A regional project for drawing up inventories of flora and vegetation in Catalonia (Spain)

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ABSTRACT. – The project presented here arose in the context of general vegetation surveys, from European to lower levels. It is based on the computerization of both phytocoenological relevés and floristic citations by means of several programs created by Font at the University of Barcelona. Among them, XTRINAU is an Editor of tables which allows the user a wide scope of functions with relevés, including the creation of data banks of relevé tables. Subsequent programs CONVERBD and FLORACAT perform the transformation of vegetation relevés into floristic data and offer diverse retrieval facilities. The processing of published data, funded by the Regional Government, is yielding increasing data banks of tables of relevés (about 12,000 relevés at present) and of floristic data.

KEY WORDS – Floristic citations, relevés, data processing, data banks, retrievals.

1. INTRODUCTION

Catalonia is a relatively small Region (31,980 sq. km) in the northeastern corner of the Iberian peninsula, which nevertheless includes high phytogeographic diversity. A strong S to N gradient, mainly owing to the presence of the Pyrenean ranges in the northern zone (reaching more than 3000 m a.s.l.), allows a wide floristic scope; moreover, a continentality gradient is evident from the sea coast to the inner plains of the Ebro basin.

Therefore, rich flora and vegetation occur in the area; they can be estimated as formed by some 3200 vascular species and about 500 associations (both taxonomic units used in a broad sense). These phytogeographic units make up rich and varied Mediterranean landscapes in lowlands and dry mountains (including dry thermophilous, dry continental and mild aspects), medio-European countrysides at mid altitudes of wet mountains and subalpine and alpine sceneries in the Pyrenees.

Flora and vegetation have been recorded in many publications, few of which are global and the majority more or less disperse. The floristic citations

published (i.e., a single observation of a species at a geographical location) can be estimated as about 1,500,000. The bulk of them come from local Floras (concerning areas of about 100-400 km^2), and the other from floristic notes or taxonomic revisions. Moreover, an estimated 400,000 citations are included in the phytocoenological relevés. Phytocoenology began in Catalonia in 1934, and has been yielding data increasingly until present; in the last decade a good number of local, intensive studies and several syntaxonomic revisions have been produced, mainly dealing with mountain vegetation. The result are about 18,000 phytocoenological relevés, some of them contained in unpublished dissertations.

In the context of vegetation surveys from regional to continental levels, the first step undertaken by Catalan botanists was to obtain a complete inventory of data, as a general basis for subsequent general studies, both floristic and phytocoenological, as well as for other phytogeographic purposes. A project was planned by Font and funded by the Environment Department of the Regional Government (Departament de Medi Ambient, Generalitat de Catalunya). This is devoted to the gathering, organization and exploitation of all the published data concerning vascular flora and phytocoenology in the territory of Catalonia. Prior to this ongoing inventory, an attempt in this field was initiated with the support of the "Institut d'Estudis Catalans" (Vigo *et al.*, 1989).

2. Aims

The aim of this project, named "Inventari florístic i fitocenològic de Catalunya", is to develop tools with which to manage the aforementioned data. This mean the following main facilities:

— Scientific

- Support in the elaboration of any floristic work, at any geographic or taxonomic level within the boundaries of Catalan vascular flora.
- Facilitate comparative studies of relevés, tables of relevés or synoptic tables, in order to effect syntaxa revisions or general prodromi of vegetation.
- Production of distribution maps of taxa or syntaxa, based on the UTM grid of 10 x 10 km squares.

— Managemental

- Planning of future floristic or phytocoenological research, according to the geographic distribution of previous studies.
- Maintaining databases with applications in diverse fields: Red Books of flora and vegetation, flora and vegetation monitoring projects, delimitation of preserved areas, general conservation policies.

3. Method

3.1. General aspects

The project presented develops through two phases, namely:

— 1993-1995: Computerizing of phytocoenological relevés, including their transformation into floristic data

— 1996-2001: Computerizing of floristic data

After these introductory aspects, this paper briefly describes the main rules and procedures of the former phase, which is at present in its second year.

The tables of relevés are compiled in the "Departament de Biologia Vegetal, Universitat de Barcelona" through the Editor of phytocoenology tables XTRINAU release 2.0 (Fig. 1). This is a set of progams created by Font (1991, 1994), which can run on any Personal Computer (386 cpu or higher). It is based on the language REXX 3.0, and includes more than 250 routines. It enables the user to create, store and manage tables of relevés. Subsequent programs for PC, CONVERBD and FLORACAT, due to a direct commission from the Environment Department, facilitate the exploitation of floristic and phytocoenological data.

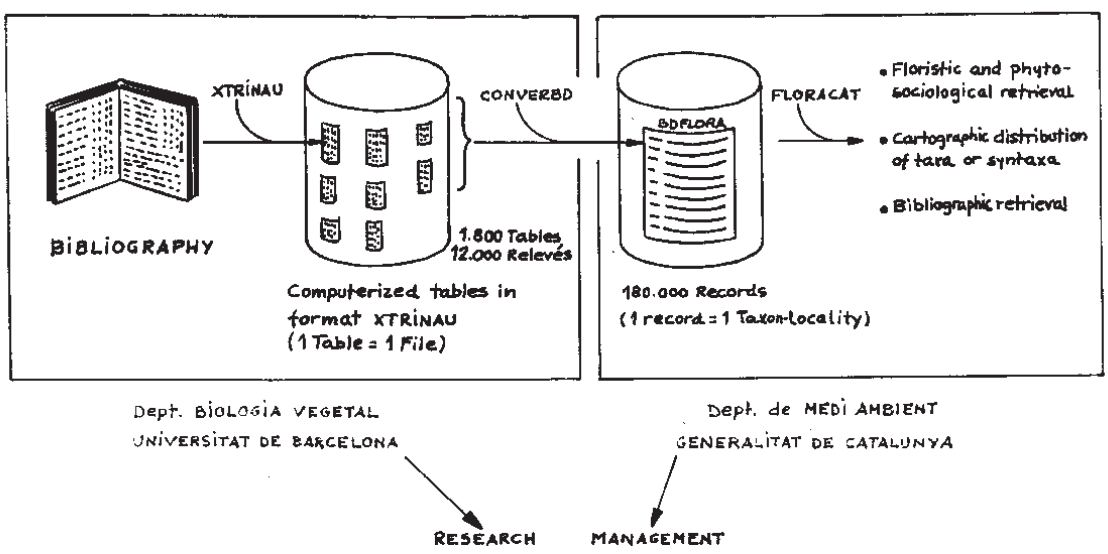

Fig. 1 – Scheme showing the main procedures of the general project

3.2. XTRINAU

XTRINAU rel. 2.0 (short, XTR2) can start with either manual or semiautomatic imput (Fig. 2). In the first procedure, single relevés or tables of relevés are typed by hand. This has yielded a database of some 12,000 relevés since 1993. In the second, a system of Optic Character Recognition (OCR) is used, namely an Epson GT8000 Scanner and OMNIPAGE software, which enables the recognition of ASCII characters. Then, a thorough revision of draft prints is necessary (as it is in the typing procedure). This has proved to be a very efficient system in most cases, and mainly for medium sized and large tables; only the tables with low printing quality are not suitable for the OCR system.

XTR2 keeps the data in the form of tables of relevés, similar to ordinary tables. Each table results in one main file containing the taxa and their values, plus three complementary, automatically created files, which include the data concerning the ecology, locality and structure of the relevés. The fact that relevés are stored in particular tables, compared with huge relevé banks, enables routine processes, such as deletions (of one relevé, of one taxa) or realignment of relevés, as this involves only small files.

Each relevé has a reference number which remains the same through any procedure of XTR2. Nomenclature of the taxa also remains as given by each author; complementary notes on identification (cf., grex, sect.,...) can be kept, as well as development indications (mainly used for trees: seedling, shrubby or

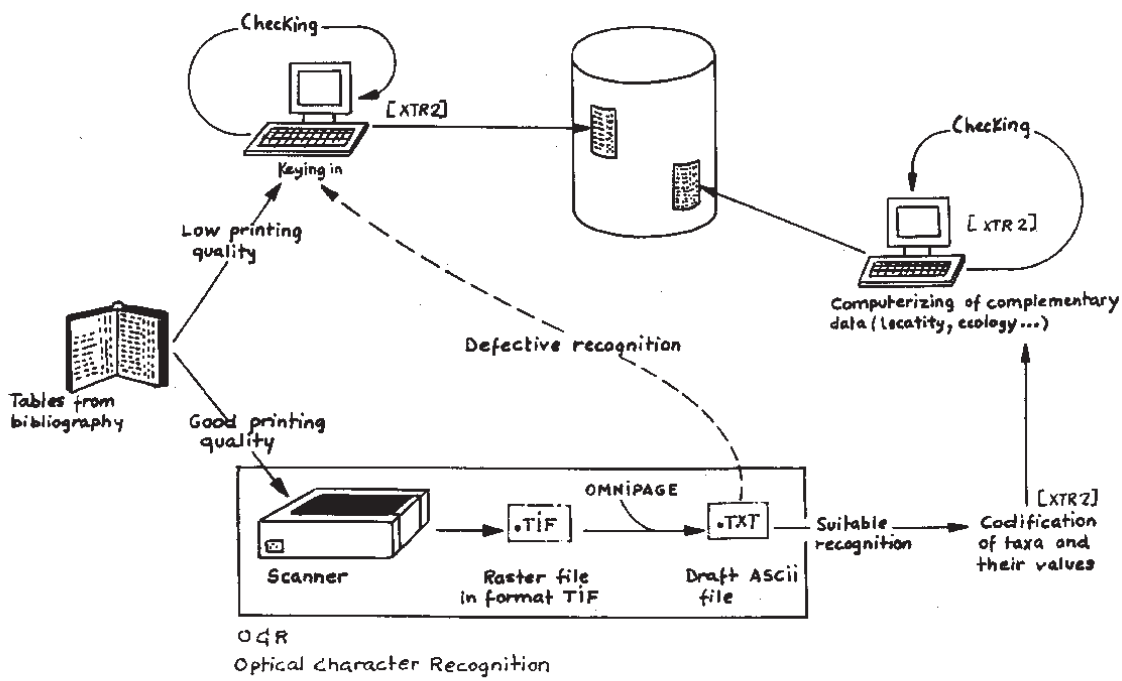

Fig. 2 - Data processing from phytocoenological bibliography into data bank

tiller, adult). Synonymization and any other change in the name of taxa are always the responsibility of each author working on computerized relevés. As a rule, the only complementary datum indispensable (i.e., searched for if lacking in a published relevé) is the reference to the 10 x 10 km square of the UTM grid.

A set of peripheral, general thesaurus files are created by the development of XTR2, all of them connected with main functions and containing specific files: taxa (which allows the user to enter truncated names when typing), syntaxa, synonyms (both of taxa and syntaxa), references, syntaxonomic classification, character-taxa of each syntaxon (which can be used to classify the taxa automatically within a table according to syntaxonomic units), life forms and distribution areas. For special-purpose phytocoenological studies, data fields related to relevés and concerning ecology, locality and structure can be expanded or restructured.

Among the main functions performed by XTR2 are the following (see also Fig. 3):

— As a table processor,
- Construction of tables from single relevés
- Revision of tables (checking on orthography)
- Joining of tables into larger ones
- Realignement of species (rows) or relevés (columns)
- Printing of tables

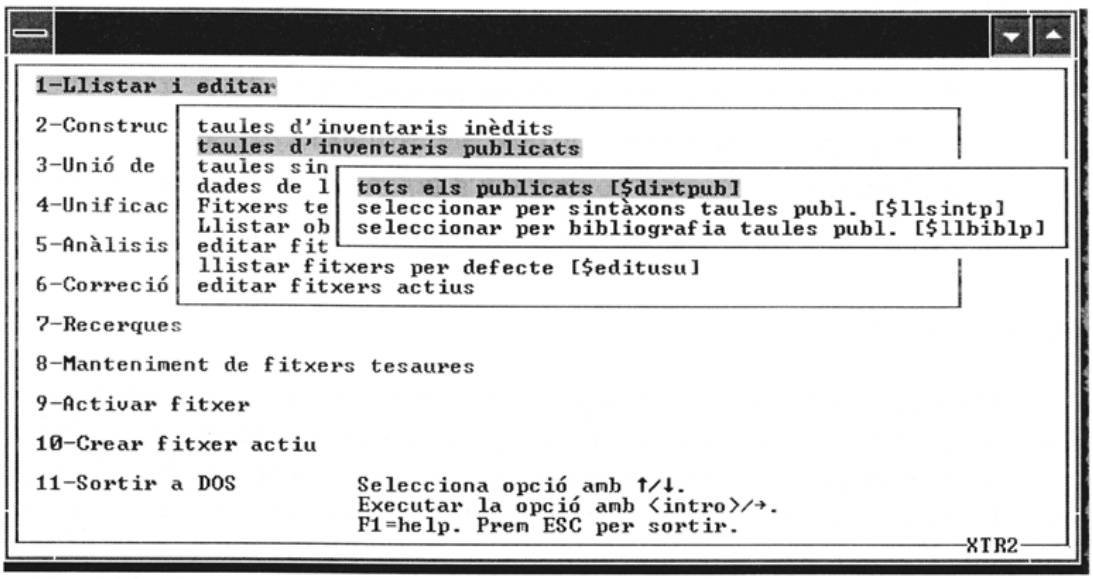

Fig. 3 - Screen showing the general menu of XTR2 program. Main facilities are the following: 1, list and edit; 2, construction of tables; 3, joining of tables; 4, synonymization; 5, statistical analyses; 6, checking on orthography; 7, retrievals; 8, management of theasaurus files; 9, activate files; 10, create active files; 11, exit to DOS. Each one allows a scope of possibilities through pop-up menus.

— As data bank of tables,

- Retrievals on ecology of taxa or syntaxa (localities, substrata, altitudes, slope degree,...)
- Cartographic distribution of taxa or syntaxa (UTM grid)
- Synthetic spectra (chorological, of life forms,...)

3.3. CONVERBD AND FLORACAT

CONVERBD is a sigle program which transforms XTR2 data files (tables of relevés) into a large, general data bank, named BDFLORA. This consists of a DBase IV file of n registers, any one of them corresponding to a floristic record; when the record comes from a relevé, the general data of this relevé (structure, syntaxonomic classification,..) remain bound to the record. Each register (row) is made of a number of codified fields (name of the taxa; UTM square; locality; author;...); and each field is related to a corresponding, peripheral theasaurus files.

As mentioned above, BDFLORA will gather floristic data from non-phytocoenological papers in the second phase of the project.

The second special-purpose program, FLORACAT, includes many routines, and enables the user to exploit the data contained in BDFLORA. It is written in DBase IV, and is presented as a set of pop-up menús. It is conceived as a retrieval tool, both in the scientific and in the management aspects. The main options are:

— Retrievals of floristic and phytocoenological data
— Cartographic distributions of taxa and syntaxa
— Bibliographic references concerning a taxon, a syntaxon or a country

4. SOME RESULTS

The main results come from the facilities set by the first program, XTR2. In this aspect, several vegetation surveys and shorter papers have been produced through this table processor during recent years, mainly dealing with Pyrenean vegetation (Carreras *et al.*, 1993; Casanovas, 1994; Font, 1993; Soriano, 1992;...). The corresponding relevés made up the initial bulk of the vegetation data bank. Other phytocoenological studies, some of them synthetical, are going on through XTR2.

In the retrieval aspect, floristic data have already been used for cartographic projects, namely in drawing up distribution maps of higher plants (Bolòs *et al.*, 1994).

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