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LICHENOLOGICAL STUDIES IN NORTH EAST ITALY I: THE COMPUTERIZATION OF THE TSB LICHEN HERBARIUM*

STUDI LICHENOLOGICI IN ITALIA NORD ORIENTALE

I: UNA BANCA DATI BASATA SULL'ERBARIO LICHENOLOGICO TSB

Abstract — The lichen herbarium of the Trieste University (TSB), that contains ca. 8500 samples (average yearly input: 2000-3000 samples) has been computerized. Structure and information content of the databank are briefly described, with particular regard to the samples collected in the Friuli-Venezia Giulia Region (60.3% of the total).

Key words: Databanks, Herbarium, Lichens, Friuli-Venezia Giulia.

Riassunto breve— *L'erbario lichenologico dell'Università di Trieste (TSB) è stato computerizzato. Esso contiene circa 8500 campioni di licheni, di cui il 60.3% è stato raccolto in Friuli-Venezia Giulia. Il tasso di accrescimento annuo dell'erbario è mediamente di 2000-3000 campioni. L'articolo descrive brevemente la struttura ed il contenuto informazionale della banca dati, che assolve funzioni sia di tipo curatoriale sia di supporto alla ricerca fitogeografica ed ecologica.*

Parole chiave: Banca dati, Erbario, Licheni, Friuli-Venezia Giulia.

Introduction

The storage and retrieval of large data sets has always been one of the major problems for the taxonomist. Most of the relevant information was and is stored in herbaria and critically summarized in floras or monographic works. Updated information about the contents of herbaria is often very scanty, a fact that may strongly reduce the efficiency in the taxonomist's work. In recent times, several botanical in-

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stitutions throughout the world started data banking programs, whose principal aim was to improve the efficiency of data retrieval from herbaria. (CREIGHTON et al., 1971; CROVELLO, 1972; FORERO & PEREIRA, 1976; BRILL, 1978; MORRIS & GLEN, 1978). A review of the main computerized herbarium catalogues is in PANKHURST (1984).

In Italy, the Botanical Institute of the Trieste University produced a series of databanks for floristic, vegetational and phytogeographical data. The first databank, (whose software is TAXIR) contains information on the whole Italian flora (NIMIS, 1981a, 1981b; PIGNATTI, 1976, 1981; ANZALDI & MIRRI, 1980; FEOLI & FEOLI, 1983; NIMIS et al., 1984), the second databank is based on a new software specifically designed for smaller databases (local data banks) (LAGONEGRO et al., 1982). The latter bank contains data on the distribution of vascular plants in North Eastern Italy, obtained in connection with the project of Floristic Cartography of Central Europe. This work is almost complete and will result in a monograph on the quantitative phytogeography of the study area (POLDINI, in prep.). Within the framework of this project, directed by Prof. L. Poldini, it was decided to adapt the existing software to the computerization of a herbarium. The phanerogamic herbarium of the Trieste Botanical Institute contains more than 100.000 specimens. Its computerization would have exceeded the present resources of the Institute. Therefore, it was decided to create a databank with the herbarium Nimis. This provided us with a relatively small (ca. 8500 samples), but steadily growing database concerning lichens, a group of organisms whose distribution in Europe, and particularly in Italy, is very little known. This paper describes the databank, with particular reference to data concerning the Friuli-Venezia Giulia Region.

Previous lichenological research in Friuli-Venezia Giulia

The Friuli-Venezia Giulia Region, that includes the northeasternmost corner of Italy, was very little studied from the lichenological point of view. Until recent times, the only relevant floristic contribution was the one of GLOWACKI (1874). In the last ten years, an intensive research has been carried out on the lichen flora and vegetation of the area. Species list from different parts of the region have been published by NIMIS & LOI (1982a, 1982b, 1984) and CLERC (1983), three studies of epiphytic lichen vegetation were published by NIMIS & DE FAVERI (1981) and NIMIS (1982a,

1982b) and a phytogeographical note concerning the lichen flora of the Trieste Karst is in NIMIS & LOSI (1983).

Furthermore, the lichen flora and vegetation of the two principal towns of the region, Trieste and Udine, has been recorded and mapped, in connection with air pollution studies (NIMIS, in prep.). One of the results of this activity was the creation of a lichen herbarium at the Botanical Institute of the Trieste University. The computerization of the herbarium has been carried out in order to provide an instrument for a more efficient organization of further researches in the lichen flora and vegetation of the study area.

The Database

The TSB lichen herbarium contains to date 8512 lichen samples. The total number of species is 1642. 5140 samples (60.3%) were collected in the Friuli-Venezia Giulia Region, for a total of 883 species. About 20% of the samples were collected in other parts of Italy. The rest includes my personal lichen collections from countries outside Europe, mainly from North America, the Svalbard Archipelago and the Canary Islands. Main duplicate collections have been sent by Dr. Vitikainen, Helsinki (*Peltigera*), Dr. Ferraro, Corrientes (South American Lichens) and Dr. Vežda, Brno (several groups, many epiphyllid lichens). The yearly rate of increase is now of ca. 2000-3000 samples.

The stand of floristic lichenological research in the Friuli-Venezia Giulia Region is illustrated in fig. 1. The areas where sampling was most intense are: the Lumiei Valley (quadrants 41/42-95), the Val Rosandra (49-103), the siliceous massive of the Mts. Paularo-Dimon (44-94), the calcareous massive of M. Canin (46-96), the Tarvisio Forest (46-95) and the area surrounding Tarcento, in the eastern hills (45-97). The geographic sector that most needs to be studied is the Friulian lowland, that however, is the less interesting from the lichenological point of view because of high anthropic pressure. On the whole, the study area is far from being thoroughly investigated.

Software and Data

The adopted software is described by LAGONEGRO et al. (1982). It performs

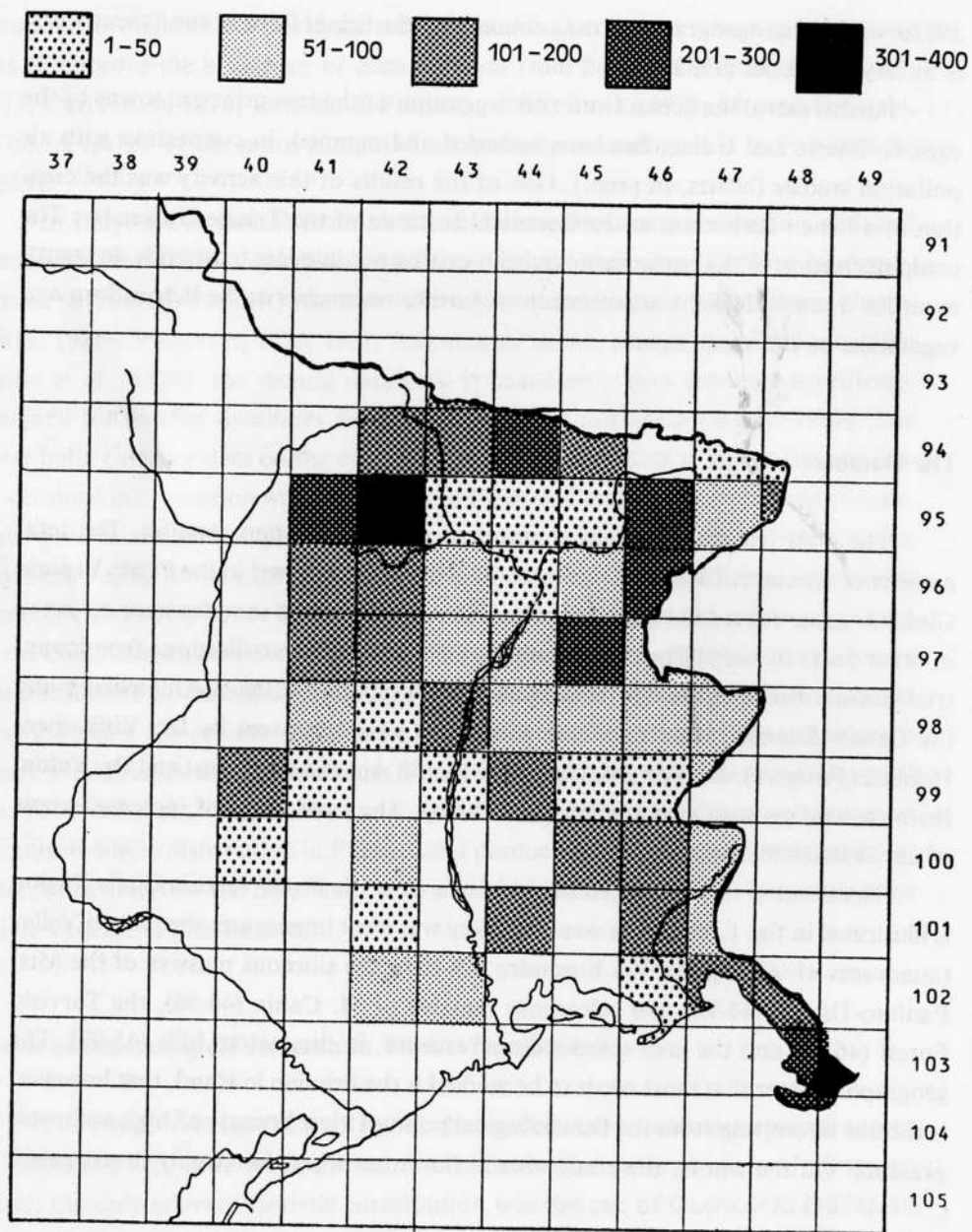


Fig. 1 - Sampling intensity of lichens in the Friuli-Venezia Giulia Region (based on the number of samples present in the TSB lichen herbarium).
 - Intensità di campionamento dei licheni nel Friuli-Venezia Giulia (sulla base del numero dei campioni dell'erbario lichenologico dell'Università di Trieste).

the following main operations: 1) Creation of the basic archive 2) Creation of two dictionaries (species and localities) and their management. 3) Information recovery. 4) Printing of distribution maps. Further programs have been added to the basic software for improving the efficiency of information recovery and for obtaining quantitative data to be further analyzed by numerical methods. The former were developed in conjunction with the computerization of the lichen herbarium, the latter are being used for the "Flora of Friuli-Venezia Giulia Project" directed by Prof. Poldini.

For each herbarium specimen, the following informations have been stored in the bank:

- Progressive number of herbarium envelope.
- Geographic sector. The Friuli-Venezia Giulia Region has been subdivided into 6 sectors, as follows: 1) Carnic Alps, 2) Carnic Pre-Alps, 3) Julian Alps, 4) Julian Pre-Alps, 5) Friulian lowland (0-350 m), 6) Karst Region.
- Quadrant number. The study area has been subdivided into quadrants and sub-quadrants, according to the system adopted for the Floristic Cartography of Central Europe (see fig. 1).
- Substrate types. These data are organized as follows: 1) Rock type, 2) Soil type, 3) Tree species or genus (for species growing on bark), 4) type of wood (state of wood rotting). The data are coded with a 4-digit code, the first digit refers to main substrate type (rock, soil, bark, wood), the second to possible main subdivisions within the type (e.g. acid, neutral, basic soil), the last two digits are left for the coding of tree, rock and soil types. 99 possibilities are thus available for each substrate type. They have been fully utilized only in the case of trees.
- Elevation in metres.

Additional information attached to the species records (i.e. not bound to herbarium labels) is as follows:

- pH-range (from extremely acidophytic to basiphytic).
- Nitrogen requirements (from anitrophytic to extremely nitrophytic).
- Moisture requirements (from hygrophytic to very xerophytic).
- Light requirements (from very skiophytic to very photophytic).
- Distribution pattern in Europe.

These informations are as in WIRTH (1980).

Outputs

Possible outputs from the databank are:

- 1) Species lists (for localities, geographic sectors, areas specified by locality lists etc.).
- 2) Frequency of a given species in a given substrate-type, or its frequency distribution along with elevation.
- 3) Distribution map of a given species within the Friuli-Venezia Giulia Region, and its locality list.
- 4) Matrices with the frequencies of species with the same distribution pattern, and/or ecological requirements in different quadrants, geographic sectors, elevation belts or substrate types.

Outputs like 1) and 3) are mainly of curatorial relevance, whereas outputs like 2) and 4) may be used as data source for quantitative phytogeographical and ecological studies.

Aims of the databank

The two main aims of the databank concern: a) curatorial activities, b) scientific research.

As far as point a) is concerned, the bank is now fully operating. The basic archive is continuously updated and a printout is produced two times a year (January and September). Interested people may obtain a copy of the printout upon request to the author. Other requests, in particular locality lists or distribution maps for given species, will be sent within a month. This will allow specialists of given groups to get information about the existence of samples that eventually might be obtained on loan. The printout of the basic archive further allows an easier and more efficient consultation of the herbarium itself.

The utilization of the databank for scientific research projects is centred on phytogeographical and ecological studies of the lichen flora and vegetation of Friuli-Venezia Giulia. Software and data are organized in such a way as to obtain from the bank numerical data in a form that is ready to be processed by several programs of multivariate analysis available at the Botanical Institute of the Trieste University. However, this potential cannot be exploited until a more homogeneous sampling intensity will not be achieved in the whole of the study area. For this reason, a specific project, financed by M.P.I. funds has been approved in 1985. The results of this field-work activity will strongly increase the yearly input rate of the herbarium (and hence of the databank). The results of specific studies carried out in the framework

of this project will be published as further contributions in the series opened by this paper.

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RIASSUNTO — Le ricerche lichenologiche svolte presso l'Istituto di Botanica di Trieste negli ultimi dieci anni hanno portato alla costituzione di un erbario lichenico che attualmente comprende circa 8500 campioni, il 60% dei quali è stato raccolto in Friuli-Venezia Giulia. L'erbario è in rapido accrescimento, con un tasso medio di 2000-3000 nuovi campioni l'anno. Esso ha dimensioni e caratteristiche tali da renderne vantaggiosa la gestione tramite calcolatore. È infatti di dimensioni relativamente ridotte, ma in rapida espansione, ed i campioni sono stati identificati dalla stessa persona in tempi recenti, il che evita problemi di carattere nomenclaturale e di revisione dei campioni, che spesso risultano di difficile soluzione nella computerizzazione di erbari più grandi e più antichi.

La banca dati descritta nel presente lavoro si basa sul software di LAGONEGRO et al. (1982), e contiene informazioni su distribuzione, ecologia e ripartizione altitudinale delle specie licheniche contenute nell'erbario. Le funzioni della banca dati sono dupplici: da un lato essa permette una più efficiente gestione dell'erbario stesso, e si configura quindi come servizio a disposizione degli specialisti, dall'altro è potenzialmente utilizzabile quale strumento nello studio fitogeografico ed ecologico della flora e vegetazione lichenica del Friuli-Venezia Giulia.

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