Verh. Berl. Bot. Ver. 5 S. 121 - 131 Berlin 1985

A STUDY OF SAXICOLOUS LICHENS FROM SELECTED SITES IN SOUTH–WEST BERLIN (WEST)

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Abstract:

A detailed survey of saxicolous lichens in south-west Berlin (West) was undertaken in November 1984. Various representative habitats were investigated at numerous sites, confirming the importance of saxicolous substrata for lichens in urban areas. More interesting and/or diverse floras were to be found on substrata which buffered the effects of air pollutants and on imported metalliferous ballast along disused railway tracks. Ecological notes are provided for the 49 taxa recorded.

Zusammenfassung:

Untersuchung von saxicolen Flechten an ausgewählten Standorten in Berlin (West). Im November 1984 wurde die saxicole Flechtenflora im Südwesten von Berlin (West) an verschiedenen repräsentativen Standorten - unter Einbeziehung zahlreicher Einzelpunkte - detailliert untersucht. Dabei bestätigte sich, daß Gestein in urbanen Räumen von großer Bedeutung als Flechtensubstrat ist. Ein besonders interessantes und/oder relativ mannigfaltiges Artenspektrum fand sich auf Substraten, von denen bekannt ist, daß sie die Wirkung von Luftverunreinigungen abpuffern, sowie auf importierten schwermetallreichen Schottersteinen an unbenutzten Bahnstrecken. 49 Taxa wurden erfaßt und - mit Bemerkungen zu ihrer Ökologie versehen - in Form einer Liste zusammengestellt.

Introduction

The lichen floras of urban areas have been studied for many years, and for more than a century the paucity of the flora in such areas has been fully recognized; the decline of the lichen flora, which is attributed mainly to a rise in air pollution level, has been monitored for many urban and industrial complexes throughout the world over the past few decades. However, such monitoring has been mainly undertaken using epiphytic species, the diversity of which is dramatically reduced by conditions operating in suburbia; in the more vitiated central areas only one or two species are to be found, while in some cases there is a total absence of lichens. Nevertheless, a modest lichen flora is normally to be found in saxicolous habitats, where the substratum may provide a degree of buffering and/or a niche situation which ameliorates an otherwise hostile environment. In those urban areas experiencing a beneficial change following the implementation of a clean air policy, the saxicolous lichen flora has been quicker to respond successfully then the epiphytic flora (SEAWARD 1976).

Lichen studies in West Berlin to date (with the exception of SCHULZ-KORTH 1931; GRUMMANN & POELT 1972) have shown a similar bias towards the epiphytic flora, and it has been possible to monitor the effects of increased air pollution since considerable base-line data exist. Several detailed surveys have been undertaken on epiphytic lichens in recent years (eg. LEUCKERT et al. 1982; RUX & LEUCKERT 1980), and terricolous lichens have also received some attention (LEUCKERT et al. 1982; LEUCKERT 1983), but only one published source provides information on saxicolous species (GRUMMMANN & POELT 1972). It is hoped that this present survey will (a) provide base-line data, (b) show the comparative richness of the saxicolous lichen flora, (c) indicate habitats worthy of conservation, and (d) stimulate others to extend existing knowledge of the West Berlin enviroment so that rises and falls in air pollution can be monitored spatially and temporally, particularly where the epiphytic lichen flora has been drastically reduced to a monovegetation where diversity counts are meaningless. It is also important to appreciate the mellowing effect of lichens on modern architectural surfaces (SEAWARD 1979), particularly in the case of a city such as Berlin (West) where large-scale rebuilding of roads, bridges, civic buildings, etc. has taken place. In this context, it is noteworthy that where modern materials have been used in the reconstruction and repair of ancient monuments, the subsequent colonization by a markedly different lichen flora accentuates the difference in the building materials.

Lichens have been shown to be deleterious to stonework (JONES & WILSON 1985), however, attempts to clean lichens from such surface to restore homogeneity or reveal detailed carving are almost certainly more destructive than a policy of non-interference; indeed, lichen thalli may provide a living barrier to certain detrimental environmental effects such as acid rain.

The present survey was undertaken over a single week during early November 1984, and therefore only a limited area could be covered. However, a range of

representative sites in south-west Berlin was investigated in depth, and the resultant list can be considered as a satisfactory statement of the saxicolous lichen flora.

It has been shown from detailed investigations of the West Yorkshire conurbation in England (SEAWARD 1975, 1978, 1981; SEAWARD & HENDERSON 1984) that saxicolous substrata provide fruitful hunting grounds for the diligent lichenologist: of a total of 185 taxa recorded there over the past 17 years, 146 were saxicolous. The importance for lichens, in terms of the urban environment, of this type of substratum over terricolous, lignicolous and corticolous substrata is self-evident. Undoubtedly, more comprehensive surveys of West Berlin would undoubted achieve similar results, from which useful numeric analyses of species immigration and extinction could be deduced.

Study area

Five major areas (see figure 1, A - E) were studied within a region of south-west Berlin (West) which encompasses Glienicker Park and selected parts of Berliner Forst Düppel; 18 of the sites investigated are described in more detail as follows:

1. Glienicker Park: bastion constructed of five courses of calcareous (?Jurassic) blocks, providing vertical faces (67 - 75 cm in height) with a moderately diverse lichen flora on the upper (c. 45 cm) inwardly-facing parts including *Aspicilia contorta, Caloplaca* spp. and *Sarcogyne regularis*, with the crevices providing a suitable niche for *Bacidia sabuletorum*.
2. Glienicker Park: ornamental brick bridge, where only the coping provides a suitable habitat for lichens.
3. Glienicker Park: imported calcareous limestone rocks as landscaping material, supporting a very poor lichen flora due to shading by trees.
4. Glienicker Brücke: eastern parapets constructed of hard siliceous blocks, the mortar pointing of which provides localized calcium-enrichment, hence a variable flora, eg. *Acarospora fuscata, Candelariella aurella* (and var. *heidelbergensis*), *C. vitellina, Lecanora albescens, L. muralis, L. polytropa, Lecidea fuscoatra* (var. *grisella*), *Polysporina simplex* and *Sarcogyne regularis*.
5. Schloß Glienicke: early 19th century country mansion house with terraces, balustrade, fountain, pergola, etc. constructed mainly of sandstone, and supporting a diverse lichen flora; the fountain provides suitable bird perches and hence supports a good nitrophilous lichen flora, and the reconstructed parts have noticeably different species composition and configuration.
6. Böttcherberg: old, disused vineyard, the imported calcareous rocks and stonework providing a suitable habitat for numerous lichens including several pyrenocarpous species.
7. Böttcherberg: calcareous blocks forming upper terraces of old, disused vineyard with limited lichen flora, but none on Loggia Alexandra.

8. Kirche St. Peter u. Paul: „Russian-style" (1834 - 1837) church, with decorative footings to walls (80 - 100 cm), those on the south and east providing crevices/niches for several, mainly calcareous, lichens.

9. Kirche St. Peter u. Paul: terrace and balustrade to north of church, constructed of brick and sandstone; the sandstone coping (with ferric intrusions) has considerable mortar pointing and cement reconstruction thereby providing substrates for a diverse lichen flora. Siliceous border stones to a small raised garden shaded by west wall of church support good lichen flora on horizontal surfaces, including well-developed *Trapelia coarctata*. Coping to balustrade provides a most suitable lichen habitat, with most surfaces covered by diverse flora, particularly *Candelariella vitellina, Lecanora polytropa, Lecidea fuscoatra* (var. *grisella*), *Placynthiella icmalea* (c. fr.), *Scoliciosporum umbrinum* and *Trapelia obtegens*; the mortar joints and reconstructed areas of the balustrade (particularly coping on end of western section) support numerous calcicoles, including several small thallii of *Rinodina gennarii*. The mortar crevices of the high retaining wall (N-facing) beneath the balustrade contain *Bacidia egenula*.

10. Kirche St. Peter u. Paul: small cemetery, containing numerous memorials, only one of which supported a lichen (*Physcia* sp.).

11. Berliner Forst Düppel (North-west): disused brick bridge in woodland; although in shade, the cement coping and mortared vertical surface provide substrates for a few lichen species.

12. Berliner Forst Düppel (North-west): brick garden-wall, with flat sandstone coping, mainly covered by *Lecidea fuscoatra* (var. *grisella*).

13. Berliner Forst Düppel (South): disused railway line, with metalliferous ballast stones (most probably imported from Harz Mountains) supporting a very interesting lichen flora including *Baeomyces rufus, Stereocaulon nanodes* (also growing directly on iron rails), *S. pileatum, S. vesuvianum* and *Trapelia obtegens*.

14. Berliner Forst Düppel (South): railway embankments, with numerous *Cladonia* spp., and wooded areas (mainly *Betula*) along their length on both sides of the track containing the best epiphytes observed during this investigation; concrete fence-posts and cementwork, etc. provide further lichen habitats on the side of the tracks.

15. Berliner Forst Düppel (South): retaining wall of bridge embankment, with cement coping, supporting several lichens including *Arthonia lapidicola* and *Aspicilia contorta*.

16 Berliner Forst Düppel (South-east): bridge parapets and cement-rendered retaining walls of embankments, with numerous lichen species, the composition of the flora depending mainly on aspect/degree of shade.

17. Berliner Forst Düppel (South-east): disused railway line, with metalliferous ballast stones (most probably imported from Harz Mountains) supporting disappointing lichen flora relative to site 13; habitat now lacks many of those species reported by GRUMMANN and POELT (1972) due to major changes in environmental conditions brought about by invasion of trees from neighbouring woodlands.

In addition to the above sites, intervening areas were examined in south-west Berlin (West) for a more complete picture of the lichen flora, and comparative studies were also undertaken in the region of the Botanischer Garten (Dahlem) and in central Berlin (eg. Köllnische Heide).

Species list

Species found solely, or occasionally, on saxicolous substrata in the study area are listed below. The numbers in parentheses refer to the study sites (see preceding section), and the nomenclature is based mainly on HAWKSWORTH et al. (1980).

Acarospora fuscata (Nyl.) Arnold
On flat, siliceous coping stones of bridge parapet (4).

Arthonia lapidicola (Taylor) Branth & Rostrup
On brick of retaining wall of bridge embankment (15).

Aspicilia calcarea (L.) Mudd.
On cement parapet of railway bridge (16); on calcareous walls of bastion (1) - perhaps referable to next species.

A. contorta (Hoffm.) Krempelh.
On calcareous walls of bastion (1); on cementwork of coping, retaining wall of bridge embankment (15).

Bacidia egenula (Nyl.) Arnold
On mortar of high retaining wall (N-facing) beneath balustrade near church (9).

B. sabuletorum (Schreber) Lettau
In mortar crevices of bastion (1).

Baeomyces rufus (Huds.) Rebent.
On railway ballast and adjacent stones of embankment (13); 3 cm diam. sterile thallus on shaded siliceous border stone of raised garden near church (8) referable to this species.

Buellia punctata (Hoffm.) Massal.
On railway ballast (13).

Caloplaca citrina (Hoffm.) Th. Fr.
On cementwork, mortar, and calcareous rocks and monuments (1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 16).

*C. **decipiens*** (Arnold) Blomb. & Forss.
On calcareous walls of bastion (1).

*C. **holocarpa*** (Hoffm.) Wade
On calcareous rocks and stonework of old, disused vineyard (6, 7).

*C. **saxicola*** (Hoffm.) Nordin
On calcareous walls of bastion (1).

Candelariella aurella (Hoffm.) Zahlbr.
On mortar joints, cementwork, road kerbstones and monuments (4, 5, 9, 14, etc.).

var. ***heidelbergensis*** (Nyl.) Wirth
On mortarwork of bridge parapet (4) - see also POELT (1971).

*C. **vitellina*** (Hoffm.) Müll. Arg.
On siliceous coping stones and monuments (4, 5, 9).

Lecania erysibe (Ach.) Mudd
On reconstructed part of monument (5); in mortar crevices of church walls (8); on cement parapet of railway bridge (16).

Lecanora albescens (Hoffm.) Branth & Rostrup
On calcareous walls of bastion (1); on mortarwork of bridge parapet (4).

*L. **conizaeoides*** Nyl. ex Crombie
On siliceous monuments (4, 5), coping stones (9), brickwork (8), etc.

*L. **dispersa*** (Pers.) Sommerf.
On concrete, mortar, cement and other calcareous substrata throughout the study area (at all sites except 10, 17).

*L. **muralis*** (Schreber) Rabenh.
On cement and concrete (13, 14, 16, etc.); on mortar, extending onto siliceous materials (4, 8); on monument steps (5); on other calcareous substrata (1, etc.).

*L. **polytropa*** (Hoffm.) Rabenh.
On brick (2), siliceous coping stones (4, 9) and monuments (5). Probably some material referable to *L. stenotropa* Nyl., but all specimens examined microscopically, even those with very small apothecia, proved to be *L. polytropa*.

Lecidea fuscoatra (L.) Ach.
On siliceous coping stones (4, 5, 9, 12) and on railway ballast (13). Wide variation in morphology and colour, but all material given critical examination referable to var. *grisella* (Flörke ex Schaerer) Nyl.

L. spec.
On metalliferous railway ballast (13). Epithecium green; excipulum medium-brown, outer edge brown-black; paraphyses branched and often anastomosed; thallus Pd-, C-, I-; spores 10 - 11 x 3.5 - 4.5 µm.

L. spec.
On sandstone monument (5). Epithecium brown; hypothecium brown; medulla Pd-, C-, I+blue; spores 9 - 10 x 3 - 3,5 µm.

Lecidella scabra (Taylor) Hertel & Leuckert
On siliceous coping of balustrade near church (9).

L. stigmatea (Ach.) Hertel & Leuckert
On cementwork (9, 11, 15, 16, etc.), concrete (13, 14), mortar (4, etc.) and other calcareous materials (1, 5, 6, 7). Wide variation in morphology and colour.

Lepraria incana (L.) Ach.
On shaded stonework, including mortar crevices, on railway ballast (1, 3, 5, 6, 7, 8, 9, 11, 13, 14, 16, 17, etc.) and iron rails (17).

Phaeophyscia orbicularis (Necker) Moberg
On calcareous walls of bastion (1) and cement coping (11, 15).

Physcia adscender (Fr.) H. Olivier
On calcareous walls of bastion (1); juvenile specimen, probably referable to this species, on gravestone (10).

Placynthiella icmalea (Ach.) Coppins & P. James
On siliceous coping of balustrade near church (9) - c. fr.

Polysporina simplex (Davies) Vězda
On hard siliceous block of bridge parapet (4).

Protoblastenia rupestris (Scop.) Steiner
On cement-rendered, retaining wall (S-facing) of bridge embankment (16).

Psilolechia lucida (Ach.) M. Choisy
On shaded railway ballast, deriving metal-enrichment from overhanging ironwork (18).

Rinodina gennarii Bagl.
Several thalli on cement reconstruction of balustrade coping (9).

Sarcogyne regularis Körber
On calcareous walls of bastion (1), on mortarwork of bridge parapet (4), and on calcareous rocks and stonework of old, disused vineyard (6, 7).

Scoliciosporum umbrinum (Ach.) Arnold
On brick (2, 11), cement (16), railway ballast (13, 17) and a variety of other stonework (5, 8, 9, etc.).

Stereocaulon nanodes Tuck.
On railway ballast and iron rails (13, 17).

S. pileatum Ach.
On railway ballast (13).

S. vesuvianum Pers.
On railway ballast (13).

Trapelia coarctata (Sm.) Choisy
On siliceous border stones of raised garden near church (8).

T. cf. *involuta* (Taylor) Hertel
On siliceous border stones of raised garden near church (8).

T. obtegens (Th. Fr.) Hertel
On railway ballast (13, 17) and on siliceous coping of balustrade (9).

T. placodioides Coppins & P. James
On railway ballast (13).

Verrucaria baldensis Massal.
On calcareous rocks imported for landscaping, vineyard terracing, etc. (3, 6, 7).

V. cf. *hochstetteri* Fr.
On calcareous stonework of old, disused vineyard (6).

V. muralis Ach.
On mortar, cementwork and a variety of other calcareous substrates (6, 7, 8, 14, 16, etc.).

V. murina Leighton
On calcareous rocks and stonework of old, disused vineyard (6).

V. nigrescens Pers.
On a variety of calcareous (1, 5, 8, 14, etc.) and siliceous (4, 9, etc.) substrata.

V. viridula (Schrader) Ach.
On cement-rendered retaining wall (N-facing) of bridge embankment (16); on stonework of old, disused vineyard (6).

Many of the above records are substantiated by specimens deposited in the herbaria of the Botanischer Garten und Museum Berlin-Dahlem (B), and the author (Herb. Seaward).

Discussion

Although the lichen flora is undoubtedly impoverished by an urban environment, careful search of a range of habitats will almost invariably lead to the discovery of a relatively rich flora (a) in suburban areas and (b) in refugia and/or on buffering substrata in inner urban areas which ameliorate otherwise hostile conditions. This has been amply demonstrated by the present survey of the saxicolous lichen flora of south-west Berlin (West).

Man-made substrata provide suitable habitats for lichens; this is particularly so in the case of older buildings (eg. Kirche St. Peter u. Paul, Glienicker Park Bastion, Schloß Glienicke). Preservation of such monuments can often therefore be justified on botanical as well as historical grounds; restoration and cleaning of historic buildings should proceed with caution.

Asbestos-cement is a particularly important habitat for lichens in urban areas, but awaits detailed investigation in Berlin (West). Large-scale importation of rocks for the landscaping of Glienicker Park, the terracing of vineyards at Böttcherberg, and the provision of ballast for the many railway lines which intersect Berlin, have all developed their own interesting lichen floras. Of particular importance in terms of conservation are the disused railway lines, whose metalliferous ballast supports noteworthy lichen assemblages.

Disused railway lines should be critically monitored, since it will be necessary to prevent (a) the removal of the track and (b) the invasion of saplings from woodlands which border the tracks; such an invasion has already resulted in a deterioration of the lichen flora on the Wannsee - Dreilinden railway line (cf. GRUMMANN & POELT 1972). Disused railway lines should be conserved, since they provide environmental corridors which can often breathe life into otherwise barren areas.**

Finally, lichens also play an important role as monitors of air pollution. They cannot totally replace sophisticated pollutionrecording devices, but studies of distribution and ecological performance of lichens can usefully supplement, and indeed complement, data obtained from a normally limited number of gauges. It was apparent from this survey that the pattern of air pollution over the area studied is complex, and is not truthfully represented by simplistic cartographical interpretations by local authorities whereby concentric isopleths are shown to encircle the „centre" of the city. For example, the influence of urbanization/industrialization (Potsdam) which envelops the south-west corner of Berlin (West) would appear to have a more marked influence on the lichen flora at many sites surveyed than at certain sites visited in the Neukölln region near the centre of the City.

Acknowledgements

I am indebted to the Institut für Ökologie of the Technische Universität Berlin for financial support for this survey, and to the Institut für Systematische Botanik und Pflanzengeographie of the Freie Universität Berlin and the Botanischer Garten Berlin-Dahlem for their hospitality. I would also like to express my warm appreciation of the practical help and personal kindness afforded to me by Professor C. Leuckert, Professor H. Sukopp and Dr. H. Sipman. I am also grateful to Dr. B. J. Coppins (Royal Botanic Garden, Edinburgh) for confirmation and identification of the more critical material.

** It is sad to report that since this survey the ballast along the railway track at Berlin Forst Düppel (South) - site 13 - has been renewed and the unusually diverse and interesting saxicolous lichen flora has disappeared in consequence (Leuckert, pers. comm.).

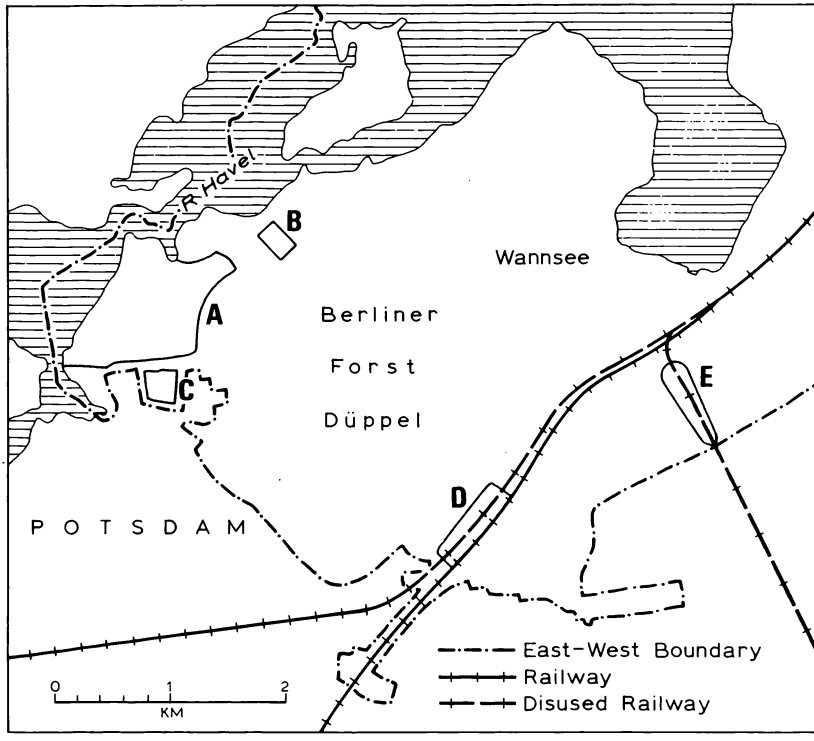

Figure 1. South–west Berlin (West), showing principal areas investigated: A = Glienicker Park, B = Kirche St. Peter u. Paul, C = Böttcherberg, D and E = Disused railway tracks in South and South–east Berliner Forst Düppel.

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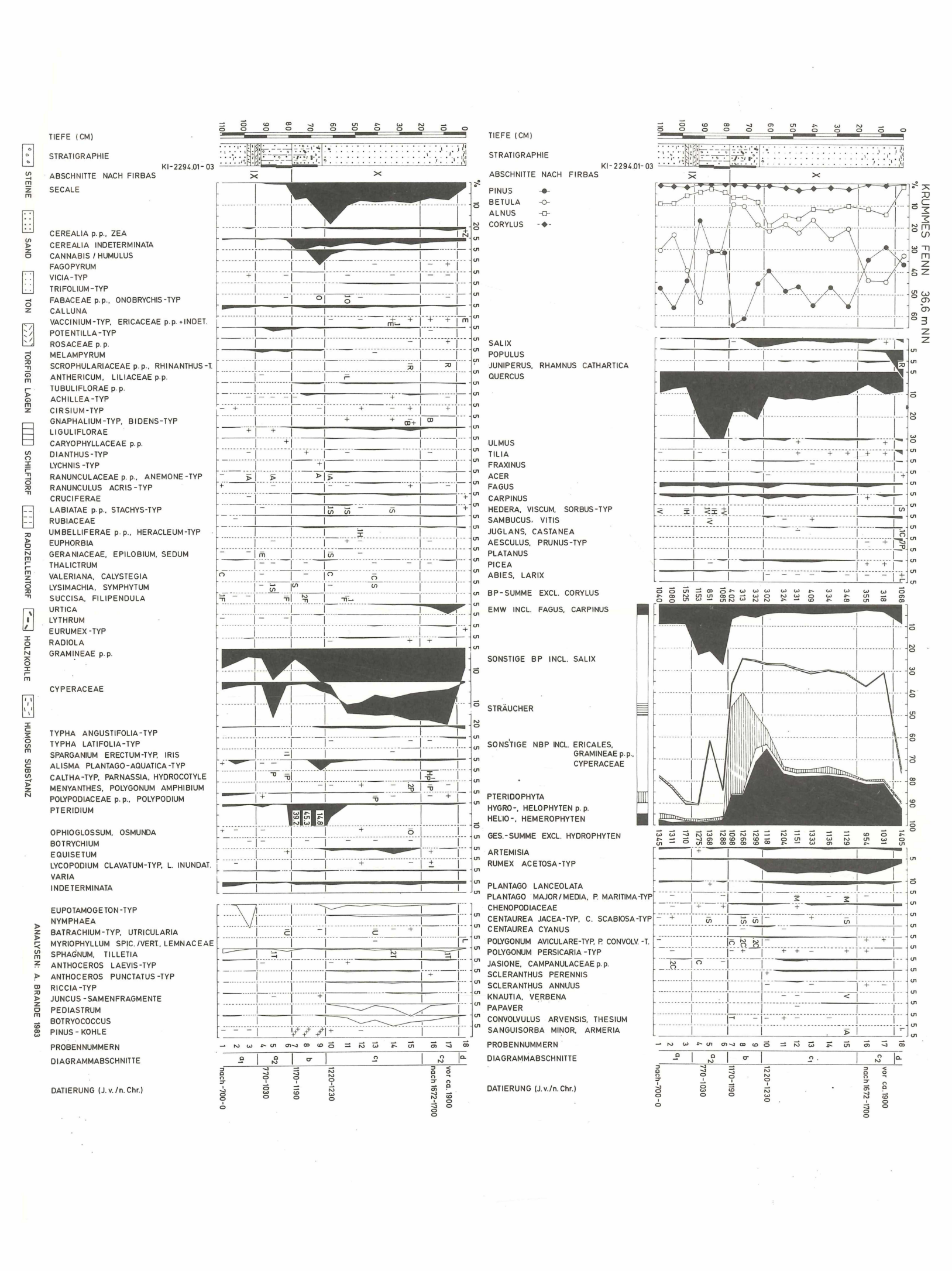
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ABSCHNITTE NACH FIRBAS
SECALE
CEREALIA p.p., ZEA
CEREALIA INDETERMINATA
CANNABIS / HUMULUS
FAGOPYRUM
VICIA-TYP
TRIFOLIUM-TYP
FABACEAE p.p., ONOBRYCHIS-TYP
CALLUNA
VACCINIUM-TYP, ERICACEAE p.p. +INDET.
POTENTILLA-TYP
ROSACEAE p.p.
MELAMPYRUM
SCROPHULARIACEAE p.p., RHINANTHUS-T.
ANTHERICUM, LILIACEAE p.p.
TUBULIFLORAE p.p.
ACHILLEA-TYP
CIRSIUM-TYP
GNAPHALIUM-TYP, BIDENS-TYP
LIGULIFLORAE
CARYOPHYLLACEAE p.p.
DIANTHUS-TYP
LYCHNIS-TYP
RANUNCULACEAE p.p., ANEMONE-TYP
RANUNCULUS ACRIS-TYP
CRUCIFERAE
LABIATAE p.p., STACHYS-TYP
RUBIACEAE
UMBELLIFERAE p.p., HERACLEUM-TYP
EUPHORBIA
GERANIACEAE, EPILOBIUM, SEDUM
THALICTRUM
VALERIANA, CALYSTEGIA
LYSIMACHIA, SYMPHYTUM
SUCCISA, FILIPENDULA
URTICA
LYTHRUM
EURUMEX-TYP
RADIOLA
GRAMINEAE p.p.
CYPERACEAE
TYPHA ANGUSTIFOLIA-TYP
TYPHA LATIFOLIA-TYP
SPARGANIUM ERECTUM-TYP, IRIS
ALISMA PLANTAGO-AQUATICA-TYP
CALTHA-TYP, PARNASSIA, HYDROCOTYLE
MENYANTHES, POLYGONUM AMPHIBIUM
POLYPODIACEAE p.p., POLYPODIUM
PTERIDIUM
OPHIOGLOSSUM, OSMUNDA
BOTRYCHIUM
EQUISETUM
LYCOPODIUM CLAVATUM-TYP, L. INUNDAT.
VARIA
INDETERMINATA
EUPOTAMOGETON-TYP
NYMPHAEA
BATRACHIUM-TYP, UTRICULARIA
MYRIOPHYLLUM SPIC./VERT., LEMNACEAE
SPHAGNUM, TILLETIA
ANTHOCEROS LAEVIS-TYP
ANTHOCEROS PUNCTATUS-TYP
RICCIA-TYP
JUNCUS-SAMENFRAGMENTE
PEDIASTRUM
BOTRYOCOCCUS
PINUS-KOHLE
PROBENNUMMERN
DIAGRAMMABSCHNITTE
DATIERUNG (J.v./n.Chr.)
nach -700-0
770-1030
1170-1190
1220-1230
nach 1672-1700
vor ca. 1900
PINUS
BETULA
ALNUS
CORYLUS
SALIX
POPULUS
JUNIPERUS, RHAMNUS CATHARTICA
QUERCUS
ULMUS
TILIA
FRAXINUS
ACER
FAGUS
CARPINUS
HEDERA, VISCUM, SORBUS-TYP
SAMBUCUS, VITIS
JUGLANS, CASTANEA
AESCULUS, PRUNUS-TYP
PLATANUS
PICEA
ABIES, LARIX
BP-SUMME EXCL. CORYLUS
EMW INCL. FAGUS, CARPINUS
SONSTIGE BP INCL. SALIX
STRÄUCHER
SONSTIGE NBP INCL. ERICALES, GRAMINEAE p.p., CYPERACEAE
PTERIDOPHYTA
HYGRO-, HELOPHYTEN p.p.
HELIO-, HEMEROPHYTEN
GES.-SUMME EXCL. HYDROPHYTEN
ARTEMISIA
RUMEX ACETOSA-TYP
PLANTAGO LANCEOLATA
PLANTAGO MAJOR/MEDIA, P. MARITIMA-TYP
CHENOPODIACEAE
CENTAUREA JACEA-TYP, C. SCABIOSA-TYP
CENTAUREA CYANUS
POLYGONUM AVICULARE-TYP, P. CONVOLV.-T.
POLYGONUM PERSICARIA-TYP
JASIONE, CAMPANULACEAE p.p.
SCLERANTHUS PERENNIS
SCLERANTHUS ANNUUS
KNAUTIA, VERBENA
PAPAVER
CONVOLVULUS ARVENSIS, THESIUM
SANGUISORBA MINOR, ARMERIA
STEINE
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ANALYSEN: A. BRANDE 1983