

Species combination
The seed mixture "calcareous grassland on gravel for the Munich Plain“ primarily contains species of the association *Xerobromion* Br.-Bl. et Moor 1938 as well as of the classes *Sedo-Scleranthetea* Br.-Bl. 1955 em. Th. Müll. 1961 and *Seslerietalia albicantis* Br.-Bl. 1948. The

species combination of the seed mixture should be as representative as possible of the biotope type.

Typical species
*e.g. Anthyllis vulneraria, Hippocrepis comosa, Leontodon incanus, Linum catharthi*cum*, Thymus praecox.* These should be complemented by further species*.*

Sowing calcareous grassland (semi-arid grassland of the Munich Plain)

Site conditions
More or less nutrient-poor, dry, skeletal soil. Sunny or under light stands of pines

Suitable recipient sites
Only on sites with a comparatively natural soil profile (pararendzina over gravel of the lower terrace). A_h (or A_p)-C profile; the A_h profile usually comprises 10 to 30 cm. The A_P profile usually measures 30 to 40 cm. Not on filled sites, unless filled with gravel (and material from the subsurface) from the natural area (Quartery gravel). For long-term preservation the calcareous grassland has to be mowed or pastured annually.

Species combination
The seed mixture "calcareous grassland for the Munich Plain" mainly contains species of the associations *Mesobromion erecti* Br.-Bl. et Moor 1938 and *Cirsio-Brachypodion* Had. et Klika 1944. Additionally, single species of the classes *Erico-Pinetea* Horvat 1959 and *Trifolio-Geranietea sanguinei* Th. Müll. 1961 have been allocated to the calcareous grassland. The species combination of the seed mixture should be as representative as possible of the biotope type.

Sowing ruderal vegetation

Site conditions
Sunny; more or less nutrient-poor, dry to moderately dry, skeletal soil.

Suitable recipient sites
More disturbed sites on pararendzinas; also on compacted or relocated soils (e.g. on roadsides). The sowing of species that belong to the sweet clover vegetation is also suited for sites that are to be only mowed every few years.

Species combination
The seed mixture "ruderal vegetation for the Munich Plain" contains species of the association *Dauco-Melilotion.* Again, the species combination of the seed mixture should be as representative as possible of the biotope type.

Typical species
e.g. *Melilotus alba, Melilotus officinalis, Daucus carota, Berteroa incana, Cichorium intybus, Echium vulgare*, *Reseda lutea*. These should be supplemented by further species.

Importance of certification and monitoring

So far there are no effective regulations and control mechanisms of legal protection in place for autochthonous seeds of wild plants from the natural area. The implementation of the presented concept, however, requires certification and monitoring. These instruments would offer the user extensive protection from falsely labeled seed batches, it protects the producer against unfair competition, and finally it is an essential component of quality assurance. Such a system of certification and monitoring should include the following elements:

- documentation of the collection of the original seed (collector, place of collection, collection date; where appropriate herbarium records and permit for collection)
- control of the production (site inspection, seed storage, seed processing)
- quality control (germination capacity, compliance with thresholds of unwanted species)
- control of distribution (goods flow control)

In 2006 the “Verband deutscher Wildsamen- und Wildpflanzenproduzenten“ introduced a private certification and control system which considers the above criteria. So far, the system has only been applied to wild flower seeds on the regional level (so-called “regio-seed“). The regions of reference always comprise several natural areas. In principle this certification and control system can also be implemented for seedings with mixtures originating from the natural area. Since these measures are usually conducted in the context of defined projects it should be possible to also control the goods flow for this clear reference area.

This documented origin of the seed determines which species from the natural area can be combined by the regional seed producer. The supplementation with further species for the application in defined projects seems possible, given sufficient lead time for the propagation.

5 Literature

Anderlik-Wesinger, G. (2002): Spontane und gelenkte Vegetationsentwicklung auf Rainen. Untersuchungen zur Effizienz verschiedener Methoden der Neuanlage. Verlag Agrarökologie, Bern.

Bayerische Akademie für Naturschutz und Landschaftspflege (2002): Landschaftspflegekonzept Bayern. - http://www.landschaftspflegekonzept.de/

Bayerisches Landesamt für Umwelt (o.J.): Arten- und Biotopschutzprogramm Bayern. - http://Altbayern/lfu/natur/arten_und_biotopschutz/absp/start.htm

Bayerisches Staatsministerium f. Umwelt, Gesundheit u. Verbraucherschutz (2005): Bayerisches Naturschutzgesetz.

Bayerisches Staatsministerium f. Landesentwicklung u. Umweltfragen (Hrsg.) (2004): Arten- und Biotopschutzprogramm Bayern - Landkreis Freising.

Bischoff, A. & Müller-Schärer, H. (2005): Ökologische Ausgleichsflächen: die Bedeutung der Saatherkünfte. Hotspot 11: S. 17

Braun, W. (2006): Die Vegetationsentwicklung auf künstlich geschaffenen Kiesflächen im Dachauer Moos nach Mähgutausbringungen (Teil 2). Berichte der Bayerischen Botanischen Gesellschaft 76, 235-266

Bundesministerium f. Umwelt u. Reaktorsicherheit (2002): Bundesnaturschutzgesetz.

Fetzer, K.D., Grottenthaler, W., Hofmann, B., Jerz, H., Rückert, G., Schmidt, F. & Wittmann, O. (1986): Standortkundliche Bodenkarte von Bayern 1:50.000, München-Augsburg und Umgebung. Erläuterungen. München: Bayerisches Geologisches Landesamt

Hacker, E. & Hiller, A. (2003): Herkunftsproblematik bei krautigen Pflanzen - Regiosaatgut als Perspektive für die Einführung eines bundesweiten Mindeststandards. BfN-Skripten 96, 55-61

Hepp, E. & J. Poelt (1979): Die Garchinger Heide. Berichte der Bayer. Bot. Gesellschaft 42, 5-14

Jerz, H. (1993): Geologie von Bayern. II. Das Eiszeitalter in Bayern – Erdgeschichte, Gesteine, Wasser, Boden. Stuttgart: Schweizerbarth´sche Verlagsbuchhandlung

Jeschke, M. & Kiehl, K. (2006): Auswirkung von Renaturierungs- und Pflegemaßnahmen auf die Artendiversität von Gefäßpflanzen und Kryptogamen in neu angelegten Kalkmagerrasen. Tuexenia 26, 223-242

Keller, M. & Kollmann, J. (1998): Bedeutung der Herkunft von Saatgut. Untersuchungen an Buntbrachen und anderen ökologischen Ausgleichsflächen. Naturschutz und Landschaftsplanung 30, 101-106

Kiehl, K., Thormann, A. & Pfadenhauer, J. (2006): Evaluation of initial restoration measures during the restoration of calcareous grasslands on former arable fields. Restoration Ecology 14, 148-156

Kiehl, K. & Wagner, C. (2006): Effects of hay transfer on long-term establishment of vegetation and grasshoppers on former arable fields. Restoration Ecology 14, 157-166

Kiehl, K. & Pfadenhauer, J. (2007): Establishment and long term persistence of target species in newly created calcareous grasslands on former arable fields. Plant Ecology 189, 31-48

Kirmer, A. (2004): Methodische Grundlagen und Ergebnisse initiierter Vegetationsentwicklung auf xerothermen Extremstandorten des ehemaligen Braunkohlentagebaus in Sachsen-Anhalt.

Kirmer, A. & Tischew, S. (2006): Handbuch naturnahe Begrünung von Rohböden. Teubner Verlag Wiesbaden.

Klingenstein, F. und Eberhardt, D. (2003): Heimisches Saat- und Pflanzgut aus Sicht des Naturschutzes auf Bundesebene. BfN-Skripten 96, 18-24

Lippert, W. (1989): Die Garchinger Haide und ihre Pflanzenwelt. In: Gemeinde Eching (Hrsg.): Garchinger Heide - Echinger Lohe, Naturschutzgebiete in der Gemeinde Eching, Landkreis Freising. Bruckmann, München, 34-45

Meynen, E., Schmithüsen, J., Gellert, J., Neef, E. Müller-Miny, H. & J.H. Schultze (Hrsg.) (1962): Handbuch der naturräumlichen Gliederung Deutschlands. Bundesanstalt Landeskunde Raumforschung. Selbstverlag, Bad Godesberg

Miller, U. & J. Pfadenhauer (1997): Renaturierung von Kalkmagerrasen. Zur Vorhersage der gelenkten Sukzession durch Aufbringung von diasporenhaltigem Mähgut. Verhandl. der Ges. für Ökologie 27, 155-163

Molder, F. (1997): Begrünungen mit samenreifem Heu zur Umgehung der Ökotypenproblematik bei der Anlage artenreicher Grünlandbestände im Landschaftsbau. Rasen Turf Gazon 3: 64-80

Nickel, E. (2003): Autochthones Saat- und Pflanzgut - Anforderungen des Naturschutzes. BfN-Skripten 96, 26-32

Pfadenhauer, J. & C. Liebermann (1986): Eine geobotanische Dauerbeobachtungsfläche im Naturschutzgebiet Garchinger Heide. Berichte der Bayer. Bot. Gesellschaft 57, 99-110

Pfadenhauer, J., Fischer, F.P., Helfer, W., Joas, C., Lösch, R., Miller, U., Miltz, C., Schmid, H., Sieren, E. & K. Wiesinger (2000): Sicherung und Entwicklung der Heiden im Norden von München. Schriftenreihe Angewandte Landschaftsökologie, Heft 32. Bundesamt für Naturschutz (Hrsg.). Bonn - Bad Godesberg.

Pfadenhauer, J. & U. Miller (2000): Verfahren zur Ansiedlung von Kalkmagerrasen auf Ackerflächen. – In: Pfadenhauer, J., Fischer, F.P., Helfer, W., Joas, C., Lösch, R., Miller, U., Miltz, C., Schmid, H., Sieren, E. & K. Wiesinger: Sicherung und Entwicklung der Heiden im Norden von München. Angewandte Landschaftsökologie 32: 37-87

Pfadenhauer, J. & K. Kiehl (2003): Renaturierung von Kalkmagerrasen. Bayerisches Landesamt für Umweltschutz (Hrsg.), Angewandte Landschaftsökologie, Heft 55. Bonn – Bad Godesberg.

Pfadenhauer, J., Kiehl, K., Fischer, F. P., Schmid, H., Thormann, A., Wagner, C. & Wiesinger, K. (2003): Empfehlungen zur Neuschaffung und Wiederherstellung von Kalkmagerrasen. - In: Pfadenhauer, J. & Kiehl, K. (Hrsg.): Renaturierung von Kalkmagerrasen. Angewandte Landschaftsökologie 55: 253-260

Quinger, B.; Bräu, M. & Kornprobst, M. 1994: Lebensraumtyp Kalkmagerrasen. 2 Teilbände. Landschaftspflegekonzept Bayern Band II.1. – Hrsg.: Bayer. Staatsministerium für Landesentwicklung und Umweltfragen (StMLU) u. Bayer. Akademie für Naturschutz und Landschaftspflege (ANL). München.

Quinger, B. (2002): Wiederherstellung von artenreichem Magergrünland (Arrhenatherion) und Magerrasen (Mesobromion) auf Grünlandstandorten durch Mahd im Bayerischen Alpenvorland. - In: Bayerisches Landesamt für Umweltschutz (Hrsg.): Wiederherstellung und Neuschaffung von Magerrasen. - Augsburg - Schriftenreihe des Bayerischen Landesamts für Umweltschutz 167: 23-32

Riedel, B.; Haslach, H. J. (2007): Landschaftskonzept Münchner Norden. Unveröff. Gutachten i. A. des Heideflächenverein Münchener Norden e.V. Eching.

Riemenschneider, M. (1956): Vergleichende Vegetationsstudien über Heidewiesen im Isarbereich. Berichte der Bayer. Bot. Gesellschaft 31, 75-120

Röder, D., Jeschke, M. & K. Kiehl (2006): Vegetation und Böden alter und junger Kalkmagerrasen im Naturschutzgebiet „Garchinger Heide“ im Norden von München. Forum Geobotanicum 2, 24-44

Sendtner, O. (1854): Vegetations-Verhältnisse Südbayerns nach den Grundsätzen der Pflanzengeographie und mit Bezugnahme auf Landescultur. Literarisch-artistische Anstalt, München

Thormann, A., K. Kiehl & J. Pfadenhauer(2003). Einfluss unterschiedlicher Renaturierungsmaßnahmen auf die langfristige Vegetationsentwicklung neu angelegter Kalkmagerrasen. Angewandte Landschaftsökologie 55**,** 73-106

Tränkle, U. (2002): Sieben Jahre Mähgutflächen. Sukzessionsuntersuchungen zur standorts- und naturschutzrechtlichen Renaturierung von Steinbrüchen durch Mähgut 1992 - 1998. - Themenhefte der Umweltberatung im ISTE Baden-Württemberg e.V. 1: 56 S

Valentien, D. & Burkhardt, I. (1995): Landschaftsplanerisches Konzept zur Entwicklung der Heiden im Norden Münchens. - Eching (Heideflächenverein Münchener Norden e. V; unveröff. Gutachten)

Wiesinger, K., Joas, C. & Burkhardt, I. (2003): Zehn Jahre Heideprojekt Münchner Norden - Umsetzung und Praxiserfahrung. - In: Pfadenhauer, J. & Kiehl, K. (Hrsg.): Angewandte Landschaftsökologie 55: 261-272

Will, H., Eichinger, N., Röder, D. & Kiehl, K. (2005): Vegetationsentwicklung auf Bodenabtragsflächen unterschiedlichen Alters im Naturschutzgebiet Garchinger Heide. Berichte der Bayerischen Botanischen Gesellschaft 74, 169-180.Wittmann, O. (1983): Standörtliche Landschaftsgliederung von Bayern. München: Bayerisches Geologisches Landesamt.

Zahlheimer, W. (2000): Biologische Vielfalt und Florenverfälschung – das Thema aus der Sicht einer bayerischen Naturschutzbehörde. Tagungsbericht Westheimer Forum 29. Februar 2000, 4-11

Zahlheimer, W. & Schuhwerk, F. (2006): Grundsätzliches zum Thema „Autochthone Pflanzen“: - http://www.flora-deutschlands.de/Dateien/autochthone_pflanzen.pdf

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