The performance of a British predictive technique (RIVPACS) in some Mediterranean rivers of Spain.

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Abbreviated title: RIVPACS in Mediterranean rivers

SUMMARY.

1. Macro-invertebrate samples were collected from 117 sites on sixty rivers and streams throughout Valencian Community (E Spain) by qualitative sampling in spring and summer. Information of twenty environmental variables was also collated for each site. The biotic indices BMWP', ASPT' and number of taxa were calculated for each site.

2. Sixty unpolluted sites were classified by two-way indicator species analysis (TWINSPAN). A preliminary classification of sites into eight groups has been proposed. Information on the species and environmental features which characterize each group is also presened.

3.- Multiple discriminant analysis (MDA) was employed to predict the group membership of the 117 sites using the twenty environmental variables. Ecological Quality Index values and classes, based on BMWP', ASPT' and number of taxa were also derived ffor each site. When the three forms of EQI were integrated into an overall ecological quality class, 55.5% of sites were included in class A, 22.7% in class B, 9.2% in class C and 10.9% in class D.

4.- The River Invertebrate Classification and Prediction System (RIVPACS), as derived in Great Britain, was found to be useful approach for the predicting the macro-invertebrate fauna of sites in rivers and streams of Valencian Community, on the basis of their environmental features.

INTRODUCTION

The objective of this study is to develop a successful system for predicting the macro-invertebrate assemblage structure of sites on Mediterranean rivers and, on the basis of the predictions, for evaluating the ecological quality of the streams. The approach adopted is based on the RIVPACS methodologies developed in Great Britain (Wright *et al.*, 1993). In this approach predictions are based upon measured physical and chemical features of the sites features.

The importance of biological indicators to assess water quality has became widely recognised in recent years. The majority of European countries have developed classification schemes for their waters (Metcalfe, 1989) using some biological component of the flora and fauna (diatoms, macrophytes, meiobenthos, benthic macro-invertebrates or fish).

In 1980 the Biological Monitoring Working Party (BMWP) score was introduced in the United Kingdom for assessing river quality (Armitage *et al.*, 1983). The BMWP score, together with the number of scoring taxa and the Average Score per Taxon (ASPT), reflects the status of assemblages of benthic macro-invertebrates with respect to the degree to which they are affected by pollution. However, they do not take account of the natural physical and chemical properties of rivers, which have a fundamental influence on aquatic communities. The need to take account of intrinsic differences of macro-invertebrate assemblages in unpolluted streams of different character and location has been solved by the application of computerised models which allow site-specific predictions to be to be made of the nature and composition of biological assemblages and their biotic index values based on field and map-measured environmental properties of the sites.

RIVPACS (River InVertebrate Prediction and Classification System) is a micro-computer-based system with applications in river management, conservation and environmental impact assessment. It was developed by the Institute of Freshwater Ecology (IFE) (Moss *et al.*, 1987; Furse *et al.*, 1987; Wright *et al.*, 1989) and has been applied extensively by the National River Authority (NRA) (England and Wales) and River Purification Boards (Scotland) in biological surveys of rivers, including the nationwide River Quality Survey of 1990 (Sweeting *et al.*, 1992).

The objectives underlying the development of RIVPACS were to produce a biological classification on unpolluted river sites throughout Great Britain, based on their macro-invertebrate fauna, and to examine whether the type of macro-invertebrate community expected at an unstressed site could be predicted using physical and chemical features (Wright *et al.*, 1993).

The current version of the system, RIVPACS III is based on a detailed examination of 613 unpolluted sites and their macroinvertebrate species from almost 100 catchments across Great Britain. The sites were sampled seasonally and the multivariate statistical methods, DECORANA (Hill 1979a) and TWINSPAN (Hill 1979b) were used to ordinate and classify the different sites according to the fauna present. It was found that a small number of environmental variables (maximum - 12) offered an acceptable mechanism that could be used to predict the fauna to be expected at a site in the absence of environmental stress.

The comparison between the invertebrate fauna expected in the absence of environmental stress and the fauna actually present provides a basis for assessing whether there has been a loss of ecological quality at a site. The ratio of the observed to predicted values of the BMWP indices can be expressed as a series of Ecological Quality Indices (EQI) which can be used to define classes in a hierarchical manner (EQI bands).

In Spain the performance of the British version of RIVPACS II has been shown to provide useful interpretations of the quality of two rivers in Galicia (Armitage *et al.*, 1990), using family level data and the BMWP indices. However, species composition of families and the biotic scores differ in Spain and Great Britain. Thus Alba-Tercedor & Sanchez-Ortega (1988) proposed an Iberian version of the BMWP score system (BMWP'). In their version some families scores have been changed and also additional families and their scores have been incorporated in order to make the system both more comprehansive and also more appropriate to Spanish rivers.

In this paper RIVPACS methodologies are used to produce a single classification of running-water sites in one area of Spain, the Valencian Community, based on species lists of macro-invertebrates obtained from two season's sampling.

DESCRIPTION OF THE STUDY AREA

The area studied comprises the three provinces of the Valencian Community: Castellón, Valencia and Alicante (surface area 23.305 km2), in the east of the Iberian penninsula.

The lithology of the area is dominated by sedimentary material (mainly limestones, dolomites and loams). Less important are the detritic rocks (clays, mudstones, sandstones and conglomeratess) and the evaporitic rocks (chalks and salts). The geological substrata are mainly calcareous with high permeability. This effect of this on the watercourses is that they often go to ground and continue as sub-surface flow.

The climate of the region is typically Mediterranean with hot and dry summers and winters which are warmest at the coast and coldest in the mountains. It is characterized by irregular annual precipitation, with maximum rainfall in autumn (sometimes 200mm^3 d^{-1}). Average annual temperatures are between 9°C in San Juan de Peñagolosa (Castellón) and 19.6°C in Benidorm (Alicante).

The hydrographic networks are composed by two differente types of rivers: short streams with their headwaters in mountain ranges close to the coast and large rivers which originate on the eastern border of the "meseta". Short streams are the typical mediterranean rivers, with high slope, low water flow and with natural disturbances (droughts and floods). Some of them can be considered to be semi-arid streams (Vidal-Abarca *et al.*, 1992). The larger rivers have shallower slopes and a regular water-flow and many have dams built across them for hydropower generation.

A total of 119 sites from 60 rivers in Comunidad Valenciana were chosen for study (Figure 1). Only six of these rivers were large watercourses originating outside the three provinces. These were the Mijares and Villahermosa (Castellón), the Cabriel, Jucar and Turia (Valencia) and the Segura (Alicante). The other watercourses are short streams arising within the community. Many of these are tributaries of the six large rivers.

METHODS

Data collection

Study sites

Ninety eight sites were visited in both spring and summer 1990. On each visit, single macro-invertebrate samples were collected from each site with flowing water. In practice only 94 sites could be sampled for macro-invertebrates in spring and 90 in summer, whilst 96 had taxa present in one or both seasons. In this study macro-invertebrates were defined as specimens >3mm in total length. At each site values of a standard set of environmental variables was also measured in each of the two seasons. The 96 sites with taxa present were subsequently used to develop preliminary classifications.

A further 21, new sites were sampled in the same way in spring and summer 1994 and the biological and environmental data collected was used to test and refine the preliminary classification.

Environmental variables

Data on 20 variables (Table 1) were abstracted for use in developing predictive models. Altitude, distance from source, latitude, longitude and province were taken from 1:50.000 maps (Spanish Army's Geographic Service). Dominant midstream and marginal substratum, water velocity, mean water width and depth, pH, conductivity and dissolved oxygen were measured in the field and alkalinity, calcium, nitrite, nitrate, amonia, sulphate and total hardness were analysed in the laboratory. Field derived samples were taken in both spring and summer. Fuller details of the methologies used are described in Pujante (1993).

Macro-invertebrate samples.

Macro-invertebrate samples were taken using a long-handled a pond-net with a mesh size of 2 mm. Sampling duration was five minutes and collections at each site were made from a transect across the river of approximately 25 m in length. Each pond-net sample was subsequently supplemented by specimens collected during 10 minutes of hand-sorting from stones and wood surfaces. Samples thus covered all habitat types.

Collections were fixed in the field with 10% formaldehyde. Samples were sorted in the laboratory using flat-bottomed white trays and the specimens removed were preserved in a 9:1 mixture of 70% alcohol and glycerin.

Identifications were carried in the Deparment of Animal Biology (Valencia University) using the best available keys. Further identifications of selected specimens were made, and taxonomic advice given, by specialists in the Iberian Fauna. However, some taxa could not be taken beyond genus and some were not identified beyond family level. The latter were principally Diptera and some families of Trichoptera.

The sampling and sorting procedures used were not considered suitable for quantitative data and taxon records for each sample were held as presence/absence information only.

Biotic indices

The Iberian version of British BMWP system, as modified by Alba-Tercedor & Sanchez-Ortega (1988), was used to represent the assemblages of each site as a set of simple numeric indices. The three component indices of the Iberian BMWP' system are BMWP' score, number of scoring taxa and ASPT'. Values of each of these three forms of the index, were calculated for each individual spring and summer samples from each site. Combined site index values were also calculated using the full list of taxa collected from both seasons' samples from each site.

Data storage

Data were stored, as flat ASCII files, on a micro-vax II mainframe computer at the Institute of Freshwater Ecology, Dorset, England.

Study sites

Details of the study sites and samples were held in sample register. This comprised the following information for each site: a unique sample identification code, river name, site name, site geographic reference and sampling date. Each sample identification code consisted of an eight digit character string in which each successive pair of digits represented river name, site name, sample number and season of sampling (01 for summer, 02 for spring and 00 for combined season).

Separate sample registers were compiled for each season (spring, summer and combined) and year (1990 and 1994) of sampling.

Environmental data

The environmental variables were in two data-files: one for the 96 sites from 1990 and another for 21 new sites from 1994. Each file was in fixed format and held site mean values for each variable in standard character positions. Each set of values for each site was prefixed by that sites unique identification code as used in the sample register.

For each site, province, dominant midstream and marginal substratum, water velocity, mean water width and depth and were held as categorical data. Values of the other map and field derived variables were held as continuous data. Of these, each chemical parameter, altitude and distance from source were stored as $\log_{10}$ transformed values.

Macro-invertebrate data

A full list of the taxa recorded at each study site is given in Appendix I, together with the frequency of occurrence of each taxon in each season.

Six separate data-files were prepared representing each single or combined seasons' samples for each year of sampling. Thus this set was directly equivalent to the six sample registers described in a previous section.

For each sample in each file the data structure was the unique site code, as used in the sample register, followed by a standard set of taxon codes, representing the list taxa present in the sample and concluded by the site terminator (-1).

The numeric codes for each taxon were an extension of a system developed for Great Britain (Maitland, 1977) as modified by the Biological Determinand Dictionary Working Group (1989) and adapted to include the additional taxa found in this study but not present in the British fauna. Each taxon code was an eight digit character string incorporating an encrypted taxonomic hierarchy. Thus the four successive pairs of digits representing each taxon identified its order (or higher category), family, genus and species respectively.

Data Analysis

Ordination of the sites, based on their combined seasons' faunal lists, was carried out using detrended correspondence analysis (DCA), implemented using the DECORANA program (Hill, 1979a). Two-way indicator species analysis was used to classify the same set of sites. The TWINSPAN program (Hill, 1979b) and combined seasons' faunal lists were used for this purpose.

Multiple discriminant analysis (MDA) was used to relate the site groupings to the environmental data. The SAS/Vax version of MDA (SAS, 1990) was used to find combinations of the values of the 20 recorded variables which best replicated the existing biological groups (Klecka, 1975). In this way discriminant function equations are generated which minimise the within group variance, in ordination space, of the location of all sites in the same end group of the biological classification and maximise the between group variation of sites in different end groups.

Fuller details of the multivariate analyses applied in this study are given by Furse *et al.* (1984) and Wright *et al.* (1984).

RESULTS

Biological characteristics of the intial set of sites

A total of 184 different taxa were identified from the 96 sites sampled in spring and/or summer 1990. Of these 145 occurred in the spring samples and 150 in those taken in summer. The best represented group were the Coleoptera with 38 distinct taxa, followed by Trichoptera (25 taxa), Mollusca (21) and Diptera (18). The most frequently occurring taxon was the Hydropsychidae. Specimens of this family, which were not identified further, were present at 74 sites in spring, 71 sites in summer and 84 sites in the combined seasons' faunal lists. This was followed by *Baetis* sp. (73, 72 and 81). More details about the taxon richness and faunal characteristics of each site are given in Pujante (1993).

Preliminary evaluation of the ecological quality of sites

Single and combined seasons BMWP', number of taxa and ASPT' indices for the 96 sites successfully sampled in 1990 exhibited a wide range of values (Table 2). Alba-Tercedor & Sanchez-Ortega (1988) proposed a framework for classifying BMWP' index values into five quality classes, although it was not stated what duration and frequency of sampling was required in order to assess sites using this framework.

On the basis of their system, 14 of the single samples collected from the Valencian Community in spring 1990 fell into class V (heavily polluted waters). Of the others, 15 were in class IV (very polluted waters); 37 in class III (polluted waters); 26 into class II (certain degree of pollution) and 2 into class I (unpolluted waters). When the same procedures were applied to the 90 single samples in summer, 9 fell into class V; 6 into class IV; 29 into class III; 36 into class II and 10 into class I.

Finally, when Alba-Tercedor and Sanchez-Ortega's system was applied to the combined species lists from both the spring and summer samples from each site, 10 sites were designated as class V; 7 as class IV; 15 in class III; 37 in class II and 27 in class I.

The initial classification of sites

The classifications derived using Alba-Tercedor & Sanchez-Ortega's techniques were used as the first stage of selecting a sub-set of sites for further analysis. On this basis, all 27 class I sites were accepted according to their BMWP' score. From the remaining sites a second group of sites were accepted according to their ASPT' value and, in some instances, number of taxa. In this group, the minimum acceptable ASPT' was set at 4.35 but, as a second criterion, sites with ASPT' in the range 4.35-4.99 were only accepted if they had more than 12 scoring taxa.

The lowest acceptable ASPT' was chosen to be slightly higher than lowest ASPT value (4.27) included in the British RIVPACS II (Wright *et al.*, 1988). The requirement of a minimum number of taxa was introduced to exclude sites with poor habitat quality whose faunal diversity was low but whose ASPT' was elevated by the presence of a very small number of relatively high scoring taxa. As a tertiary screen on the latter sub-set sites which met the criteria were nonetheless rejected if they were known to be subjected to any form of pollution.

As a result of the selection procedures 48 sites were subsequently classified using TWINSPAN. Ten end groups were derived based on their distinctive ecological and/or geographical identity (Figure 2). Where possible, end-groups with fewer than three sites were avoided although there was one distinct exception to that rule.

The number of sites and their BMWP' index values for each TWINSPAN group were examined (Table 3). Mean nitrate (NO_3-N) and total alkalinity ($CaCO_3$) were also compared. Marked differences were apparent between the groups. For example, groups 4 and 6 had highest mean values for ASPT' of 5.87 and 5.76 respectively. They also had the lowest mean concentrations of nitrates (0.69 and 0.71 mg l^{-1}) and alkalinity (0.58 and 0.60 mg l^{-1}). In contrast, group 8 had the lowest mean value of ASPT' (5.00) and the highest value for nitrates (1.14 mg l^{-1}) and alkalinity (0.67 mg l^{-1}).

The within-group variability in the assemblage structure of their component sites can be examined graphically by means of an axis 1 by axis 2 DCA ordination plot of the combined season taxon lists for the 48 sites (Figure 3). The position of each of the of the sites is indicated by the number of the TWINSPAN group in which it occurred.

Each axis of the ordination represents an integrated environmental gradient which partially explains the between-site differences in the composition of their macro-invertebrate assemblages. The most influential environmental variables along each gradient (axis) can be explored using correlation analyses (Table 1). The highest correlations been the axis 1 DECORANA scores for each site and single environmental variables were with variables reflecting the geological character of their catchments. These were conductivity (LCOND, r = -0.521) and calcium (LCAL: r = -0.491). In contrast, the highest correlations on Axis 2 were found with variables which expressed geographical situation such as longitude (LON: r = 0.634) and distance of the site from the source of the river (DS: r = 0.530). The highest environmental correlates with in axis 3 and axis 4 were the dominant midstream substratum type (DMASUB: r = 0.600) and the river width (WIDTH: r = -0.582) respectively.

The overall variability within the data-set can be expressed by the eigenvalue of each axis which is equal to the maximised dispersion of the species scores and lies between 0 and 1. According to ter Braak (1995) eigenvalues greater than 0.5 represent good separation of species along an axis. In this case the eigenvalues of 0.304 (Axis 1), 0.244 (Axis 2); 0.204 (Axis 3) and 0.159 (Axis 4) are comparatively low and indicate that most sites have several taxa in common. This is demonstrated by the ordination plot of the first two axes of the DCA plot (Figure 3) which shows the poor degree of discrimination between many of the biological classification group in these principal dimensions.

The best segregated groups ion the first two dimensions are are one, three and seven whilst the highest degree of overlap is between four, five (a very dispersed group), six, nine and ten.

Biological characteristics of the secondary set of sites

A total of 117 taxa were recorded from the 21 new sites in the 1994 sampling programme. Of these, 154 were present in spring and 116 in summer. The greater number of taxa recorded 1994 than 1994 results from two complementary factors. Firstly, whereas the 1990 sites were selected without reference to their perceived water quality, the 1994 locations were specifically selected on the basis that they were believed to be substantially unpolluted. Secondly, a wider range of taxonomic keys were available for identification of the 1994 samples and, hence, many taxa were identified to a greater level of precision than in 1990.

In terms of overall taxon composition, the 1994 results were similar to those found in 1990. Coleoptera remained the best represented group with 43 taxa, followed by Trichoptera (27) and Diptera (20). Once again Hydropsychidae was the most frequently captured family. It was present at 20 of the 21 sites with 17 records in spring and 14 in summer.

BMWP' index values for the 21 new sites are given in Table 5 for both single and combined seasons samples. Applying Alba-Tercedor & Sanchez-Ortega's (1988) quality classification system to the spring samples resulted in 18 of the 21 sites being placed in Class I, two in Class II and one in Class III. The results for summer samples indicated poorer quality. For that season five sites were placed in Class I, eight in Class II, seven in Class III and one in Class IV. When spring and summer samples were combined, eleven sites fell in Class I, seven in Class II and two in Class III.

The extent to which the fauna and BMWP' index values of the sites could be predicted from environmental data was examined using the same approach as developed in Britain for RIVPACS (Wright *et al.* 1993). The first stage was to apply MDA to quantify the relationship between the biological classification of the 96 original sites (Figure 2) and their recorded environmental characteristics for 20 separate variables (Table 1). This provided linear discriminant functions of the first four axes of the discriminant space which could then be employed to assign new sites to the existing classification in a probabalistic manner (Furse *et al.*, 1987)

For a new site the biological classification group to which it was assigned by MDA was the group in which it had the highest probability of membership However, the predicted probabilities of capture of each taxon at the new site were integrated functons of the probabilties of that site belonging to each of the ten groups in the biological classification and the known frequency of capture of each taxon in each classification group (Furse *et al.*, 1987). In a similar fashion, predicted (= expected) BMWP' values are also derived from a site's probabilities of belonging to each biological classification group and the mean BMWP' index values of the composite sites of each of the ten groups.

In this analysis, not only was MDA used to probalistically assign each of the 21 new sites to the ten biological classification groups but the same procedures were also applied to all of the original 96 sites sampled in 1990. In this way, expected (E) BMWP' index values were predicted for each of the 117 sites sampled. Combined seasons observed (O) BMWP' index values for each 117 sites were compared with the equivalent combined season expected values to provide Ecological Quality Index (EQI) values for each site for each of BMWP' score, number of taxa and ASPT.

The derived EQI values were used as a filter to provide an improved and enlarged sub-set of sites for developing a new and improved biological classification for future quality assessments. The criteria used for site assessments were that each selected site needed to have minimum EQI values of 0.72 (BMWP' score), 0.77 (number of taxa) and 0.88 (ASPT). These were close to, but slightly lower than the minimum acceptable values used in the River Quality Survey of Britain to designate top quality (Band A) sites (Sweeting et al 1993). The more generous criteria for acceptance were chosen to allow for slightly more rigorous site selection procedures in later iterations of the development of the classification, as also applied in Britain (Wright *et al.* 1995).

A total of sixty sites met all the selection criteria for inclusion in the new biological classification. These comprised 42 of the 48 sites included in the first classification, ten of the 21 new sites and eight of the original 96 sites which had not met the criteria for inclusion in the first classification.

The TWINSPAN classification of the sixty sites was developed to five levels of division. A necessary precursor to this exercise was the standardisation of different taxonomic levels achieved in 1990 and 1994. This eliminated any possible distortion which could be introduced by the more precise identification attained for the 1994 sites. End groups were examined for group size and within group homogeneity of biological and environmental characteristics of the component sites. As a consequence several divisions were terminated at higher levels, leaving a final classification of eight end-groups each containing at least three sites (Figure 4). Also the number of sites in each TWINSPAN group was examined at the fifth level of division (Table 8). Group 4 presents the higher value for BMWP' and ASPT' and low values for alkalinity and nitrates. Groups 2 and 8 presents the lower values for ASPT'.

The DCA axis 1 versus axis 2 ordination of the sixty sites, based on combined season samples, is shown in Figure 5. The position of each site in ordination space is indicated by the number of the TWINSPAN group in which it occurred. The eigenvalues of the new ordination are: 0.311 (Axis 1); 0.238 (Axis 2); 0.165 (Axis 3) and 0.136 (Axis 4). These are very close to the original classification and demonstrate that the inclusion of the extra eighteen sites and the exclusion of six of the original 48 has not altered the range of variability in the macro-invertebrate assemblage composition.

In the new ordination, the highest correlations between values of environmental variables and Axis 1 scores were with site distance to source (DS: r = -0.767) and river depth (DEPTH: r = -0.664) (Table 9). Axis 2 scores are most highly correlated with longitude (LON: r = 0.443) and province number (PRO: r = -0.377) whilst Axis 3 is most strongly correlated latitude (LAT: r = 0.479) and Axis 4 with dominant mid-stream substratum size (DMISUB: r = 0.476). Thus, axis 1 represents an environmental gradient of decreasing river size and axes 2 and 3 provide geographic discrimination.

On the first and second axis ordination plot there was less apparent overlap of the eight TWINSPAN end-groups (Figure 5) than occurred with the first classification (Figure 3). Groups 1 to 4 were the most distinctive, with the greatest overlap occurring between groups 5, 7 and 8. Group five was the most diverse group with sites at either end of the axis 2 range. One site was an extreme outlier but experimentation with its removal led to other outliers appearing and the process of successive elimination of outliers merely served to progressively reduce the sub-set of sites.

MDA was applied to the new classification to measure its effectiveness at site allocation in internal tests and to evaluate the ecological quality of all 117 sampling sites. In the internal tests, the measure of success was the extent to which the environmental data canreplicate the biological classification. This is represented by the proportion of sites which are most probably assigned, by MDA, to the same group in which they are placed biologically. The overall percentage of sites correctly assigned to their biological group was 85% (Table 10). Groups 1, 3 and 8 contained the highest percentage of correctly classified (100%). Conversely, the lowest success rate was in Group 5, the most heterogeneous group (Figure 5), where only 60% of sites were correctly allocated by MDA.

The linear discriminant functions derived from applying MDA to the second discriminant function were used to derive three sets of EQI values (for BMWP score, number of taxa and ASPT) for combined season samples from each of the 117 sites. In order to evaluate the ecological quality of the sites a simple banding scale was derived which was equivalent to that used in Britain . The minimum EQI values used as criteria for including sites in the second biological classification were accepted as the lower limits of the top quality band (Table 11). The subsequent two bands, B and C, were given the same width as the difference between unity (i.e the observed index value (O) exactly matches the expected value (E)) and the minimum acceptable value for Band A. The fourth and lowest quality band, D, was defined as all EQI values below the minimum acceptable value for Band C.

The overall ecological quality of each site was taken to be the lowest (= poorest) of the three bands derived from the separate EQI's for BMWP' Score, number of taxa and ASPT. This is similar to the methodology used in Britain to evaluate the results of the 1990 River Quality Survey (Sweeting *et al.*, 1993: Wright, 1993). On this basis, 66 sites were evaluated as being of good quality (Band A), 26 of fair quality (B), eleven of poor quality (C) and 13 of bad quality (D) (Table 12).

DISCUSSION

Multivariate statistical techniques are gaining widespread applicability in freshwater studies. For example, ordination and classification techniques were used to correlate macro-floral and invertebrate asemblages with stream chemistry and other environmental variables in Wales (Ormerod, 1987; Ormerod & Edwards, 1987; Ormerod, Wade & Gee, 1987; Wade, Ormerod & Gee, 1989). Even has been used for know the changes in same specific communities (Leps, Soladan & Landa, 1989). In North America multivariate techniques has been used for alternative classifications in the distribution of invertebrates (Corkum, 1989; Corkum & Ciborowski, 1988). Many more examples could be cited from a wide variety of countries. These include the application of ordination and classification techniques to examine the fauna of the Mediterranean-flowing rivers of the Valencian regions (Pujante 1993).

In Britain, over the last twenty years, the effectiveness of multivariate classification and prediction techniques to evaluate the ecological quality of rivers has been clearly demonstrated. One technique, RIVPACS, has been thoroughly tested in the rivers throught Great Britain (Wright et al., 1993). The operational application of the method (Sweeting *et al.*, 1993) has established the viability of the method for operational purposes.

Two pilot applications of an early version of the British RIVPACS system have also demonstrated its limited applicability in Iberia. In Spain, Armitage et al. (1990) showed that, when applied to family level data, the British model gave useful evaluations of the ecological quality of two rivers in Galicia and clearly identified the stressed sites. Similarly, Furse *et al.* (1990) applied the model to four substantially unpolluted sites on tributaries of the Rio Tejo and one on a tributary of the Vouga. In all five cases they demonstrated close matches between the observed and expected ASPT values. However, Rodriguez & Wright, 1988, Armitage *et al.* (1990) and Wright (1994) all correctly reasonened that the faunal and environmental data-bases which have been developed for rivers in Britain can never have direct application to the full range of environmental conditions and macroinvertebrate assemblages within Spain and that effort will need to be put into developing equivalent data-bases for that country.

On this assumption, Furse *et al.* (1990) concluded that there were no obvious reasons why localised versions of RIVPACS could not be developed soon for particular regions of Portugal, although they recognised that an effective national system would be a longer term goal. Armitage *et al.* (1990) reached similar conclusions for Spain, where they identified that an initial goal should be to develop a series of small independant models in identifiable climatic zones. They reasoned that if each model was developed using standard methodologies, then they could be linked to form a wider, national system at a later date.

The first steps towards an Iberian version of the RIVPACS methodology were established by Graça *et al.* (1889) who showed that a regional classification scheme similar to that developed for British rivers was also useful for assessing water quality in Portugal. Within Spain, Alba-Tercedor & Prat (1992) recognised the considerable value of predictive models for ecological quality evaluations and expressed their own interest in advancing the approach.

The current application of the RIVPACS techniques to the fauna of the Mediterranean-flowing rivers of the Valencian Community is the first attempt to create an effective localized model for a limited geographic region of Spain. In this pilot study, the macro-invertebrate assemblages of 117 river sites in provinces of Castellón, Valencia and Alicante were assessed in relation to environmental variables. The first analyses involved a macro-invertebrate data-set, collected for another purpose, from 96 running water sites.

An essential requirement for developing RIVPACS techniques in other regions of Europe is the availability of a wide range of good quality streams and rivers to act as reference sites, coupled with use of standard sampling techniques, a uniform level of identification of the fauna and access to good quality environmental data (Wright *et al.*, 1993). The 96 sites selected for this study met the requirements of the common sampling approach and level of identification, even though the level of identification varied between families. However, there were no effective techniques available for determining the suitability of sites for use as reference locations. The sites had not been selected on the basis that they were of good ecological qualiyty. Many sites were subject to pronounced loss of summer flow or even complete dessication and several were subject to either agricultural, domestic or industrial contamination or the combination of two or more of these influences.

In the absence of proven "off-the-shelf" algorithms for assessing the suitability of sites for representing the reference condition, an iterative approach was developed. The first stage in the iteration was to use an ad hoc and ill-defined procedure established by Alba-Tercedor & Sanchez-Ortega (1988). They presented a pragmatic approach in which they sub-divided observed BMWP' index values into a series of ranges which they defined as representing different quality classes. No information was given on sampling procedures or frequency and intensity of sampling. An arbitrary decisions was taken to accept all of the sites whose combined season BMWP' index values placed them in Alba-Tercedor & Sanchez-Ortega's highest quality class. A second arbitary decision was taken to increase the sub-set of initial reference sites by adopting similar criteria of minimum acceptable ASPT values and number of taxa which were similar to those used to select sites for RIVPACS This approach was adopted even though it was not clear whether similar intrinsic target values are appropriate to the rivers of Britain and the Valencian Community, particularly when two different BMWP systems are used (Armitage et al. 1983; Alba-Tercedor & Sánchez-Ortega, 1988).

Having established a provisional reference data-set the 48 sites it contained were classified into ten groups, distinguished by their differing macro-invertebrate assemblages, different physical characteristics and water chemistry and, in some cases by their discrete regional distribution. For example, groups 4, 5 and 6 were exclusively composed of apparently sites from the provice of Castellon. Classification groups 1, 2 and 3 were also predominantly composed of sites that were considered to have a low likely of significant pollution in the experience of the authors. In contrast, the four remaining groups were characterized by lower BMWP' index values and higher mean nitrate concentration and may therefore not be suitable as reference sites. DCA also indicated differences between the extent of water mineralization and the geographical position of the sites in the different biological classification groups.

The next stage in the process of developing an operational system were to extend the data-base of reference sites, with particular emphasis on in-filling site types and geographical regions which were poorly represented in the original data-base. The extended data-base thus provided an opportunity to refine the procedure for selecting reference sites. This was achieved by use of MDA. Now all the 117 sites were evaluated by comparing their observed BMWP' index values against expected values as predicted from the initial reference set. This allowed the sites best matching or exceeding provisional targets to be selected as the new reference set. In this way, the number of reference sites increased from 48 to 60.

Multi-variate analysis of the new reference set led to a number of changes. In particular the broader coverage actually led to a reduction in the number of distinctive end groups because there were fewer outliers. This, in turn, increased the mean number of sites in each classification group. Thus, when the classification was subsequently used for predictive purposes each prediction was normally based on a wider representation of sites with the first classification and hence more likely to be reliable.

In the group 1 of the new classification were three very distinctive sites belonging to the group of watercourse popularly known as "ramblas". The unique character of these streams is due to temporal variability in their water-flow and the disturbance this causes to the structure of their biological assemblages (Vidal-Abarca *et al.*, 1992). In other Mediterranean rivers the presence or absence of flow throughout the year seems to be the most important factor in regulating their macro-inveretbrate species composition (Gallardo, 1994).

Most of the sites beloging to group 2 of the classification are on short streams, with high taxon richness and good water quality. Groups 3 and 4 comprise sites on longer rivers such as Palancia, Bergantes and Villahermosa. These tend to nave high BMWP' index values. The rest of the groups (5 to 8) are primarily composed of sites with higher nitrate concentrations and lower values for BMWP' indices. In the new DCA, geographical variables had a strong influence in the ordination.

In contrast with the results obtained by Martinez-Ansemil & Membiela (1992) for watercourses in Galicia, the present study revealed strong influences on the spatial distribution of the macroinvertebrate fauna due to water mineralization (first ordination) and the longitudinal replacement of populations (second ordination). In the unpolluted rivers of the Valencian Community, Coleoptera were clearly the best represented taxonomic group, as was the case in other mediterranean rivers (Gallardo, 1991). However, the assemblage composition of the unpolluted sites also shows other traits. Thus, Turbellaria and Ephemeroptera occurred more frequently than Trichoptera and rheophilic species contituted the largest component of the macro-invertebrate assemblages in these sites. These findings are also in line with findings in other mediterranean rivers (Prat *et al.*, 1983; Puig *et al.*, 1987; Puig, 1990).

The current research programme has demonstrated the potential for developing regional versions of "RIVPACS" in Iberia but it has also highlighted some of the major practical difficulties that need to be overcome. The first of these is settling on an acceptable group of reference sites. Part of the decision making process is deciding what the reference sites are meant to represent. The principal alternatives are that they represent the best ecological quality achievable in practice, given they way in which the countryside is currently managed, or whether higher targets should be set based in the optimum assemblages that the rivers could support in the absence of any anthropgenic influences. The first could be considered the pragmatic approach and the second the idealistic.

It is the view of the authors that the current reference set represent neither the pragmatic nor idealistic case. Many groups in the current classification still show indications of organic enrichment and reduction in BMWP' index values and better sites made be needed for the regions or river types represented in these groups. In particular, more lowland sites, nearer to the estuaries and the more densely populated coastal strip are required, although these will not be easy to find.

The system would therefore benefit from further iterations of extending the data-base, re-defining and stiffening the criteria for acceptance of reference sites, in the manner used during RIVPACS development (Wright *et al.*, 1995). In this way the system will become increasingly reliable for practical operational and scientific use.

The second practical difficulty in setting up regional models is optimising the size of the region so that it represents a broad range of different assemblage types but does not become so big that there are little or no taxa in common at sites at either end of environmental range. If the geographic range is too small then there is little or no discrimination between sites. If it is too large then the assemblage data for one extreme of the range can only confuse, and certainly not enhance, predictions in another area. In Britain, for example, the latest version of RIVPACS (RIVPACS III) contains separate modules for Great Britain and Northern Ireland (Wright *et al.*, 1995). Before this decision was taken predictions for Irish sites, where the fauna is intrinsically less diverse, contained expectations of occurrence of taxa which were absence from that country but present in Great Britain. The same problem is currently being faced in development of RIVPACS in Australia and their a variety of different models are being developed for different eco-regions (Norris, personal communication). Furthermore, the most important environmental variables in defining the structure of macro-invertebrate assemblages in one eco-region may not be the same as those operating in another. The range of environmental conditions over which reliable predictions can be made using a limited number of variables must always be investigated and defined (Moss *et al.*, 1987).

The current reference set for the Valencian Community may not attain optimal heterogeneity for practical applications. The eigenvalues of the principal ordination axes fall below the ideal minimum of 0.5 recommended by ter Braak (1995) as indicative of good species separation. However, extending the geographic range beyond the three provinces would lead to the introduction of other, very different ecoregions.

One way in which the heterogeneity of the reference data-set might be extended is to improve the precision of identification. For example, many taxa were not identified as precisely in the 1990 data-set as in 1994 and many groups (eg Hydropsychidae) were only identified to family in each year. According to Alba-Tercedor *et al.* (1992) the the study of the macro-invertebrate communities in Spain requires a more detailed taxonomic base. Wright (1994) argues that the level to which the fauna was identified would be a critical decision to develop a pilot version of RIVPACS in Spain (Wright, 1994).

The preliminary results of the current study confirm that tpredictive, RIVPACS-style techniques can be auseful for assessing water quality in the Mediterranean rivers of the Valencian Community but that more development work still needs to be done. Parallel studies in other regions of Spain and Portugal are also recommended.

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TABLE 1. Environmental variables used in analysis, their acronyms and notes on measurement. Continuous variable acronyms prefixed L were transformed to $\log_{10}$.

Variable (number)	Acronym	Measurement units	Notes
Map variables			1
Site distance to source (v1)	DS	km	
Province (v2)	PRO	Three categories	2
Latitude (v3)	LAT	Degrees:minutes N	
Longitude (v4)	LON	Degrees:minutes E/W	
Altitude (v5)	ALT	m	
Site variables			
Dominant middle substratum (v6)	DMISUB	Six categories	3
Dominant margin substratum (v7)	DMASUB	Six categories	4
Mean current velocity (v8)	CV	Four categories	5
River width (v9)	WIDTH	Four categories	6
River depht (v10)	DEPTH	Four categories	7
pH (v11)	pH		
Conductivity (v12)	LCOND	μmhos cm^{-1} at 20°C	
Disolved oxygen (v13)	LDOXI	mg l^{-1}	
Alkalinity (v14)	LALK	meq l^{-1}	
Calcium (v15)	LCAL	mg l^{-1}	
Nitrite (v16)	LNITRI	mg l^{-1}	
Nitrate (v17)	LNITRA	mg l^{-1}	
Amonia (v18)	LAMO	mg l^{-1}	
Sulphate (v19)	LSUL	mg l^{-1}	
Total Hardness (v20)	LTH	°d	

1. National Topographic Series map scales were 1:50.000.

2. Geographic provinces were: 1, Alicante; 2, Castellón; 3, Valencia.

3. Dominant middle substratum categories were: 1, Pebbles and gravel; 2, Pebbles and sand; 3, Pebbles and silt; 4, Gravel and sand; 5, Gravel and silt; 6, Clay and silt.

4. Dominant margin substratum categories were: 1, Pebbles and gravel; 2, Pebbles and sand; 3, Gravel and sand; 4, Gravel and silt; 5, Clay and silt; 6, Channel.

5. Mean current velocity categories were: 1, >100 cm s^{-1}; 2, >50-100 cm s^{-1}; 3, >10-50 cm s^{-1}; 4, <10 cm s^{-1}.

6. River widht categories were: 1, >0.5-2 m; 2, >2-5m; 3, >5-10 m; 4, >10 m.

7. River deep categories were: 1, >5-30 cm; 2, >30-60 cm; 3, >60-120 cm; 4, >120cm.

TABLE 2. Stream site designations and BMWP' (B), number of Taxa (T) and ASPT (A) values for 98 sites in spring (1), summer (2) and combined seasons (C).

Code	Number	River name	Location	B1	T1	A1	B2	T2	A2	BC	TC	AC
S1	1010100	SEGURA	ORIHUELA	1	1	1.00	3	2	1.50	3	2	1.50
S2	1020100	SEGURA	BENEJUZA	1	1	1.00	0	0	0.00	1	1	1.00
V2	2010100	VINALOPO	SAX	3	2	1.50	9	4	2.25	9	4	2.25
V3	2020100	VINALOPO	NOVELDA	8	3	2.67	3	2	1.50	8	3	2.67
Se1	3010100	SERPIS	COCENTAI	3	2	1.50	0	0	0.00	3	2	1.50
Se2	3020100	SERPIS	LORCHA	38	9	4.22	36	8	4.50	47	11	4.27
Se3	3030100	SERPIS	VILLALON	38	10	3.80	55	13	4.23	64	16	4.00
Se4	3040100	SERPIS	GANDIA	32	10	3.20	49	13	3.77	69	19	3.63
Mn1	4010100	MONTNEGRE	TIBI	6	3	2.00	6	3	2.00	9	4	2.25
Ja1	5010100	JALON	BENICHEM	55	11	5.00	62	14	4.43	96	20	4.80
Al1	6010100	ALGAR	FUENTES	40	9	4.44	63	13	4.85	80	17	4.71
G1	7010100	GUADALEST	BENIARDA	_	_	_	69	16	4.31	69	16	4.31
G2	7020100	GUADALEST	CALLOSA	42	12	3.50	37	11	3.36	48	14	3.43
Am1	8010100	AMADORIO	RELLEU	85	18	4.72	102	22	4.64	145	30	4.83
Gi1	9010100	GIRENA	VALL DE	9	3	3.00	53	11	4.82	53	11	4.82
Gi2	9020100	GIRENA	BENIARBE	59	15	3.93	56	14	4.00	80	20	4.00
Sa1	10010100	SELLA	CRA. FIN	54	13	4.15	66	15	4.40	83	19	4.37
To1	11010100	TORREMANZANAS	XIXONA	2	1	2.00	6	3	2.00	6	3	2.00
M1	12010100	MIJARES	LA MONZO	60	12	5.00	61	12	5.08	73	15	4.87
M2	12020100	MIJARES	FUENTE D	56	9	6.22	43	8	5.38	80	13	6.15
M3	12030100	MIJARES	ARANUEL	67	12	5.58	73	13	5.62	88	15	5.87
M4	12040100	MIJARES	CIRAT	85	15	5.67	67	11	6.09	103	18	5.72
M5	12050100	MIJARES	TOGA	72	11	6.55	64	11	5.82	94	16	5.88
M6	12060100	MIJARES	RIBESALB	52	9	5.78	72	12	6.00	88	15	5.87
M7	12070100	MIJARES	CRA. OND	80	15	5.33	78	15	5.20	101	19	5.32
P1	13010100	PALANCIA	NACIMIEN	_	_	_	91	16	5.69	91	16	5.69
P2	13020100	PALANCIA	LOS CLOT	60	8	7.50	142	26	5.46	142	26	5.46
P3	13030100	PALANCIA	VENTAS D	38	7	5.43	112	19	5.89	130	21	6.19
P4	13040100	PALANCIA	TERESA	32	6	5.33	_	_	_	32	6	5.33
P5	13050100	PALANCIA	JERICA	38	8	4.75	94	22	4.27	109	24	4.54
P6	13060100	PALANCIA	NAVAJAS	30	6	5.00	54	14	3.86	64	15	4.27
P7	13070100	PALANCIA	SEGORBE	29	6	4.83	57	13	4.38	57	13	4.38
P8	13080100	PALANCIA	GELDO	37	10	3.70	85	20	4.25	97	23	4.22
P9	13090100	PALANCIA	SOT DE F	19	6	3.17	69	18	3.83	70	19	3.68
Mo1	14010100	MONTAN	MONTAN	80	15	5.33	81	13	6.23	116	21	5.52
Vi1	15010100	VILLAHERMOSA	VILLAHER	76	14	5.43	114	20	5.65	132	23	5.74
Vi2	15020100	VILLAHERMOSA	CEDRAMAN	112	17	6.59	113	20	6.00	164	28	5.86
Vi3	15030100	VILLAHERMOSA	ARGELITA	84	16	5.25	84	14	6.36	122	21	5.81
Vi4	15040100	VILLAHERMOSA	VALLAT	67	12	5.58	89	14	5.05	107	18	5.94
B1	16010100	BERGANTES	MOLINO P	68	13	5.23	111	22	4.85	117	23	5.09
B2	16020100	BERGANTES	PTE. VIL	48	9	5.33	97	20	5.05	107	21	5.10
B3	16030100	BERGANTES	LA BALMA	22	3	7.33	101	20	6.57	101	20	5.05
B4	16040100	BERGANTES	LTE. PRO	61	10	6.10	92	14	5.36	112	18	6.22
Ce1	17010100	CENIA	ROSSEGAD	75	12	6.25	118	22	5.78	145	26	5.58
Ce2	17020100	CENIA	FONT S	85	13	6.54	104	18	5.58	119	20	5.95
L1	18010100	LUCENA	NACIMIEN	98	17	5.76	67	12	5.58	111	20	5.55
L2	18020100	LUCENA	ALCORA	124	22	5.64	72	13	5.54	135	25	5.40
Ro1	19010100	RODECHE	LTE. PRO	94	14	6.17	88	13	6.77	111	17	6.53

TABLE 2. (continued)

Code	Number	River name	Location	B1	T1	A1	B2	T2	A2	BC	TC	AC
Mm1	20010100	MAIMONA	FTE. LA	56	9	6.22	81	13	6.23	95	16	5.94
Mm2	20020100	MAIMONA	MONTANEJ	89	16	5.56	73	12	6.08	118	21	5.62
Co1	21010100	CORTES	BCO. DE	98	16	6.13	149	26	5.73	161	29	5.55
T1	22010100	TURIA	TORRE AL	50	11	4.55	36	11	3.27	64	16	4.00
T2	22020100	TURIA	CASAS BA	41	9	4.56	55	12	4.58	75	16	4.69
T3	22030100	TURIA	RINCONAD	32	6	5.33	31	6	5.17	33	7	4.71
T4	22040100	TURIA	ZAGRA	37	7	5.29	41	8	5.13	41	8	5.13
T5	22050100	TURIA	CALLES	36	8	4.50	41	10	4.10	51	12	4.25
T6	22060100	TURIA	CHULILLA	60	12	5.00	74	14	5.29	81	16	5.06
T7	22070100	TURIA	GESTALGA	53	11	4.82	42	7	6.00	75	14	5.36
T8	22080100	TURIA	PEDRALBA	33	8	4.13	43	8	5.38	55	11	5.00
T9	22090100	TURIA	RIBARROJ	35	9	3.89	33	8	4.13	41	10	4.10
Eb1	23010100	EBRON	CUESTA D	90	16	5.63	74	13	5.69	96	17	5.65
Eb2	23020100	EBRON	LOS SANT	72	13	5.54	86	17	5.06	107	20	5.35
Va1	24010100	VALLANCA	VALLANCA	63	12	5.25	60	12	5.00	77	16	4.81
Ar1	25010100	ARCOS	LOSILLA	67	12	5.58	74	14	5.29	82	16	5.13
Tu1	26010100	TUEJAR	NACIMIEN	53	10	5.30	57	12	4.75	68	14	4.86
Re1	27010100	REATILLO	LAS CANA	43	7	6.14	83	14	5.93	102	17	6.00
Re2	27020100	REATILLO	SOT DE C	61	12	5.08	62	14	4.43	89	19	4.68
Ma1	28010100	MAGRO	ANTES UT	3	2	1.50	21	6	3.50	22	7	3.14
Ma2	28020100	MAGRO	PUENTE J	3	2	1.50	6	3	2.00	6	3	2.00
Ma3	28030100	MAGRO	HORTUNAS	33	10	3.30	39	11	3.55	45	13	3.46
Ma4	28040100	MAGRO	TABARLA	55	11	5.00	30	9	3.33	67	15	4.47
Ma5	28050100	MAGRO	CASA FLO	7	2	3.50	31	10	3.10	31	10	3.10
Ma6	28060100	MAGRO	ALCUDIA	27	8	3.38	_	_	_	27	8	3.38
Mi1	29010100	MIJARES P	LA PARID	97	17	5.71	76	12	6.33	118	20	5.90
Mi2	29020100	MIJARES P	DOS PUEN	49	8	6.13	37	7	5.29	56	10	5.60
Bu1	30010100	BUNOL	VENTA L'	50	11	4.55	52	10	5.20	80	16	5.00
Bu2	30020100	BUNOL	ALBORACH	15	5	3.00	9	4	2.25	21	7	3.00
J1	31010100	JUCAR	JALANCE	54	10	5.40	19	4	4.75	54	10	5.40
J2	31020100	JUCAR	SUMACARC	19	5	3.80	43	9	4.78	53	12	4.42
J3	31030100	JUCAR	ALBERIQU	_	_	_	_	_	_	_	_	_
J4	31040100	JUCAR	ALBALAT	_	_	_	_	_	_	_	_	_
J5	31050100	JUCAR	ANTES CU	2	1	2.00	_	_	_	2	1	2.00
C1	32010100	CABRIEL	LA FUENS	98	17	5.76	_	_	_	98	17	5.76
C2	32020100	CABRIEL	TAMAYO	91	16	5.69	69	13	5.31	105	19	5.53
C3	32030100	CABRIEL	FUENTEPO	54	8	6.75	74	12	6.17	92	14	6.57
C4	32040100	CABRIEL	CASAS DE	40	6	6.67	91	17	5.35	101	18	5.61
Ca1	33010100	CANTABAN	MOLINO B	61	13	4.69	95	18	5.28	98	19	5.16
Cz1	34010100	CAZUNTA	BICORP	40	7	5.71	37	7	5.29	48	9	5.33
Ga1	35010100	GRANDE	QUESA	44	9	4.89	58	9	6.44	86	16	5.38
Es1	36010100	ESCALONA	QUESA	54	12	4.50	42	10	4.20	79	17	4.65
Sl1	37010100	SELLENT	SELLENT	30	7	4.29	62	13	4.77	67	14	4.79
A1	38010100	ALBAIDA	BENIGAMI	26	7	3.71	47	13	3.62	52	14	3.71
A2	38020100	ALBAIDA	GENOVES	54	14	3.86	67	16	4.19	90	21	4.29
A3	38030100	ALBAIDA	TORRE LL	36	8	4.50	39	12	3.25	63	16	3.94
A4	38040100	ALBAIDA	VILLANUE	41	10	4.10	59	15	3.93	76	18	4.22
Cl2	39010100	CLARIANO	MONTABER	10	4	2.50	5	2	2.50	10	4	2.50
Xe1	40010100	XERACO	XERACO	21	8	2.63	9	3	3.00	21	8	2.63
Bl1	41010100	BULLENS	CRA.OLIV	36	7	5.14	42	8	5.25	50	10	5.00

TABLE 3. Mean values of BMWP'; number of Taxa, ASPT' and selected environmental variables for TWINSPAN groups from 48 sites. All values are means.

	TWINSPAN group									
	1 (n=5)	2(n=5)	3(n=4)	4(n=6)	5(n=8)	6(n=6)	7(n=5)	8(n=1)	9(n=5)	10(n=3)
BMWP'	110.4	84.8	108.0	121.8	128.5	97.3	82.4	55.0	89.6	67.3
Taxa	20.0	17.2	21.5	20.8	23.1	17.0	14.8	11.0	15.8	13.7
ASPT'	5.49	4.94	5.03	5.87	5.58	5.76	5.58	5.00	5.65	5.01
DS	0.85	1.39	1.03	1.26	1.21	1.96	2.27	2.16	1.71	0.81
ALT	2.89	2.61	2.51	2.71	2.69	2.54	2.66	2.20	2.60	2.19
LALK	0.64	0.65	0.66	0.60	0.61	0.58	0.61	0.67	0.66	0.66
LNITRA	0.86	0.92	0.90	0.69	0.97	0.71	1.09	1.14	0.71	1.13

TABLE 4. Correlation coefficients between ordination scores for Axes 1-4 and environmental variables for 48 sites.

Variable	Axis 1	Axis 2	Axis 3	Axis 4
DS	-0.414	0.462	0.172	-0.151
PRO	-0.328	0.154	-0.270	0.208
LAT	-0.066	0.180	-0.319	0.095
LON	0.252	0.553	0.184	-0.261
ALT	0.343	0.141	-0.310	0.013
DMISUB	-0.147	-0.152	0.320	0.147
DMASUB	0.021	-0.010	0.510	0.014
CV	-0.271	-0.283	0.091	-0.020
WIDTH	-0.393	0.214	-0.106	-0.437
DEPTH	-0.279	0.291	0.055	-0.141
pH	-0.023	0.153	0.017	0.088
LCOND	-0.440	0.011	0.354	-0.007
LDOXI	0.036	-0.226	0.020	0.068
LALK	0.371	-0.268	0.206	0.023
LCAL	-0.415	0.295	0.501	0.016
LNITRI	-0.363	0.136	0.463	0.125
LNITRA	0.100	0.049	0.108	0.150
LAMO	-0.404	0.324	0.195	-0.014
LSUL	-0.041	-0.048	0.183	-0.031
LTH	-0.392	0.207	0.453	0.007

TABLE 5.Stream site designations and BMWP' (B), number of Taxa (T) and ASPT (A) values for 21 n~~e~~ew sites in spring (1), summer (2) and combined seasons (C).

Code	Number	River name	Location	B1	T1	A1	B2	T2	A2	BC	TC	AC
Rs1	42010100	RESINERO	BEJIS	119	20	5.95	153	28	5.46	194	34	5.71
At1	43010100	ARTEAS	VENTAS B	139	29	4.79	56	16	3.50	150	32	4.69
Ag1	44010100	ALGIMIA	PENALBA	34	8	4.25	81	17	4.76	104	21	4.95
Cr1	45010100	CARIDAD	AHIN	159	30	5.30	166	29	5.72	196	37	5.30
Aq1	46010100	ARQUET	ALFONDEG	122	25	4.88	130	23	5.65	172	33	5.21
Sn1	47010100	ANTONIO	SERRA	78	19	4.11	65	13	5.00	116	26	4.46
Lm1	48010100	MORENOS	LOS DUQU	86	17	5.06	50	11	4.55	119	24	4.96
Ac1	49010100	ALCANTARILLA	LOS DUQU	67	16	4.19	108	25	4.32	138	30	4.60
Ab1	50010100	ALBOSA	CASAS PE	106	24	4.42	57	14	4.07	109	25	4.36
Bq1	51010100	BOQUERON	LOS COJO	103	22	4.68	84	15	5.60	119	26	4.58
Ao1	52010100	ARGONGUENA	TERESA D	131	27	4.85	90	19	4.74	155	30	5.17
Za1	53010100	ZARRA	AYORA	105	24	4.38	44	10	4.40	123	27	4.56
Ls1	54010100	DE LOS SANTOS	ALCUDIA	42	9	4.67	31	7	4.43	57	13	4.38
Bo1	55010100	BOLBAITE	BOLBAITE	131	23	5.70	44	10	4.40	157	29	5.41
Cl1	39020100	CLARIANO	ONTENIEN	85	20	4.25	89	19	4.68	110	24	4.58
On1	56010100	ONTENIENTE	ONTENIEN	65	15	4.27	55	12	4.58	80	19	4.21
V1	2030100	VINALOPO	BANERES	100	21	4.76	65	16	4.06	121	26	4.65
Fa1	57010100	FABARA	BENIARDA	50	9	5.36	79	18	4.39	111	23	4.83
Pe1	58010100	PENAGUILA	BENASSAU	104	25	4.16	106	23	4.61	147	32	4.59
Vl1	59010100	VALLESETA	GORGA	94	23	4.00	44	13	3.38	108	26	4.15
En1	60010100	ENCANTAT	BENIARRE	92	23	4.00	79	19	4.16	98	25	3.92

TABLE 7. The twenty variables values for ninety-eight sites used for MDA. v1 to v20 as in Table 1.

Code	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17	v18	v19	v20
S1	2.26	1	38.05	0.58	1.38	6	5	3	4	3	7.35	3.49	0.46	0.84	2.38	-0.47	0.85	0.30	2.70	1.87
S2	2.30	1	38.05	0.52	1.40	6	5	4	4	3	7.55	3.49	0.54	0.83	2.25	-0.50	1.26	0.30	2.70	1.94
V2	1.71	1	38.25	0.55	2.45	5	4	3	2	1	8.25	3.23	0.70	0.98	2.70	-0.17	1.23	0.30	2.95	1.98
V3	0.60	2	38.42	0.38	2.87	3	3	4	1	1	8.20	2.95	0.86	0.74	1.90	-1.51	0.62	-1.40	1.73	0.91
Se1	1.28	1	38.44	0.37	2.60	5	4	3	2	2	7.70	3.02	0.81	1.17	1.99	-0.12	-1.43	0.30	2.30	1.31
Se2	1.57	1	38.51	0.19	2.32	5	4	2	3	2	8.20	2.79	0.97	0.70	1.97	-0.55	0.73	-0.84	2.30	1.33
Se3	1.77	3	38.54	0.13	2.23	4	3	2	2	3	8.55	2.70	0.97	0.66	1.94	-0.53	1.31	-0.80	1.98	1.22
Se4	1.85	3	39.02	0.12	1.30	4	3	2	3	2	8.60	2.79	0.89	0.63	2.01	-0.50	1.43	-0.83	2.03	1.30
Mn1	1.08	1	38.32	0.35	2.66	5	4	2	3	1	8.10	3.19	0.93	0.99	2.27	0.04	0.51	0.30	2.70	1.66
Ja1	0.90	1	38.55	0.16	2.60	1	1	4	1	1	7.45	2.95	0.93	0.66	2.46	-0.62	0.92	0.21	2.70	1.61
Al1	0.85	1	38.42	0.15	2.23	2	2	2	3	1	8.00	2.69	1.04	0.56	1.88	-0.76	0.71	-0.94	2.48	1.16
G1	0.30	1	38.41	0.13	2.60	1	1	2	2	2	8.50	2.56	1.07	0.61	2.05	-0.69	0.70	-0.88	2.48	1.21
G2	1.28	1	38.42	0.15	2.20	5	4	3	2	1	7.80	2.79	1.06	0.63	2.15	-0.17	1.12	-0.36	2.48	1.34
Am1	1.04	1	38.44	0.19	2.68	2	2	2	2	2	7.50	2.81	1.05	0.74	1.97	-0.58	0.86	-0.83	2.48	1.31
Gi1	1.01	1	38.52	0.13	2.60	4	3	2	3	2	7.75	2.69	1.02	0.60	1.97	-0.61	0.81	-0.80	2.48	1.21
Gi2	1.45	1	38.51	0.18	1.64	1	1	2	3	2	7.50	2.63	1.04	0.57	1.98	-0.71	1.40	-0.81	2.30	1.19
Sa1	0.85	1	38.30	0.15	2.30	4	6	2	1	1	8.35	2.89	1.12	0.67	2.09	-0.59	0.56	-0.80	2.48	1.32
To1	0.65	1	38.32	0.33	2.45	5	4	3	2	1	7.15	3.10	0.95	0.86	2.20	-0.17	0.95	0.30	2.48	1.55
M1	1.93	3	40.13	0.37	2.81	4	3	2	2	2	7.90	2.85	0.98	0.59	2.06	-0.48	0.69	-0.22	2.11	1.31
M2	1.98	3	40.05	0.32	2.77	4	3	3	3	2	7.55	3.08	0.90	0.63	2.22	-0.63	0.73	-0.11	2.30	1.45
M3	2.00	3	40.04	0.33	2.66	4	2	2	4	2	8.35	3.14	1.00	0.56	2.20	-0.51	0.75	0.06	2.48	1.46
M4	2.02	3	40.04	0.35	2.62	4	1	2	4	3	8.40	3.10	1.02	0.62	2.21	-0.49	0.76	0.04	2.48	1.49
M5	2.04	3	40.03	0.40	2.48	1	1	3	4	2	7.60	3.12	0.95	0.59	2.16	-0.68	0.73	0.11	2.48	1.54
M6	2.10	3	40.01	0.17	2.28	1	3	2	2	2	8.15	2.99	1.03	0.52	2.14	-0.56	0.53	-0.12	2.30	1.40
M7	2.12	3	40.01	0.13	1.95	1	3	3	3	3	8.30	2.95	0.92	0.54	2.02	-0.47	0.76	-0.15	2.23	1.34
P1	1.18	3	39.56	0.57	2.97	1	1	2	2	2	8.60	2.48	0.96	0.53	1.85	-0.95	0.81	-0.83	2.30	1.13
P2	0.70	3	40.04	0.57	2.93	1	1	1	2	2	8.45	2.57	0.99	0.55	1.94	-0.65	0.70	-0.49	2.30	1.16
P3	0.95	3	39.54	1.00	2.83	1	3	1	3	3	8.15	2.62	0.96	0.55	1.96	-0.66	0.83	-0.81	2.30	1.14
P4	1.38	3	39.55	0.35	2.78	4	3	1	3	2	7.80	2.62	1.03	0.60	1.96	-0.63	0.72	-0.76	2.30	1.16
P5	1.38	3	39.55	0.35	2.68	4	3	2	3	2	8.20	2.71	0.93	0.60	1.97	-0.57	-0.74	-0.82	2.30	1.21
P6	1.48	3	39.53	0.32	2.54	4	3	2	3	2	8.00	2.89	0.94	0.57	2.01	-0.46	-0.37	0.77	2.30	1.27
P7	1.56	3	39.52	0.33	2.52	4	3	2	4	3	8.40	2.95	0.93	0.58	2.06	-0.50	0.94	-0.87	2.30	1.27
P8	1.60	3	39.50	0.35	2.48	6	5	2	4	4	8.40	2.95	0.97	0.62	2.09	-0.40	1.00	-0.90	2.30	1.35
P9	1.66	3	39.52	0.35	2.34	1	1	2	4	3	8.20	2.95	0.92	0.60	2.11	-0.41	1.50	-0.60	2.30	1.37
Mo1	0.70	3	40.01	0.34	2.83	1	1	2	1	1	8.30	3.01	1.00	0.58	2.15	-0.49	0.48	-0.09	2.70	1.49
Vi1	1.48	3	40.12	0.37	2.83	1	1	2	4	2	8.55	2.74	0.98	0.58	1.86	-0.69	0.49	-0.89	2.12	1.17
Vi2	1.54	3	40.00	0.39	2.79	1	1	2	2	2	8.30	3.01	0.99	0.60	2.08	-0.66	0.62	-0.21	2.30	1.36
Vi3	1.74	3	40.04	0.21	2.57	1	1	2	3	2	7.85	2.86	1.10	0.57	1.99	-0.53	0.79	-0.37	2.30	1.28
Vi4	1.76	3	40.02	0.21	2.44	1	1	2	3	2	8.45	2.91	0.98	0.54	1.97	-0.66	0.67	-0.37	2.30	1.31
B1	1.15	3	40.43	0.14	2.89	4	3	3	2	2	8.35	2.87	0.93	0.67	2.01	-0.72	1.32	-0.49	1.77	1.27
B2	1.31	3	40.40	0.11	2.82	4	3	3	2	2	8.05	2.95	0.93	0.59	2.05	-0.73	1.27	-0.61	1.67	1.33
B3	1.48	3	40.45	0.19	2.76	4	3	3	2	2	8.25	3.00	0.94	0.61	2.09	-0.81	1.33	-0.58	1.76	1.39
B4	1.56	3	40.53	0.13	2.72	1	1	2	2	3	8.25	2.96	0.97	0.57	2.11	-0.76	1.17	-0.47	1.75	1.46
Ce1	0.78	3	40.40	0.14	2.64	4	2	2	2	3	8.30	2.81	0.94	0.69	1.98	-0.79	1.03	-0.75	1.79	1.35
Ce2	0.90	3	40.40	0.05	2.62	1	1	2	3	3	8.50	2.81	0.91	0.71	2.01	-0.83	1.17	-0.64	1.86	1.26
L1	0.60	3	40.12	0.17	2.79	4	3	3	2	2	7.35	2.68	0.93	0.69	2.02	-0.69	0.62	-0.39	1.79	1.21
L2	1.20	3	40.01	0.12	2.20	1	1	3	3	3	7.95	3.10	1.01	0.48	2.24	-0.49	0.74	0.03	2.00	1.53
Ro1	1.20	3	40.12	0.36	2.81	1	1	2	1	1	8.35	2.71	0.98	0.62	1.96	-0.69	0.95	-0.46	1.05	1.20

TABLE 7. (continued)

Code	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17	v18	v19	v20
Mm1	1.48	3	40.04	0.47	2.89	2	2	2	2	2	8.30	2.87	1.03	0.63	2.10	-0.35	0.55	-0.24	2.00	1.19
Mm2	1.57	3	40.04	0.32	2.77	4	3	2	2	2	8.35	2.86	0.94	0.52	2.08	-0.59	0.53	-0.22	2.00	1.36
Co1	1.26	3	40.05	0.32	2.81	1	3	3	2	1	8.55	2.83	0.99	0.56	1.93	-0.80	0.58	-0.46	1.31	1.21
T1	2.25	2	40.13	1.15	2.89	3	5	2	3	3	8.05	3.07	0.88	0.72	2.24	-0.42	1.03	0.23	1.89	1.54
T2	2.27	2	40.02	1.15	2.86	1	5	2	2	3	8.00	3.03	0.88	0.75	2.21	-0.56	0.94	0.14	1.91	1.46
T3	2.29	2	40.03	1.13	2.81	4	4	2	3	3	7.90	3.24	0.90	0.75	2.29	-0.64	0.97	0.21	1.99	1.54
T4	2.35	2	39.42	1.00	2.71	4	4	1	2	2	8.15	3.18	0.86	0.74	2.24	-0.53	1.09	0.18	1.88	1.52
T5	2.34	2	39.42	1.00	2.60	4	3	2	3	4	8.55	3.13	0.87	0.48	2.22	-0.66	0.95	-0.12	1.92	1.42
T6	2.25	2	39.42	0.42	2.38	1	4	3	3	3	8.10	3.06	0.95	0.58	2.20	-0.61	0.99	-0.15	1.89	1.49
T7	2.20	2	39.36	0.52	2.30	4	3	2	2	3	8.05	3.05	0.95	0.64	2.21	0.21	1.13	0.25	1.90	1.44
T8	2.16	2	39.36	0.59	2.20	4	3	2	1	3	7.90	3.04	0.92	0.67	2.20	-0.55	1.14	-0.16	1.92	1.49
T9	2.43	2	39.33	0.34	1.78	4	3	2	1	3	8.25	3.08	0.87	0.61	2.21	-0.59	1.38	-0.03	1.90	1.48
Eb1	1.08	2	40.11	1.19	2.91	1	1	2	3	3	8.00	2.76	0.99	0.66	1.99	-0.71	0.92	-0.45	1.65	1.32
Eb2	1.22	2	40.14	1.17	2.90	1	3	2	2	2	7.95	2.77	0.98	0.69	2.03	-0.75	0.89	-0.72	1.79	1.27
Va1	0.30	2	40.04	1.21	2.88	1	3	3	1	2	7.35	2.69	0.97	0.74	1.97	-0.96	0.94	-0.48	1.59	1.25
Ar1	1.07	2	40.02	1.17	2.95	1	1	2	2	2	8.65	2.89	0.95	0.57	2.03	-0.52	0.99	-0.61	1.70	1.33
Tu1	0.30	2	39.47	0.60	2.76	1	1	2	2	2	7.50	2.90	0.94	0.67	2.16	-0.61	0.96	-0.23	1.62	1.35
Re1	1.32	2	39.33	1.11	2.65	4	3	2	2	3	8.50	2.66	0.98	0.68	1.91	-0.65	0.94	-0.64	1.79	1.17
Re2	1.51	2	39.43	0.55	2.40	1	3	2	2	3	8.60	2.62	0.99	0.62	1.92	-0.75	0.86	-0.66	1.67	1.13
Ma1	0.30	2	39.34	1.13	2.87	6	5	4	1	2	8.20	2.91	0.92	0.67	2.14	-0.37	1.52	-0.41	1.86	1.49
Ma2	1.18	2	39.32	1.16	2.81	5	5	2	2	2	7.60	2.97	0.68	0.83	1.95	-0.13	0.80	0.30	2.48	1.45
Ma3	1.46	2	39.23	1.20	2.71	5	3	2	3	2	7.90	2.96	0.73	0.81	2.11	-0.13	0.85	0.27	1.90	1.41
Ma4	1.53	2	39.22	0.58	2.65	1	1	2	3	3	8.40	2.96	0.80	0.75	2.12	0.12	0.81	0.06	1.95	1.45
Ma5	1.85	2	39.21	0.60	2.30	5	3	2	3	3	8.35	3.11	0.89	0.80	2.12	0.21	0.87	0.32	1.97	1.44
Ma6	2.01	2	39.24	0.56	1.40	5	3	2	3	3	8.30	3.02	0.90	0.68	2.21	0.13	1.89	-0.01	2.00	1.54
Mi1	0.70	2	39.23	0.57	2.73	1	1	3	1	2	7.65	2.89	1.02	0.71	1.95	-0.65	1.18	-1.17	1.77	1.32
Mi2	0.95	2	39.22	0.56	2.64	1	3	3	3	2	7.95	2.93	1.03	0.68	2.06	-0.57	1.11	-0.60	1.93	1.40
Bu1	0.79	2	39.33	0.52	2.75	1	6	3	1	2	8.20	2.74	0.96	0.73	2.02	-0.31	1.01	-0.63	1.78	1.20
Bu2	1.28	2	39.24	0.56	2.45	5	4	2	2	2	8.25	2.83	0.94	1.00	2.10	0.26	1.16	0.34	2.09	1.36
J1	2.59	2	39.12	1.18	2.54	6	5	4	4	2	8.35	2.60	0.98	0.69	2.09	-0.78	0.75	-0.41	1.88	1.46
J2	2.63	2	39.14	0.37	1.60	4	1	2	4	3	8.15	2.96	1.00	0.69	2.13	-0.46	0.92	-0.48	1.90	1.53
J3	2.65	2	39.13	0.32	1.18	6	5	2	4	4	8.10	3.06	0.99	0.72	2.16	-0.04	1.57	-1.00	1.94	1.47
J4	2.67	2	39.12	0.40	1.00	6	5	2	4	4	7.70	3.04	0.95	0.73	2.19	-0.07	1.54	-0.33	2.00	1.51
J5	2.69	2	39.10	0.16	0.30	6	5	3	4	4	7.72	3.11	1.00	0.81	2.24	0.22	1.54	-0.32	2.48	1.53
C1	2.25	2	39.31	1.32	2.74	1	1	2	3	3	8.35	2.97	0.97	0.89	2.12	-0.77	1.08	-0.81	1.70	1.47
C2	2.32	2	39.22	1.35	2.66	1	3	2	4	4	8.20	2.98	0.96	0.56	2.12	-0.74	1.20	-0.77	1.73	1.43
C3	2.36	2	39.20	1.20	2.58	4	3	2	3	4	8.35	2.98	0.94	0.59	2.08	-0.68	1.14	-0.84	1.94	1.45
C4	2.40	2	39.22	1.14	2.54	1	3	2	3	3	8.45	3.08	0.97	0.59	2.17	-0.80	1.33	-0.33	1.97	1.50
Ca1	1.99	2	39.13	1.20	2.67	4	4	2	1	2	8.50	2.92	0.98	0.69	2.09	-0.75	1.04	-0.52	1.53	1.45
Cz1	1.08	2	39.13	0.56	2.51	4	3	1	2	1	8.15	2.91	1.03	0.64	1.93	-0.60	1.34	-0.89	2.00	1.31
Ga1	1.04	2	39.14	0.57	2.42	4	3	2	2	2	8.50	3.22	1.04	0.79	1.85	-0.84	0.74	-0.92	1.90	1.26
Es1	0.59	2	39.13	0.58	2.15	5	4	3	2	2	8.46	3.01	1.04	0.59	2.05	-0.57	0.94	-0.90	2.00	1.38
Sl1	0.88	2	39.02	0.35	1.78	4	3	2	1	2	8.35	3.35	0.95	0.70	2.24	-0.34	1.35	-0.17	2.00	1.57
A1	1.11	2	38.56	0.34	2.18	1	3	2	3	3	8.50	2.90	0.93	0.82	2.03	0.17	1.07	-0.28	1.71	1.31
A2	1.34	2	39.01	0.33	2.08	1	1	3	3	2	8.15	2.96	0.93	0.74	2.03	0.09	1.12	-0.51	1.62	1.35
A3	1.45	2	30.02	0.33	1.70	1	1	2	4	2	8.10	2.93	0.90	0.73	2.01	0.08	1.49	-0.12	1.90	1.34
A4	1.54	2	39.04	0.31	1.60	6	4	2	4	3	8.35	3.03	0.93	0.73	2.04	0.21	1.49	-0.48	1.92	1.34
Cl2	1.00	2	38.51	0.37	2.53	5	5	3	2	1	8.50	2.93	0.88	0.60	1.78	-1.02	0.99	-1.09	1.93	1.12
Xe1	0.93	2	39.03	0.14	0.70	3	6	4	2	2	7.80	3.47	0.93	0.83	2.31	-0.22	1.63	-0.23	1.95	1.70
Bl1	0.60	2	38.52	0.17	1.00	4	3	3	2	2	7.55	3.11	0.91	0.57	1.99	-0.59	1.39	-0.61	2.02	1.18

TABLE 8. Mean values of BMWP', number of Taxa, ASPT' and selected environmental variables for TWINSPAN groups from 60 sites. All values are means.

	TWINSPAN group							
	1 (n=3)	2(n=10)	3(n=5)	4(n=9)	5(n=10)	6(n=12)	7(n=8)	8(n=3)
BMWP'	138.7	130.7	119.0	140.0	99.1	101.3	87.6	63.0
Taxa	26.7	26.9	23.4	24.3	17.5	17.7	17.0	13.0
ASPT'	5.18	4.83	5.07	5.77	5.66	5.75	5.16	4.83
DS	1.01	0.75	1.35	0.96	1.42	2.01	1.54	2.00
ALT	2.57	2.61	2.79	2.80	2.31	2.50	2.44	2.40
LALK	0.73	0.64	0.61	0.62	0.61	0.61	0.69	0.65
LNITRA	0.75	0.75	1.09	0.76	0.90	0.87	0.88	1.02

TABLE 9. Correlation coefficients between ordination scores for Axes 1-4 and environmental variables for 60 sites.

Variable	Axis 1	Axis 2	Axis 3	Axis 4
DS	-0.694	0.085	-0.178	0.118
PRO	-0.313	-0.265	0.109	0.081
LAT	-0.369	-0.093	0.350	-0.001
LON	-0.300	-0.311	0.158	-0.023
ALT	0.194	0.022	0.345	-0.190
DMISUB	0.800	0.026	0.144	0.214
DMASUB	-0.044	0.096	0.212	0.120
CV	0.520	-0.199	-0.169	0.049
WIDTH	-0.580	-0.143	-0.136	0.016
DEPTH	-0.601	0.009	0.021	0.070
pH	-0.093	0.130	0.309	-0.001
LCOND	-0.377	-0.122	-0.164	0.154
LDOXI	-0.207	0.205	-0.002	-0.071
LALK	0.299	0.154	-0.255	0.096
LCAL	-0.425	-0.027	-0.136	-0.111
LNITRI	-0.288	0.016	-0.007	-0.004
LNITRA	-0.250	0.225	0.049	-0.035
LAMO	-0.564	-0.154	-0.011	-0.057
LSUL	-0.153	0.556	-0.218	-0.024
LTH	-0.426	-0.028	-0.195	0.014

Table 10. Prediction of TWINSPAN groups for 60 sites using multiple discriminant analysis on twenty environmental variables.

Group	No. of sites	Predicted group membership 1	2	3	4	5	6	7	8	% sites correctly predicted
1	3	3								100.0
2	10		9					1		90.0
3	5			5						100.0
4	9				8		1			88.89
5	10				2	6	1	1		60.0
6	12			1			11			91.67
7	8					1		6	1	75.0
8	3								3	100.0
Total no.sites	60									84.0

TABLE 11. The two seasons combined band ranges.

	A (good)	B (fair)	C (poor)	D (bad)
ASPT	≥0.88	0.76-0.87	0.64-0.75	≤0.63
Taxa	≥0.77	0.54-0.76	0.31-0.53	≤0.30
BMWP	≥0.72	0.44-0.71	0.16-0.43	≤0.15

TABLE 12. Observed (Ob), predicted (Pr), EQI values and Bands for BMWP (B), number of Taxa (T) and ASPT (A) for all sites studied (119).

Code	ObB	PrB	EQIB	ObT	PrT	EQIT	ObA	PrA	EQIA	Band
S1	3.0	138.6	0.02	2.0	26.7	0.08	1.50	5.18	0.29	DDD
S2	1.0	138.6	0.01	1.0	26.7	0.04	1.00	5.18	0.19	DDD
V2	9.0	88.2	0.10	4.0	17.1	0.23	2.25	5.16	0.44	DDD
V3	8.0	75.2	0.11	3.0	15.1	0.20	2.67	4.96	0.54	DDD
Se1	3.0	87.5	0.03	2.0	17.0	0.12	1.50	5.16	0.29	DDD
Se2	47.0	130.2	0.36	11.0	26.8	0.41	4.27	4.83	0.88	CCA
Se3	64.0	98.2	0.65	16.0	20.0	0.80	4.00	4.90	0.82	BAB
Se4	69.0	63.0	1.10	19.0	13.0	1.46	3.63	4.83	0.75	AAC
Mn1	9.0	87.6	0.10	4.0	17.0	0.24	2.25	5.16	0.44	DDD
Ja1	96.0	130.7	0.73	20.0	26.9	0.74	4.80	4.83	0.99	ABA
Al1	80.0	130.7	0.61	17.0	26.9	0.63	4.71	4.83	0.98	BBA
G1	69.0	130.7	0.53	16.0	26.9	0.59	4.31	4.83	0.89	BBA
G2	48.0	130.5	0.37	14.0	26.9	0.52	3.43	4.83	0.71	CCC
Am1	145.0	130.7	1.11	30.0	26.9	1.12	4.83	4.83	1.00	AAA
Gi1	53.0	130.7	0.41	11.0	26.9	0.41	4.82	4.83	1.00	CCA
Gi2	80.0	130.7	0.61	20.0	26.9	0.74	4.00	4.83	0.83	BBB
Sa1	83.0	88.2	0.94	19.0	17.1	1.11	4.37	5.16	0.85	AAB
To1	6.0	109.2	0.05	3.0	21.9	0.14	2.00	4.99	0.40	DDD
M1	73.0	106.0	0.69	15.0	19.4	0.77	4.87	5.52	0.88	BAA
M2	80.0	103.9	0.77	13.0	18.5	0.70	6.15	5.65	1.09	ABA
M3	88.0	101.3	0.87	15.0	17.7	0.85	5.87	5.75	1.02	AAA
M4	103.0	101.2	1.02	18.0	17.7	1.02	5.72	5.75	0.99	AAA
M5	94.0	101.2	0.93	16.0	17.7	0.91	5.88	5.75	1.02	AAA
M6	88.0	100.9	0.87	15.0	17.6	0.85	5.87	5.73	1.02	AAA
M7	101.0	96.5	1.05	19.0	17.1	1.11	5.32	5.63	0.94	AAA
P1	91.0	132.7	0.69	16.0	23.1	0.69	5.69	5.75	0.99	BBA
P2	142.0	139.8	1.02	26.0	24.3	1.07	5.46	5.77	0.95	AAA
P3	130.0	139.9	0.93	21.0	24.3	0.86	6.19	5.77	1.07	AAA
P4	32.0	134.5	0.24	6.0	23.4	0.26	5.33	5.75	0.93	CDA
P5	109.0	117.3	0.93	24.0	22.9	1.05	4.54	5.12	0.89	AAA
P6	64.0	87.8	0.73	15.0	17.0	0.88	4.27	5.17	0.83	AAB
P7	57.0	109.6	0.52	13.0	19.3	0.68	4.38	5.72	0.77	BBB
P8	97.0	104.4	0.93	23.0	18.5	1.24	4.22	5.68	0.74	AAC
P9	70.0	132.1	0.53	19.0	23.0	0.83	3.68	5.76	0.64	BAC
Mo1	116.0	139.6	0.83	21.0	24.3	0.87	5.52	5.77	0.96	AAA
Vi1	132.0	109.3	1.21	23.0	19.4	1.18	5.74	5.65	1.02	AAA
Vi2	164.0	123.9	1.32	28.0	21.6	1.30	5.86	5.74	1.02	AAA
Vi3	122.0	102.1	1.19	21.0	17.8	1.18	5.81	5.75	1.01	AAA
Vi4	107.0	102.8	1.04	18.0	18.0	1.00	5.94	5.74	1.03	AAA
B1	117.0	118.9	0.98	23.0	23.4	0.98	5.09	5.07	1.00	AAA
B2	107.0	119.0	0.90	21.0	23.4	0.90	5.10	5.07	1.01	AAA
B3	101.0	118.9	0.85	20.0	23.4	0.86	5.05	5.07	1.00	AAA
B4	112.0	120.4	0.93	18.0	21.1	0.85	6.22	5.71	1.09	AAA
Ce1	145.0	126.6	1.14	26.0	22.1	1.18	5.58	5.73	0.97	AAA
Ce2	119.0	139.3	0.85	20.0	24.2	0.83	5.95	5.77	1.03	AAA
L1	111.0	105.5	1.05	20.0	19.4	1.03	5.55	5.46	1.02	AAA
L2	135.0	99.2	1.36	25.0	17.5	1.43	5.40	5.66	0.95	AAA

TABLE 12. (continued)

Code	ObB	PrB	EQIB	ObT	PrT	EQIT	ObA	PrA	EQIA	Band
Ro1	111.0	99.5	1.12	17.0	17.6	0.97	6.53	5.65	1.16	AAA
Mm1	95.0	101.4	0.94	16.0	17.9	0.89	5.94	5.66	1.05	AAA
Mm2	118.0	109.6	1.08	21.0	20.6	1.02	5.62	5.35	1.05	AAA
Co1	161.0	118.5	1.36	29.0	23.3	1.25	5.55	5.08	1.09	AAA
T1	64.0	87.7	0.73	16.0	17.0	0.94	4.00	5.16	0.77	AAB
T2	75.0	87.7	0.86	16.0	17.0	0.94	4.69	5.16	0.91	AAA
T3	33.0	92.0	0.36	7.0	17.2	0.41	4.71	5.37	0.88	CCA
T4	41.0	73.2	0.56	8.0	14.7	0.55	5.13	4.97	1.03	BBA
T5	51.0	99.8	0.51	12.0	17.5	0.69	4.25	5.71	0.74	BBC
T6	81.0	73.5	1.10	16.0	14.3	1.12	5.06	5.07	1.00	AAA
T7	75.0	75.2	1.00	14.0	15.0	0.94	5.36	5.00	1.07	AAA
T8	55.0	64.3	0.86	11.0	13.2	0.83	5.00	4.85	1.03	BAB
T9	41.0	63.0	0.65	10.0	13.0	0.77	4.10	4.83	0.85	AAA
Eb1	96.0	88.0	1.09	17.0	17.0	1.00	5.65	5.17	1.09	AAA
Eb2	107.0	87.8	1.22	20.0	17.0	1.18	5.35	5.16	1.04	AAA
Va1	77.0	87.7	0.88	16.0	17.0	0.94	4.81	5.16	0.93	AAA
Ar1	82.0	108.9	0.75	16.0	19.5	0.82	5.13	5.59	0.92	AAA
Tu1	68.0	92.5	0.74	14.0	17.5	0.80	4.86	5.28	0.92	AAA
Re1	102.0	89.6	1.14	17.0	17.1	0.99	6.00	5.25	1.14	AAA
Re2	89.0	89.6	0.99	19.0	17.1	1.11	4.68	5.25	0.89	AAA
Ma1	22.0	95.7	0.23	7.0	17.5	0.40	3.14	5.46	0.57	CCD
Ma2	6.0	87.6	0.07	3.0	17.0	0.18	2.00	5.16	0.39	DDD
Ma3	45.0	87.6	0.51	13.0	17.0	0.76	3.46	5.16	0.67	BBC
Ma4	67.0	87.7	0.76	15.0	17.0	0.88	4.47	5.16	0.87	AAB
Ma5	31.0	86.2	0.36	10.0	16.8	0.60	3.10	5.14	0.60	CBD
Ma6	27.0	63.0	0.43	8.0	13.0	0.62	3.38	4.83	0.70	CBC
Mi1	118.0	132.0	0.89	20.0	23.0	0.87	5.90	5.75	1.03	AAA
Mi2	56.0	89.0	0.63	10.0	17.1	0.59	5.60	5.22	1.07	BBA
Bu1	80.0	87.6	0.91	16.0	17.0	0.94	5.00	5.16	0.97	AAA
Bu2	21.0	87.6	0.24	7.0	17.0	0.41	3.00	5.16	0.58	CCD
J1	54.0	63.0	0.86	10.0	13.0	0.77	5.40	4.83	1.12	AAA
J2	53.0	63.0	0.84	12.0	13.0	0.92	4.42	4.83	0.92	AAA
J3	–	–	–	–	–	–	–	–	–	–
J4	–	–	–	–	–	–	–	–	–	–
J5	2.0	63.0	0.03	1.0	13.0	0.08	2.00	4.83	0.41	DDD
C1	98.0	100.7	0.97	17.0	17.6	0.96	5.76	5.73	1.01	AAA
C2	105.0	101.2	1.04	19.0	17.7	1.08	5.53	5.75	0.96	AAA
C3	92.0	101.1	0.91	14.0	17.6	0.79	6.57	5.75	1.14	AAA
C4	101.0	99.8	1.01	18.0	17.5	1.03	5.61	5.71	0.98	AAA
Ca1	98.0	87.7	1.12	19.0	16.9	1.12	5.16	5.18	1.00	AAA
Cz1	48.0	92.4	0.52	9.0	17.6	0.51	5.33	5.25	1.02	BCA
Ga1	86.0	102.1	0.84	16.0	17.8	0.90	5.38	5.74	0.94	AAA
Es1	79.0	99.3	0.80	17.0	17.5	0.97	4.65	5.66	0.82	AAB
Sl1	67.0	99.9	0.67	14.0	17.7	0.79	4.79	5.66	0.85	BAB
A1	52.0	87.7	0.59	14.0	17.0	0.82	3.71	5.16	0.72	BAC
A2	90.0	87.3	1.03	21.0	16.7	1.26	4.29	5.23	0.82	AAB
A3	63.0	71.7	0.88	16.0	14.4	1.11	3.94	4.94	0.80	AAB
A4	76.0	63.7	1.19	18.0	13.1	1.37	4.22	4.84	0.87	AAB
Cl2	10.0	92.8	0.11	4.0	17.9	0.22	2.50	5.18	0.48	DDD
Xe1	21.0	64.9	0.32	8.0	13.3	0.60	2.63	4.86	0.54	CBD

TABLE 12. (continued)

Code	ObB	PrB	EQIB	ObT	PrT	EQIT	ObA	PrA	EQIA	Band
Bl1	50.0	98.9	0.51	10.0	17.5	0.57	5.00	5.66	0.88	BBA
Rs1	194.0	140.0	1.39	34.0	24.3	1.40	5.71	5.77	0.99	AAA
At1	150.0	130.7	1.15	32.0	26.9	1.19	4.69	4.83	0.97	AAA
Ag1	104.0	138.7	0.75	21.0	26.7	0.79	4.95	5.18	0.96	AAA
Cr1	196.0	130.7	1.50	37.0	26.9	1.38	5.30	4.83	1.10	AAA
Aq1	172.0	130.7	1.32	33.0	26.9	1.23	5.21	4.83	1.08	AAA
Sn1	116.0	138.4	0.84	26.0	26.2	0.99	4.46	5.28	0.85	AAB
Lm1	119.0	140.0	0.85	24.0	24.3	0.99	4.96	5.77	0.86	AAB
Ac1	138.0	132.7	1.04	30.0	23.1	1.30	4.60	5.76	0.80	AAB
Ab1	109.0	101.2	1.08	25.0	17.7	1.42	4.36	5.75	0.76	AAB
Bq1	119.0	137.7	0.86	26.0	24.0	1.09	4.58	5.76	0.79	AAB
Ao1	155.0	138.7	1.12	30.0	26.7	1.13	5.17	5.18	1.00	AAA
Za1	123.0	138.7	0.89	27.0	26.7	1.01	4.56	5.18	0.88	AAA
Ls1	57.0	130.7	0.44	13.0	26.9	0.48	4.38	4.83	0.91	BCA
Bo1	157.0	138.7	1.13	29.0	26.7	1.09	5.41	5.18	1.05	AAA
Cl1	110.0	137.7	0.80	24.0	26.7	0.90	4.58	5.13	0.89	AAA
On1	80.0	133.7	0.60	19.0	26.8	0.71	4.21	4.96	0.85	BBB
V1	121.0	131.8	0.92	26.0	26.9	0.97	4.65	4.88	0.95	AAA
Fa1	111.0	130.7	0.85	23.0	26.9	0.86	4.83	4.83	1.00	AAA
Pe1	147.0	130.7	1.12	32.0	26.9	1.19	4.59	4.83	0.95	AAA
Vl1	108.0	136.7	0.79	26.0	26.7	0.97	4.15	5.09	0.81	AAB
En1	98.0	138.7	0.71	25.0	26.7	0.94	3.92	5.18	0.76	BAB

Appendix. Macroinvertebrate fauna collected in the 119 sites with the taxon code

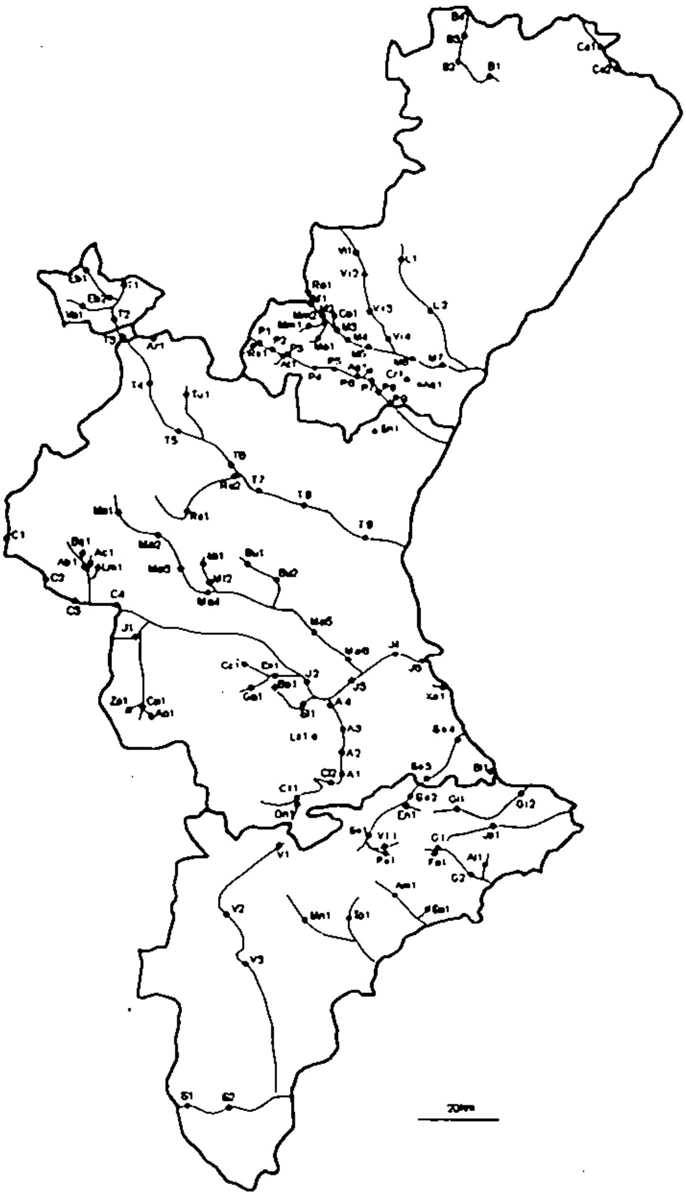
		Frecuency (no. of sites)	
Code	Taxa	Spring	Summer
02010201	*Hydra viridissima*	1	-
03120300	*Dugesia* sp.	37	44
03120304	*Dugesia gonocephala* (Dugès)	5	3
03120305	*Dugesia mediterranea* Benazzi et al.	2	-
13010101	*Theodoxus fluviatilis* (L.)	6	7
13040000	Hydrobiidae	8	13
13040600	*Mercuria* sp.	2	-
13040701	*Semisalsa stagnorum* (Gmelin)	1	-
13040200	*Pseudamnicola* sp.	1	-
13049900	*Pseudamnicola (Corrosella)*sp	1	-
13040301	*Potamopyrgus jenkinsi* (Smith)	38	36
13040800	*Neohoratia* sp.	1	-
13990501	*Bithynia tentaculata* (L.)	5	2
13990502	*Bithynia leachii* (Sheppard)	1	1
13140101	*Melanopsis dufouri* Férussac	27	27
13070101	*Lymnaea truncatula* (Müller)	15	12
13070103	*Lymnaea palustris* (Müller)	-	1
13070107	*Lymnaea peregra* (Müller)	24	33
13080202	*Physella acuta* (Draparnaud)	40	56
13090102	*Planorbis metidjensis* (Forbes)	-	1
13090306	*Gyraulus laevis* (Alder)	2	5
13090401	*Hippeutis complanatus* (L.)	1	2
13100201	*Ancylus fluviatilis* Müller	37	37
14030200	*Pisidium* sp.	5	10
14030202	*Pisidium casertanum* (Poli)	1	1
14030213	*Pisidium nitidum* Jenyns	5	1
16000000	Oligochaeta	7	5
16020105	*Chaetogaster limnaei* Von Baer	7	-
16020707	*Nais elinguis* Müller	1	-
16030101	*Tubifex tubifex* (Müller)	7	6
16030201	*Psammoryctides barbatus* (Grube)	4	2
16030302	*Limnodrilus hoffmeisteri* Claparede	1	-
16030303	*Limnodrilus udekemianus* Claparede	-	2
16030305	*Limnodrilus profundicola* (Verrill)	1	-
16030502	*Potamothrix bavaricus* (Öschman)	-	2
16040000	*Enchytraeus* group	2	4
16060201	*Stylodrilus heringianus* Claparède	9	6
16080301	*Eiseniella tetraedra* (Savigny)	14	16
17020301	*Glossiphonia heteroclita* (L.)	1	-
17020401	*Batracobdella paludosa* (Carena)	-	1
17020501	*Helobdella stagnalis* (L.)	8	20
17020601	*Placobdella costata* (Fr Müller)	1	1
17030101	*Haemopis sanguisuga* (L.)	3	1
17030301	*Limnatis nilotica* (Savigny)	-	1
17040201	*Dina lineata* (Müller)	41	41
19000000	Hydracarina	18	12
24030200	*Daphnia* sp.	2	-
25000000	Ostracoda	4	4
28030201	*Proasellus coxalis* (Dollfus)	4	2

28040101	*Sphaeroma hookeri* Leach	-	1
28070000	Gammaridae	-	1
28070600	*Echinogammarus* sp.	4	5
28070601	*Echinogammarus berilloni* group	2	3
28070602	*Echinogammarus echinosetosus* Pinkster	12	19
28070603	*Echinogammarus longisetosus* Pinkster	23	21
28070604	*Echinogammarus pacaudi* Hubault & Ruffo	2	2
28070605	*Echinogammarus simoni* Chevr.	4	7
28070606	*Echinogammarus margalefi* Pinkster	1	-
2807070	*Eulimnogammarus macrocarpus* Stock	4	4
28990101	*Atyaphyra desmaresti* (Millet)	2	2
28990201	*Dugastella valentina* (Ferrer Galdiano)	4	10
28100101	*Austropotamobius pallipes lusitanicus* (Mateus)	1	5
28100201	*Procambarus clarki* (Girad)	15	6
30020100	*Baetis* sp.	83	81
30020105	*Baetis rhodani* (Pictet)	9	2
30020300	*Centroptilum* sp.	25	9
30020201	*Centroptilum luteolum* (Müller)	2	-
30020202	*Centroptilum pennulatum* Eaton	2	4
30020300	*Cloeon* sp.	-	5
30020301	*Cloeon dipterum* (L.)	6	7
30020302	*Cloeon simile* Eaton	2	1
30020402	*Procloeon concinnum* Eaton	15	3
30090101	*Oligoneuriella rhenana* Imhoff	-	3
30030100	*Rhithrogena* sp.	1	-
30030201	*Heptagenia sulphurea* (Müller)	13	1
30030400	*Ecdyonurus* sp.	42	44
30040102	*Leptophlebia vespertina* (L.)	8	-
30040201	*Paraleptophlebia submarginata* (Stephens)	10	2
30040301	*Habrophlebia fusca* (Curtis)	7	10
30040101	*Choroterpes picteti* (Eaton)	1	12
30040501	*Thraulus bellus* Eaton	3	1
30050101	*Ephemerella ignita* (Poda)	5	13
30060101	*Potamanthus luteus* (L.)	-	2
30070100	*Ephemera* sp.	3	-
30070102	*Ephemera danica* Müller	1	-
30080202	*Caenis luctuosa* group	50	51
30100101	*Prosopistoma pennigerum* (Müller)	1	2
31020100	*Protonemura* sp.	2	-
31020103	*Protonemura meyeri* (Pictet)	1	-
31020401	*Nemoura cinerea* (Retzius)	1	3
31030100	*Leuctra* sp.	13	22
31030101	*Leuctra geniculata* (Stephens)	-	1
31040104	*Capnia nigra*	2	-
31050200	*Perlodes* sp.	-	1
31050400	*Isoperla* sp.	4	2
31060101	*Dinocras cephalotes* (Curtis)	1	2
31060301	*Eoperla ochracea* Kolbe	-	4
31060210	*Perla marginata* Stephens	9	5
32010102	*Platycnemis acutipennis* Selys	6	-
32010103	*Platycnemis latipes* Rambus	3	5
32020101	*Pyrrhosoma nymphula* (Sulzer)	9	15
32020406	*Coenagrion lindeni* Selys	-	1
32020501	*Ceriagrion tenellum* (Villers)	1	-
32030110	*Lestes viridis* (Linden)	-	2
32030111	*Lestes macrostigma* (Eversmann)	1	-
32030201	*Sympecma fusca* (Linden)	1	-
32040101	*Calopteryx splendens* (Harris)	6	11

32040102	*Calopteryx virgo* (L.)	-	1
32040103	*Calopteryx haemorrhoidalis* (Linden)	-	1
32059901	*Onychogomphus uncatus* (Charpentier)	5	8
32059902	*Onychogomphus forcipatus* (L.)	5	21
32060102	*Cordulegaster bidentatus* Selys	-	4
32060103	*Cordulegaster annulatus*	6	2
32079901	*Boyeria irene* (Fonscolombe)	10	19
32070301	*Anax imperator* Leach	1	3
32070302	*Anax parthenope* Selys	1	2
32080301	*Oxygastra cutissi* (Dale)	1	-
32090101	*Orthetrum cancellatum* (L.)	-	1
32090102	*Orthetrum coerulescens* (Fabricius)	4	6
32090103	*Orthetrum brunneum* (Fonscolombe)	1	-
32090302	*Sympetrum fonscolombei* (Selys)	1	1
32090307	*Sympetrum vulgatum* (L.)	-	1
33030102	*Hydrometra stagnorum* (L.)	13	17
33040100	*Velia* sp.	-	2
33040200	*Microvelia* sp.	1	1
33050100	*Gerris* sp.	10	19
33060101	*Nepa cinerea* L.	11	23
33070201	*Naucoris maculatus* Fabricius	7	5
33090100	*Notonecta* sp.	3	9
33100102	*Plea minutissima* (Fuessly)	2	4
33110100	*Micronecta* sp.	-	2
33110500	*Corixa* sp.	4	4
35010200	*Peltodytes* sp.	1	2
35010201	*Peltodytes caesus* Duftschmidt	3	1
35010300	*Haliplus* sp.	7	20
35010303	*Haliplus lineatocollis* (Marsham)	5	-
35010313	*Haliplus mucronatus*	1	-
35030200	*Laccophilus* sp.	4	10
35030202	*Laccophilus hialinus* (Degeer)	8	5
35030300	*Hydrovatus* sp.	-	1
35030400	*Hydphydrus* sp.	1	1
35030500	*Bidessus* sp.	1	5
35030700	*Deronectes* sp.	6	14
35039900	*Potamonectes* sp.	1	-
35033001	*Yola bicarinata* (Latreille)	1	6
35039500	*Hydroporus* sp.	1	-
35030900	*Graptodytes* sp.	1	-
35030905	*Stictonectes lepidus* (Olivier)	2	4
35031100	*Agabus* sp.	7	1
35031108	*Agabus didymus* (Olivier)	-	1
35031300	*Ilybius* sp.	-	3
35031301	*Ilybius fuliginosus* (Fabricius)	1	-
35031401	*Copelatus haemorrhoidalis* (Fabricius)	1	-
35031500	*Rhantus* sp.	-	1
35033101	*Meladema coriacea* Castelnan	4	6
35031700	*Dytiscus* sp.	2	1
35032201	*Scarodytes halensis* (Fabricius)	4	9
35040100	*Aulonogyrus* sp.	-	2
35040202	*Gyrinus urinator* Illiger	1	-
35040205	*Gyrinus bicolor*	1	-
35040301	*Orectochilus villosus* (Müller)	3	2
35950100	*Ochthebius* sp.	6	1
35950200	*Hydraena* sp.	5	10
35050301	*Limnebius truncatellus* (Thunberg)	1	-
35050500	*Helophorus* sp.	-	1

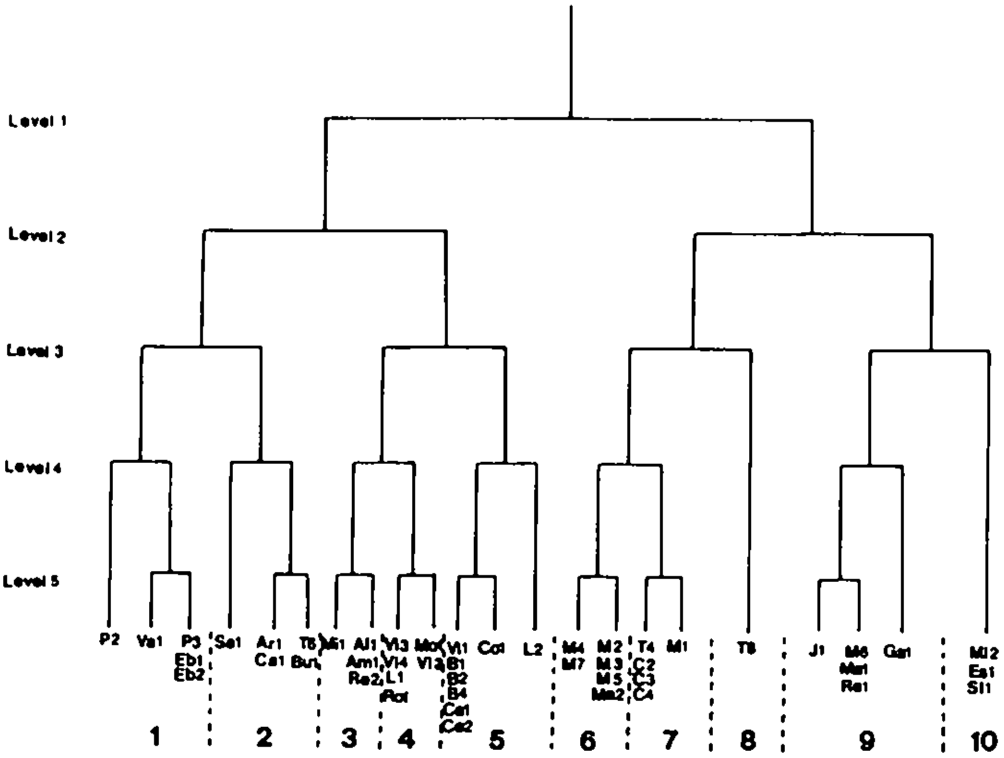
35051000	*Anacaena* sp.	1	-
35051003	*Anacaena bipustulata* (Marsham)	1	-
35051100	*Laccobius* sp.	9	28
35051200	*Helochares* sp.	4	7
35051201	*Helochares lividus* Forst.	4	2
35051300	*Enochrus* sp.	-	1
35051701	*Hydrous piceus* (L.)	4	8
35051800	*Berosus* sp.	-	1
35070301	*Coelostoma hispanicum* Küst.	1	2
35090100	*Elodes* sp.	2	3
35090300	*Cyphon* sp.	5	6
35090500	*Hydrocyphon* sp.	3	8
35100100	*Dryops* sp.	9	16
35100201	*Helichus substriatus* (Müller)	3	7
35119901	*Dupophilus brevis* Mulsant & Rey	2	-
35110100	*Elmis* sp.	28	39
35110200	*Esolus* sp.	3	7
35110300	*Limnius* sp.	3	10
35110500	*Normandia* sp.	-	4
35110600	*Oulimnius* sp.	9	5
35110700	*Riolus* sp.	3	9
35110801	*Stenelmis canaliculata* (Gyllenhall)	7	4
36010101	*Sialis lutaria* (L.)	1	-
38010000	Rhyacophilidae	2	-
38010100	*Rhyacophila* sp.	10	9
38010101	*Rhyacophila dorsalis* (Curtis)	-	1
38010104	*Rhyacophila munda* McLachlan	4	1
38170000	Glossosomatidae	4	2
38170300	*Agapetus* sp.	6	6
38020000	Philopotamidae	15	11
38020200	*Wormaldia* sp.	2	1
38020301	*Chimarra marginata* (L.)	3	3
38030000	Polycentropodidae	23	22
38030301	*Polycentropus flavomaculatus* (Pictet)	4	5
38030501	*Cyrnus trimaculatus* (Curtis)	1	-
38040000	Psychomyiidae	2	1
38040201	*Tinodes waeneri* (L.)	1	2
38040208	*Tinodes dives* (Pictet)	2	-
38990102	*Ecnomus deceptor* McLachlan	2	-
38050000	Hydropsychidae	84	69
38050100	*Hydropsyche* sp.	7	14
38050109	*Hydropsyche siltalai* Dohler	1	-
38060102	*Agraylea sexmaculata* Curtis	6	3
38060300	*Hydroptila* sp.	27	33
38060311	*Hydroptila vectis*	2	2
38060501	*Orthotrichia angustella* (McLachlan)	3	4
38060600	*Oxyethira* sp.	1	1
38070000	Phryganeidae	2	-
38080000	Limnephilidae	5	3
38080200	*Apatania* sp.	1	-
38080500	*Limnephilus* sp.	1	-
38081202	*Halesus digitatus* (Schrank)	1	-
38081504	*Micropterna squax* McLachlan	1	-
38081600	*Mesophylax* sp.	-	1
38081601	*Mesophylax impunctatus* McLachlan	1	-
38081602	*Mesophylax aspersus* Ramb.	3	-
38089800	*Stenophylax* sp.	2	-
38100100	*Beraea* sp.	2	-

38110101	*Odontocerum albicorne?* (Scopoli)	1	-
38120000	Leptoceridae	1	3
38120802	*Setodes argentipuctellus* McLachlan	-	1
38150000	Brachycentridae	1	-
38160000	Sericostomatidae	1	-
38160101	*Sericostoma personatum* (Spence)	-	3
38160102	*Sericostoma vittatum* Ramb.	-	2
40010000	Tipulidae	10	7
40011700	*Tipula* sp.	2	-
40011731	*Tipula montium* (group)	3	-
40011739	*Tipula maxima* Poda	1	-
40980000	Limoniidae	3	2
40020000	Psychodidae	2	2
40020200	*Pericoma* sp.	1	-
40040000	Dixidae	2	2
40040100	*Dixa* sp.	4	6
40040200	*Dixella* sp.	2	-
40050100	*Chaoborus* sp.	2	-
40060000	Culicidae	3	8
40080900	*Atrichopogon* sp.	7	7
40990000	Chironomidae	79	71
40150000	Simuliidae	62	47
40160000	Stratiomyidae	9	10
40160300	*Oxycera* sp.	2	-
40160602	*Stratiomys furcata* Fabricius	1	1
40170000	Empididae	-	1
40180000	Dolichopodidae	1	-
40190100	*Atherix* sp.	5	4
40970300	*Chrysophilus* sp.	-	1
40200000	Tabanidae	4	5
40210000	Syrphidae	1	1
40250000	Anthomyidae	2	4



(Here I must added a small Peninsule Iberica map)

Fig. 1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Bu
Mi1
Al1
Am1
Re2
Vi3
Vi4
L1
Rot
Mo
Vi2
Vi1
B1
B2
B4
Ce1
Ce2
Co1
L2
M4
M7
M2
M3
M5
Ma2
T4
C2
C3
C4
M1
T8
J1
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Fig 2

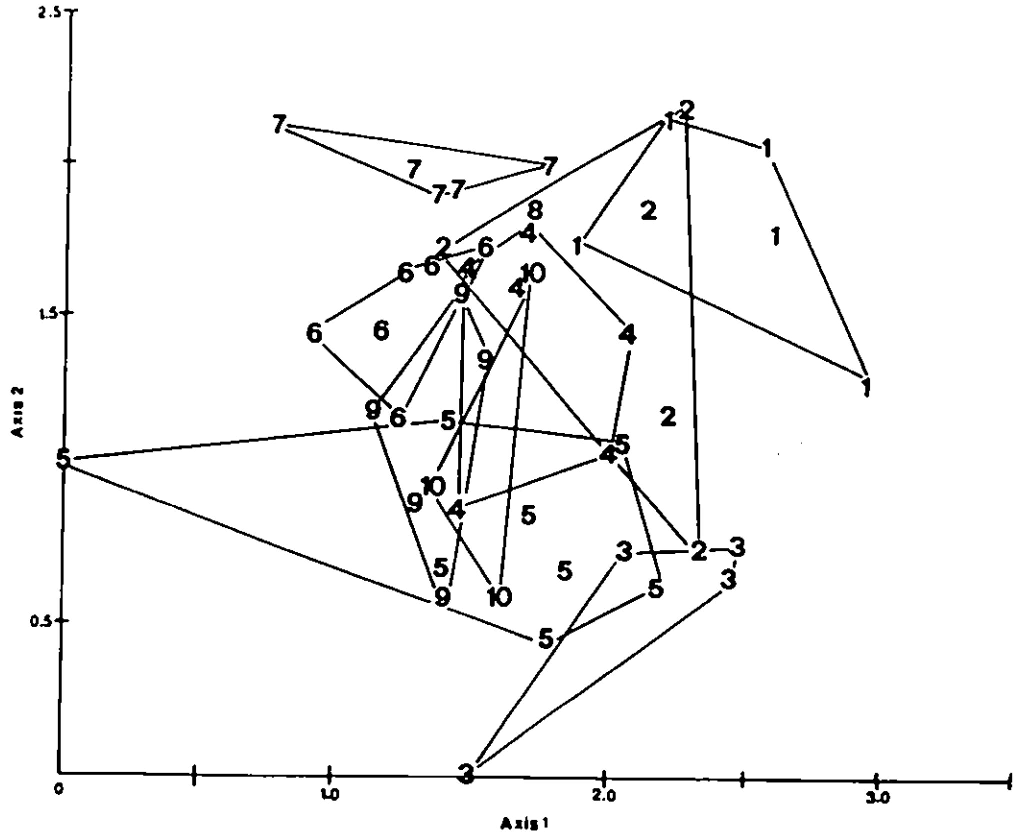
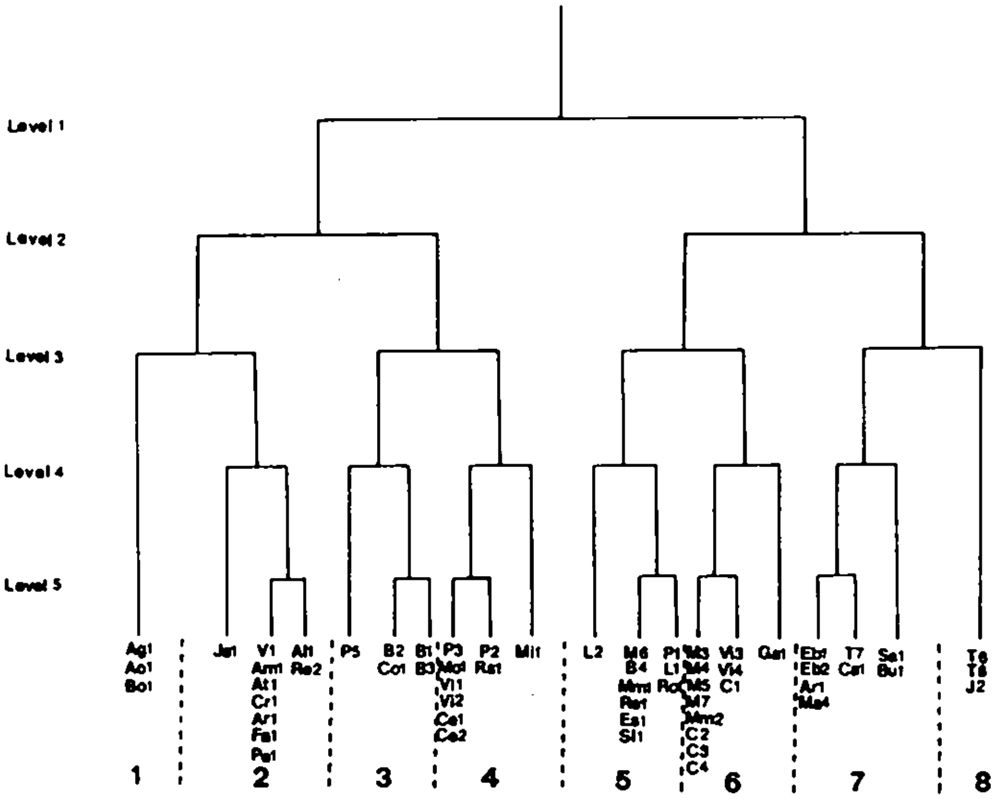


Fig. 3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B3
P3
Mo1
Vi1
Vi2
Ce1
Ce2
P2
Rs1
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L2
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B4
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P1
L1
Ro
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M7
Mm2
C2
C3
C4
Vi3
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Fig. 4

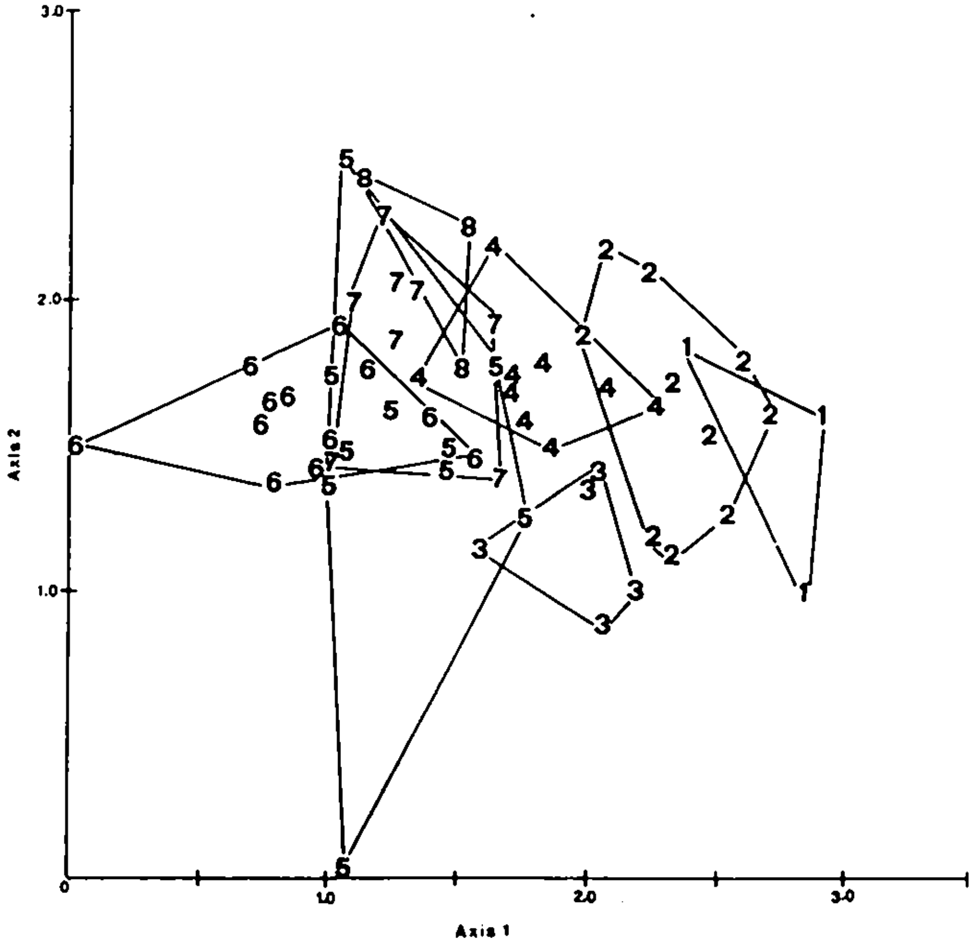

Fig 5