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ARITZACUN VALLEY, NAVARRA, SPAIN

R G H BUNCE

INSTITUTE OF TERRESTRIAL ECOLOGY
MERLEWOOD RESEARCH STATION
GRANGE OVER SANDS
CUMBRIA
ENGLAND LA11 6JU

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Institute of Terrestrial Ecology
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1989

FOREWORD

I first visited the Batzan and Aritzacun valleys during the course of a British Council fellowship in 1985. A subsequent brief visit in June 1986 led to the invitation from the Forest Department, to advise on the potential ecological impacts of a new road in the Aritzacun valley, the work for which was done in October 1986. The building of a road in such an isolated area has a wide range of potential impacts, which necessitated the survey described in this report. The experience gained in that survey provided the necessary framework for the zonation described herein, and also proved useful in showing successional relationships on abandoned fields. The initial working was completed by June 1987. The final preparatory work for the report was completed with the assistance of Jane Owens and Chris Benefield in August/September 1989.

R G H Bunce June 1989

CONTENTS

INTRODUCTION

The first impression of any area comes from the appearance of the landscape, which in the case of the two valleys (Aritzacun and Urrizate; **Fig 1(b)**), is very striking. On the upper slopes there are distinctive sandstone hills, bright greenslopes with tongues of forest; whereas in the valleys there is a patchwork of fields and red roofed houses against a background of dense forest. The fields form a small part of the overall scene, which therefore, conveys an impression of minimal disturbance by man - even though the landscape is the product of traditional management practices.

The distinctive nature of the valleys is derived from their geographical position in a high rainfall area but, also, being in northern Spain (see **Figure 1(a)**), in a relatively warm climate described as Lusitanean and similar to western Ireland. Thus, areas of similar altitude, in comparable rainfall zones in Britain, would not be forested to such a high level. Elsewhere in Spain and France, such mountains are in lower rainfall areas, and experience a more continental climate. Currently, there are no detailed comparisons between such mountain areas, but the unusual combination of climatic features means that the area, in addition to the patterns of current and past management, is of outstanding general conservation interest separated into three main categories.

1. Landscape: the complex mosaic of landscape features, and the balance between them, means that the valleys are of exceptional value in visual terms, particularly when taken in conjunction with the lack of disturbance.

2. Wildlife / vegetation: the colonies of vultures on the cliffs are outstanding, but there is also a wide range of other wildlife present. In floristic terms, although not rich in species in comparison with the central Pyrenees, for a western afforested valley all the characteristic species expected are present, as well as some representatives of alpine and upland environments. The consideration of the assemblages of species forming the vegetation is also significant, reflecting strong Lusitanean influence mixed with Continental ,Atlantic and some Alpine species.

3. Resource: this involves the conservation of factors such as soils,water and timber. Currently, the valleys are in a stable state, and whilst some further exploitation could take place, there is no doubt that modern intensive commercial forestry would have deleterious effects.

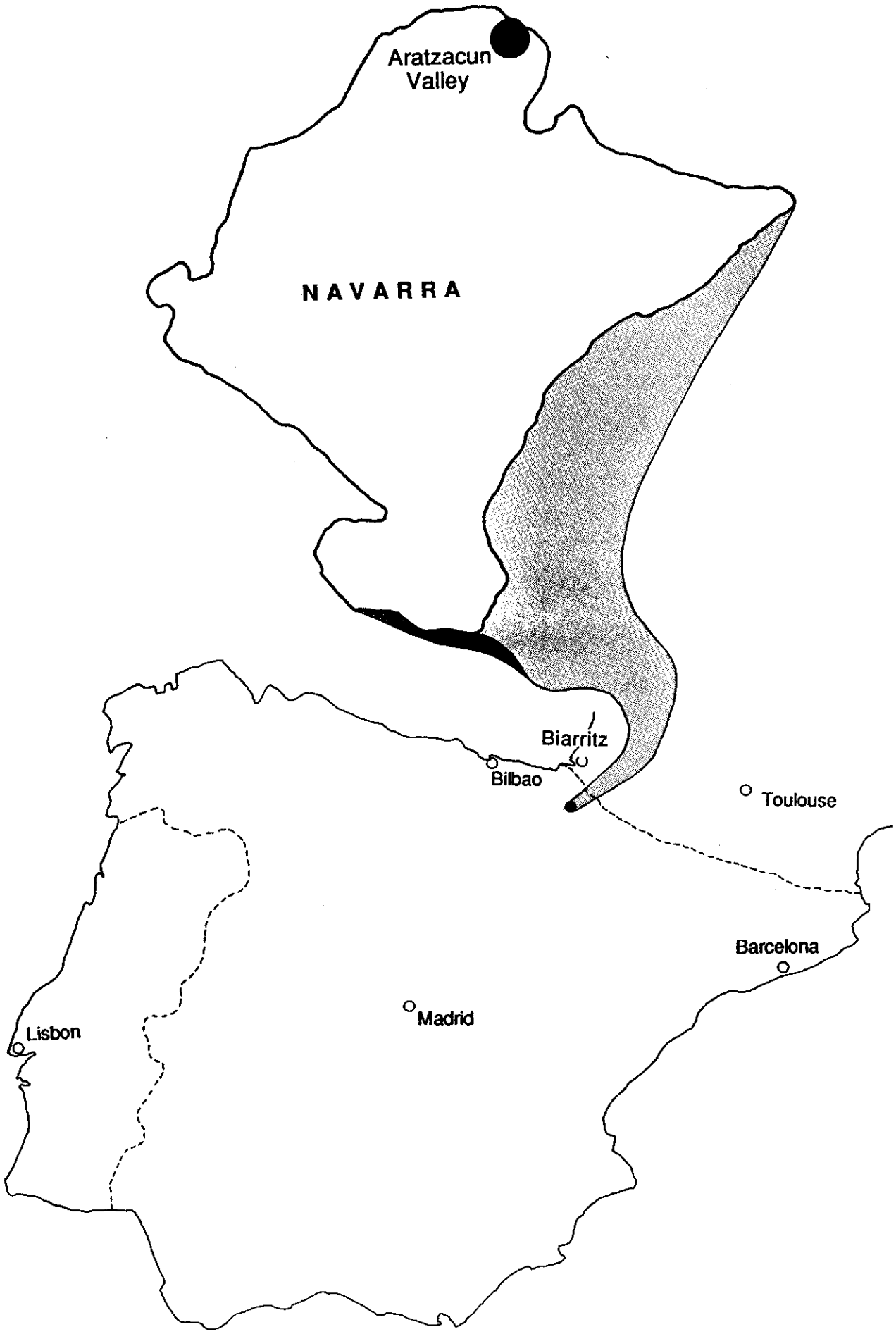

Aratzacun
Valley
NAVARRA
Biarritz
Bilbao
Toulouse
Barcelona
Madrid
Lisbon

Fig 1 (a)

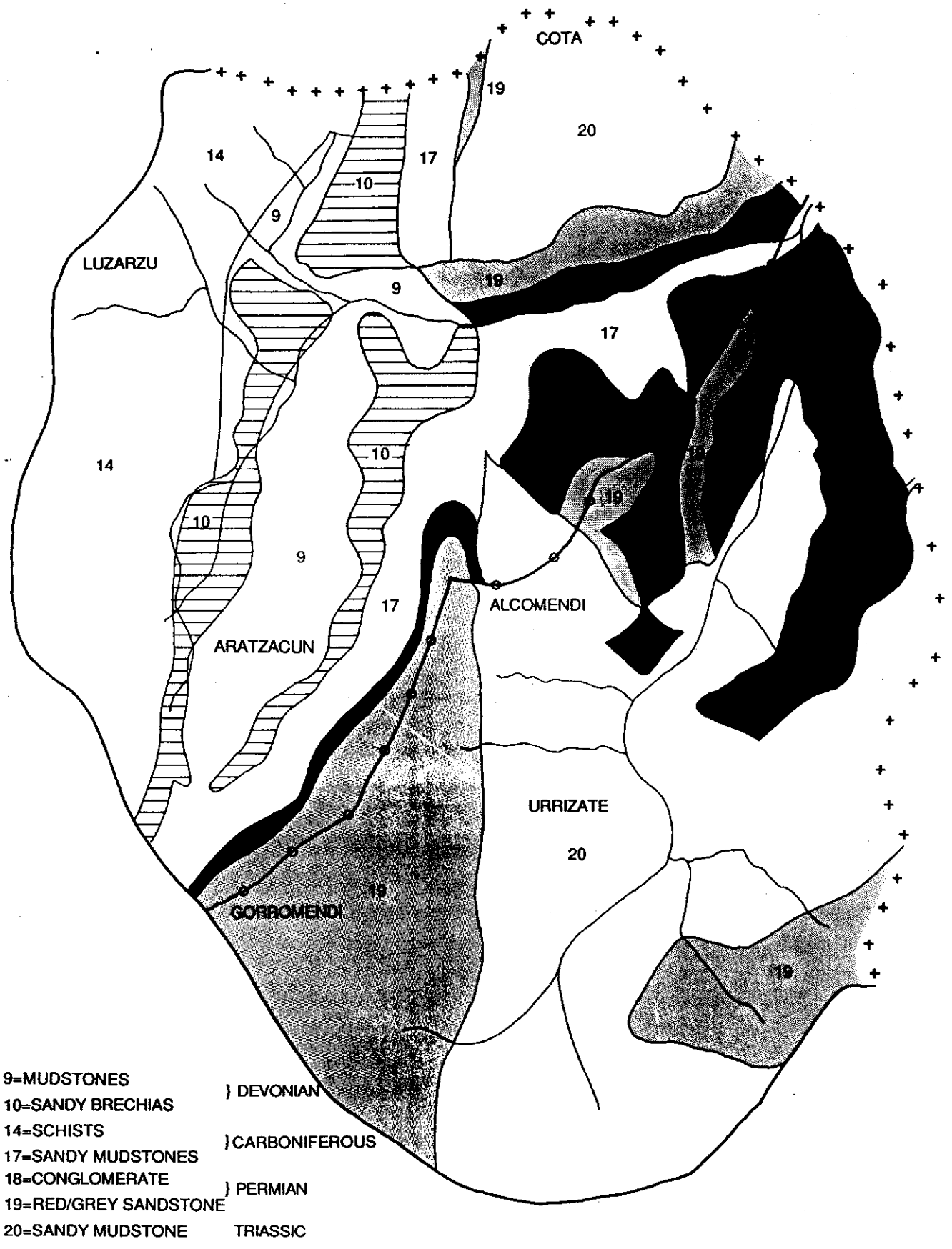


Fig 1(b) Geological strata

Within the valleys as a whole, one of the first features which strikes a visiting ecologist is the complex series of forest types present and their relationship with the environment. In many areas of Europe the correlations between species composition and environment apparent in the valleys have been broken down by the intensity of man's exploitation. Although, here, the trees have been intensely utilized by man over many centuries, the distribution of the major species, (beech, alder and oak) show clear correlations with environmental factors in terms of slope, water relations and nutrient levels. A further point is that, in comparison with many other areas, there is a limited representation of exotic species in the valley, ie species from outside Europe. Only a few small trial plots of *Quercus rubra* and *Pseudotsuga menziesii* are present. There is, however, only a very small area of relatively unmanaged woodland, that is forest which has not been cut in recent years. The only such area is near the summit of Alcomendi. One of the major features in the valley is the previous intense management of the trees in the valley floor, many of which have been pollarded, lopped, topped and coppiced.

The principal feature structure is therefore the 'V' shaped subsidiary valleys rather than the 'U' shaped patterns usual in glaciated areas. Also, the dense forest cover has restricted the range of species present in the valley. Not only has this been important in terms of current landscape, but also in the evolution of the range of species present in the area.

Communications are necessary for modern living in mountainous areas, and their paucity has been a major factor in the limitation of the development of the valleys. In the view of the planners, it is a social necessity to improve the quality of roads in the valley. In ecological terms it is therefore necessary to assess the impacts of such improvements. This is one of the major factors considered in the later section of this report.

It is always necessary to bear in mind the economic criteria and financial returns that are involved in land use. The problems of the Aritzacun valley are familiar to anyone who has travelled in western Europe, whether of the mountains of Scotland, Wales, the Massif Central, or elsewhere in thePyrenees. The difficulties imposed by the terrain and climate mean that the maintenance of a viable population is increasingly difficult, because of economic facts. Yet human influence is an essential component of such landscapes, in that the variety of forms and fields not only give rise to much wildlife interest, but also contribute to the outstanding characteristics of the scenery.

Clearly many factors had to be taken into account when the zonation was determined, but in particular, an attempt was made to include the overriding considerations of the

social aspects of the area.

The vegetation survey probably missed some species, particularly those that come early in the spring and summer, because of the time of year of the survey. There is no doubt that a full survey throughout the year would greatly increase the number of species found. Moreover, the animal populations present in the valley were omitted because of the time scale of the study.

The whole survey showed that if action is not taken, then much of the valley will return to forest. Abundant regeneration was noted in many areas, particularly on the heath-land and around the margins of the old fields. If any agricultural use was withdrawn then, these would rapidly return to forest.

An additional interesting point is the richness of the lichen flora - *Lobaria* species in particular. These are indicators of clean air and show that the valley as a whole has a clean atmosphere. The amount of regeneration seen suggests that there is already a decline in grazing pressure. This, taken in conjunction with the limited number of farms currently active, suggests that if some action is not taken then in 15 or 20 years time, the valley will be depopulated.

TOPOGRAPHY

Both valleys are deep cut and 'V' shaped, with distinctive subsidiary peaks on spurs running out from the main ridges. Small rivers have cut back into the main ridges, and there is a dissected and complex topography, with many counter slopes. Differing geology (**Figure 1 (b)**) on the eastern side of the Aritzacun valley (ie sandstones and conglomerates) has produced steep slopes running down from dissected tablelands, as opposed to the more gentle slopes of the west. The main ridge from Gorramendi to Alcomendi is a striking feature, and its northerly end terminates in a spectacular sandstone ridge emerging from the forest cover. In the south there is another major scarp overlooking Aritzacun, with a number of towers and rock pinnacles. There is something of a dip slope at first on the west side of the Urrizate valley, but the east side of this valley is even steeper than Aritzacun. The exception to the generally rounded slopes of the west side, typified by the summit of Lizarzu, are the small sandstone scarps in the bottom of the valley.

Patches of exposed rock are scattered throughout both valleys, and relate to the detailed geological patterns. The upper slopes are much steeper and drier than those further down, but there are considerable local modifications due to slumping of geological strata and local erosion patterns. The appearance of the valley is dominated by the contrast between the bright green fields of the valley floor, which are always associated with small flat areas, as opposed to the bracken covered slopes with strips of forest following up the rivers. This emphasises the topography, picking out the dendritic nature of the river systems.

The geology of the valleys is complicated and varied, particularly in Aritzacun, and there are a wide range of different geological strata. The valley is mainly a complex of different series of sandstones and mudstones, with the sandstones frequently eroded to give steep cliffs However, there is also an extensive area of schist on the high west side of Aritzacun, giving way in the valley below which is dominated in turn by sandy brechias and mudstones. On the north side of the Aritzacun, there is a steep series of sandstone conglomerate cliffs, leading to upper rounded sandstone slopes of the Penas de Ichusi mountain. The eastern ridge of Aritzacun is formed by an alternating series of sandstones and conglomerates, forming spectacular outcrops along the summit of the ridge. Urrizate, in contrast, is relatively simple, with the south half of the valley comprising sandstones and mudstones, generally giving rise to moister soils than further down the valley. On the east side, however, there is a similar type of spurs and re-entrants and 'V' shaped dentritic valleys as in much of Aritzacun. The northern half of the Urrizate valley is a complex of conglomerates and sandstones,

which have been eroded to form big cliffs in a very steep step-like formation. This is further reflected in the next valley to the east, which has a very large area of steep cliffs supporting their own vulture colony.

The soils of the valley are dominated by acid brown earths and brown podsolic types, although the detailed patterns, to a non-expert soil surveyor, are often camouflaged by the intense red staining in the soil. There are extensive brown earths on the better drained lower slopes, and many gleyed brown earths by the stream sides. At the higher levels on the poorer sandstone soils with free drainage outside the forest, there are extensive podsols, but these have remained as podsolised brown earths or brown podsolic soils beneath the forest cover. At the higher levels of the valley on the summit ridges, there is limited coverage of peaty podsols, familiar to those who know the western Atlantic environment. By the stream sides themselves, and also in the valley bottoms by the rivers, there are some ground water gleys, but these are restricted in their occurrence.

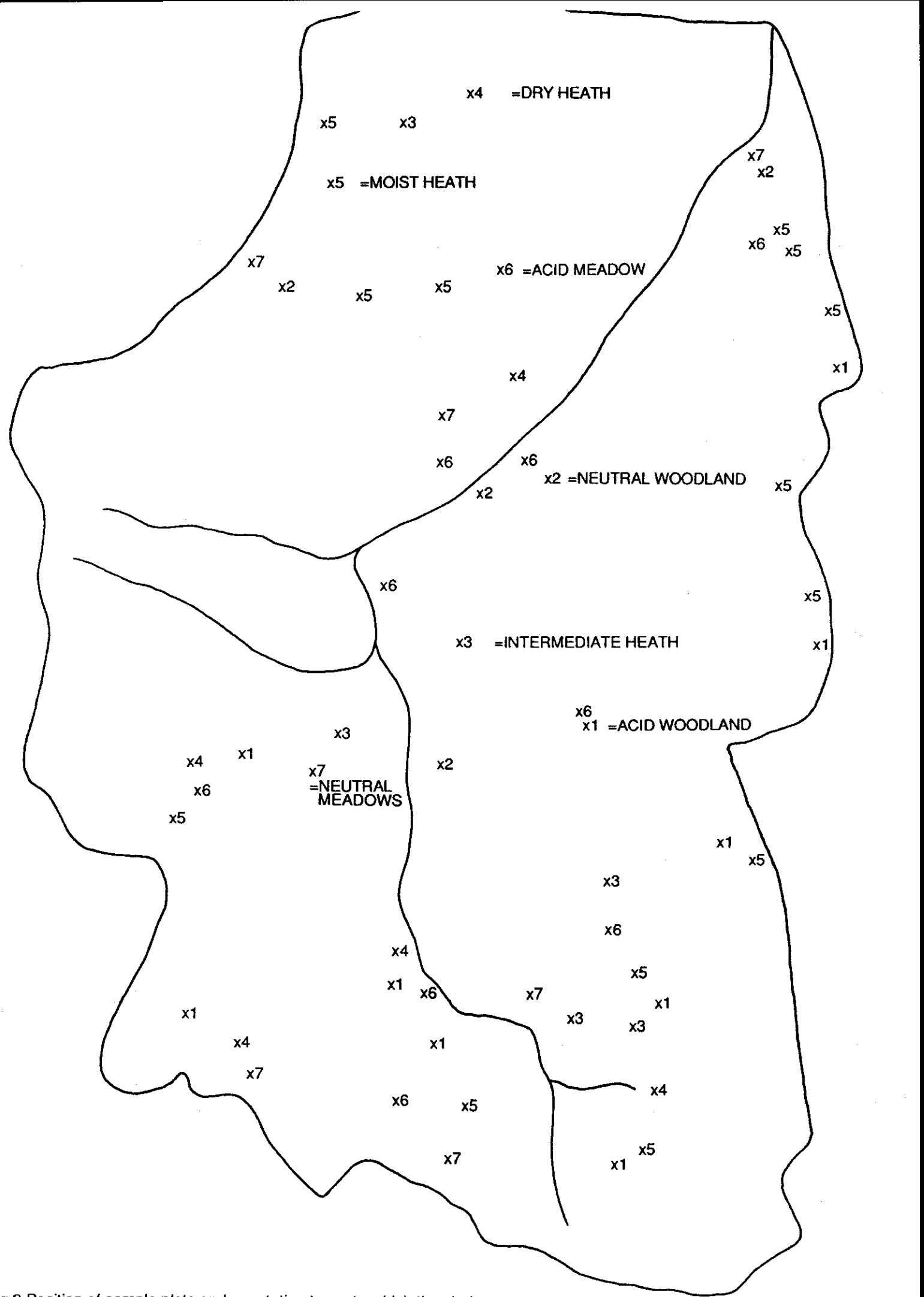
METHODS

Because of the short duration of the survey, it was not possible to carry out a detailed statistical analysis of the topography and soil patterns in both valleys, so the study concentrated on the Aritzacun with a subsidiary analysis of the Urrizate. The sample plots were determined by strata determined by a combination of the following characteristics:

1. The aerial photography map of woodland, heath and meadows drawn up by the forest services was used as the primary structure of the stratification.
2. Geological series. The main strata were then combined into the different geological series, to provide a second tier of division.
3. Two altitude zones were then superimposed.
4. The east and the west aspects of the valley were then separated.

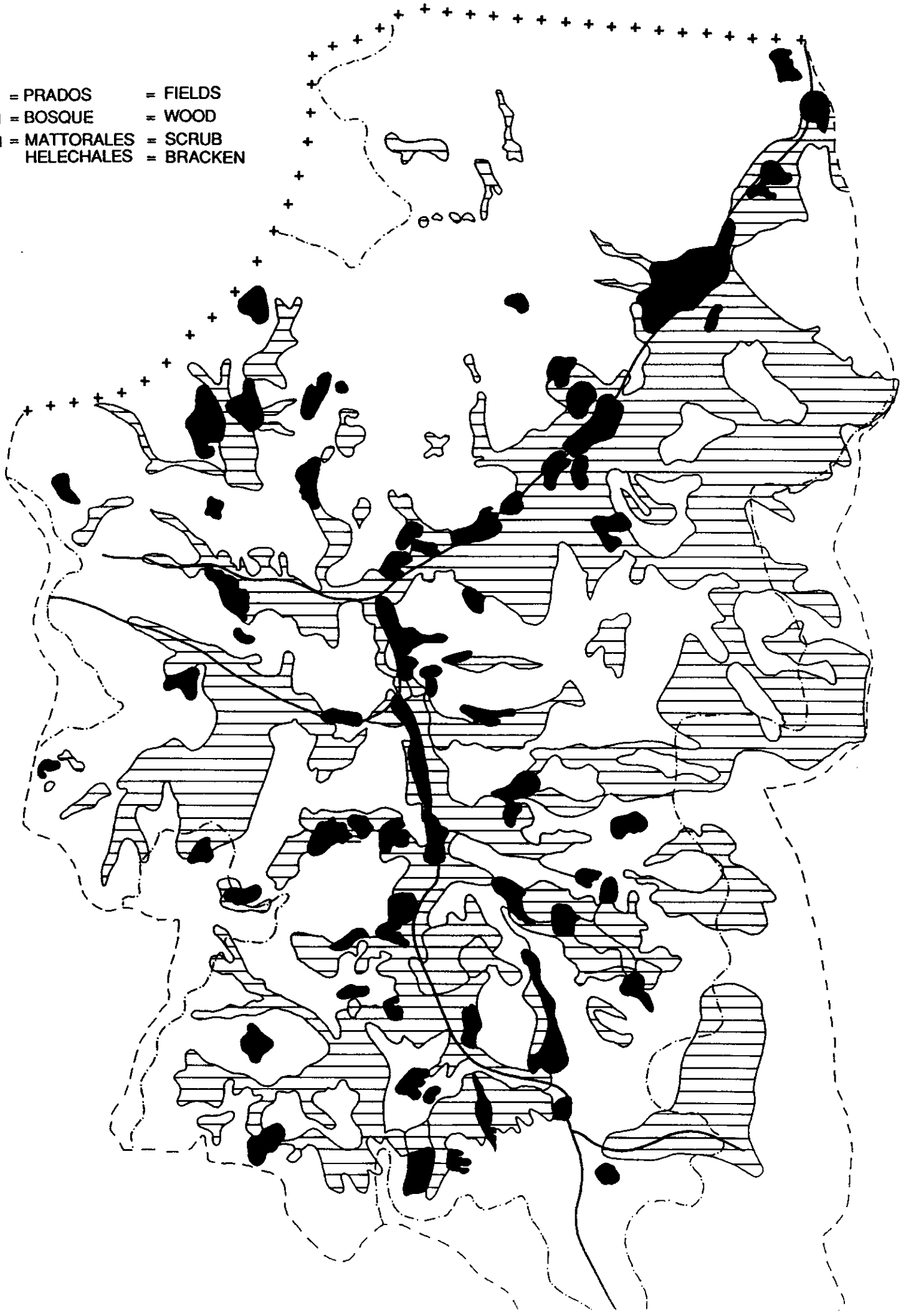
This gave a total of some 65 different combinations of environmental characteristics, to form strata which would ensure that as wide a range of conditions as possible would be sampled. The strata were not necessarily present in all combinations, and in these cases, they were omitted. The different combinations were marked on to the maps and different starting points made every day according to the recommendations of the forest service. At the sample points, a list of all species of flowering plants and bryophytes was made in a 200 square metre quadrat. Unfortunately not all plots could be completed because of the time available for the survey period. However, as can be seen from **Figure 2**, a reasonable unbiassed coverage of the whole valley was obtained, and provided sufficient samples to draw the major divisions between the different types of vegetation. The distribution of the three strata, that is the woodland, heath and fields is shown in **Figure 3**. This map was achieved by drawing the outline of the map provided by the forest service, and by a photo-reduction process. There is some distortion due to the photographic process, but the main outlines of the principal areas of woodland and fields are truly represented on the map. The major area of difficulty was, however, beneath the summit of Gorramendi because aerial photographs were not available for this area. The map of the woodland patch below the summit there was therefore determined from experience of the approximate area covered.

The analysis of the vegetation was carried out by two multivariate procedures, TWINSPAN and DECORANA. The analysis of the data was carried out at Merlewood Research Station.



g 2 Position of sample plots and vegetation types to which they belong:-

Fig 3 Distribution of 3 habitat types in Aratzacun valley



VEGETATION

There is a wide range of identifiable, fragile groups of species and individuals in the valleys. In particular, certain species of Lusitanean origin are of interest in that they appear amongst mainly Atlantic vegetation. Much of the variation in the vegetation is due to the action of man upon the original vegetation cover in the valleys. This is demonstrated conclusively below, and is readily apparent on travelling through the valley.

1. There are many Atlantic species in the valley widely present in the western environments of Britain and Europe , e.g. *Potentilla erecta* and *Galium saxatile.*
2. Lusitanean species , e.g. *Daboica cantabrica* and *Wahlenbergia hederacea.*
3. There are also a limited number of alpine species eg *Vincetoxicum hirundinaria.*
4. Many of the species in the valley are, however, widespread European species of mesotrophic environments in terms of soil and climate. e.g. *Arrhenatherum elatior* and *Centaurea nigra.*
5. There are a number of continental species, e.g. *Galeobdolon luteum* and *Anemone hepatica.*
6. There are also a few species with strong Mediterranean affinities e.g. *Asphodelus alba.*
7. There are also a number of cosmopolitan species e.g.*Pteridium aquilinum.*

No Pyrenean endemics were seen on thi visit, but the time of year militated against the observation of complete species list. The complete list of the vegetation species recorded is given in **Appendix A.** As mentioned above, the species list is not complete because of the lack of vernal and summer species However, the autumn crocus, *Colchicum autumnale* was recorded, which would not have been observed in the spring period. The top four species in terms of frequency are those that belong to the wide ranging Atlantic grasslands series ie*Agrostis tenuis,Pteridium aquilinum, Festuca ovina* and *Potentilla erecta.*

The hierarchy of the analysis is given in **Figures 4** and **5.** The first division separates meadows with a consistent species composition, and a fairly narrow range on the DECORANA ordination, shown in subsequent figures. The second division on the non-meadows side, separates woodlands from heaths on the basis of *Fagus* and associated species. The interpretation below is intended to simplify the descriptions so that as much information as possible is contained in the diagrams. **Figures 6** and **7,** therefore, give the interpretation of the divisions in the analysis, and **Figure 3** shows the distribution of the types in the Aritzacun valley. **Figure 8** gives the soils.

Fig 4 Hierachy of Twinspan

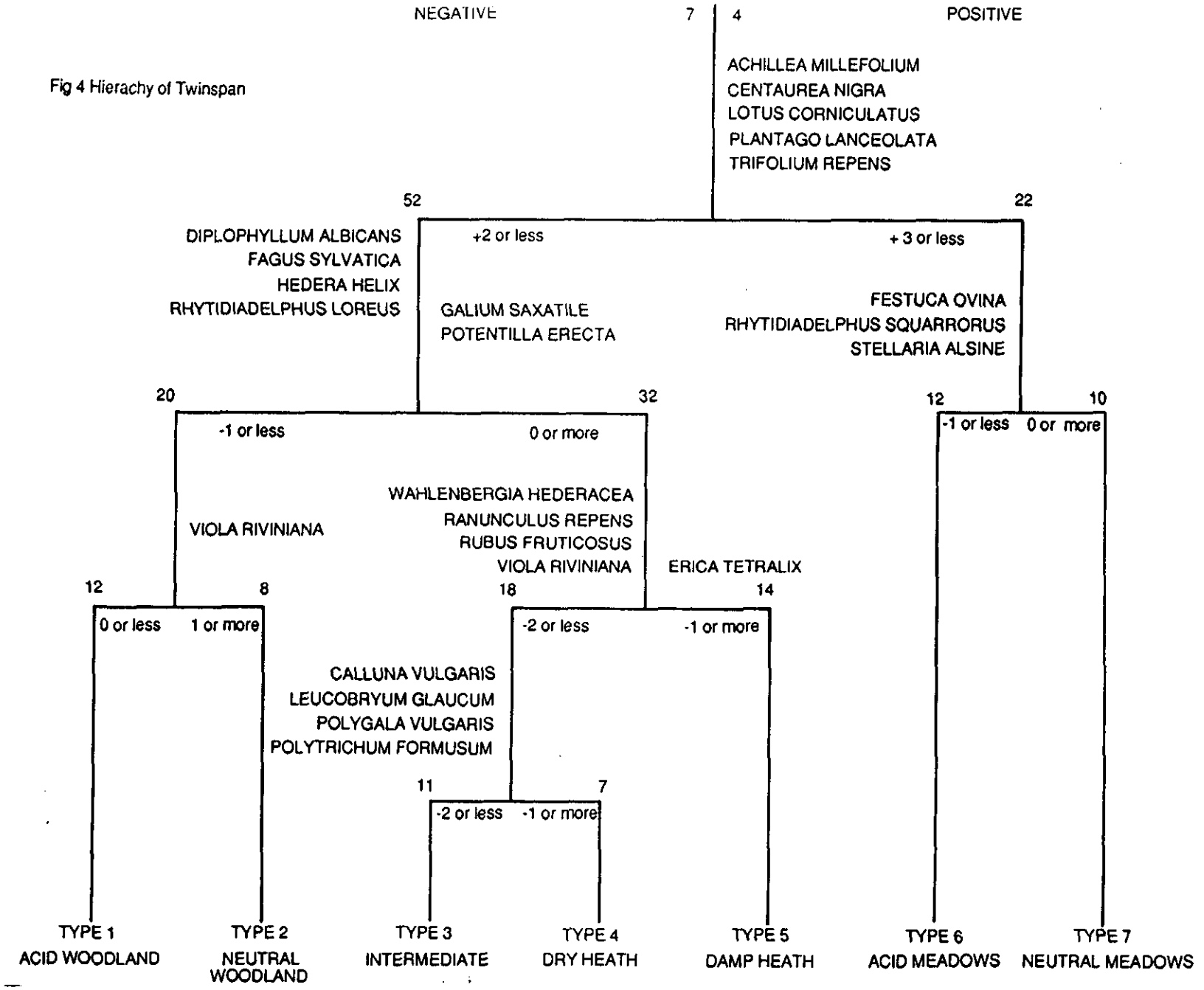


Fig 5 Interpretation of Twinspan with cover species & habitat

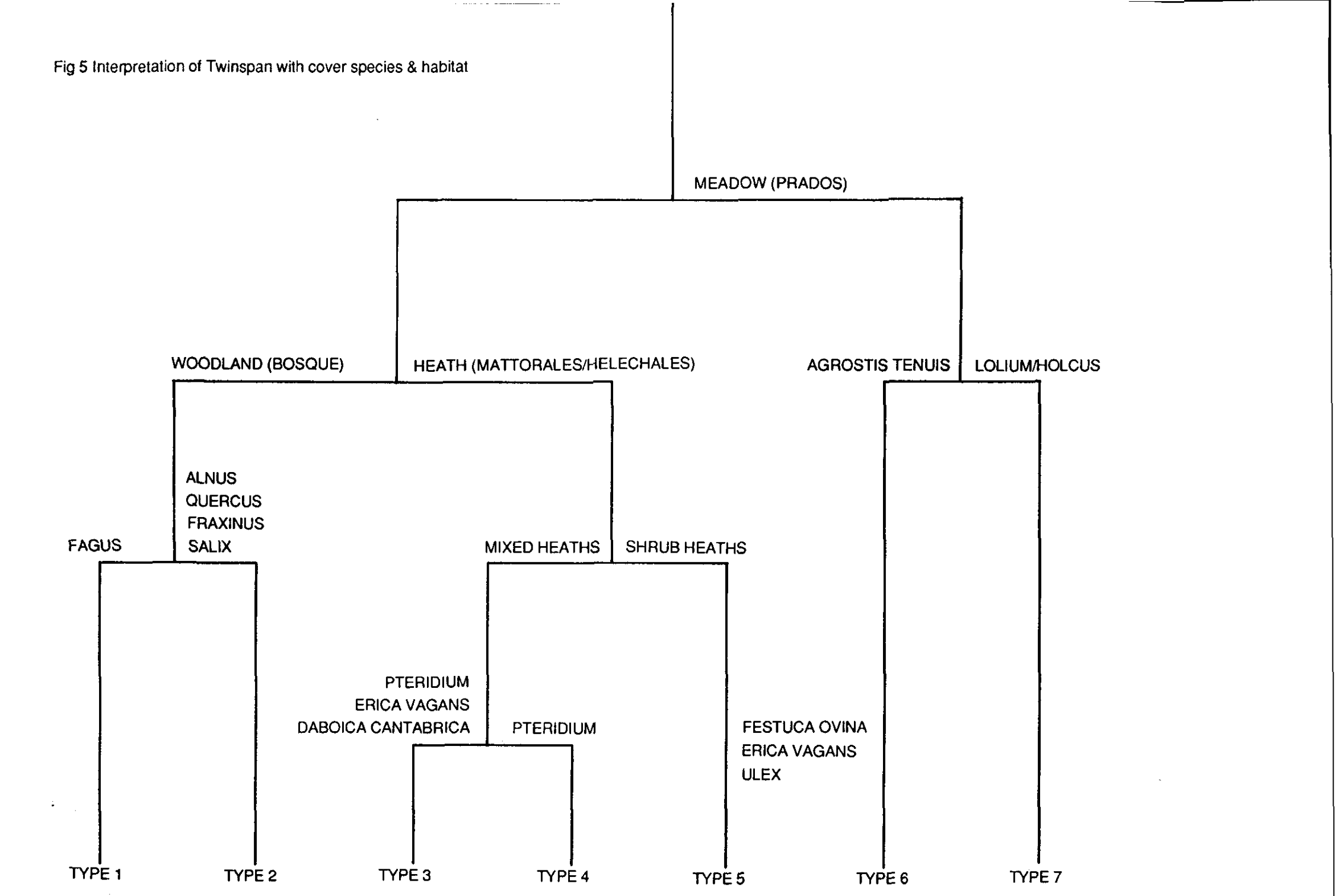


Fig 6 Typical species of the seven vegetation types on the Decorana ordination

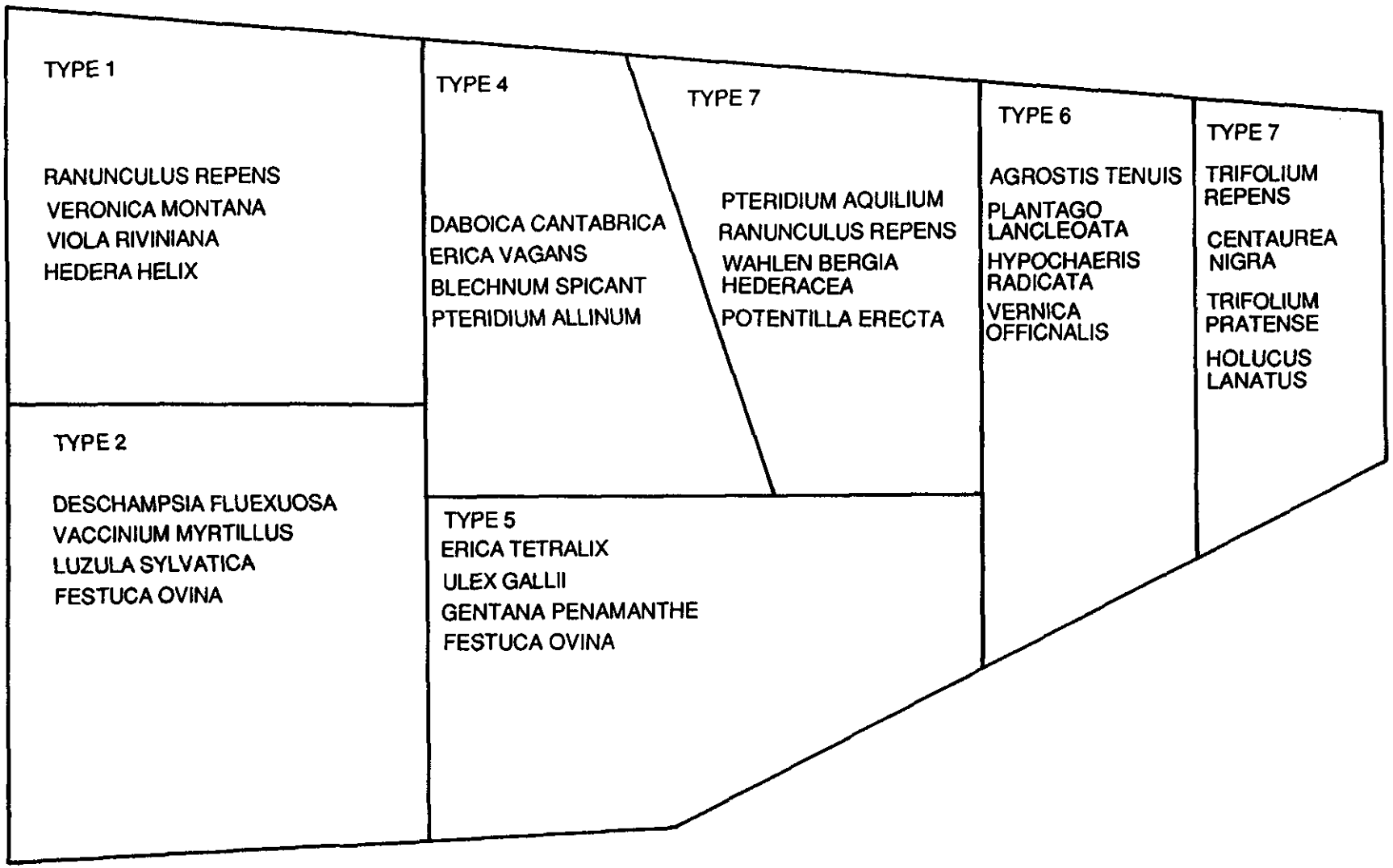


Fig 7 Principal cover species and division of plots between Urrizate andAratzacunon the Decorana Ordination

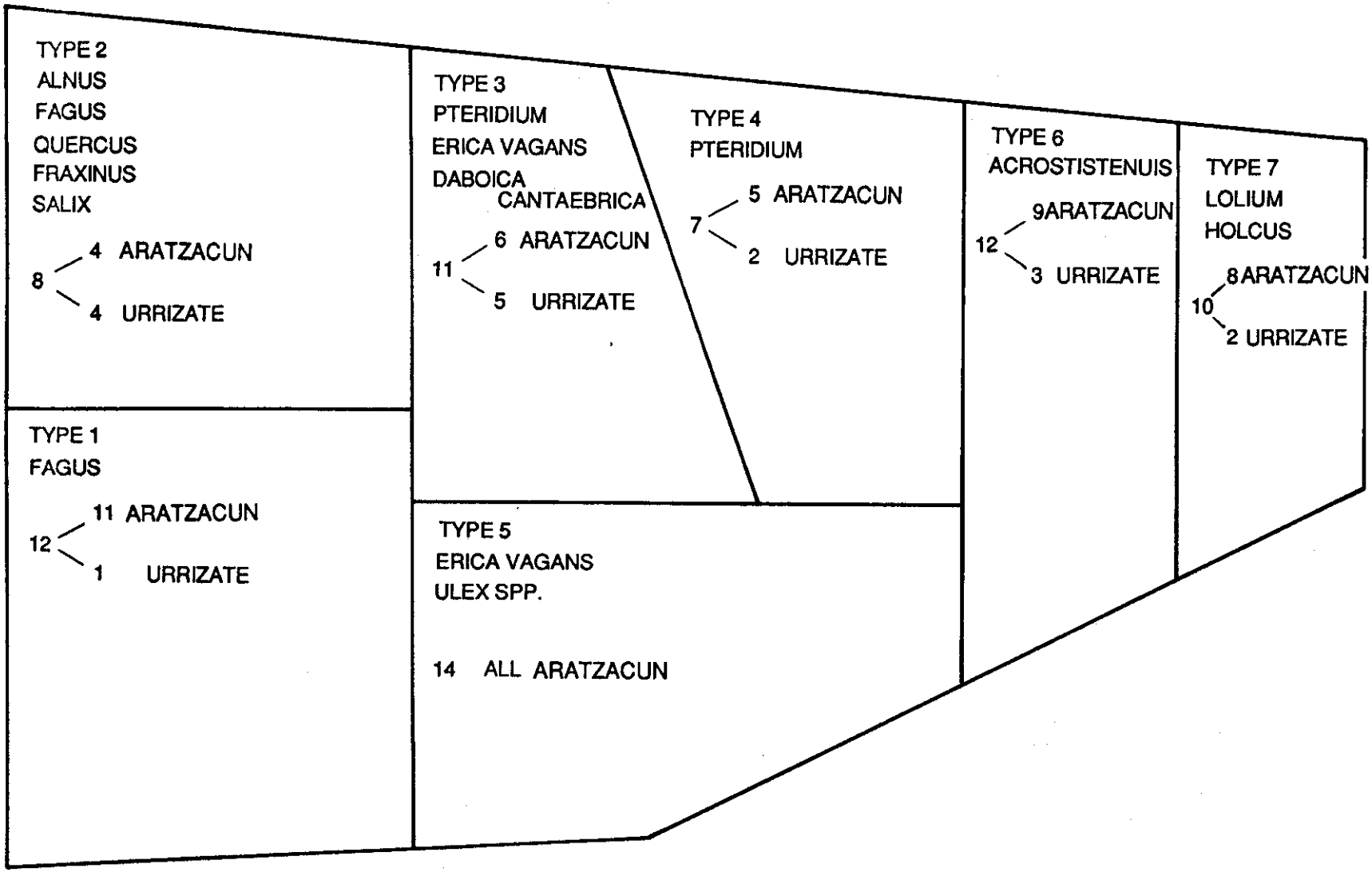
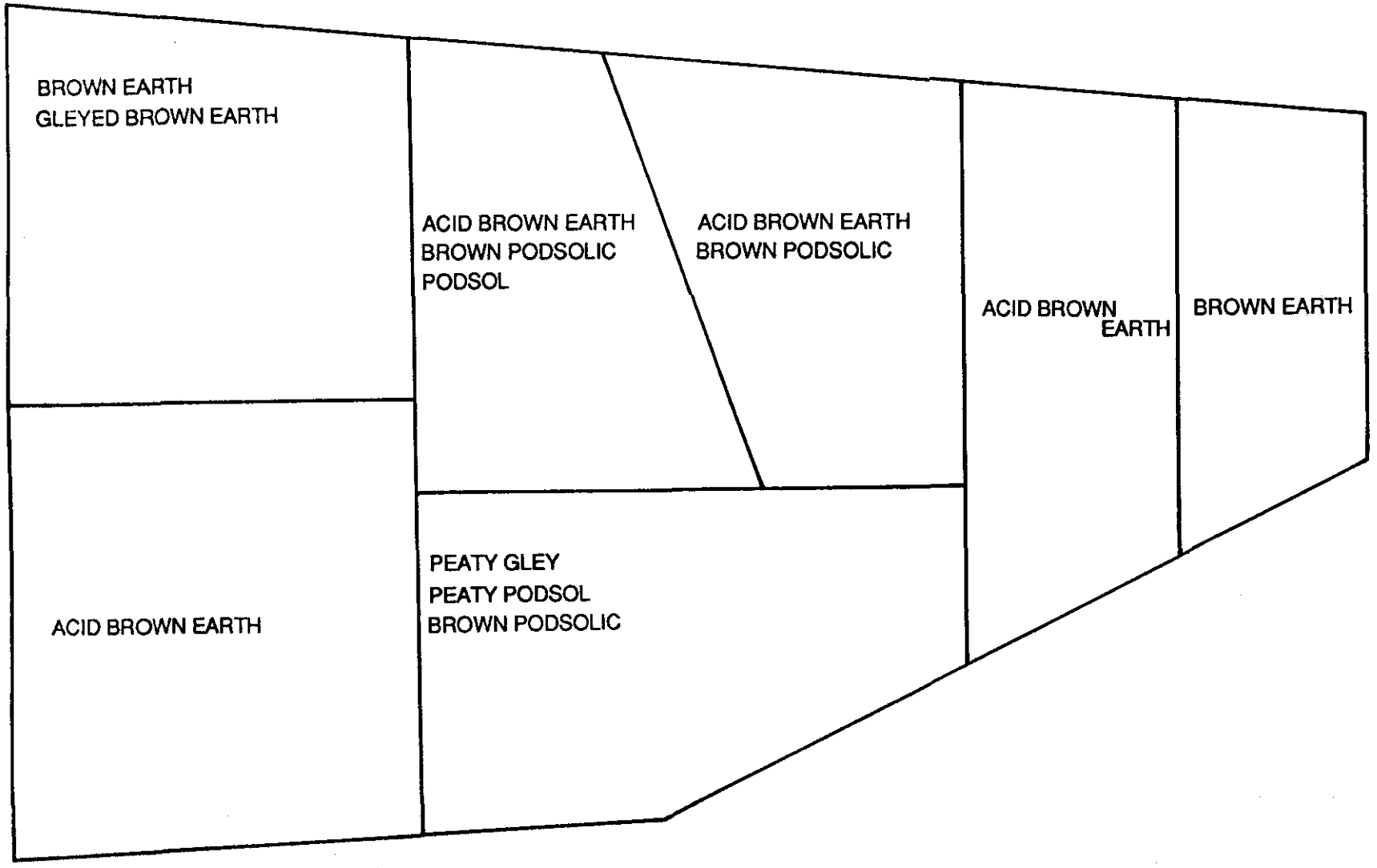


Fig 8 Typical soil types of the seven vegetation types on the Decorana Ordination



Woodland class 1 tends to be on the upper slopes, because these are much drier, more sandy and more acidic. By contrast, woodland type 2 tends to be in the valley bottom, because it is associated with the flushed and rich soils by the stream sides. The dry heather type 4 occurs mainly on the mid-slopes, because in the higher areas the comparable sites would probably be more acidic because of the great exposure.

Figure 9 shows the high correlation of the vegetation types with the strata of woodland, heath and meadows. This high correlation shows that the principal gradients in the valley are associated with management. The clearing of the forest involves increasing the nutrient level of the meadows by management leading to the development of meadows. If, however, the forest has been cleared without improvement, then heath becomes the dominant vegetation. The vegetation is thus primarily related to the type of management which has taken place historically; as much as to the management which is currently taking place. **Figures 10 - 12** show the dynamic relationships between the vegetation types. These are derived from an interpretation of the DECORANA ordination by conversion of the static positions of the plots into their seral relationships. This shows that the pathways from improvement can move to one of two categories. On the other hand, for declining intensity, the changes are restricted to adjacent types. Positive management would initially involve only the clearing of the forest and probably introduction of grazing animals. Whilst this may still take place, it is most likely that modern management would involve the addition of fertilisers or herbicides to the present fields. Also, however, around the margins of the field cutting and spraying could take place to prevent shrub invasion into productive grassland. In this case the damage can be variable, depending upon the amount of inputs. On the other hand, decline will take place more slowly, and will take two main forms:

(a) the gradual loss of nutrients added from fertilising. This will be a slow process, principally in the meadows;

(b) the invasion of heath or field margins by woody species. This will be slow at first, but may, subsequently, be at a faster rate. The tables are self evident, and show the major patterns in the vegetation and the key species involved in the divisions. Apart from the main habitats which cover very large areas in the valley, there are local habitats which were missed from the survey as the samples deliberately avoided interphases between the major habitats, and also missed rare habitats. Such habitats do, however, contain many interesting species, and the following were recognised.

1. River sides. The small areas of water by the rivers have typica marshy vegetation, with many species such as *Galium palustre* and other species from wet habitats, such as a *Eupatorium cannabinum*.

2. Old fields. These were well covered in the survey, but a number of other interesting old fields are also seen, and it is essential in the long term to survey these more intensively throughout the whole valley. For example, a species of *Linum*, perhaps *L.*

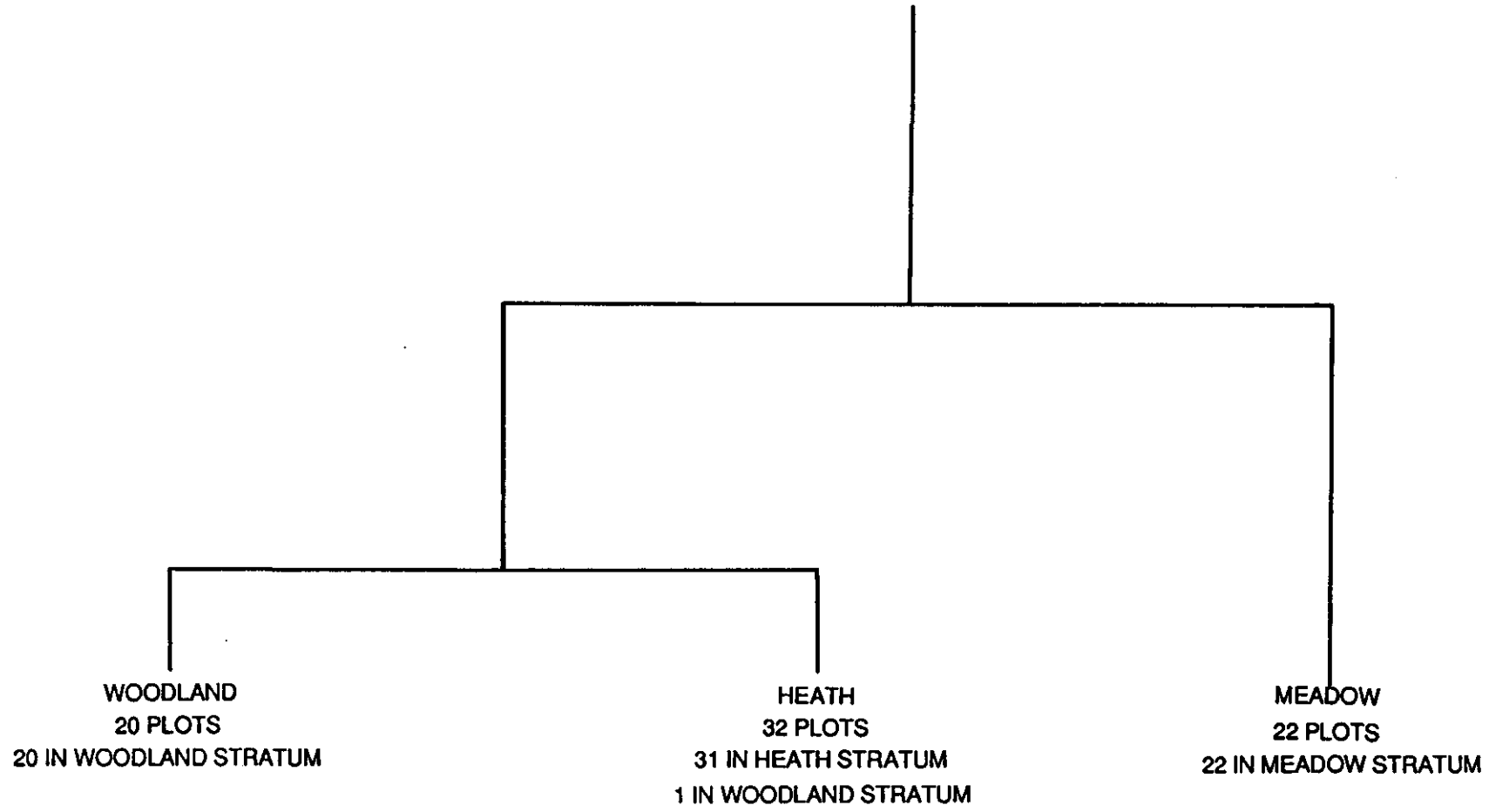
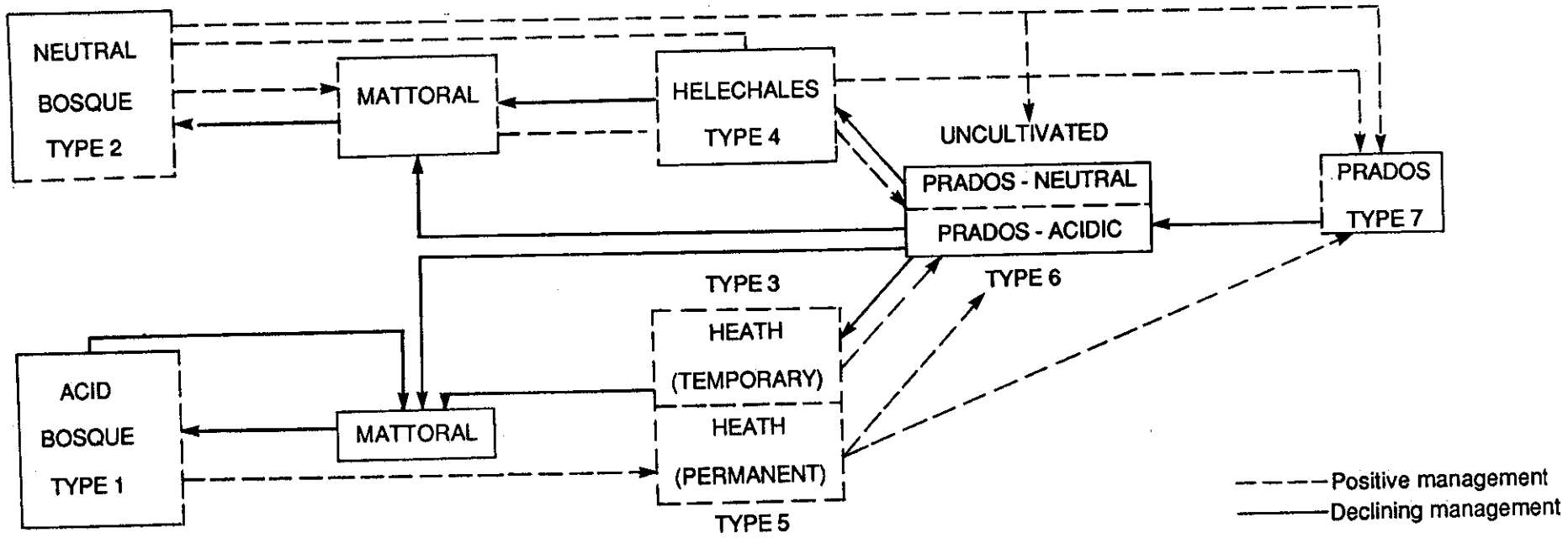


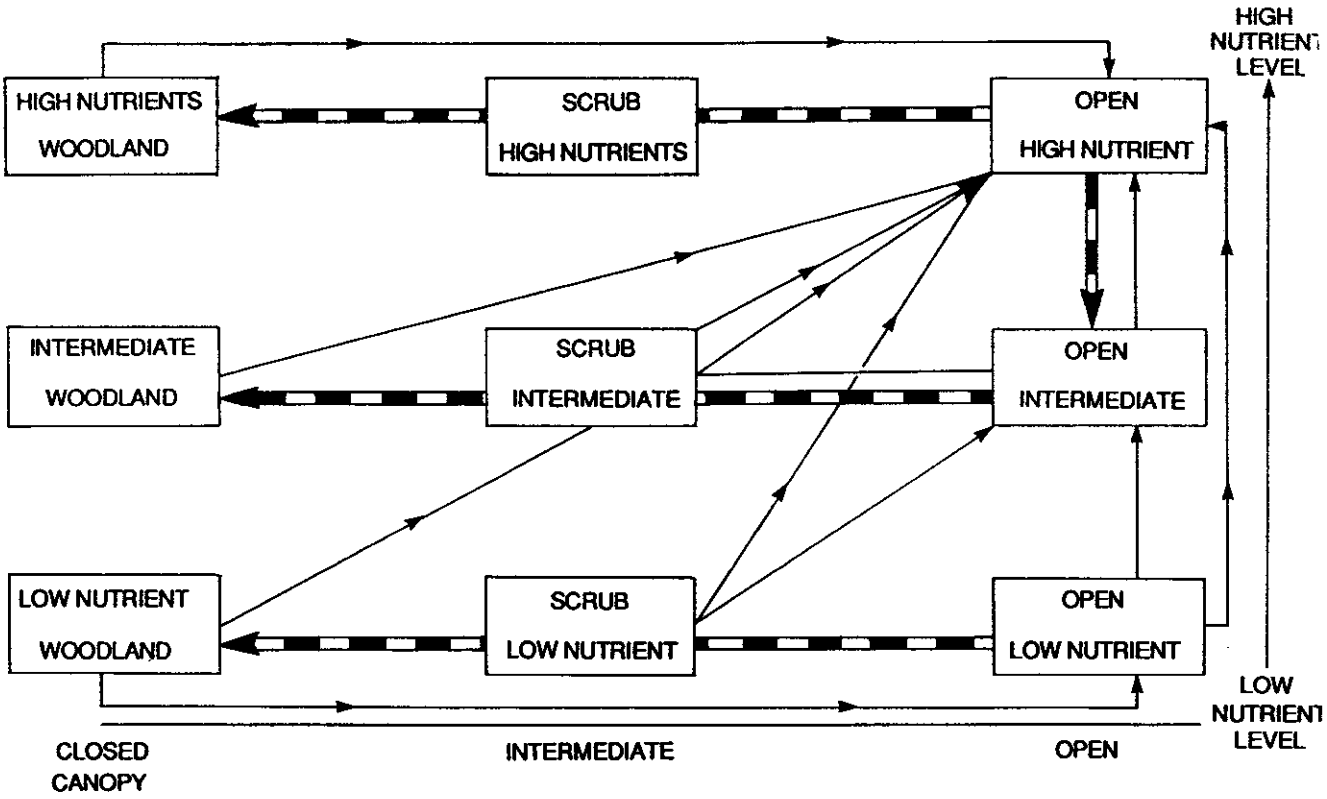
Fig 9 Proportion of sample plots recorded in the three Strata that fell within the Twinspan Vegetation groups.

Fig 10 Management relationships of the Vegetation types



BOSQUE = WOOD
MATTORAL = SCRUB
HELECHALES = BRACKEN
PRADOS = FIELDS

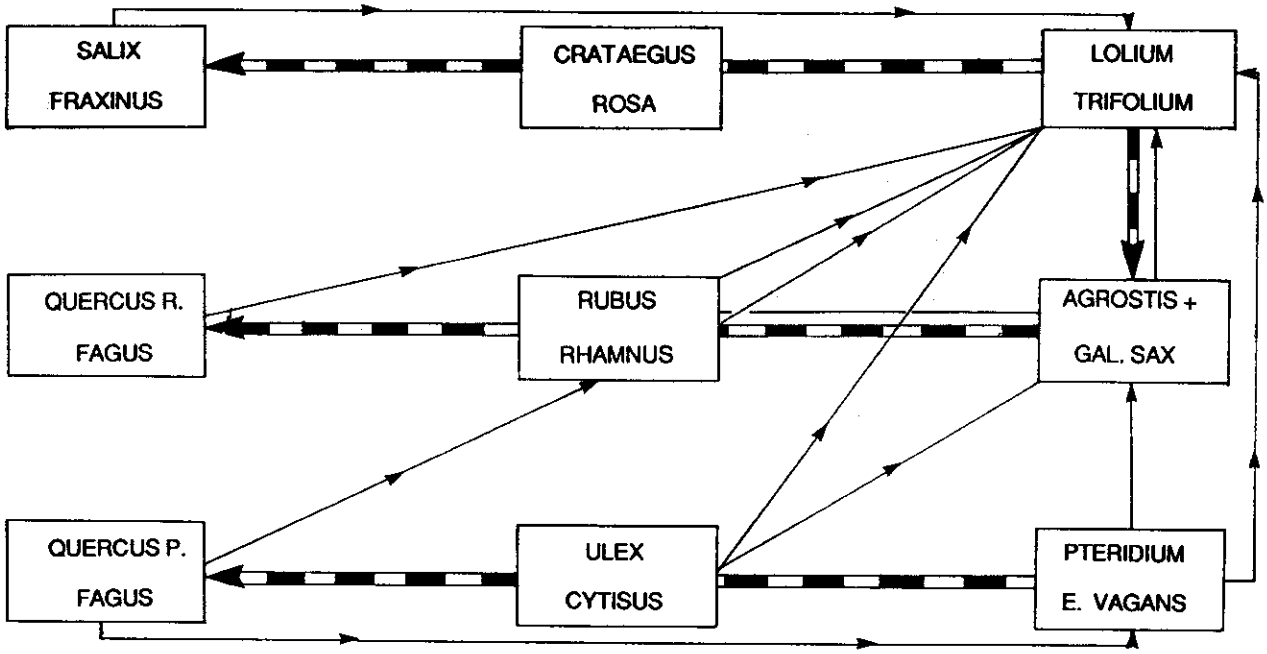
Fig11 Derived from position onRAOAxes
(habitat types)



Diagrammatic representation of transfers in environment in Aratzcoo Valley according to possible changes in management. Canopy closure in this context is an environmental factor there are more potential transfers under management than decline

—— Management inputs (clearance and/or fertilised
▬ Decline in intensity

Fig12Derived from position on RAOAxes
(species)



Diagramatic representation of transfers in vegetation in AratzacunValley according to possible changes in management

——— Management input (clearance and/or fertilised)
▬▬ Decline in intensity

narbonense was present in one or two fields.

3. Cliffs. The cliff vegetation is well protected due to its isolation,and an individual study would yield further species, and could prove interesting as far as the affinities of the vegetation as a whole are concerned. For example, an alpine species of *Silene* was seen only on the cliffs.

4. Old forests. These are mainly of *Fagus* and have already been mentioned briefly. The area below Alcomendi, in particular, has a fine forest of ancient *Fagus* trees. However, there are other areas, notably of *Quercus pyrenaica*, below Gorramendi and some of the Alnus woods in the valley bottom are old and relatively undisturbed.

5. Heaths. These have been specified fairly well in the vegetatio classification, because they ar so widespread in the valley. However, there are some specific areas of heath that are different from the general pattern which need further study, and which have interesting assemblages of species from a conservation viewpoint, supporting species such as *Ulex gallii* and *Erica tetralix*.

6. Flushes. These are species rich, with a wide range of interesting plants not present elsewhere. They are scattered through the mountain slopes and are, usually, intensively grazed. Typical of such flushes are *Linum catharticum* and *Briza media*. Throughout the valley as a whole, certain species are indicative of the gradual trend towards reforestation. Thus, at the highest level *Rubus*, *Crataegus* and *Rosa* are colonising the old fields. Further, *Pteridium*, is also an aggressive species. In association with the dynamic paterns shown in Figure 10, there are other indicator species which can be used to determine the age of the pastures, such as *Holcus*, *Achillea*, *Prunella* and *Centaurea nigra*.

. **Table 1.** Proportion of vegetation types described in **Figures 4-6** recorded from within the management zones, in order to show the characteristic of the vegetation present in the zones.

	1	2	3	4	5	6	7
1 (i) Cultural (mixed)	2	3	1	2	1	3	4
(ii) Cultural (sheep)	1	-	-	2	7	2	2
2 Forest management	3	3	2	2	1	3	-
3 Reserve	5	-	2	-	5	2	-

1 = Acid woodland
2 = Neutral woodland
3 = Intermediate heath
4 = Dry heath
5 = Damp heath
6 = Acid meadows
7 = Neutral meadows

ZONE DESCRIPTION

It is suggested that the valley should be divided into three zones, within which there should be a single major objective, but where locally subsidiary activities should be permitted, eg useful fields in the forest management zone should still be managed for hay or grazing, although the presumption overall would be for forest development. The principal objective is for a zonation that will provide the guidelines for structuring the management of the valley.

The boundaries between the zones (**Figure 13**) have been progressively refined during the study, and after the visit to the valley. They have been simplified in order to show the main features for which they are designed. However, they should not be considered as final and should be re-drawn more exactly in conjunction with the rangers, foresters, planners and local people. For the present purpose, the boundaries should be used as an indication of where the line might be eventually drawn. The distribution of the vegetation types was also used to draw the boundary, as shown in **Table1.** The distribution of these vegetation types clearly reflects the relationships beween the management zones. The zones are:-

1. The cultural zone. (zone 1)

Objective: the maintenance of a working population, with the application of farm management practice to ensure viability, together with support from tourist enterprises and local industries.

2. The forest management zone.(zone 2)

Objective: the exploitation of the forest largely through traditional practices, to provide a source of timber products and employment.

3. Reserve zone. (zone 3)

Objective: the maintenance of protection forest and the conservation of fragile groups of species and habitats.

Development control, that is planning applications for specific activities such as quarries, will still be essential to restrict the exploitation of individual sites in the valley. Planning regulations have proved essential throughout Europe in such areas. It would no doubt be useful to visit other national parks and reserve areas in England and France in order to obtain advice on the necessary procedures that should be adopted within a park area.

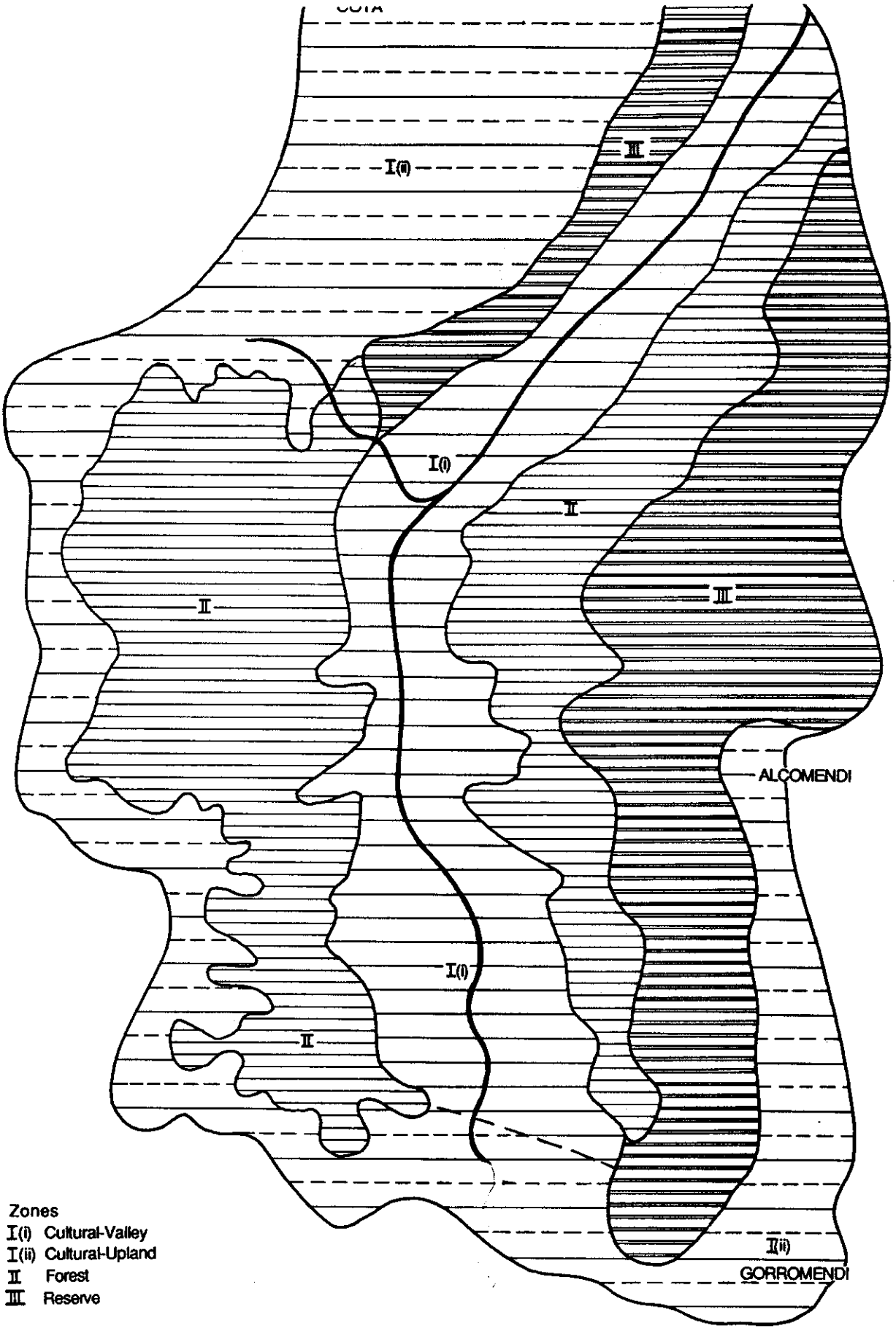

COTA
I(ii)
III
I(i)
II
III
II
ALCOMENDI
I(i)
II
II(ii)
GORROMENDI
Zones
I(i) Cultural-Valley
I(ii) Cultural-Upland
II Forest
III Reserve

Fig 13

POLICIES

The cultural zone would be divided into two sub-zones, which are altitudinally based and which have contrasting farming practice.

Zone 1 (i) Lower slopes, predominantly cattle

The valley bottom with principally hay meadows and cattle on the farms. There are a number of houses here that have recreation potential, (see below). Rural crafts and recreation facilities would also be encouraged, eg honey and pottery. In this zone, liming and use of fertilizers, provided that they were not used to excess, would not be excluded. Although primarily a production area, **Table 1** shows that a complete range of all the vegetation types recorded in the valley are present within this zone. In this table the vegetation types of **Figure 6** were recorded from within the zones in order to show the range of vegetation present. Conservation of wildlife and landscape in particular although being subsidiary to the main purpose of the zone, should still be a major sub-objective. Likewise the quality of the tree crop should be improved by management, and would be an important subsidiary occupation providing further income. It is suggested that the many buildings should be used for developing a tourist industry, based on holiday cottages rather than time-share, the considerations are as follows:

TIME-SHARE

Positive benefits

1. Exclusive clientele, and providing clients who have considerable amounts of money to spend.
2. Work would be provided for local people.

Negative factors

1. Time-share development experience elsewhere has proved that the operation is expensive to set up.
2. The time-share development often assumes additional facilities, not necessary for the holiday cottage trade, eg swimming pools, restaurants, and sports halls. This would involve further disturbance in the valley.
3. Time-share needs to be carried out in a single development programme.
4. The market in time-share is currently (1987) static. It has been difficult in many cases to sell the time-share units, which has generally proved to be a costly exercise.

HOLIDAY COTTAGES

Negative factors

1. The visitors to holiday cottages tend to have less cash to spend than time-shared accommodation.
2. There is a need to exploit the market for the product by relatively expensive advertisments.

Positive aspects

1. The existing cottages could be improved and developed, providing work for local people, not only in construction work, but also in cleaning and minor tasks subsequently.
2. Visitors to holiday cottages tend to spend their money locally rather than in the major complexes of time share developments.
3. The holiday cottages can be developed from existing buildings as more becomes available, rather than in an expensive single development as in the case of time-share.
4. There is a low ecological impact associated with holiday cottages in comparison with the large developments of time-share.
5. The market for holiday cottages is continuing to expand . Many of the holiday cottages companies in France are still developing, and the number of holidays being sold for these purposes is also increasing.
6. There is a possibility of a franchise with a company such as Brittany Ferries, who would then do the advertising and development of the market. This could remove the major financial responsibility from the Navarra government.

The conclusion, therefore, is that holiday cottage development is more likely to be sympathetic to the present status of the valley. It is also likely to be within the financial constraints of the Navarra government and could be beneficial for development of not only the conservation of the buildings in the valley, but also the provision of work for local people.

Camping presents a range of environmental problems, not least those of waste disposal and sewage. Moreover, there are also problems with fires and with general disturbance in the valley. It seems, therefore, that camping is not appropriate because of the isolated nature of the valleys. There would, within the cultural zone, need to be control of activities such as fires and picnicing. This should probably be managed by a ranger service in order to control development sympathetically.

Zone 1 (ii) Upper slopes, predominantly sheep-

The upper slopes, by contrast to the valley bottom, are exposed and used for open range sheep grazing, with some areas of intensive grassland management by fertiliser and re-seeding. The potential for such improvement is somewhat limited and whilst nitrogen in the ground water could be a long-term problem, it does not seem so likely at the moment because of the relatively low sheep numbers. It is not envisaged that the sheep should necessarily be confined strictly to the zone movement into either of the other zones in the traditional manner would, generally, not be deleterious. However, there is a long-term problem of woodland regeneration in the valley because the sheep tend to shelter in the woodlands in bad conditions, affecting the ground vegetation. However, by contrast, much of the heath vegetation is maintained by sheep grazing. Removal of the sheep would, therefore, encourage the shift back to forest. **Table 1** shows that this zone is dominated by the poor, dry and moist heath vegetation associated with

low nutrient status of the soils on the upper slopes. Much of the heath vegetation is in its present, relatively stable, state because of the sheep, but this would alter quite rapidly if left ungrazed. Many of the farmers in this area come from the Batzan valley and graze horses as well as sheep. The area is also a popular one for shooting, mostly pigeons, which come over the low col between the Gorramendi and the Batzan valley. This shooting is not a major impact in the valley and occurs over a short period, and is not, therefore, considered ecologically significant. No information was obtained about other hunting in the valley.

Zone (2) Forest management

This occupies the mid-slopes of the east of the valley, and the broad, generally Pteridium covered slopes of the west and south-west. Some trial plantations have already been made here, and it will be seen in **Table 1** that these are the poorest of the vegetation types in terms of species. The main objective in this area should be the improvement of the standard of the forest by traditional techniques, but there is also considerable potential for forest plantations. Many of the slopes are already poor for grazing because the bracken has shaded out the ground vegetation, except on isolated rocky knolls. There would have to be, therefore, intensive management in the early years in order to control the bracken. There is also the potential for inclusion of new species eg *Nothofagus*.

Experience, as suggested below, should be gained from comparable areas in France and south-west England. The landscape could undoubtedly accept more trees in this zone, because, in general, there are many large areas with no trees present. There have been no problems of afforestation in the surrounding valleys in terms of environmental impact, although there have been difficulties in identifying the best species to use. Forest roads need to be built carefully in this zone - the use of existing lines outlined below should restrict any impacts. Within the zone, any useful fields should still be maintained for agricultural purposes. Also, there are specific habitats, eg stream sides and heaths, which are important for conservation purposes which should still be maintained, although the presumption in the zone is for forestry.

Zone(3). Reserve The area of this zone in the west, below the mountain of Penas de Ichusi, is on the very steep cliffs, on which there is a large colony of vultures. In the east the suggested area is immediately below the ridge from Gorramendi to Alcomendi, and on the extension of the ridge to the north. **Figure 5** shows that a limited range of vegetation types is present within the zone, with heath vegetation of the damp type being particularly abundant. Other habitats are also present on cliffs at the higher levels. In general this zone is of limited use for other purposes, and the trees on such steep and remote slopes are difficult to exploit. The trees are also protecting the land from erosion, and therefore exploitation is not advisable. There is no reason why sheep should not be allowed into the zone, since they would probably maintain the heath in the current condition. A further emphasis in the zone, is in its maintenance as a

mature, undisturbed landscape, forming a backdrop to the valley. The number of visitors is limited by the present difficulty of access, so restriction on new path developments would be sufficient. Shooting should be banned from the conservation area.

In conclusion, therefore, the above are only guidelines and detailed prescriptions for specific areas should be developed in a management plan by joint planning between the various parties concerned ie local residents, farmers and the forest department as well as the government of Navarra.

THE URRIZATE VALLEY

The main emphasis of the survey was on the Aritzacun valley. However, a preliminary one day examination was carried out in the Urrizate. The valley was walked throughout its length. Sample plots were placed on areas close to the path in woods, heaths and meadows throughout the valley. These are not, therefore, representative in any strict sense, but do give some impression of the comparison of this valley and Aritzacun.

The results are shown in **Figure 4**. These show that except for the very poor heath, all the vegetation types of the Aritzacun were also found in the Urrizate valley. The initial study, therefore, confirms, the view that the valleys are comparable. However, the geological patterns, particularly in the upper parts of the Urrizate valley, will probably mean that the balance between the various vegetation types is different. Further survey of the valley is necessary to determine more detailed comparisons, but it seems likely that the moist woodland of the upper part of the valley could well be different from any woodland vegetation in the Aritzacun. In addition, four other comments about the Urrizate valley are made.

1. The fields in Urrizate are probably more threatened because of the lower grazing pressure. This is leading to colonization by woody species along the margin of the fields. By contrast, there was evidence of overgrazing immediately by the river, presumably because of the lack of shepherding away from the main footpaths.
2. The beech woods are not exploited very much at the moment in the south of the valley, and it would probably be best that these should be maintained in this condition. There is probably less stock than Aritzacun, and this was shown by the widespread regeneration of scrub in many areas.
3. The oak woods in the valley bottom had all been exploited very heavily in the past, and had been managed on a wood-pasture system, which has now largely ceased.
4. In the valley as a whole, all the woodland areas as mentioned above showed extensive regeneration. However, on the dense bracken areas, and on the very dry slopes in the north of the valley, there was very little evidence of regeneration. This could well change with the inclusion of new animals, or with any further extension of the main road through the valley.

CONCLUSION

It was concluded that the Aritzacun valley should be developed in the first instance, in order to establish and validify the methods that could maybe be used subsequently in Urrizate. At the moment it seems appropriate to maintain the *status quo* in Urrizate and allow development in Aritzacun, in order to gain the experience and to assess the ecological impacts in the valley. This consolidates the current status of Urrizate, as a quiet valley, with little development.

IMPACTS OF POTENTIAL DEVELOPMENTS

ROAD (Tarmac)

Direct effects

1. Limited, provided that the road keeps to the exisiting line in the upper valley.
2. Careful design will be needed to define the line in the lower valley, so that the habitats are disturbed as little as possible.
3. Care will needed in construction to avoid erosion and destruction of marginal habitats.
4. Culverts will need to be built carefully, because of the high rainfall.

Indirect effects

1. Greatly increased public pressure will have associated effects on wildlife.
2. There will be greater ease of exploitation of the forest adjacent to the road.
3. There will be improved communications for farmers in the valley, which will benefit the local economy and tourism.
4. The pattern and character of the valley will change because of the influx of people.
5. Gates of cattle grids would be required to control sheep and cattle movement.

Conclusion: A carefully designed and managed road would have few direct impacts, but would be a major influence in the long term, particularly on the social structure of the valley.

POWERLINES AND TELEPHONE LINES

These have limited effects on the wildlife and the resource, but do have an effect upon landscape appearance. Careful design of the siting of lines can minimise such intrusions, and these are not seen as a significant impact.

FISH FARM

1. Such a development would have limited effects on landscape if carefully sited and screened.
2. There would, however, be a major impact on the water resource, through high suspended solids in outflow, together with high nitrogen levels leading to eutrophication. Such effects could probably be modified by installing filtering equipment.
3. There would be a limited localised effect on wildlife downstream, due to eutrophication.

Conclusion: With proper design and controls, a fish farm in the lower valley would have limited impact.

ROADS (forest)

Direct effects~

1. The evidence from existing new roads is that there is erosion and gullying on the actual surface, as well as on the spoil at the sides.

2. There is, therefore, an increased sediment load in the feeder streams and main river, which will be affecting fish and insects. Such impacts would be potentially hazardous for a fish farm and would also influence the use of water lower in the valley. There will also be an increasing rate of runoff, and consequent impact on the hydrology.

3. Landscape appearance will be altered through new spoil and road cutting across natural features.

4. New areas of forest will be exploited with associated disturbance, and effects on wildlife and landscape.

5. New areas of the valleys will be opened up to public access and consequent disturbance.

Indirect effects:

comparable to Tarmac roads~

Conclusion: Further development of forest roads would be a major impact in a variety of ways and, therefore, needs careful consideration. Improvement of existing tracks would be a compromise, and could extend communications without the same degree of impact.

FOREST EXPLOITATION

Direct effects

1. Increased runoff and nutrient loss, which would occur follow felling,could be modified by making small coups and careful extraction. Extraction by traditional methods has minimal impact, but modern, extensive exploitation could be deleterious.

2. The loss of old trees would be counter-balanced by diversification of ground vegetation through the opening of the canopy.

3. The maintenance of a traditional forestry industry fits in with the long term policies for the valley.

Conclusion: Within the forest management zone, forestry should be the main activity and should have little negative impact, but considerable employment benefits, provided that certain safeguards are employed.

HOLIDAY COTTAGES

Many houses in the valley are currently not used, and are becoming derelict. Conversion to holiday cottages would have the following effects (the relative merits of holiday cottages as opposed to timeshare have been outlined above).

1. Houses currently in a bad state of repair would become well maintained.

2. Money would be brought into the valley to enable maintenance of traditional features.

3. Provided that adequate sewerage treatment was a condition of development, the impact would be limited to the presence of more visitors.

4. The recreation activities associated with holiday cottages has a relatively low impact on wildlife, provided that there is a ranger service.

Conclusion: Development of rented holiday cottages could be used to maintain traditional houses within the landscape. However, camping would have a major landscape impact and would have a waste disposal problem.

SHEEP GRAZING

1. Maintenance of an open grass sward and traditional pattern of use, with open areas on the hill summits, is usually valued highly in landscape terms.
2. The present hydrological pattern of fast runoff will be maintained, assuming by the same areas are involved, but there could be problems with high levels of nitrogen in the ground water if numbers increase significantly.
3. Increased fertiliser and pesticides use needs to be considered in the long term. .

Conclusion: Traditional sheep farming maintains the current situation, and provided that undue intensification does not take place, is conformable with the ecology of the valley.

CONIFER PLANTATION

1. The soil where the plantations are likely to be established are quite well buffered, so that acidification is unlikely to be important - especially as the nearby plantations tend to be sufficiently open to have ground vegetation.
2. Large blocks of new plantations are unlikely to be involved, so that effects on landscape and wildlife are relatively small.
3. Associated roads are considered separately.
4. Limited employment will result in the long term and could be linked with a ranger service, and holiday cottage industry.

Conclusion: A balanced development of plantation forestry at the head of the valley would have a relatively small impact.

SUGGESTIONS FOR FUTURE ACTIONS

A. General Management

1. A field centre could be established for studying the ecology of the valley, and as a base for working parties to assist with conservation objectives.

2. A wardening ranger service could be set-up, to cope with the increased level of use if the road is developed.

3. Increases in the recreational pressure should be coordinated with the provision in the valley, ie uncontrolled access without benefits to the permanent inhabitants should not be encouraged.

4. An overall management plan should be written with defined objectives, and a plan of work over several years.

5. A separate plan should be drawn up for the maintenance of the buildings in the valley, with the possibility of a franchise for holiday cottage development.

B. Local Management

6. Traditional crafts should be encouraged and maintained for display and educational purposes.

7. If a road is built, the siting of car parks is critical, in order to direct public use.

8. Paths should be well way-marked, and routes carefully designed, to have minimal disturbance.

C. Education and Research

9. There should be formalised links with the appropriate forest services in France and Britain, to ensure that relevant information is available, particularly on new species eg *Nothofagus.*~

10. Trial plantations could be set up within the forest plantation zone, and in small blocks in the management zone in the valley bottom.

11. The production of good and accurate guide books and information is of major importance for the conservation of the valley as a whole.

12. A detailed survey of the vegetation and habitats in the valley should be undertaken for monitoring the impact of increased disturbance.

13. Surveys of other groups eg birds, insects and fungi should be undertaken.

14. Liaison should be encouraged with educational institutions eg Pamplona University and the Pyrenean Research Institute at Jaca, to promote scientific research in the valleys.

FUTURE RESEARCH REQUIREMENTS

1. A detailed map of the vegetation types in the valley. This would involve further sampling of the valleys.
2. More detail on the specialised habitats such as spring lines, flushes and cliffs could well reveal more information about the species in the valley. This would include coverage of the vernal species.
3. The above information, in conjunction with management information from the forest department, should be used to further develop the zonal concept
4. A careful analysis and survey should be carried out to determine the best route for the new road to be build through the valley.
5. Stock maps and management plans should be prepared for the main areas of forest in the valley.
6. The valley should be compared with other local valleys, in order to establish the particular priorities which may be rather different on a local scale than just within the valley itself. Specific items that are unique to the valley could be identified, and this could be important in the overall conservation plan for the valley.
7. Very little information was collected about the distribution of animal species and birds in the valley. A study of these would be essential to further assist the development of the management plan for the conservation of the fauna of the valley. In addition survey of a variety of other forms of fauna (eg insects and small mammals) would also be beneficial.
8. A series of permanent vegetation plots should be set up in order to monitor the changes in vegetation, notably the invasion of anthropomorphic habitats by woody species.

DESCRIPTIONS OF VEGETATION TYPES

TYPE ONE ***Acid woodland***
MAIN TYPE: *Fagus sylvatica*
GROUND FLORA (COVER): *Vaccinium myrtillus, Festuca ovina*
PREFERENTIALSPECIES: *Deschampsia flexuosa, Erica vagans, Calluna vulgaris, Dicranella heteromalla , Isothecium myosuroides ,*
CONSTANTSPECIES:*Luzula sylvatica, Thuidium tamariscinum, Rhytidiadelphus loreus, Polytrichum formosum ,Hypnum cupressiforme, Diplophyllum albicans*

The most widespread woodland type in the valley, within which moist, sites with a high moss cover would probably separate out if further survey were carried out. Typically present on the upper acid steep rock slopes, on northern and western aspects on sandstone, but present throughout where there are either rocks with low calcium levels or by steep stream sides. The soils are either brown podsolic or acid brown earths, as opposed to podsols outside the canopy. In general of lower productivity than Type 2. The ground vegetation is often sparse, because of dense shade, and is often grazed. At higher levels this type of woodland becomes more open, with heath species growing in the glades.

TYPE TWO ***Neutral woodland***

TREE SPECIES MAINLY: ***Fagus sylvatica***

BUT ALSO: ***Quercus petraea/robur, Salix spp ,Fraxinus excelsior, Alnus glutinosa***

PREFERENTIAL SPECIES: ***Daboecia cantabrica, Ranunculus repens***
Veronica montana ,Viola riviniana ,Athyrium filix-femina ,
Cardamine flexuosa, Geranium robertianum, Eurhyncium praelongum

CONSTANT SPECIES: ***Hedera helix ,Oxalis acetosella, Thuidium tamariscinum***

This type is mainly associated with streamsides and grows on soils that are either inherently nutrient rich,or, to those which are flushed from above. It is, therefore, typical of the lower slopes and the valley bottoms and could readily be divided into a series of sub-types. The soils are invariably gleyed brown earths, but also include ground water gleys and brown earths. The ground vegetation is quite variable, depending on the soil conditions. In general, the productivity is likely to be high, but there may be problems of extraction because of the wet soils.

TYPE THREE ***Intermediate heath***

COVER SPECIES: *Pteridium aquilinum, Erica vagans, Calluna vulgaris*

PREFERENTIAL SPECIES: *Daboecia cantabrica, Calluna vulgaris, Blechnum spicant, Thuidium tamariscinum, Polytrichum formosum, Hypnum cupressiforme, Hylocomium splendens, Leucobryum glaucum , Pleurozium schreberi*

CONSTANT SPECIES: *Pteridium aquilinum Agrostis tenuis, Potentilla erecta, Viola riviniana*

This Type is widespread on the mid- and upper slopes, often under rocky conditions, and with somewhat mixed soils ,with *Pteridium* growingon the deeper soils. The slopes are often steep and well drained, with acid brown earths and brown podzolic soils predominating. Otherwise, a wide range of situations are covered but, often, sunny slopes seem to be preferred. If planted with trees this vegetation would be probably of intermediate productivity, depending upon aspect and altitude. There is considerable nature conservation interest in this type becauses of its relatively rich species complement, and unusual species eg *Gentiana pneumonanthe.*

TYPE FOUR ***Dry heath***

COVER SPECIES: *Pteridium aquilinum*

PREFERENTIAL SPECIES: *None*

CONSTANT SPECIES: ***Pteridium aquilinum, Agrostis tenuis, Potentilla erecta, Ranunculus repens ,Wahlenbergia hederacea, Viola riviniana, Festuca ovina***

The dense cover of *Pteridium aquilinum* leads to a low species complement in this type, with sparse vegetation cover beneath the dense fronds. The type occurs mainly on the mid to lower slopes, under relatively good soil conditions, being well drained and allowing dense growth of *Pteridium.* The type is relatively uniform in its composition, and, perhaps, covers some 10% of the valley. The soils are predominantly acid brown earths. This type of vegetation indicates that conditions are suitable for the growth of trees, and its low general interest suggests that it has a high potential for afforestation.

TYPE FIVE ***Damp shrub heath***

COVER SPECIES: *Festuca ovina, Erica vagans ,Ulex gallii, Dicranum scoparium*

CONSTANT SPECIES: *Pteridium aquilinum, Agrostis tenuis, Potentilla erecta, Galium saxatile, Festuca ovina, Hypnum cupressiforme*

The cover of this type is rather variable, depending upon the local management - with heavily grazed areas to more grassy present. There is also a wide range of soil types depending upon drainage. The soils vary from podzols, peaty podzols to peaty gleys. The wetter areas have peat as a surface horizon. The type is generally at the higher levels in the valleys and much of the summit ridges between Alcomendi and Gorromendi being covered with this type of grassland, as well as the high ridges in the west. However, on easier slopes, these grasslands could be improved by ploughing and fertilising. As far as nature conservation is concerned, there is much interest in the heaths, as they have a range of important plant species eg *Centaurea rupestris* and *Gentiana pneumanthe*, as well as having a rich insect fauna. The heavily grazed areas with much grass are less interesting than those with more of the Ericaceous plants. Intermediate levels of grazing are therefore required, since, in the absence of browsing, forest would return.

TYPE SIX ***Unimproved acid meadows***

COVER SPECIES: *Agrostis tenuis* (*Pteridium* invading)

PREFERENTIAL SPECIES: *Pteridium aquilinum, Veronica chamaedrys, Stellaria alsine, Festuca ovina, Rhytidiadelphus squarrosus*

CONSTANT SPECIES: *Veronica officinalis, Agrostis tenuis, Trifolium repens, Plantago lanceolata, Cynosurus cristatus ,Hypochaeris radicata*

These meadows are usually at the higher levels, or are more remote, as they have not been improved, either by fertiliser or farmyard manure. They are immediately identified by their colour in the landscape, dull green as opposed to the bright green of the improved meadows. Many will have formerly been hay meadows and have buildings associated with them. These have a high nature conservation interest, as they contain sensitive species such as *Spiranthes spiralis,* and are very easily modified by changes in management. At present many are also threatened by invasion of *Pteridium* and *Rubus* because of the decline in management. These meadows are mainly grazed rather than being cut for hay, and the grass is generally short. This type intergrades with the improved meadows. The soils are mainly acid brown earths.

TYPE SEVEN ***Improved neutral meadows***

COVER SPECIES: *Lolium perenne, Holcus lanatus, Arrenatherum elatior*

PREFERENTIAL SPECIES: *Lolium perenne, Stellaria graminea, Crepis capillaris,Cerastium vulgatum*

CONSTANT SPECIES: *Agrostis tenuis Holcus lanatus, Trifolium pratense , Hypochaeris radicata, Centaurea nigra, Plantago lanceolata*

These meadows are usually at low altitude in the valley, with some exceptions, notably in the southern edge and in the north-west of the border with France. The species composition varies according to the degree of improvement, but, with only a few being intensively managed as pure *Lolium* grasslands. The remainder are quite herb-rich and are usually cut for hay earlier in the year and and other species may therefore be present. In some cases, therefore, meadows of this type could have considerable nature conservation significance - especially with traditional management. Their bright green appearance is of particular importance in landscape terms. Their occurrence depends, in part on ease of access, and in part to small patches of level land that enable hay making. The soils are mainly brown earths, due to higher nutrient levels, but would revert to acid brown earths in time.

APPENDIX A

Frequency (from 74 plots) of the species in the field survey. Species with under 5 records are included, but no frequency is given.

FLOWERING PLANTS AND FERNS

Acer campestre
Achillea millefolium 7
Agrimonia odorata
Agrostis stolonifera
Agrostis tenuis 69
Aira praecox
Ajuga reptans 10
Alnus glutinosa
Anemone hepatica
Angelica sylvestris
Anthemis nobilis 15
Anthoxanthum odoratum 9
Aquilegia vulgaris
Agrostis stolonifera
Arrhenatherum elatior
Arum italicum
Asphodelus alba
Asplenium murale
Asplenium trichomanes
Athyrium filix-femina 11

Barbarea vulgaris
Bellis perennis 14
Betula spp
Blechnum spicant
Brachypodium sylvaticum 6
Bromus erectus
Bromus ramosus

Callitriche stellata
Calluna vulgaris 26
Campanula patula
Capsella bursa-pastoris
Cardamine flexuosa / hirsuta 7
Cardamine raphinastrum
Carex binervis
Carex pilulifera 24
Carex remota
Carex sylvatica
Carline vulgaris

Carum carvi *9*
Castanea sativa
Centaurea nigra *21*
Centaurea rupestris
Centaureum erythraea
Cerastium vulgatum *11*
Chenopodium album
Chrysanthemum leucanthemum
Chrysosplenium alternifolium
Chrysosplenium oppositifolium
Circaea lutetiana *5*
Cirsium palustre *8*
Cirsium vulgatum
Clematis vitalba
Colchicum officinale
Corylus avellana. *18*
Crataegus monogyna *7*
Crepis capillaris *0*
Cynosurus cristatus *11*

Daboecia cantabrica *16*
Dactylis glomerata *8*
Deschampsia cespitosa
Deschampsia flexuosa *26*
Dianthus fimbriatus
Digitalis purpurea *6*
Dryopteris borreri *7*
Dryopteris dilitata

Epilobium montanum
Erica cinerea *6*
Erica tetralix *11*
Erica vagans *30*
Eupatorium cannabinum
Euphorbia helioscopa
Euphrasia spp

Fagus sylvatica *18*
Festuca gigantea
Festuca ovina *55*
Festuca rubra *8*
Fragaria vesca
Fraxinus excelsior

Galeobdolon luteum
Galium cruciatum *6*
Galium palustre
Galium saxatile *34*
Gentiana pneumananthe
Geranium robertianum *7*

Oxalis repens

Parapholis strigosa
Pedicularis palustris
Phleum pratense
Pimpinella saxifraga
Plantago lanceolata *23*
Plantago major
Plantago media
Poa annua *7*
Poa pratensis
Poa trivialis
Polygala vulgaris
Polygonum aviculare
Polygonum persicaria
Polypodium vulgare
Populus tremula
Potentilla erecta *40*
Potentilla sterilis
Prunella grandiflora *6*
Prunella vulgaris *15*
Prunus avium
Prunus spinosa
Pteridium aquilinum *54*

Quercus pyrenaica
Quercus petraea/robur *7*

Ranunculus acris *15*
Ranunculus repens *40*
Rhamnus cathartica
Rosa canina
Rubus fruticosus *27*
Rumex acetosa *10*
Rumex acetosella *8*
Rumex conglomeratus
Rumex obtusifolius *6*
Ruscus aculeatus

Sagina procumbens
Salix atrocinera
Salix capraea
Salvia spp
Sambucus ebulis
Sambucus nigra
Sanicula eropaea
Saxifraga umbrosa
Scilla verna
Scrophularia aquatica
Sedum telephium

Sherardia arvensis
Sieglingia decumbens *17*
Solanum nigrum
Solidago virgaurea
Sorbus aria
Sorbus aucuparia
Spiranthes spiralis
Stachys betonica *11*
Stellaria alsine *5*
Stellaria graminea *7*
Stellaria holostea
Stellaria media
Succisa pratensis

Tamus communis
Taraxacum officinalis (agg *15*
Teucrium scorodonia
Thelypteris oreopteris
Thymus drucei. *12*
Trifolium pratense. *15*
Trifolium repens *30*

Ulex europaeus .....
5
Ulex gallii. *7*
Ulmus montana
Urtica dioica

Vaccinium myrtillus *13*
Verbena officinalis
Veronica beccabunga
Veronica chamaedrys *12*
Veronica montana *6*
Veronica officinalis *8*
Veronica serpyllifolia *7*
Vicia sepium
Vincetoxicum hirundaria
Viola riviniana *36*

Wahlenbergia hederacea ..... *..26*

MOSSES , LIVERWORTS AND LICHENS

Acrocladium cuspidatum
Atrichum undulatum *17*

Brachythecium rutabulum

Campylopus flexuosus