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Bryological advances in Spain (1983-1992)

Abstract

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Following some basic facts and considerations on Iberian bryogeography, a review of the present situation of bryological research in Spain is presented, with considerations on its development during the past decade and an outlook on future research priorities in the field.

Some bryogeographical data

Spain is situated at the western end of the Mediterranean basin where, in the Iberian Peninsula, the very different Mediterranean and Atlantic climates meet and interact. Accordingly, the Iberian Peninsula can be subdivided into two phytoclimatic regions: the Medioeuropean region (N Portugal, Galicia, mountains of Cantabria, Pyrenees), subject to the influence of the Atlantic and with rainfall throughout the year; and the Mediterranean region, corresponding to the greater part of Spain, whose climate is characterized by a marked in summer drought and varying amounts of total annual precipitation. The Mediterranean portion of Spain belongs to the Western Mediterranean subregion and may be further subdivided into two large superprovinces (Rivas-Martínez & al. 1993): the Mediterranean Ibero-Atlantic superprovince, with precipitations of Atlantic origin usually showing a winter maximum, which covers the westernmost parts of the peninsula and extends eastward along some of the high mountain chains (Central System, Sierra Morena, Betic Sierras); and the Mediterranean Ibero-Levantine superprovince, which comprises the south-eastern parts of Spain (east coast, Catalan highlands, Ebro valley, etc.) and receives less precipitations, with maxima in autumn and spring, and even includes semiarid portions (in the south-east and Ebro valley).

The Canary Islands form a subregion of their own, the Canarian subregion, quite different from the rest of Spain. They will not be considered here.

The climatic variety of Spain results not only in a rich cormophyte flora but also in a very diverse and interesting bryophyte flora, whose relations with the principal forest types and other ecological parameters were recently analysed by Casas (1993). We shall mention some of its chorological aspects here.

In the Medioeuropean region of Spain, bryophytes with a boreal distribution dominate. On the high mountain chains (Pyrenees, mountains of Cantabria, and sometimes Sierra Nevada) arctic-alpine and subarctic-alpine species can be found. In Spain they are rare relict species, and elsewhere in the European mountains they present a fragmented distribution pattern. Examples are *Amphidium lapponicum, Anthelia juratzkana, Catoscopium nigritum, Cephalozia ambigua, Conostomum boreale, Gymnomitrium corallioides, Paraleucobryum enerve, Polytrichum sexangulare,* and *Stegonia latifolia.*

In the same areas but at lower altitudes, where conifer and beech forests exist, the boreal-montane chorological element predominates. Some mosses and liverworts frequent in central Europe have their southern limit here: *Eurhynchium angustirete, Ptilidium crista-castrensis, Scorpidium scorpidioides, Sphagnum fuscum,* etc.

The thermophilous Atlantic element, which is characteristic of the Atlantic coasts of Europe, is present in the western parts of the Pyrenees, along the coast of Cantabria, and even in some mountain chains of Cádiz, SW Spain (Varo & al. 1992). Some of its rare species are: *Adelanthus decipiens, Cyclodictyon laetevirens, Breutelia chrysocoma, Frullania oakesiana, Pallavicinia lyellii, Hyocomium armoricum, Sematophyllum demissum,* and *Sphagnum pylaisii.*

The bryophyte component is clearly less conspicuous in the Mediterranean Region of Spain than in the Medioeuropean Region, and consists mainly of small acrocarpic mosses, mainly of the *Pottiaceae.* Among the few liverworts only the *Marchantiales* are prominent. In the Murcia province, for example, 13.2 % of the bryophyte species are liverworts and 86.8 % are mosses, of which 79.8 % belong to the *Pottiaceae.* Nevertheless, intensive studies of the dry Mediterranean Region resulted in important new records. This peculiar bryoflora also includes some boreal elements, but other elements such as the Circumtethyan (that includes the Mediterranean) and Xerothermic-Pangaean (Frey & Kürschner 1988) confer to it a character of its own. Some of the exclusively Mediterranean species are the S European *Aschisma carniolicum, Funariella curviseta, Grimmia pitardii, Leptobarbula berica,* and *Tortella inflexa;* the Ibero-N African *Phascum piptocarpum* and *Pyramidula algeriensis;* and the disjunct Ibero-Oriental (W Mediterranean and Irano-Turanian) *Crossidium laevipilum, Entosthodon hungaricus, Gigaspermum mouretii, Grimmia capillata,* and *Trichostomopsis aaronis.* Further work in arid or semi-arid zones of other Mediterranean countries may well show that these species are more widely distributed than is presently known.

Other species with a disjunct distributional pattern are also present in Spain, e.g. *Oedipodiella australis* var. *catalaunica* with a bipolar type of disjunction (S Africa, Canary Islands, Iberian Peninsula); *Trichostomopsis trivialis* with a xeropangaean disjunction, being found throughout the xeric regions of the old Pangaea (Jordan, Spain, S Africa); *Crossidium seriatum, Phascum vlassovii,* and *Crossidium aberrans,* with a circumtethyan disjunction, being present in the Madrean region of N America, the Irano-Turanian, Mediterranean, and Saharan regions.

Finally there are the Iberian endemics. Some belong to genera with an austral distribution, for example *Triquetrella arapilensis* whose congeneric species are found in New Zealand, Australia, S Africa and Chile; and *Goniomitrium seroi* (SE Spain and Canary Islands) with two congeners in Australia and the other two in Central and S Africa. Both

Table 1. Bryophyte holdings of Spanish institutional and private herbaria, with approximate number of specimens (herbarium codes after Holmgren & al. 1990 and Holmgren & Holmgren 1994)

Institution:	*Code:*	*Specimens:*
Universitat Autònoma de Barcelona, Facultat de Biologia	BCB	32000
Universitat de Barcelona, Facultat de Biologia	BCC	1500
Universidad de Granada, Facultad de Biología	GDAC	1500
Universidad de La Laguna, Facultad de Biología	TFC	9500
Universidad Complutense Madrid, Facultad de Biología	MACB	3100
Jardín Botánico de Madrid	MA	14000
Universidad de Málaga, Facultad de Ciencias	MGC	3000
Universidad de Murcia, Facultad de Biología	MUB	5000
Universidad de Oviedo, Facultad de Biología	FCO	2000
Universidad de Navarra, Facultad de Ciencias	PAMP	7000
Universidad de Salamanca, Facultad de Biología	SALA	4000
Universidad de Santiago, Facultad de Biología	SANT	3000
Universidad de Valencia, Facultad de Biología	VAB	3000
Instituto Alavés de la Naturaleza, Vitoria	VIT	17300
Instituto Asturiano de Taxonomía y Ecología Vegetal, Pravia	IBA	5000
Herbarium M. Acón Remacha	[private]	1000
Herbarium R. García	[private]	?
Herbarium J. Martínez Abaigar	[private]	1500
Herbarium R. Oliva	[private]	9000

genera can be considered as xeropangaean elements. *Acaulon* at present includes three Iberian endemics: *A. casasianum* and *A. dertosense* from the Catalan and eastern coast of Spain; and *A. fontiquerianum* described from the Spanish south-east but since also found in other points of the Mediterranean area, showing great affinity to the austral species of the genus. *Phascum* contains two endemic species, *P. cuynetii* and *P. longipes,* known from the coastal zones of eastern Spain. *Schizymenium pontevedrense* and *Anomobryum lusitanicum* are also Iberian endemics.

Present state of bryological investigation in Spain

At present there are 21 bryological research teams in Spain, distributed all over the country, of which 17 are university based, 2 work at other public institutions, and 2 privately. The number of investigators per team varies from 1 to 6 but is most often 2.

This is a high number of teams, higher than for any other Mediterranean country, most of which started work in the early eighties at the initiative of a small number of bryologists working at a few Spanish universities and headed by Professor C. Casas of the Universitat Autònoma de Barcelona (Casas 1977).

A check-list of the Spanish mosses has been available since 1981 (Casas 1981) and was updated ten years later by the same author (Casas 1991). Yet some new discoveries were made in the two subsequent years, even including a species new to science (Lara &

Mazimpaka 1993). The 1991 check-list includes 745 moss species, 90 more than were known in 1977 (Casas 1977). The liverwort flora is less well known: a check-list by Dr Casas is in preparation, by which the number of species known will increase substantially.

The bryoflora of Spain can be considered to be well known. There are no larger areas or mountain chains for which no bryological data exist, yet there are regions where further work is needed, especially in areas distant from the centres of research and often difficult to reach. The arid areas are of special interest, and although their common bryophytes are well known, new species are still being added.

In Spain there are fifteen institutional and four private herbaria known or expected to include bryophytes (Table 1). They are partly under revision, thanks to ongoing taxonomic studies and chorological mapping, which will result in the rectification of previous errors.

For some private collections of bryologists who worked in Spain the present whereabouts are unknown. Some of the early collections were recently revised, in particular those of López Seoane and Hult (Reinoso & al. 1990), and of Willkomm (Viera & Reinoso 1993, 1994). Three other collections, belonging to the botanists Lacoizqueta,

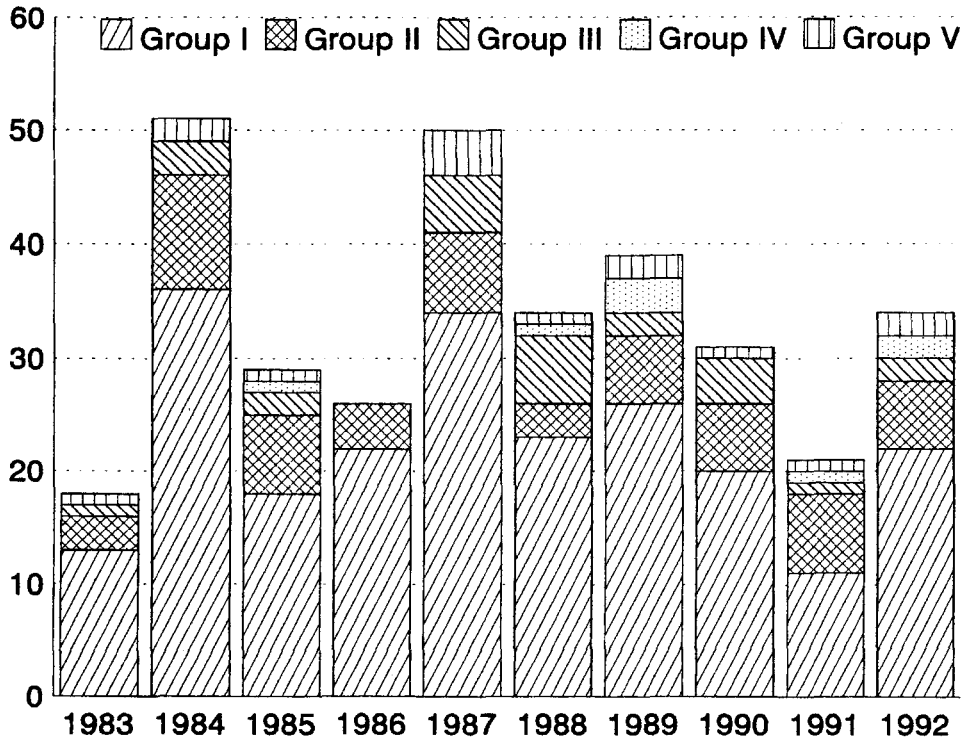

Fig. 1. Number of bryological papers and books published each year by Spanish authors during the decade 1983-1992, by subject groups (as defined in the text).

Loscos and Zubía, were recently discovered, two of which are presently being studied. Still, much remains to be done. The herbaria BCB and MA are doubtless the most important for bryology in Spain.

An exchange group for bryophyte sample, created in 1969, has helped and encouraged the formation of new bryological herbaria. The *Bryotheca hispanica*, in which 12 research teams collaborate, is based on samples of the exchange group. 1969 is also the year in which the biennial bryological meetings started, whose aim is the exploration of the less known regions of Spain by fieldwork. There is now a Spanish Society of Bryology, founded on 5 April 1990, which has about 50 members. A bulletin of information is published biannually.

An analysis of Spanish bryological research during the last decade

Research activities in Spanish bryology centre on floristics, biogeography, chorology, taxonomy, vegetation studies, and ecology. Only few bryologists work on anatomy, phytochemistry, ecophysiology, fire ecology, aspects of water and air pollution, physio

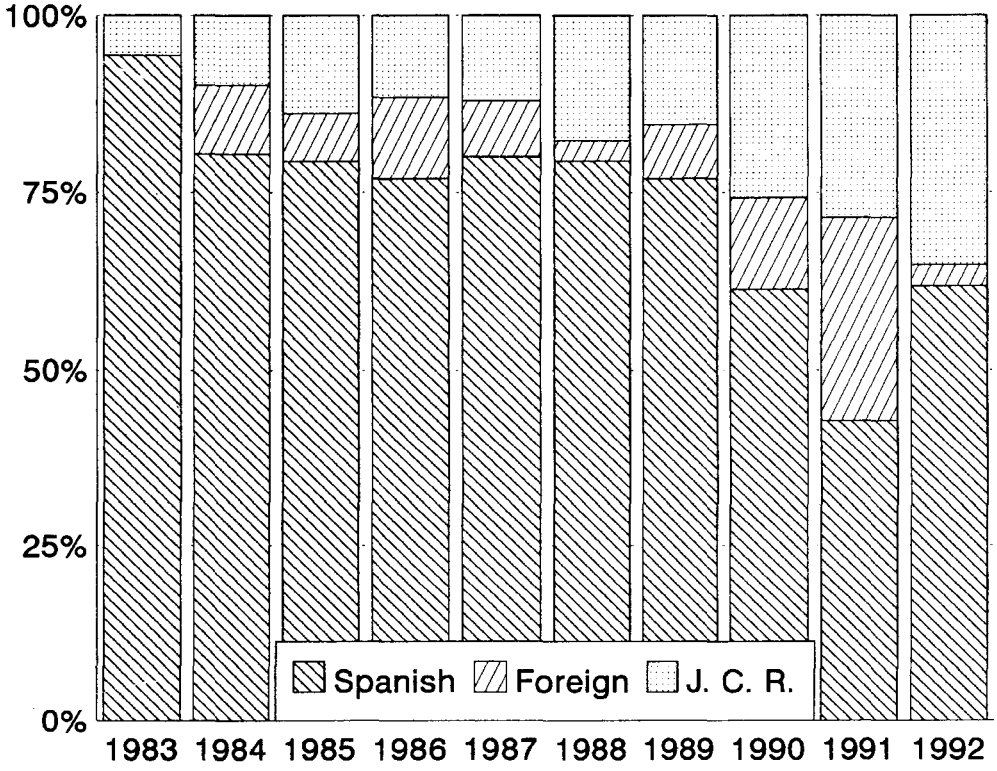

Fig. 2. Proportion of bryological papers (in %) published by Spanish authors during the decade 1983-1992 in Spanish journals, or in journals included in the Journal citation reports (I. C. R.), or in other (foreign) journals.

logy, and palaeobryology. Fig. 1 shows the number of relevant publications produced over the last ten years, classified in 5 groups of subjects, as follows:

I. flora, biogeography, chorology, mapping;

II. vegetation studies, ecology, phenology, fire ecology, pollution assessment;

III. taxonomy, spore morphology, karyology, phylogeny, anatomy;

IV. physiology, ecophysiology, reproduction studies;

V. others (palaeobryology, historical botany, revision of herbaria, bibliography, etc.).

If one discounts the years 1984, 1987 and 1989, when the proceedings of Spanish symposia of cryptogamic botany were published, a slight increase in the number of publications can be observed. Throughout the period under consideration a majority of publications deal with the subjects of group I. Within group II, a decline in publications on bryosociology and an increase in ecological publications can be noted. Little work has been done on physiology.

Most of the articles were published in Spanish journals, but in the last three years the number of papers published in foreign journals, especially those covered by the *Journal citation reports* (Anonymous 1989), has increased substantially (Fig. 2). The foreign journal preferred by Spanish bryologists is *Cryptogamie, bryologie-lichénologie,* in which 32 % of the articles published outside Spain were printed – perhaps due to the fact

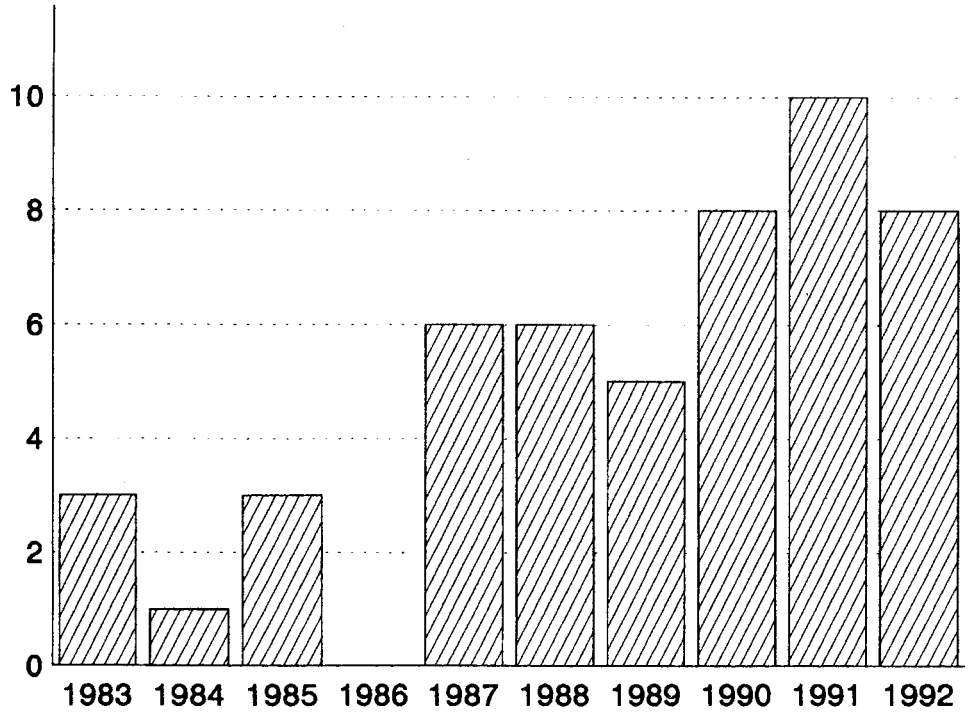

Fig. 3. Number of Spanish bryological research projects accepted for funding during the decade 1983-1992.

that this journal accepts papers written in Spanish. Less frequent are papers by Spanish authors in the *Journal of bryology* and *Lindbergia.*

The number of grant-funded bryological research projects has grown during the last decade, which bears witness of their interest and of the high quality of the research teams. This is apparent from Fig. 3, which shows the number of such projects initiated each year. Fig. 4 shows the subject areas to which the projects, many of which are multidisciplinary, can be related. Subject group III seems attract little interest, perhaps because it belongs to basic science and is held in small esteem by the funding organizations. Group IV receives little support, as there are only few teams interested in these subjects. Group V, which includes studies on conservation biology, a field of growing importance, receives more attention.

Most of the projects last for one year, since it is difficult to obtain funds for projects of longer duration (Fig. 5). Projects funded for more than three years are very rare.

Research priorities for the years to come

One of the most important objectives of Spanish bryologists is writing a complete new Flora of Iberian bryophytes. At present, the liverwort Flora by Casares-Gil (1919) and the incomplete Flora of Spanish mosses by the same author (Casares-Gil 1932) are

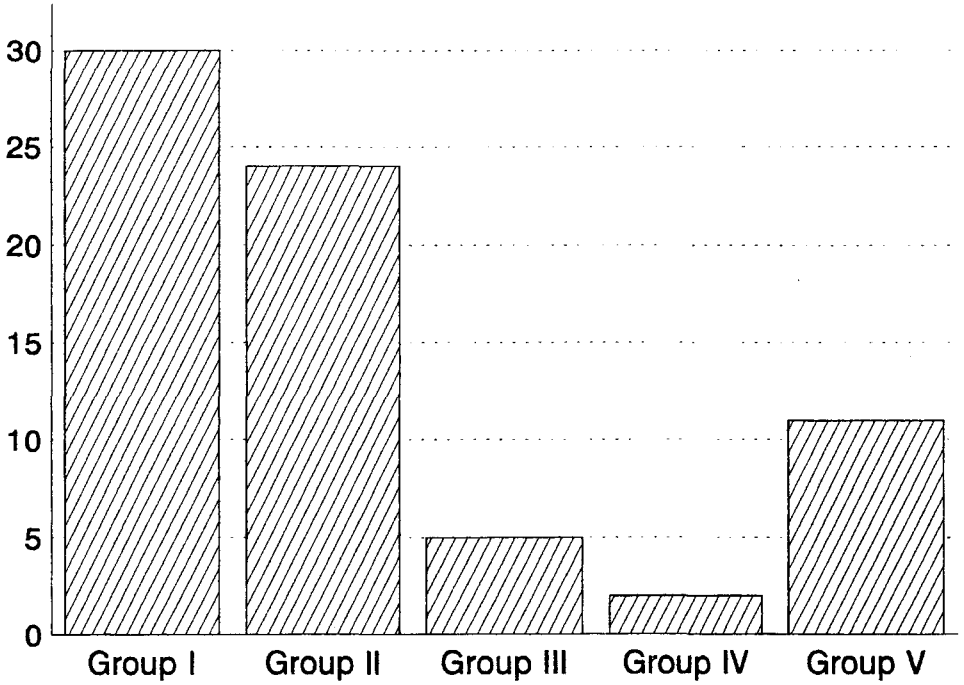

Fig. 4. Number of Spanish bryological research projects accepted for funding during the decade 1983-1992, by subject groups (as defined in the text).

the basic and most important works for Spanish bryologists. Ongoing taxonomic revisionary work and the mapping of bryophytes for Spain and Portugal, a joint project of the Universitat Autònoma de Barcelona and the Botanical Garden of Lisbon, contribute essentially to increasing our knowledge of Iberian bryophytes.

An urgent need remains, that is directly related with the afore-mentioned activities: the monographic study of some taxa that are particularly difficult in Spain, notably the genera *Gymnostomum, Grimmia, Weissia,* and the family *Brachytheciaceae.*

Spain has not remained unaffected by pollution of the environment and the destruction for sheer lucre of zones of great natural value. Such is the case of the peat bogs in Galicia and Alava, of which almost nothing is left. Other endangered regions are the Pyrenees and the Sierra Nevada, where skiing affects the slopes and canoeing the rivers, endangering the bryophyte flora. Dam construction for electric power plants and irrigation of land also endangers bryophyte communities. The arid regions are at risk due to tourist development of coastal areas, or irrigation. Desiccation of salt water lagoons entails the disappearance of rare species of *Riella.* For all these reasons, a *Red data book* of Iberian bryophytes has just been realized at the Universitat Autònoma de Barcelona and the Botanical Garden of Lisbon (Sérgio & al. 1994). This is a most meritorious and badly needed publication, which demonstrates that the funding of new research lines with little tradition in Spain is highly desirable.

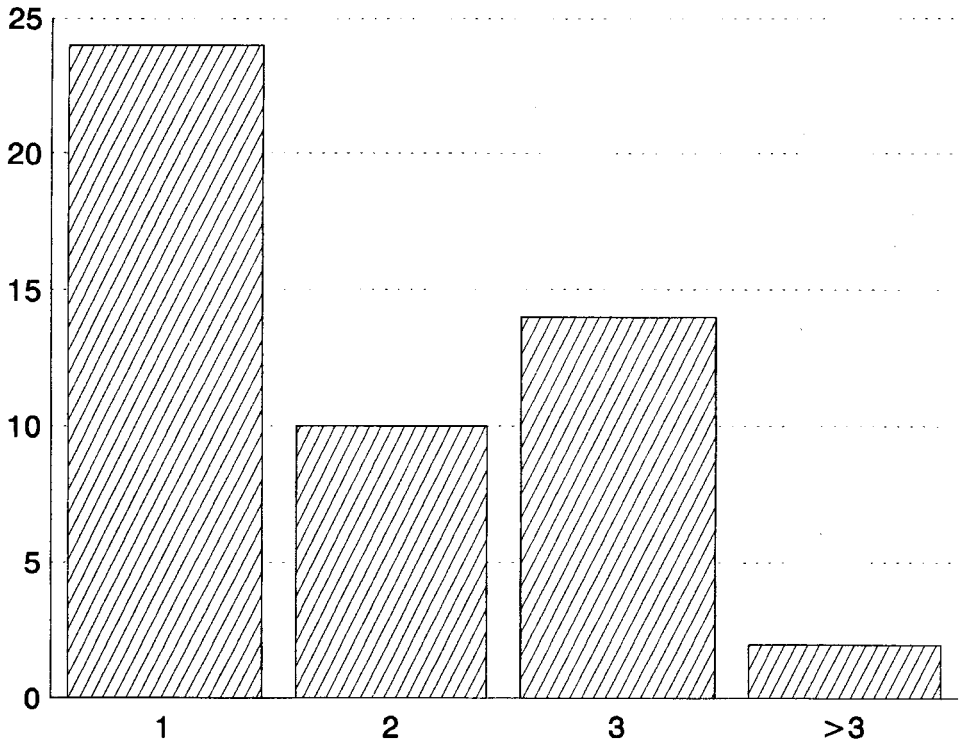

Fig. 5. Number of Spanish bryological research projects accepted for funding during the decade 1983-1992, by length of funding period (in years).

In Spain there are no amateur bryologists at present. Perhaps the British example might usefully be followed, and theoretical as well as practical field courses offered for the benefit of the laymen, whereby a more general interest in bryophytes would be encouraged.

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