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VEGETATION COVER AND HUMAN IMPACT. A COMPARISON OF THE ALMARCHAL REGION (CAMPO DE GIBRALTAR, SPAIN) AND THE TANGIER HINTERLAND (MOROCCO)

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Abstract

The effects of different human impact on the vegetation cover are studied by comparing Southwestern Andalusia and Northwestern Morocco. The peninsulas on both sides of the Straits of Gibraltar have almost identical physical conditions, but they are submitted to different land use systems. The study was carried out in a phytosociological approach at the levels "plant community" and "vegetation complex". The floristic identity is demonstrated by the example of an endemic plant community, the *Trifolio micheliani-Oenanthetum fistulosae*, which is described here. Weed communities vary according to the agrotechnical level. Traditional ploughing in selfsustaining agriculture creates agro-phytocoenoses with high alpha-diversity. Agroindustrial management, as it prevails in Spain, halves species number per field. The anthropogenetic transformation of the weed communities has a similar tendency in both countries, with a time lag in Morocco. In heathland, the anthropo-zoogenetic pressure in higher in Morocco. The result are mono-dominated stands with low alpha-diversity. The vegetation complexes are descibed by comparing two coastal hill regions, the Gaditanian Almarchal area and the Tingitanian Fahs area. Every technological level creates specific communities and its own vegetation complex. Character communities for the Spanish respectively Moroccan side can be established. "Modernization" of vegetation landscapes results in a more trivial vegetation cover. The anthropogenetic transformation of the landscape affects the plant communities and the vegetation complexes in a different way.

Introduction

The peninsulas on both sides of the Straits of Gibraltar had identical physical and biotic conditions at the beginning of human settlement. Nowadays they are submitted to different landuse systems. In this contribution the transformation of the plant cover under different economic and cultural conditions will be discussed. A comparison of the actual vegetation can show us the effects of human impact on floristic and structural diversity.

The effects of human impact on biodiversity became a field of major interest within the last few years. Widely used diversity parameters are the species number per area at the community level (taxonomic- or alpha-diversity) and the number of vegetation units per area at the landscape level (pattern- or gamma-diversity). Most studies concentrate on alpha-diversity. A more detailed consideration of the taxonomical situation ("taxic diversity") has been made by various authors, for example by ARROYO & MARAÑÓN (1990) and OJEDA & al. (1995) for shrubby heathland species of the

Campo de Gibraltar. We will not follow this aspect here, but concentrate on qualitative effects of different landuse for the plant community and the vegetation landscape as a whole. The following questions will be asked: Do character communities exist in the Spanish respectively in the Moroccan part? Which vegetation units can be found in similar frequence and abundance on both sides?

In interpreting the different diversity of anthropogenetic systems, most authors (see for example GRIME, 1979; NAVEH & WHITTAKER, 1979) follow the "intermedium disturbance hypothesis". Experimental studies like those from HOLZAPFEL (1993) show however, that the plant communities react in very different ways, even if the disturbance factor is constant. Furthermore, "medium disturbance" has to be defined for every ecosystem differently. If we compare the vegetation in Southern Spain and in Northern Morocco, we can study the species richness within one plant community or landuse type according to the intensity of human impact. To answer however the questions above, we have to pass to the landscape level. Then we can see, whether the differences in disturbance intensity result in divergent trends in habitat diversity or whether convergent processes occur in the same landuse types.

The study area

As study areas have been chosen the Campo de Gibraltar (= Gaditano) in Southwest Spain and the Tangérois (= Tingitano) in Northern Morocco (see Fig. 1). Identical geological and pedological conditions, a similar climate of atlantic-mediterranean type (see climatic graphs in Fig. 1) and a landbridge until midtertiary resulted in an almost identical flora (Gaditano-Tingitanian sector), in endemic species like *Limonium emarginatum*, in common original plant communities and in similar vegetation belts. A state of the geobotanical knowledge is given in DEIL (1995) and in NEZADAL & al. (1994), the phytogeographic links across the Straits are emphasized by GALÁN DE MERA & VICENTE ORELLANA (this volume).

The Straits are the meeting point of the economic gradient and cultural contrast between Europe and Africa. The anthropo-zoogenetic pressure (rural population density, pasture intensity) is higher in Morocco. Arable land in Spain is cultivated by great land owners who produce in a biennial crop rotation and with a considerable amount of capital for the market of the EU. Characteristics of this agro-industrial agricultural system are the application of modern ploughing techniques and of chemicals for weeding. Unprofitable soils have been abandonned in recent years. In the Rifian part of Morocco, selfsustaining small holder farming is still quite common. Rainfed agriculture of durum wheat, superficial plowing without harrowing, manual weeding and the intercalation of fallow land periods are characteristics of this traditional agricultural system. In the Spanish part, large areas are used for cattle breeding with the Retinto race in a rotation system with enclosures. In Morocco, we find a not regulated grazing system on common ground with local cow races and predominant small animal breeding (for more details see DEIL, 1990).

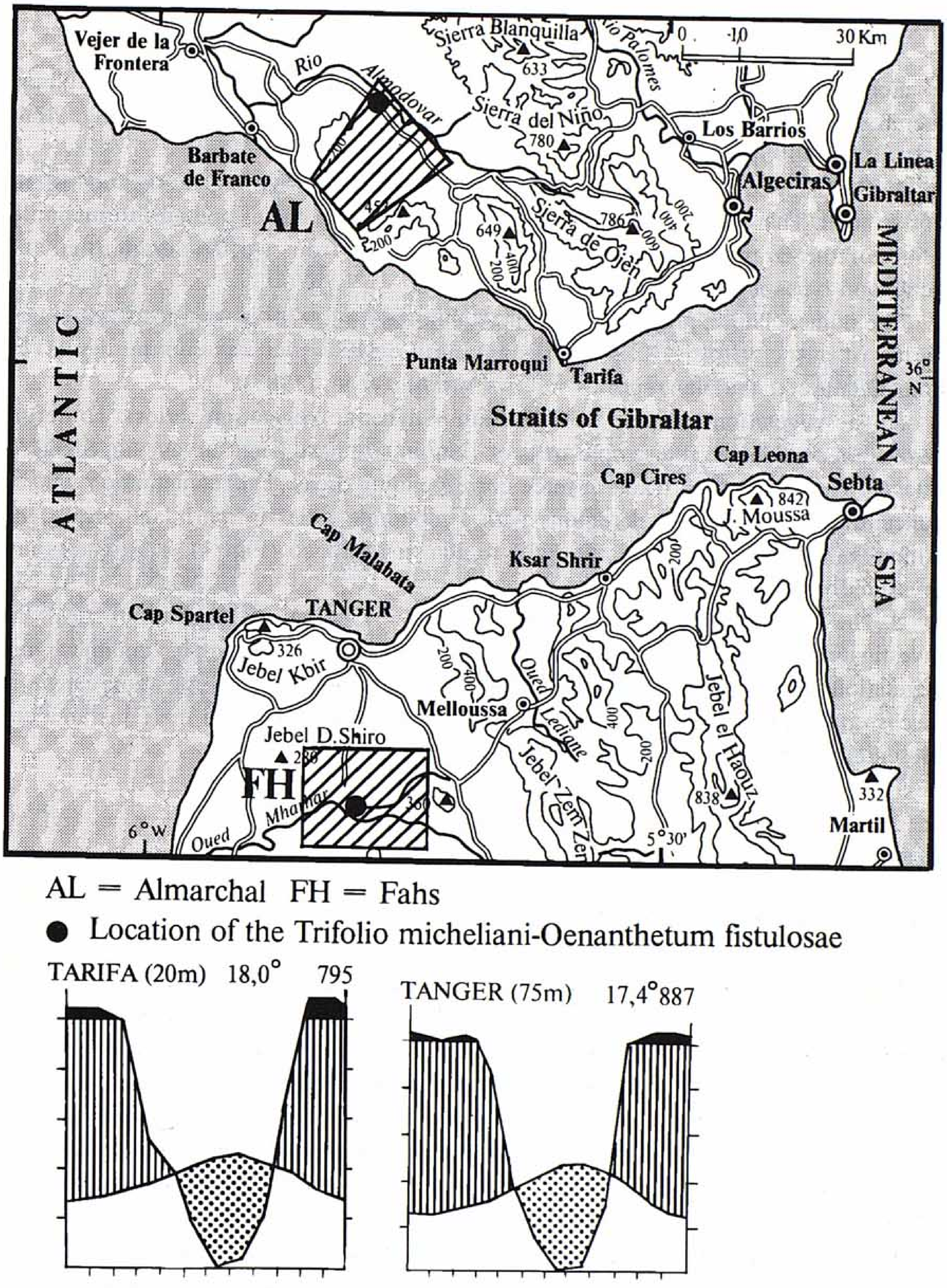

Fig. 1. The study area.

Methods and data set

Ecological phenomena are scale depending. The vegetation and the diversity have therefore been studied at three spatial scales and levels of complexity (see Fig. 2 and DEIL 1990, 1995):

1, The plant community: 1500 relevés were taken to classify vegetation units, about 150 in total. These units are associations, subassociations, facies and agroforms in the sense of the Braun-Blanquet-System. Some results from weed communities and heathland types are briefly discussed here.

The nomenclature, proposed by KOPECKY & HEJNY (1974) is used for fragmentary forms of associations (BC = basal community, DC = derivat community). The nomenclature of the plant species follows VALDÉS & al. (1987).

2, The vegetation complex (= Sigmetum = dynamic vegetation series): To define vegetation complexes, 100 sample areas of $1km^2$ in size have been surveyed in SIGMA-relevés. They have been taken in three corresponding areas. This contribution will be concentrated on two coastal regions with a moderate relief in marls and argils, the Almarchal area in Spain and the Fahs region in Morocco (Fig. 1). The results are presented in Tab. 2.

3, The vegetation landscape (= Geosigmetum = topological vegetation series): To investigate the toposequences, relevés along typical catenae were sampled and the actual vegetation of selected areas has been mapped. One example of a vegetation catena is discussed here (Fig. 2). The vegetation maps of the Almarchal and the Fahs area are presented in DEIL & SCHERER (1996).

Results

Diversity in agricultural land

In winter crops on black cotton soil, mean species number per field (within stand diversity) is 48 in Morocco, 22 in Spain. Character species of the *Ridolfion* weed community are common on both sides. The high species number in Morocco results from the additional appearence of annual pasture species *(Brachypodietalia)*, subnitrophilous ruderal herbs (*Brometalia*) and fallow land species (*Dittrichia viscosa, Ammi visnaga*), which enter into the agricultural area (see tables in DEIL & SUNDERMEIER, 1992). The rhizoms of perennial shrubs and the rosettes of the biennial herbs are not completely eliminated by the traditional plowing methods. Their seed bank is filled up during the fallow period. High alpha-diversity in traditional arable land is a result of diversification in time (rotation community) and of a moderate human impact.

Modern tilling technics halve species diversity. The species composition, stated by NEZADAL (1989) in the Campo de Gibraltar in the early 80ies, is already historical. In the 70ies, small holder farmers in the Campo de Gibraltar used the same traditional tilling methods as they are used today in the Rif region. Nowadays Rifian agro-phytocenoses represent former Spanish ones which have been transformed to pure weed

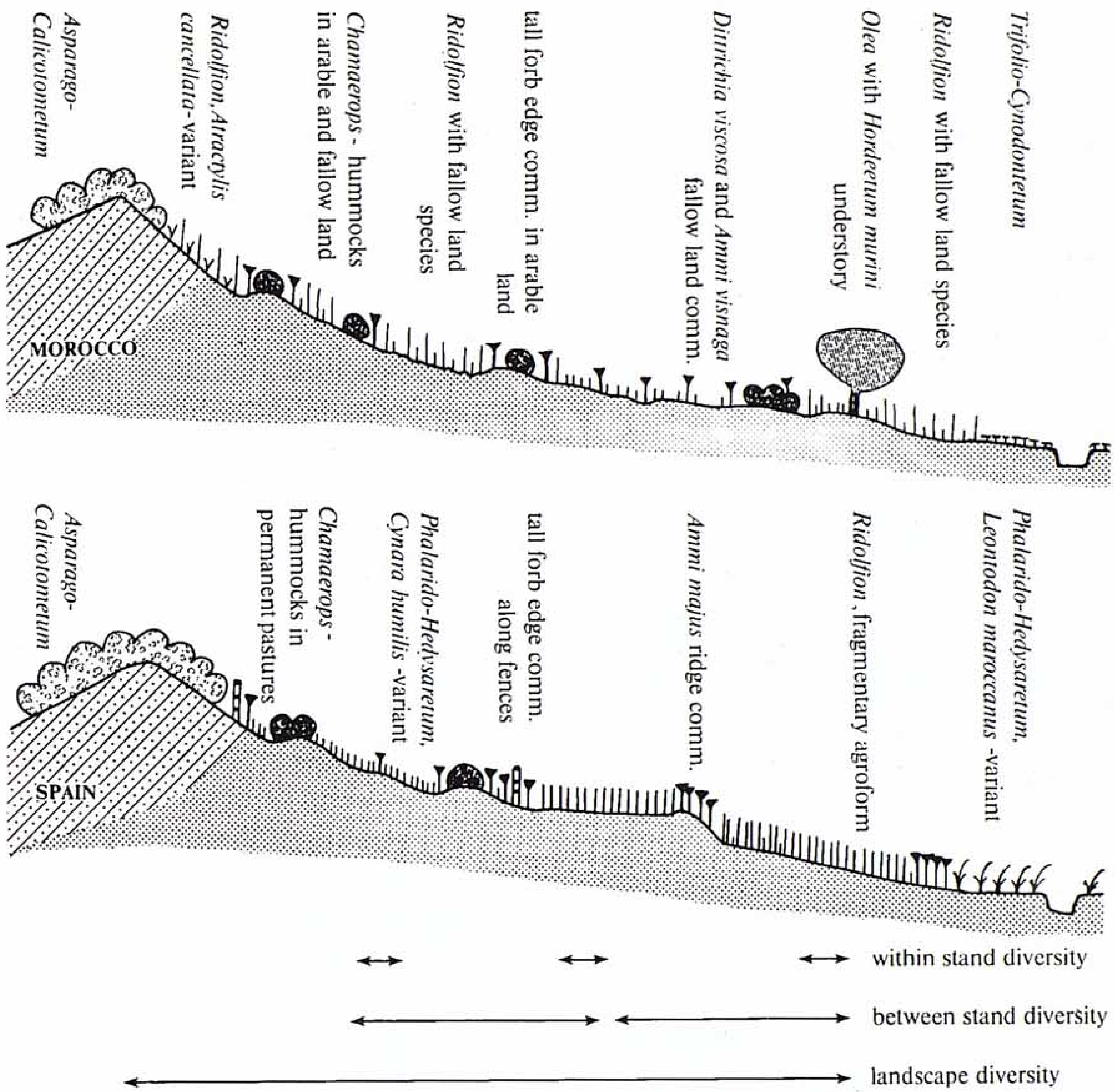

Fig. 2. Scales of floristic diversity and schematic vegetation catenae.

communities in the last decade. The anthropogenetic transformation of the weed communities has a similar tendency in both countries, with a time lag in Morocco.

Between-stand diversity and landscape diversity are enhanced in Moroccan agricultural areas by three effects:

1, *Chamaerops humilis*-patches are scattered all over the arable land. These hummocks shelter maquis species inside the palm and are surrounded by a tall forb edge community (see Fig. 3 in DEIL, 1995).

2, A broader spectrum of soil types is used for agriculture. For example, a subassociation with *Atractylis cancellata* on shallow soils is restricted to the Tingitanian peninsula.

3, The shifting cultivation system creates a considerable variety of succession stages, gamma-diversity increases.

Evenness and origin of heathland types

The effect of the different human impact on the *Ericion umbellatae*-heathland was studied in the Aljibe and the Western Rif Mountains (JUNG, 1994; DEIL, 1995). Mean species number for all heathland types is 29 in Spain, 18 in Morocco. The Spanish heathlands have also higher evenness values. The higher pasture and burning pressure in Morocco results in a lower floristic diversity and in mono-dominated stands. An exception are units dominated by *Cistus* species, where also the Spanish ones have low values. Here is the germination of therophytes supressed by allelopathic effects.

A character community for the shifting cultivation system in Morocco is the *Cistus crispus-Erica umbellata*-association. In Spain, *Cistus crispus* is restricted to its primary habitats, the shallow soils. In Morocco, it has expanded to rather deep and moist soils by frequent burning (see Tab. 2 in DEIL ,1995).

If we compare species diversity of heathland and agricultural areas, we can state an inverse situation: In Spain, human pressure is very high in arable land and less intensive in forests and shrubland. In Morocco, anthropo-zoogenetic pressure is high in maquis and medium in cultivated land. Alpha-diversity in weed communities and in heathland reflects this situation very well. The results are in accordance with the medium disturbance theory.

column	123
field number	787 736 189
Trifolio-Oenanthetum-CS	
Trifolium michelianum	12+
Sparganio-Glycerion-CS	
Oenanthe fistulosa	11.
Alisma lanceolatum	11.
Glyceria spicata	11.
Eryngium corniculatum	..+
Bolboschoenion-CS	
Scirpus maritimus s.str.	331
Phragmitetea-CS	
Oenanthe globulosa	+..
Cyperus longus	.2.
Lythrum junceum	.1.
Trifolio-Cynodontion-CS	
Trifolium resupinatum	+1+
Agropyro-Rumicion-CS	
Rumex conglomeratus	214
Rumex crispus	12.
Companions	
Mentha pulegium	1+2
Lolium rigidum	213
Phalaris caerulescens	1.1

CS = Character species

Further species: in 1: Polypogon monspeliensis 1; in 2: Polypogon maritimus s.str. 2; Leontodon maroccanus +; in 3: Agrostis pourretii 2; Ranunculus trilobus +; Oto-spermum glabrum 1; Rumex pulcher divaricatus +; Polygo-num equisetiforme +; Trifolium squarrosum +; Cotula co-ronopifolia +; Phalaris brachystachys R.

Table 2. *Trifolio micheliani-Oenanthetum fistulosae.*

Identical vegetation units

At sites with the same physical conditions and with similar human impact we observe also an identical species composition on both sides of the Straits of Gibraltar. This cannot only be stated for the primary forests, but also for secondary vegetation units and for plant communities at very specialized habitats. This will be demonstrated by the example of a wetland community, the *Trifolio-Oenanthetum*. It has been observed until now only in the perimeters of Almarchal and Fahs.

Trifolium michelianum Savi is recorded by VALDÉS & al. (1987) for Western Andalusia only from the litoral of the Huelva province and by JAHANDIEZ & MAIRE (1932) for Northern Morocco only from Sidi Kacem and Jebel Outka. It occurs however also in the southern fringes of the ancient Laguna de la Janda north of Almarchal and in a swamp meadow near Gouaret Mhahla (Fahs) in the alluvium of Oued Kebir (Fig. 1). These are the first records of this clover species from the Gaditano-Tingitanean area. It colonizes the same habitats and characterizes a very rare plant community on both peninsulas, which is described here for the first time.

The ***Trifolio micheliani-Oenanthetum fistulosae*** **ass. nov**. (Tab. 1, type relevé No. 2) forms swamp meadows, which might be briefly inundated in spring time by brackish water. It grows on hydromorphic alluvisols and vertisols, slightly nitrificated by grazing and disturbed by trampling. Characteristic elements of this tall growing, dense plant community are in an upper herbaceous layer *Scirpus maritimus*, *Oenanthe* ssp., *Rumex* spp., in the medium stratum *Alisma lanceolatum* and grasses (*Glyceria declinata, Lolium rigidum, Phalaris caerulescens*) and in the underlayer *Trifolium michelianum* and *T. resupinatum*. The relevés have been taken in May 1992 in the Laguna de la Janda (rel. 1 and 3) and in the Fahs (rel. 2).

Syntaxonomic position: This new association is well characterized by *Trifolium michelianum* and by the character species of the *Sparganio-Glycerion*. It can be included into this alliance of the *Phragmitetea*. The slightly nitrophilous conditions are underlined by the transgressive species of the alliances *Trifolio-Cynodontion* and *Agropyro-Rumicion*. The stand of relevé 3 is a transition to the *Preslio-Eryngietum corniculati*.

In more brackish conditions and at longer inundated sites, the *Trifolio-Oenanthetum* is replaced by the *Scirpetum maritimi* (CHRISTIANSEN, 1934) R.Tx. 1937, which can be interpreted as the central association of the Suballiance *Scirpenion* Riv-Mtz. & al. 1980 respectively as the southernmost and impoverished outlier of the *Bolboschoenion maritimi* Dahl & Hadac 1941. Such habitats have disappeared in the Laguna de la Janda by drainage of the Rio Almodovar. RIVAS GODAY & al. (1963) still mapped 3000 ha of halophilous plant communities there.

The *Trifolio-Oenanthetum* is replaced in non saline water and at longer inundated sites by the *Glycerio declinatae-Eleocharidetum palustris* Riv. Mtz. & al. 1980 and in floating water by the *Glycerio-Oenanthetum crocatae* Riv. Mtz. & al. ex Sanchez Mata 1989. Its species composition is also very close to the *Oenantho fistulosae-Glycerietum spicatae* Brullo & Grillo 1978 (*Alopecuro-Glycerion spicatae* Brullo & al. 1994), described for Sicily.

Character units of the Spanish and Moroccan vegetation landscapes

The studies at the level "plant community" show, that on the one hand the perimeters of Almarchal and Fahs are nearly identical in their physical conditions and offer very similar habitats (see for example the highly specialized and endemic community *Trifolio-Oenanthetum*). On the other hand, the differences in the intensity of human impact are enormous and they are well reflected by the species composition within one landuse type. According to the intensity of human impact, variants within the same community type can be observed, for example in arable land or in heathland. Considering the vegetation landscape as a whole one can ask, whether homologous sites are used in quite a different way. The result would be corresponding vegetation units. Are there differential communities for Spain respectively Morocco?

Tab. 2 presents the SIGMA-relevés from the Almarchal and the Fahs area. The location of the sampling areas can be seen from Fig. 3 and 4. A stratified random sampling procedure was applicated.

The communities in Tab. 2 are grouped according to the physiognomic character (forests and shrubland, herbaceous wetland communities etc.) and to landuse types (fallow land, agricultural land, roadsides etc.). The comparison shows the following results:

1, Common on both sides and with similar abundance we observe *Opuntia-Olea*-hedgerows, fragments of riverside forests (*Tamaricion africanae*-basal community, *Rubo-Nerietum*), relicts of primary forests (*Tamo-Oleetum*), wetland communities (*Typhetum angustifoliae, Eleocharido-Alismetum, Trifolio-Oenanthetum, Helosciadietum*), a summer crop weed community (*Kickxio-Chrozophoretum*), productive pasture communities on wet ground (*Leontodon maroccanus*-variant of the *Hedysaro-Phalaridetum*), ruderal communities on roadsides (*Anacyclo-Hordeetum, Notobasio-Scolymetum, Carduo-Silybetum*) or trampled ground (*Scleropoo-Coronopion*-basal community), *Chamaerops* hummocks in pastures and *Eucalyptus*-plantations along roads.

2, Exclusively in Spain or with higher abundance and frequency there are open shrublands (*Asparago-Rhamnetum*), the *Ridolfion* weed community in the fragmentary agroform, balks with *Ammi majus* and *Avena sterilis*, permanent pastures of medium productivity (the *Cachrys sicula*- and the typical variante of the *Hedysaro-Phalaridetum*), a thistle-dominated grazed oldfield community (*Cynaro-Scolymetum*), a vegetation unit on salty argiles (*Hordeion-Hainardia*-basal community) and a roadside banquette association (*Trifolium scabrum-stellatum*-community). The latter is colonizing allochthonous sands, a material which is not used for the construction of small roads in Morocco.

3, Concentrated in Morocco are hedges with *Acacia horrida* and *Myoporum tenuifolium* (wind shelter plantations around the scattered farms), a shrubland type adapted to high disturbance (*Asparago-Calicotometum*), the species rich agroform of the *Ridolfion*, scattered *Chamaerops* hummocks in arable land and the heavy grazed *Trifolio-Cynodontetum*. The *Ammi visnaga*- and other fallowland communities are

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Table 2. Plant communities in the Almarchal and the Fahs area.

column		11	1111111	122
	1	2345678901	2345678	901
relevé number	1	1111221177	4994494	444
	5	4789013689	2565670	413
region	A	AAAAAAAAAA	FFFFFFF	FFF
	L	LLLLLLLLLL	HHHHHHH	HHH
<u>Forests, shrubland and hedges</u>				
Tamo-Oleetum, normal form	.	11	1......	...
Tamo-Oleetum urticetosum ined.	.	........1+	++.....	...
Asparago-Rhamnetum oleoidis	.	......+221	....	...
Asparago-Calicotometum typicum	.	.........+	.2+...+	...
Olea-Marabut-forest and Iris-cemetery	.	....	+......	...
Opuntia-hedge with Olea sylvestris	.	+++++..+.+	++..111	...
Arundo donax-hedgerow	.	+......r..	....	...
Opuntia-hedge with Acacia horrida	.	....	+..+..1	...
Myoporum tenuifolium-hedgerow	.	....	+r..r.+	...
Acacia horrida-hedgerow	.	....	..+..+.	...
<u>Hygrophilous forests and shrubland</u>				
Aro-Ulmetum minoris	.	+....+....	....	...
Tamaricion africanae-BC	.	....+.....	..+....	+1+
Rubo-Nerietum	.	.........+	.....+.	13+
<u>Wetland communities</u>				
Typhetum angustifoliae	.	+.r.r..+..	.r..r+.	411
Eleocharido-Alismetum lanceolati	1	+r+.+..+..	.rr.+1.	...
Helosciadietum nodiflori	.	+.........	r..+..+	...
Trifolio micheliani-Oenanthetum fistulos.	.	..1.......	+......	...
Cyperus longus-Mentha suaveolens-edge	.	....	.+....r	11.
Oenanthe pimp.-Cyperus longus-swamp	.	....	+..+...	...
Festuca arundinacea-meadow, irrigated	.	....	...+r..	...
Potamogeton polygonifolius-stand	.	....	.....r.	1++
Phragmites australis-stand	.	....	....	1+.
<u>Roadside and ruderal communities</u>				
(Anacyclo)-Hordeetum leporini	.	1.+++++1+.	.++1++1	.11
Carduo bourgeani-Silybetum mariani	.	+.++++++.r	.+.+..+	...
Notobasio-Scolymetum maculati	.	...11+++.+	1......	2.2
Echio-Galactition-BC	.	...+.+....	.+.....	...
Scleropoo-Coronopion-BC	.	r.....rr..	..++.1.	...
(Hordeio)-Glossopappetum macroti	.	........++	+..1...	...
Cynaro-Scolymetum hispanicae	2	32.122+323	....2..	...
Trifolium scabrum-stellatum-banquette	.	1+1..+.+++	.1.....	...
<u>Pasture communities</u>				
Hedysaro-Phalaridetum, typical Var.	.	12+.1.1232	.1.2...	...
Hedysaro-Phalaridetum, Leont. mar.-Var.	.	11211111+1	1+321..	...
Hedysaro-Phalaridetum, Anthyllis-Var.	.	........1+	+++.2..	...
Hedysaro-Phalaridetum, Cachrys-Var.	.	1...1111.1	....	...
Hordeion marini-Hainardia cyl.-BC	3	r+.++++...	....	...
Trifolio-Cynodontetum	.	....	.+1r+.+	111
<u>Basiphilous forb communities</u>				
Stipion capensis-BC	.	....	.r121+.	...
Dauco criniti-Hyparrhenietum	.	........+.	+..++..	...
<u>Weed and fallow land communities</u>				
Kickxio-Chrozophoretum tinctoriae	.	32322331..	1++..11	...
Ridolfion, fragmentary form	.	33222333..	..2....	...
Tetragonolobo-Fedietum	.	...2...1.+	1......	...
Rumicion-weed comm.	.	.1...+....	21	...
Ammi majus-Avena sterilis-balk comm.	.	111+1+11..	....	...
Ammi visnaga-fallow land comm.	.	+..+...+..	1+111+2	...
Ridolfion, with Ammi visnaga	.	....	44121+3	...
Ridolfion, without Ammi, rich in species	.	....	..+.131	...
Carlina racemosa-fallow land comm.	.	....	1....r2	...
Rumicion-fallow land comm.	.	....	..+..1.	...
<u>Isolated tree and shrub species</u>				
Eucalyptus-forest	.	.+.++.....	...1...	...
Eucalyptus-roadside plantation	.	..+..+....	.r...11	...
Olea sativa	.	.........+	....+..	...
Pistacia lentiscus	.	21	....	...
Ficus carica	.	....	.+r....	...
Chamaerops in pastures	.	++.....122	+..1211	...
Chamaerops in arable land	.	....	.+..112	...
<u>Other landscape elements</u>				
Open water	.	....	....	112
Open soil	.	....	....	.14

<u>Further communities:</u> in 1: Cistancho-Arthrocnemetum 2; Chamaerops in fallow land 1; in 3: Hedysaro-Phalaridetum, Hordeum lep.-Var. 1; in 6: Scirpus maritimus-Festuca arund.-swamp +; in 7: Poo-Trifolietum subterranei 1; in 9: Ranunculus peltatus-stand r; Crataego-Populetum albae GALAN ined. r; in 11: Oenanthe globulosa-swamp 1; Hedysaro-Phalaridetum, Eryngium-Var. 1; Davallio-Sedetum baetici r; in 12: Salicetalia purpureae-BC +; in 13: Amaranthus-Chenopodium-stand +; Anthoxanthum-Chamaemelum mixtum-comm. +; Cupressus sempervirens-hedgerow +; Callitriche-stand r; Convolvulo-Genistetum clavatae 1; Ranunculus saniculifolius-stand r; in 14: Trifolium alexandrinum-meadow 1; Dittrichia-Vulpia genic.-fallow land +; Ridolfion, Atractylis cancellata-Var. r; in 16: Echietum boissieri ined. +; Ammi visnaga-roadside comm. +; in 17: Characeen-stand +; in 20: Fraxinus angustifolia +; in 21: Viticetum agnus-casti +.

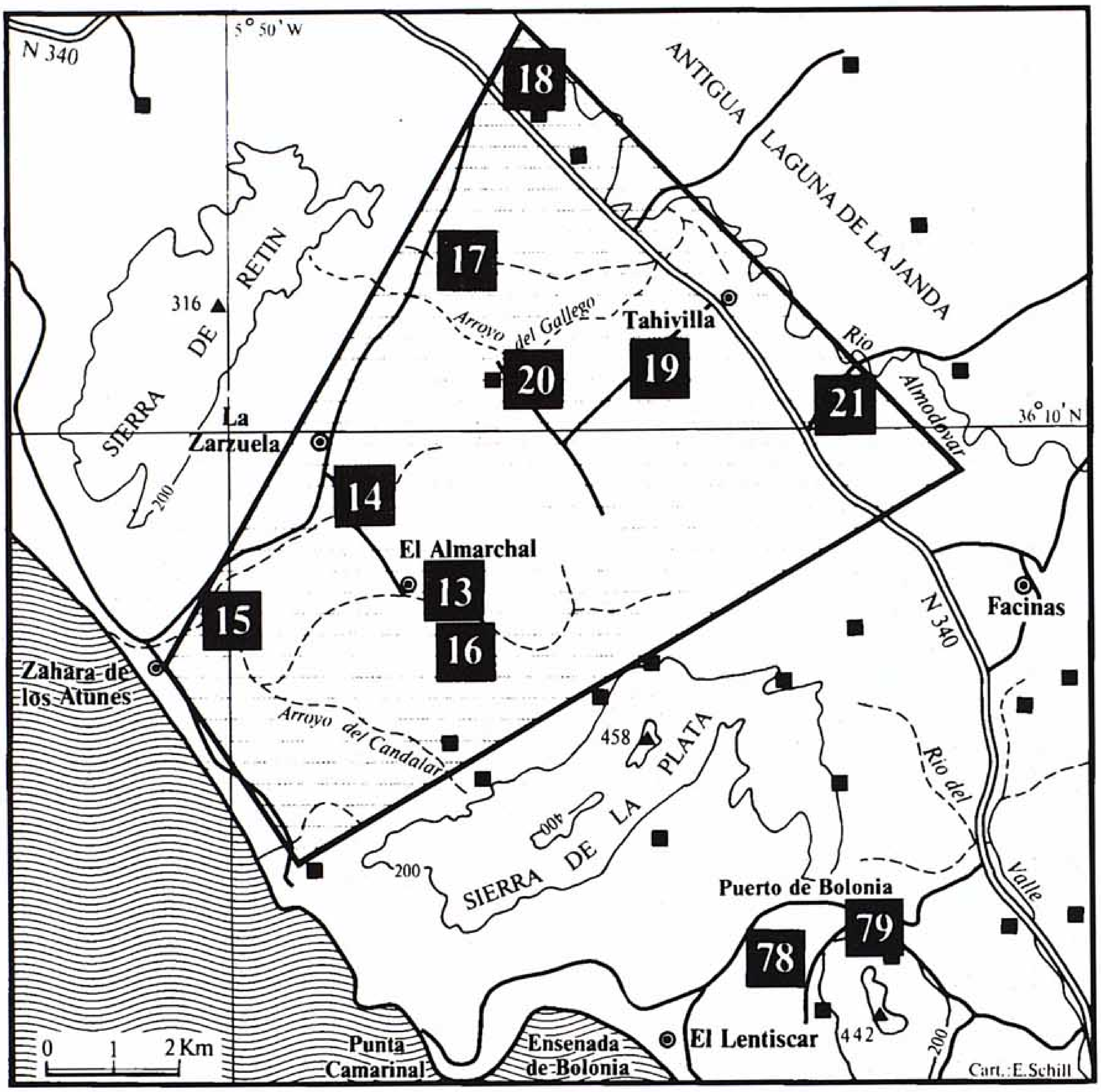

Fig. 3. Location of the SIGMA-relevés in the Almarchal area.

abundant in Morocco in the agricultural area. In Spain they are restricted to ruderal places near villages. The dominance of basiphilous units (*Stipion capensis*-basal community, *Dauco-Hyparrhenietum*) in the Fahs area is due to the occurence of small calcareous rocky outcrops there and not due to different landuse.

4, In both areas, the vegetation of the alluvial plains (see the columns 1 and 19-21) differs from the surrounding marly hills (columns 2-18). Hydrophilous and phreatophilous communities (*Potamogeton-*, *Characeae-* and *Phragmites*-stands, *Rubo-Nerietum*, *Viticetum agnus-casti*) occur in the oxbow lake of the Oued Kebir plain (rel. 19-21). The vegetation complex of a small coastal estuary near Almarchal is given by relevé 1.

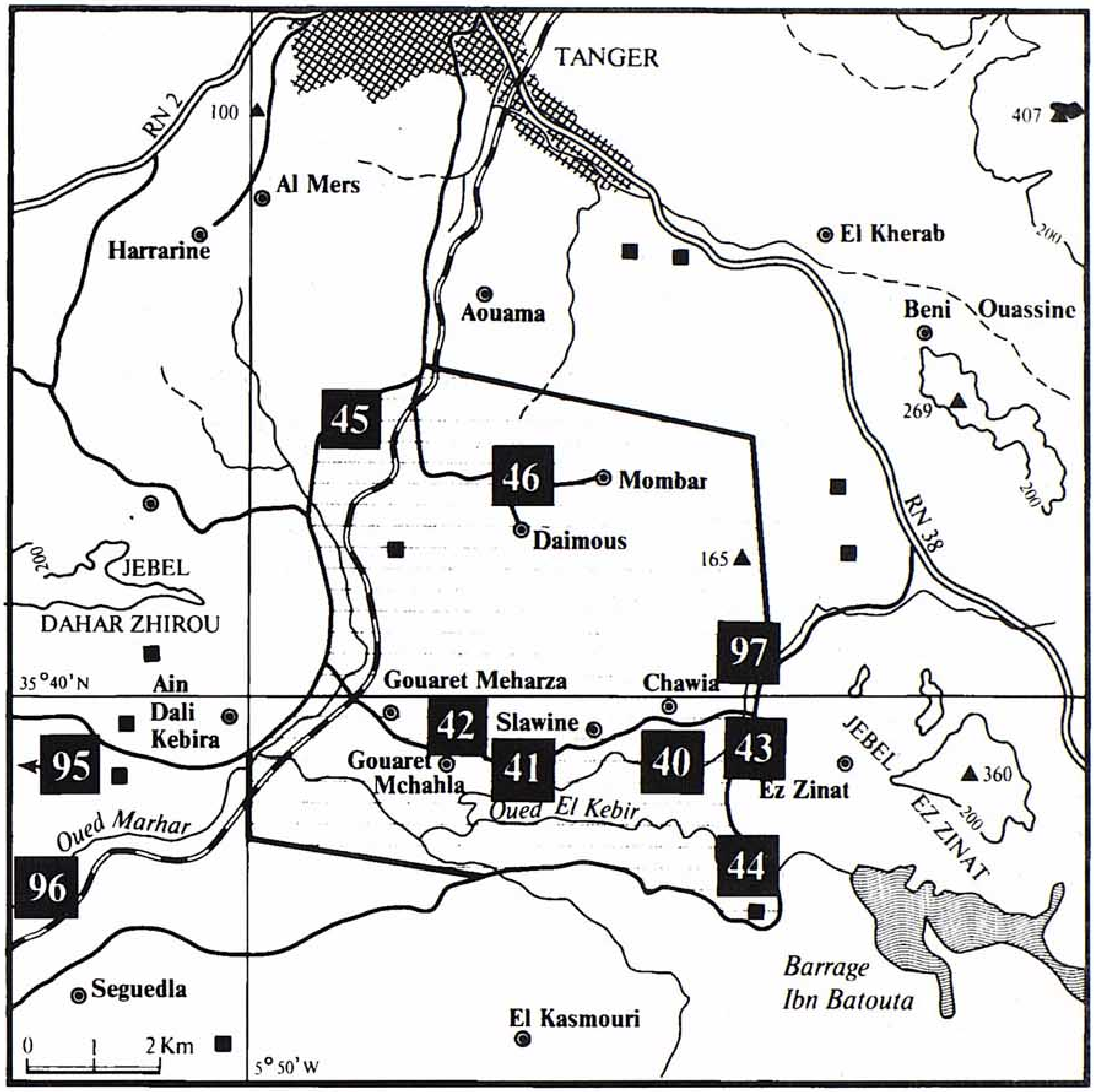

Fig. 4. Location of the SIGMA-relevés in the Fahs area.

Conclusion

There are clear differences in the composition, frequency and abundance of the communities on both sides of the Straits of Gibraltar as well as in the species composition within one plant community. We can distinguish a vegetation landscape of a selfsustaining agricultural society on the one side and an agroindustrial vegetation complex on the other side. The vegetation landscape is not only an ecosystem, but also the result of historical processes, of social conflicts and of different economic situations in both countries.

Based on a larger data set of about 100 SIGMA-relevés in six perimeters on both peninsulas (see Tab. 4 in DEIL, 1995), one can see, that the Spanish part is characterized by intact forests, by the predominance of productive permanent pasture communities and by very impoverished agrophytocoenoses.

Character units of the Moroccan vegetation landscape are species-rich forms of weed communities, a large variety of oldfield vegetation and the *Trifolio-Cynodontetum*. The latter indicates the extreme high pasture pressure on wet sites. Vegetation patterns created by ethnic and cultural traditions (socalled ethnogeobotanical elements) are of minor importance, but do exist (*Iris* cemeteries, Cañadas, Marabut forests).

The strong agroindustrial tendencies stated everywhere in the Campo de Gibraltar, take also place in those parts of Morocco, where large landed property allows modern investments (see the vegetation map for the Fahs in DEIL & SCHERER, 1996). The *Ridolfion* in its fragmentary agroform evolved already in those parts of Northern Morocco, where modern agriculture is practiced. In the surroundings of the Tangier Hinterland big landowners started with the introduction of selected dairy cattle races, which are kept in cowsheds. Hay-harvesting will form new meadow types in the near future.

"Modernisation" of vegetation landscapes results in a dramatical decrease of transition zones (ecotones and ecoclines), of multifunctional vegetation units like Dehesas and of extreme habitats like wetlands. The endemic *Trifolio micheliani-Oenanthetum fistulosa*e is extremely endangered on both sides.

In an agro-industrial system the vegetation limits become sharper and spatial patterns less disperse in comparison to a traditional system. The general tendency is a more trivial vegetation cover, between-stand diversity and landscape diversity are decreasing (Fig. 2). An exception are the active dune and the postdune systems: On the Gaditanian coast, most of the sites are protected. On the Moroccan coast, the perennial dune vegetation will be destroyed in the near future by not regulated camping activities.

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