RELATION BETWEEN SOME XILOPHAGOUS AND XILOMICETOPHAGOUS INSECTS AND *QUERCUS* SPP. (*Q. SUBER* AND *Q. ROTUNDIFOLIA*)

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Abstract: The aim of this work is to establish a relation between some insects species: (*Coroebus undatus; Coroebus florentinus; Cerambyx cerdo; Platypus cylindrus; Prinobius scutellaris; Phymatodes testaceus*) and the two *Quercus* in study (*Quercus suber; Quercus rotundifolia*). The field work consisted in collecting quantitative data (measurements of the affected trees) and qualitative data (damages presented by the refereed trees).Then by using multivariate statistical techniques (Cluster analysis; Canonical analysis) to create a relation of some species with a certain tree specie and other species with the other tree specie in study.

Keywords: Insects, multivariate techniques.

Resumo: Relação entre alguns insectos xilófogos e xilemicetógagos e os *Quercus spp*. (*Quercus suber* e *Quercus rotundifolia*).

O objectivo deste trabalho é estabelecer uma relação entre algumas espécies de insectos: (*Coroebus undatus; Coroebus florentinus; Cerambyx cerdo; Platypus cylindrus; Prinobius scutellaris; Phymatodes testaceus*) e as duas espécies de *Quercus* em estudo (*Quercus suber; Quercus rotundifolia*). O trabalho de campo consistiu na recolha de dados quantitativos (medidas das árvores afectadas) e de dados qualitativos (danos apresentados pelas mesmas).

Utilizaram-se então técnicas estatísticas multivariadas (Análise de Agrupamentos; Análise Canónica) para determinar uma relação entre algumas espécies de insectos e uma determinada árvore e outras espécies com a outra espécie de árvore do estudo.

Palavras-Chave: Insectos, técnicas multivariadas.

Introduction

Nowadays the total area of *Quercus suber* and *Quercus rotundifolia* takes up to 1.231.513 ha, being 658.567 ha occupied by the *Q. suber* and 572.946 ha by the *Q. rotundifolia* (DGF,1992). According to information provided by the Forest Institute, 1992, these tree species are mostly found in the South of Portugal, to be more accurate in Alentejo, where the *Q. suber* takes up to 72,5% of its total area and the *Q. rotundifolia* 90,2% of is total area of distribution in Portugal. There they serve several purposes like agricultural exploitation, in the manner of pasture, and in the industry, as cork extraction (Cabral, 1986).

The purpose of this research is to quantify the damage made by the following five species of *Coleoptera* in the already mentioned *Q.suber* and *Q. rotundifolia* : the longhorn beetles belong to the Cerambycidae family`s, *Cerambyx cerdo* and *Phymatodes testaceus*; the buprestids beetles belong to the Buprestidae family`s, *Coroebus undatus* and *Coroebus florentinus*; the bark beetle *Platypus cylindrus* belonging to the Platypodidae family (Chinery, 1993; Ferreira, 1991). We use the *Hypoxylon mediterraneum*, fungee because of their abundance and we try too find a relation between this and the afected threes.

In order to attain this goal five areas occupied by both tree species were selected, three had more of *Q. suber* and the remaining two more of *Q. rotundifolia*. Analysis and results, the used methodology will be explained further on, are going to be based upon collected measurements and data concerning progressive degradation and hygienic surroundings of the trees (PAMAF, 1998).

Methodology

The principle applied was to use the collected data concerning the progressive degradation and the hygienic surroundings of the trees in study.

In order to evaluate the level of degradation, the following variables were considered :

PAP- diameter of the tree at the height of 1,30 m
HDS- decortication height of the biggest branch
HF- cudgel height
HDT- heighest level of decortication
CDS- decortication coefficient (CDS max= HF+ HDS / PAP)

To evaluate the hygienic conditions of the surroundings, only one aspect was taken into account, namely DES (leaf-shedding degree). This was so, because it is a more subjective evaluation, for it relies on the experience of the investigator and also on pre-established standards (table 1).

Tab. 1 – Leaf-shedding degrees.

Leaf-shedding degree
0 - (0-10% of loosing leaves)
1 - (11-25% of loosing leaves)
2 - (26-60% of loosing leaves)
3 - (?60% of loosing leaves)
4 -dead (100% of loosing leaves)

Other data, which will determine the hygienic surroundings conditions, represent the attacks of several insect species and of one fungus, and they also respect the same criterion of the former variable are considered (table 2).

Tab. 2 – Attacks or presences of the diferent species.

PLA- *Platypus cilindrus* attacks
until 2 metres high
0 not attacked
1 until 20 holes
2 more than 20 holes
3 dead three
CER- *Cerambyx cerdo* attacks
until 2 metres high
0 not attacked
1 until 5 holes
2 more than 5 holes
3 dead three
FLO- *Coroebus florentinus* attacks
0 not attacked
1 1-2 attacked branches
2 2-5 attacked branches
3 more than five attacked branches
COB- Presence of *Coroebus undatus*
0 No
1 Yes
FUN- Presence of *Hypoxylon mediterraneum*
0 No
1 Yes
TEST- Presence of *Phymatodes testaceus*
0 No
1 Yes

Areas involved in this research:

Area 1- Herdade do Freixial, at 17 Km in the district of Évora, in the road Torre dos Coelheiros-Portel. With *Querqus suber* and *Quercus rotundifolia*. Has been analyzed 200 trees in this area.

Area 2- Herdade da Felicia, near Nª Sª Machede. Many trees in a bad condition. Just with *Quercus suber*. Has been analyzed 200 trees in this area.

Area 3- Serra de Grândola, in the national road 120, between Sª Margarida da Serra e Grândola at 25/26 Km. Just with *Quercus suber*. Has been analyzed 200 trees in this area.

Area 4- Azinhal, placed near the locality of Azinhal in the road Beja –Mértola. Just with *Quercus rotundifolia*. Has been analyzed 150 trees in this area.

Area 5- Arronches, placed near the village of Arronches in the district of Portalegre. Just with *Quercus rotundifolia*. Has been analyzed 150 trees in this area.

After a series of observations made and measurements taken, the Cluster Analysis (K-means) was applied. This sort of analysis uses the data shown in table 2, therefore allowing to make a quantitative differentiation of the trees (Reis,1997). The program used was STATISTICA and n = 900 (total number of trees used in this study).
In order to correlate the results previously obtained in the Cluster Analysis with the data shown in table 2, we made use of the Canonical Analysis; the program used was CANNOCO.

Results

With the program STATISTICA the data used were the ones shown in table 1, K-means-clustering, with 5 clusters and 10 iterations maximum, which were applied to a matrix of the type n x p (n = number of trees: rows; and p = dendrometric data: columns).
The results are shown in graphic nr.1.
With the program CANNOCO, two matrices of the type n x p were obtained. One considered the clusters and nominal data and the other correlated the infested trees and their progressive degradation and hygienic surroundings simultaneously. (Attention: zeros weren't considered, as they stand for non- infested trees). In the end a Redundancy Analysis, which took into account the biological variables as data of species and the clusters as environmental data, existing no interaction and no correlation between them, was been executed. The following results were obtained (fig 2,3,4).

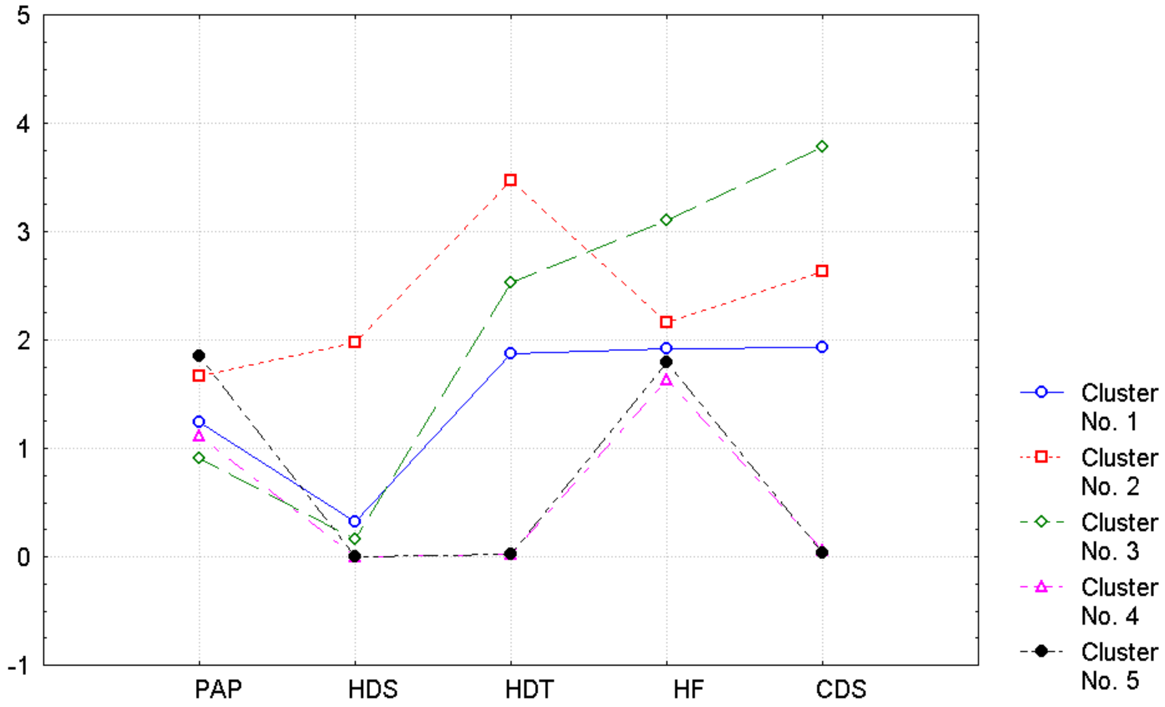

Fig.1- Cluster Analysis using the variables PAP, HDS, HDT, HF and CDS (K-Means clustering).

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Summary

Axes                                      1    2       3    4   Total
                                                                 Variance

Eigenvalues                          :   .221 .020 .001 0.000    1.000
Species-environment correlations    :   .677 .290 .164  .027
Cumulative percentage variance
   of species data                   :   22.1 24.1  24.2 24.2
   of species-environment relation:    91.3 99.5 100.0100.0

Sum of all unconstrained eigenvalues                                 1.000
Sum of all eigenvalues canónicos                                      .242
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Fig.2- Redundancy analysis summary.

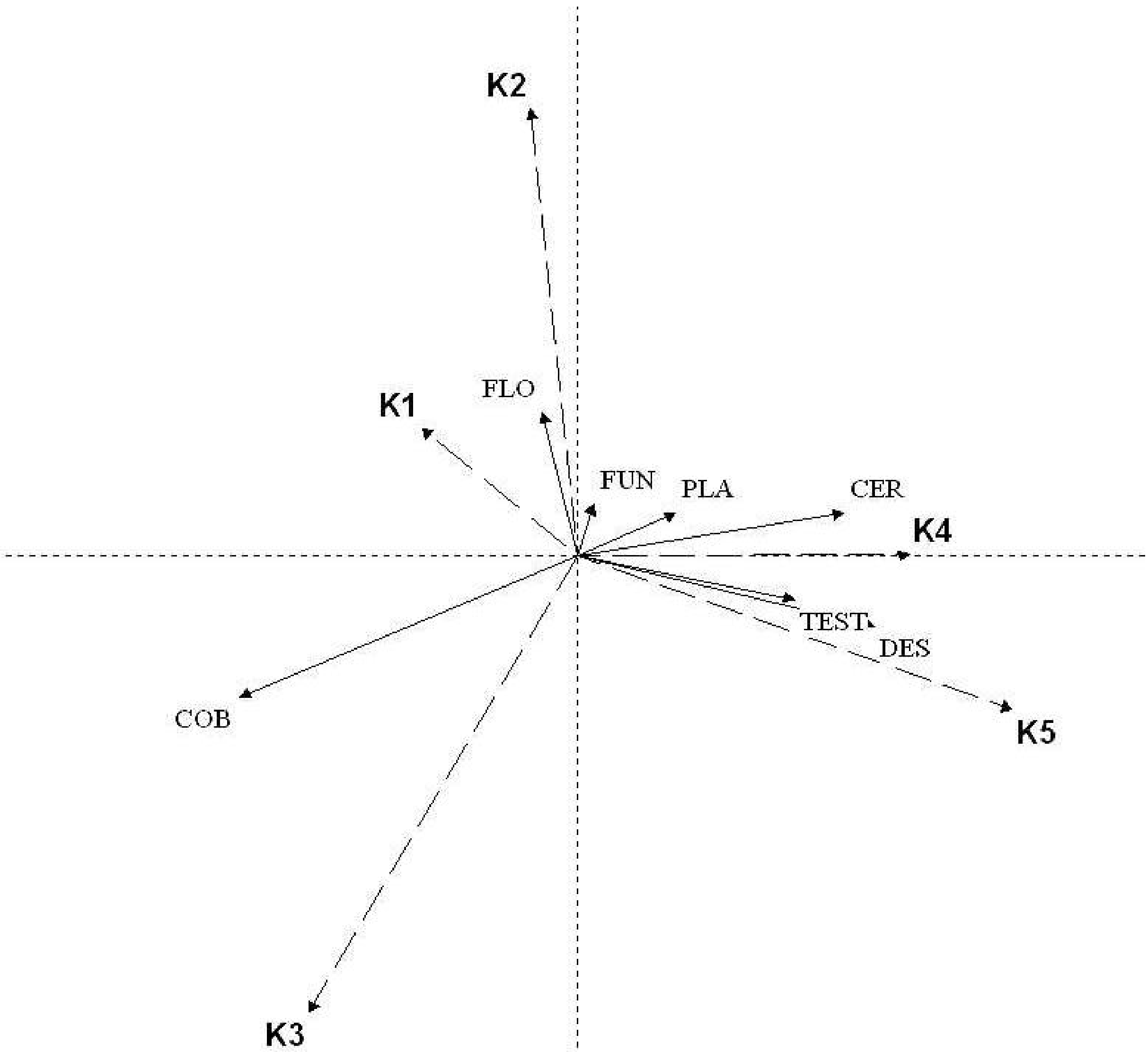

Fig. 3 – Ordination diagram of Redundancy analysis (species scores and environmental variables).

Discussion of Results

The Cluster Analysis is a statistic procedure, which attempts to create a homogenous group of individuals of which a lot of detailed information is known and then to filter out the most important in order to be able to separate them in different groups (Gaugh,1989; Reis,1997). This non-hierarchical method was chosen, for it allowed us simultaneously to control the number of groups (5) and of iterations. After n interations, the program stops, maximizes the variation between groups and minimizes the variation within groups. According to Goodal (1954), all classification procedures tend to be controlled by the investigator and not by the internal structure of the collected data.
The results in fig.1 show a clear difference among the different areas of study, for clusters 4 and 5, which are *Q. rotundifolia* (variables HDS , CDS and HDT regarding the *Q. suber* are represented by zeros)while the remaining areas are taken up by *Q. suber* . Curiously the best result was obtained when using the same number of clusters as the number of areas in study. This was achieved by only using quantitative data: any resemblance reflects the importance of the variables with higher values and bigger dispersion dispersion (Reis, 1997). The result of K-Means clustering are reclassified in nominal variables and used in canonical analysis.
When studying the canonical analysis of redundancy, the first 3 axis show 24,2% of variance (sum of all canonical values); most of the values are in the first axis (22,12 %), and the remaining two axis have 2% and 1%. The value itself is always a number between 0 and 1, the higher the value the more important is the axis (Legendre, 1998; Teer Brak, 1987).
The results in fig. 1 and 2, show a very strong relation between the species *Cerambyx cerdo* and *Phymatodes testaceus.* The leaf-shedding degree from clusters K4 and K5 correspond to *Q. rotundifolia* . and the *Coroebus florentinus* corresponds to clusters K1 and K2, which are mainly *Q. suber.* The specie *Coroebus undatus* appears only associated to cluster K2, which only consists of *Q. suber* and presents a negative correlation towards clusters K5 and K4 (*Q. rotundifolia*). After 999 Monte Carlo permutations, this model gave a positive result for the first axis, having a probability of $p<0,001$ (Borcard,1989; Teer Braak, 1987).

Conclusion

The Canonical Analysis allowed us to use the program CANNOCO and therefore come to the result with that of the 900 trees, of which 757 were represented with a zero. We got a total variation of 24,2% due to rows containing zeros could not be taken into account (Teer Braak, 1987).
It also enabled us to prove that *Cerambyx cerdo* and *Phymatodes testaceus* are more likely to appear in *Q. rotundifolia* and *Coroebus f.* and *Coroebus undatus* in *Q. suber.* The last mentioned species seems to have a negative relation towards the *Q. rotundifolia*. It also showed us that the leaf-shedding degree is , in decrescendo order, related to the infestation of *Cerambyx cerdo* and *Phymatodes testaceus* and as last *Platypus cylindricus.* Between the remaining species and leaf -shedding no relation was found.

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