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Analysis and comparison of the ground Coleoptera communities in organic and conventional orchards within the "Etna" Regional Park (Catania, Sicily)

INTERNATIONAL PhD IN

PLANT HEALTH TECHNOLOGIES AND PROTECTION OF AGRO-ECOSYSTEMS

XXVI CYCLE

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SUMMARY

ABSTRACT

In recent years, more and more emphasis has been placed on the value of biodiversity as a biological heritage that concerns not only the conservation of nature, but also of the gene pool of cultivated autochthonous plants and animals that have been bred.
In this perspective, agriculture, which in the past, has had a significantly negative impact on biodiversity, today takes a major role in the maintenance of environmental diversity.
Over the past few decades, the agricultural landscape has undergone considerable simplification, with the destruction of many natural and semi-natural elements that have interfered with the cultivated areas.
Today it is possible to speak of agriculture with a totally different outlook, inserting it in an "organic" balance, in which the agro-ecosystem can be conceived as an area large enough to include those uncultivated areas that effect the crops through exchanges between communities of organisms, substances and energy.
From studies conducted by several authors on the role of small wooded areas, hedges, borders and margins in relation to wildlife, both vertebrate and invertebrate, it was found that, in most cases, the elements of diversification of the landscape have a positive influence on biodiversity of fauna, especially on the so-called "useful fauna" to agro-ecosystems: pollinators, predators and parasitoids of insect pests that are harmful to adjacent crops.
These effects arise mainly from the fact that the natural vegetation provides food sources and alternative shelter, which are used in the periods in which the cultivated areas are not hospitable.
The biocenosis, in an agro-ecosystem, can remain extremely complex, if not altered, because the pests many predatory species and parasites are bound or restricted.
Recent studies show that a high level of biodiversity in agro-ecosystems corresponds more to a neighboring landscape mosaic than to a reduction of conventional agronomical practices.
The area of this research has been carried out in what is called “Contrada Cassone”, which can be found in the B zone of the southeastern side of the Etna Park. The territory that we are analyzing, shows a situation characterized by extensive woods, interposed by lava streams that date back to different periods and which sometimes surround some “uncultivated areas” (real isle of natural vegetation) and by some orchards. All this determines a mosaic of natural environments, half-natural and half agrarian, fragmented and isolated, inserted in a context characterized, however, by a high level of natural landscape.
This research has involved the study of ground Coleoptera communities (beetles) of three different ecosystems: a biological orchard (**BIO**), a conventional orchard (**CON**) and “chestnut wooded remnants” (**BOS),** investigated with the purpose of emphasizing the structure and the differences and similarities of these communities from a qualitative and quantitative point of view. Therefore, the study focused on the **Coleoptera Families**, for which the examination with particular reference to species of the **Carabidae**, **Tenebrionidae** and **Staphylinidae** (excluding **Aleocharinae** and **Scydmaeninae**), has been developed.
Inside each station, the pit-fall traps have been installed and filled with a solution of water, vinegar and table salt in saturation; the sampling period took 14 months, from April 2011 to June 2012.
An amount of 11,765 specimens of the Coleoptera, (that belong to a total of 32 Families and a Superfamily Curculionidea), have been collected, with 4,006 specimens that belong to a total of 21 Carabidae species, 538 specimens that belong to a total of 14 Tenebrionidae species and 325 specimens that belong to a total of 39 Staphylinidae species, (excluding Aleocharinae and Scydmaeninae).
The sampling data were standardized according to the unit effort and is expressed as a **CS** value (**Standard Capture**). The CS of Coleoptera, both for Families and species, were analyzed during the entire period of sampling and in the different stations, and even in individual traps for each station.

For the comparison between communities, a multivariate analysis was used by the method of Non Metric Multidimensional Scaling, based on the Bray-Curtis similarity index and tested with ANOSIM and SIMPROF.
All the indices and the multivariate analysis of the communities were elaborated for the Coleoptera **Families** and for species of the **Carabidae**, **Tenebrionidae** and **Staphylinidae**, (excluding **Aleocharinae** and **Scydmaeninae**).
The results obtained, have been compared with the data of a previous research conducted from April to September 2008, using the same method of pit fall-traps, in the B zone of the southern slope of the Etna Regional Park and at the same altitude (1,300 m), in three similar habitat typologies: organic and conventional orchards (apple and pear trees) and wooded remnants (BOEMI 2010).

The study has underline that:

1) A species is new for Sicilian fauna, ***Platyderus*** sp. (*in litteris*, Sciaky & Pavesi), and two species ***Gonodera metallica*** and ***Lagria rugosula****,* are first findings for Etna.

2) **The biodiversity of soil fauna appears with different aspects in relation to different stations and taxa analyzed**.
The comparison between the two sampled areas, shows that at both the Families and species level, the geographic factor, (in our case, the location on two different volcanic slopes), plays an important role along with the ecological one, (the investigated habitat type and the climatic characteristics), in determining the structure of the soil of the Coleoptera communities. The detected biodiversity, in some cases, seems to be a function of the intrinsic stations structure, while in others, it seems that in relation to the investigated animal groups, can provide a significantly different framework, even within a single station. The interpretation of the biocoenotic data must be characterized with prudence and the component investigated must be taken into account, which generally represents a fraction, more or less extensive, of the overall animal diversity, which reflects the bio-ecological characteristics of the taxa and their ecological plasticity. So, it is very complex to draw general considerations examining one, or a few animal groups, although some areas may present the structural features that confer a strong and homogeneous connotation to the structure of the soil fauna. This limitation for the biocoenotic analysis can be partially solved by a multi-taxa approach.

3) **Biodiversity is distributed in different temporal domains**.
The asynchrony of the most sampled taxa represents another aspect of biodiversity. The phenology of these taxa allows identifying in the winter season, characterized by cold winters with frequent snowmaking soil. Outside of this period, the fraction of soil fauna examined in this study, shows an articulation and a structural complexity that allows it to occupy most of the temporal domains with different species that follow one another in time. This diversity, as demonstrated by the results of recent studies, is favored by the landscape mosaic structure. The more abundantly sampled Coleoptera taxa generally show a clear preference for a station, where they make record high CS values, while they are absent or present with low CS values in the other stations. Their presence is thus linked to some patches, as opposed to the other, and therefore, is made possible precisely by the environmental mosaic that characterizes the study area.

4) **The presence of strips of natural vegetation within the agro-ecosystems increases the environmental heterogeneity determining more richness and dynamism in soil fauna communities**.

The habitat heterogeneity increases the taxonomic richness of biotic communities. As demonstrated by the presence of many woodland species, although with low CS values within orchards, the study shows that the presence of the natural vegetation edges, more or less extensive within or neighboring to the agro-ecosystems, increases environmental heterogeneity. This results in greater wealth and dynamism of the communities, allowing them to maintain, even in small areas, a significant fraction of the fauna of the natural and semi-natural environments.

5) **The biodiversity of ground fauna is influenced by the soil management**.
The different methods of cultivation, conventional or organic, do not cause any significant differences in the soil fauna; the investigated orchards, in fact, do not differ significantly from each other (more obvious are those in the Zafferana area in respect to those in the Ragalna area). The relative poverty and homogeneity of the orchard soil fauna may be put in relation to the plowing, both in regards to their annual number, and above all, the manner with which they are made. It would be appropriate that the Etna Park Authority, at least for the orchards falling in the B zone, develop guidelines that provide for the maintenance of adequate grassed stripes at the crop margins.

6) **The stations differ significantly in community structure at any level they are investigated**.
Each station has a well-defined and different fraction of soil fauna, so each selected environment retains a relevant and important portion of biodiversity.
The examination of the indices of similarity and the Non Metric Multidimensional Scaling, based on the Bray-Curtis index, show a more general homogeneity between the traps of each of the 3 stations investigated in the present study, than between that 3 stations examined in the previous research. The ANOSIM test confirms, with values always statistically significant for all groups considered, that the traps of a station are more similar to each other than to those of other stations.
This homogeneity is accompanied by a slight similarity between the stations, as evidenced by the Non Metric Multidimensional Scaling. In particular, the Parwise test shows that for all groups investigated, that the dissimilarities between the stations are, with few exceptions, statistically significant.
In conclusion, the study points out that all considered stations differ significantly from each other for the structure of coenosis investigated, both in terms of quality and quantity, and that each has such features that are able to maintain different fractions of ground fauna, thereby contributing in preserving significant and peculiar portions of biodiversity.

7) **The contribution of this biodiversity, and the stability of agro-ecosystems remains to be defined**.
The study shows a certain specificity of the soil zoocoenosis within the individual investigated stations and their contribution to the biodiversity conservation in the area, but it remains to define the effects of this biodiversity on the stability of the agro-ecosystems.

8) **In prospect of a correct land management, considering that the land investigated is in a protected area, the patches should be protected to maintain significant levels of biodiversity**.
In relation to a careful territory management, with particular attention given to protected areas, all natural patches must be preserved for their high biodiversity value. The present study shows the strategic role of the patches of the environmental mosaic for preservation of the adequate biodiversity levels of soil fauna in the areas of study. To set a correct policy of the biodiversity protection and management of a protected area, based on scientific criteria, and not aesthetic

criteria, the maintenance of high levels of the landscape heterogeneity should, therefore, be an important principle and strategy to be pursued.

1. INTRODUCTION

The agricultural production transformations of the contemporary age, based on high productivity due to a series of external inputs, generated a strong simplification of the rural landscape, causing the loss of significant aesthetic and cultural values of biodiversity. There has been a decrease in the number of cultivated plants and variety of agricultural systems, historically based on the environmental conditions of the places. We live in a world that is more complex and articulated, but we have a relatively more simple and ordinary landscape (BORIN et alii 2007), because of an increase in production and making it economically advantageous through conventional practices that leads to a substantial simplification of agro-ecosystems and a significant decrease in biodiversity (HERNÁNDEZ 1997, ALTIERI 1999, BENTON et alii 2003, ALLEN 2003, ALTIERI 2004, BUREL et alii 2004, HERZOG et alii 2005, TSCHARNTKE et alii 2005, HENDRICKX et alii 2007, FIRBANK et alii 2008, LEE et alii 2008, GEIGER et alii 2010, SAUTEREAU et alii 2010, WINQVIST et alii 2011, CARRIÈRE et alii 2013, JARVIS et alii 2013).
The idea that the richness of the species produces ecological stability goes back to DARWIN (1859) and was picked up by MACARTHUR (1955) and MAY (1973).
The hypothesis is that the number of species corresponds to the complexity of their interactions: complexity means the number of routes along which the energy can pass through a community. As a result, species-richness communities are able to better respond to a disturbance (FERRARI 2001).
For this reason, it is possible to place agriculture in an "organic" balance, in which the agro-ecosystem can be conceived as an area large enough to include those uncultivated areas that affect the crops through exchanges between communities of organisms, substances and energy. Conventionally found within an agro-ecosystem, are two different components of the functional biodiversity: *planned biodiversity*, which depends on the application of agricultural practices (such as plant species used in the field, crop rotation, types of soil tillage, etc.) and *associated biodiversity*, that includes all the components of fauna and flora that colonize the agro-ecosystem from surrounding environments, becoming part of that in relation to its conduction and structure (BESTELMEYER et alii 2003, CARDINALE et alii 2003, WEIBULL et alii 2003, PHILLIPS 2006, LETOURNEAU & BOTHWELL 2008, BALOG et alii 2009, BALOG et alii 2011).
The evaluation of the impact of agricultural practices on biodiversity conservation has long been the subject of many publications (CARCAMO et alii 1995, ALTIERI 1999, PFIFFNER & LUKA 2000, WASCHER 2000, BUGUNA-HOFFMANN 2000, STOATE et alii 2001, LIANG et alii 2001, HADJICHARALAMPOUS et alii 2002, DÖRING & KROMP 2003, WEIBULL & ÖSTMAN 2003, ALTIERI 2004, HAYSOM et alii 2004, THORBEK & BILDE 2004, PADMAVATHY & POYYAMOLI 2011), all showing some negative effects, as the most important seems to be the loss of environmental heterogeneity (PURTAUF et alii 2005, HERZOG et alii 2005, HOLE et alii 2005, SCHWEIGER et alii 2005, JACKSON et alii 2007, BRUSSAARD et alii 2007, DE ARANZABAL et alii 2008, BROCK et alii 2010, POWER 2010, WINQVIST et alii 2011).
The agriculture mainly tends to simplify the functional biodiversity, replacing the multiplicity of organisms to a reduced number of plant species and animals. This reduction of biodiversity reaches its climax in conventional farming, where, for example, the use of pesticides, while preserving the crops from harmful species, cause a general decrease in diversity and therefore, those species operating as natural predators of dangerous insects consequently cause a possible increase of the latter (ANDERSEN 1982, ALTIERI 1994, SAMSØE - PETERSEN 1995, SHAH et alii 2003, PRASAD & SNYDER 2004, BALOG & MARKO 2007, DORMANN 2007, BALOG et alii 2009, EISENHAUER et alii 2009, GIBBS et alii 2009, GEIGER et alii 2010).
In particular, the soil fauna, essential for the fertility of the soil, is very sensitive to agricultural practices and therefore, strongly decreases, both in quantity and quality (CROSSLEY et alii 1992); its diversity and abundance is also influenced by different fertilization regimes (ZHU & ZHU 2014). The structure of soil fauna communities, in turn, can be applied to indicate certain characteristics of soil fertility, such as soil organic matter content (ZHU & ZHU 2014).

The use of low environmental impact practices, the diversification of crops and the presence of marginal areas with characteristics of natural or semi-natural, help to reduce ecological simplification, resulting in an increase of functional biodiversity that make agro-ecosystems more stable. An increase of biodiversity, in turn, promotes a self sustaining agro-ecosystem, thus reducing mechanical practices and the use of chemical products.

For these reasons, an increase of generalist predator components is considered useful because, directly or indirectly, they can potentially control the populations of the phyto-saprophagous species harmful to agriculture (KAREIVA 1990, JONSEN & FAHRIG 1997, HOLLAND & THOMAS 1997, BENGTSSON et alii 2005, WESTERGAARD 2006, GIBSON et alii 2007, BIRKHOFER et alii 2008).

Many studies have been conducted in this theoretical context, comparing organic and conventional farming practices in relation to biodiversity, especially with regard to predatory species, both generalist and specialized, such as Carabidae, Staphylinidae, Araneidae, etc. (LANDIS et alii 2000, MÄDER et alii 2002, SYMONDSON et alii 2002, PFIFFNER & LUKA 2003, SHAH et alii 2003, MEEK et alii 2002, BENGTSSON et alii 2005, BIRKHOFER et alii 2008, LOBLEY et alii 2009).

It is to be noted, however, that many of these studies have investigated a single type of agro-ecosystem in relation to different agricultural practices, but they rarely direct their attention to the landscape as on a larger scale of diversity and therefore, the results are sometimes contradictory, showing positive, neutral or even negative effects in regards to the examined taxon or the environmental context (altitude, biogeographic area, etc.), where research was carried out (MOREBY et alii 1994, KROOS & SCHAEFER 1998, ANDERSEN & ELTUN, 2000, WEIBULL et alii 2003, WINDER et alii 2005, CLOUGH et alii 2007, BEST 2008, GABRIEL et alii 2010).

However, it was proved that in many cases, the main factor affecting the increase or maintenance of a high level of biodiversity in agriculture, is the mosaic structure of the landscape, regardless of reduction of conventional farming practices (WIENS 1995, ATAURI & DE LUCIO 2001, ÖSTMAN et alii 2001, RENJIFO 2001, WITH et alii 2002, ALTIERI et alii 2003, DAILY et alii 2003, EILU et alii 2003, WEIBULL & ÖSTMAN 2003, BENNETT et alii 2006, ERNOULT et alii 2006, ZAMORA et alii 2007) together with its heterogeneity degree (ROFF 1974a, ROFF 1974b, GERING et alii 2003, PAUSAS et alii 2003, TEWS et alii 2004, FISCHER et alii 2004, LASSAU et alii 2005, STRIJKER 2005, ERNOULT et alii 2006, DE ARANZABAL et alii 2008, PALMER et alii 2010, FAHRIG et alii 2011, CUNNINGHAM et alii 2013).

That population dynamics, at the level of the wide area, influence directly or indirectly, those found at the individual cultivated field. The mosaic of agricultural landscape (farmlands, tree crops and semi-natural and natural areas, etc.) guarantees to many species, useful for agriculture suitable conditions, to carry out their biological activities (breeding sites, hunting, etc.), while those conditions do not occur in a landscape characterized by an extensive monoculture (THOMAS et alii 1991, DUELLI 1997, ALTIERI 1999, SHAH et alii 2003, ZAMORA et alii 2007, BRÜHL C. A. ELTZ, 2010).

Many studies show that the presence of uncultivated areas and natural environments, inside and on the edge of an agro-ecosystem, create ecotonal bands, which increase both the quality and the quantity of animal species, due to the “edge effect” (BALDI & KISBENEDEK, 1994, LO VERDE et alii 1997).

In particular, this *phenomenon of synergism* within an agro-ecosystem facilitate the dissemination of predatory species, which can play the role, within the single cultivated field, of potential regulators for populations of destructive species, limiting, consequently, the need for using agricultural pesticides (WITH & CRIST 1995, KAREIVA & WENNERGREN 1995, DUELLI 1997, DUELLI & OBRIST 1998, HADDAD 1999, ALTIERI 1999, TSCHARNTKE et alii 2005, ROSCHEWITZ et alii 2005, DIEKÖTTER et alii 2008, CROWDER et alii 2010, CROWDER & JABBOUR 2014).

These areas, analogously at the "islands", are subject to both new colonization and extinctions (MACARTHUR & WILSON 1967; SIMBERLOFF 1974; WILLIAMSON 1989, HAILA 2002).

This spatial structure of the landscape has been correlated with that of the populations that constitute the community. It was thus possible to define two main typologies of populations: multi-

populations, correlated with wide environments and metapopulations correlated with single patches (DEN BOER 1979; DE VRIES et alii 1990, HANSKI et alii 1996, BAGUETTE 2004, BAGUETTE et alii 2007).
The mosaic structure of the environment has, for years, been under investigation, in relation to the structure of populations and communities (NIEMELÄ et alii 1986; NIEMELÄ et alii 1988; KLEIN 1989; BAUER 1989a, BAUER 1989b; SAUNDERS et alii 1991, NIEMELÄ et alii 1992; MARGULES et alii 1994, LAW & DICKMAN 1998, THOMAS 2000, GOLDEN & CRIST 2000, ATAURI & DE LUCIO 2001, MAGURA et alii 2001, NIEMELÄ 2001, MCGARIGAL & CUSHMAN 2002, OLFF & RITCHIE 2002, PARKER & MAC NALLY 2002, BAILEY et alii 2002, STEFFAN-DEWENTER & TSCHARNTKE 2002, FAHRIG 2003, TSCHARNTKE & BRANDL 2004, NOUHUYS 2005, BENNETT et alii 2006).
It is possible to hypothesize the evolutionary processes because of the high heterogeneity that the environmental mosaics provide. They are already used to distinguish this hypothesis, due to the biological evolution and variation in the space-time structure of the biocenosis (HENGEVELD 1994).
It is only possible, through the acquisition and comparison of data on real communities that are in different environmental situations, that the definition of an articulated theoretical framework of instructions at various territorial planning levels can be applied (FOSTER ET ALII 2003, ANTROP 2005); the purpose being that there has to be a high level of biodiversity maintenance (AHERN 2001, ALTIERI 2004, YOUNG et alii 2005, WEZEL et alii 2009).
Clearly, it is also applicable to agro-ecosystems management.
From an ecological standpoint, it is for this reason that the study of fragmented habitats has become essential, especially regarding those of the mediterranean environments that have many distinct limiting factors and where the land is continuously transforming (RESCIA et alii 1997, NAGENDRA et alii 2004, CLOUGH et alii 2007, DE ARANZABAL et alii 2008, GERI et alii 2010).
The natural and/or anthropic disturbance events generally determines the environments mosaic structure; the type and degree of the disturbance is also gives characteristic to the mosaic structure (WHITE & PICKETT 1985, SAUNDERS et alii 1991, FAHIRIG 2003, GERI et alii 2009).
The structure of the patches, determined by the natural disturbances, have different dynamics. For example, small extension areas, caused by the collapse of old trees, are characterized by a dynamic community that, in a short amount of time, tends to rebuild. However, much stronger and troublesome, are the fires or avalanches that can occur. The genetic structure of populations is effected because of eruptions in volcanic environments and therefore, cause continuous fragmentation of habitats (CARSON & TEMPLETON 1984, VRIJENHOEK 1985, CARSON et alii 1990, TANAKA et alii 2008)
It is crucial, nowadays, to understand the structure and dynamics of the coenosis for fragmented habitats, to provide both general and detailed information on the management of the territory that are also in line with the community policies. To protect diversity, it is fundamental to have the appropriate policies; they cannot be promoted solely on simple theoretical considerations.
Human activity has had a dramatic reverse effect on the relationship between open spaces and forests in the Mediterranean area. It has caused a reduction of fragments, inserted in a matrix, to profoundly change in these open spaces and forests; the extension of the forest in the flatland and in the hilly areas, has drastically been reduced and now, are more or less comparable to islands.
The area of study of this research is in the Contrada Cassone area of Zafferana Etnea, that falls in Zone B of the south-eastern slope of the Etna Regional Park. The territory, which includes that area, shows a situation more or less characterized by a widespread wooded area, interspersed with lava flows of different periods and with orchards. This results in a mosaic of natural, semi-natural and agricultural environments, more or less fragmented and isolated, within an environmental matrix, characterized however, by a high level of naturalness. All of Etna's natural history is characterized by eruptive activity of the volcano, which often leads to drastic and sudden changes. The woods are often reduced or fragmented by lava flows and by human activity, which have virtually destroyed the foothill of the woods. They are now represented by a few patches, very small in size, and have significantly reduced the extent of the hilly woods. The agricultural crisis, in recent years, has led to

the abandonment of cultivation of many areas, in which processes of recolonization by the primitive woody vegetation are initiated. On the other hand, the coppicing, practiced in the past for the production of coal and for domestic use, has considerably diminished in intensity. At the same time, cultural development on the problems of nature conservation has led to the elaboration of an extensive environmental legislation at a European, National and Regional level. The result of this legislation was the establishment of protected areas in order to conserve what is still left in natural or semi-natural conditions.

This system in the Etna area is mainly represented by the Etna Regional Park, established in 1981 and some regional reserves established under the Regional Law 14/81 and subsequent amendments and additions, and the sites of the "Rete Natura 2000" (SIC and ZPS), the latter set up under the national law 357/97 and the "Habitats Directive" 92/43/EEC for the protection of biodiversity within the European Community.

This research looked at the study of the soil Coleoptera communities that belong to two different agro-ecosystems (organic orchard and conventional orchard) and to a residual patch of chestnut woods. Comparisons between the three sampling stations showed different populations, from both a qualitative and quantitative point of view, and help to define the role and importance of the different patches of landscape in maintaining biodiversity at all levels.

These acquisitions allow for the start of delineation, on a scientific basis, of management criteria and the planning of agricultural activities aimed at maintaining high levels of biodiversity and an ecosystem-specific level in protected areas of naturalness, like those in Zone B of the Etna Regional Park.

The study focused on Coleoptera, for which the examination of the Families has been examined in depth, with particular reference to species of the Carabidae, Staphylinidae and Tenebrionidae.

The Coleoptera Families have a great importance for the study of soil fauna, due to their relative abundance, the number of species, their ecological specialization and diversification; the study of these components allows for the exploration of different aspects of changes in the space-time structure of the soil fauna.

Regarding the groups investigated, there have been few studies in the Mediterranean area, and they look mainly at the Coleoptera, Carabidae and Staphylinidae. The Carabidae communities have been the subject of numerous studies in Europe (DER BOER et alii 1986, HOLLAND 2002), and are used as bio-indicators, (BRANDMAYR 1980, BRANDMAYR & ZETTO BRANDMAYR 1980, PIZZOLOTTO 1993, PIZZOLOTTO 1997, BRANDMAYR et alii 2005, UEHARA-PRADO et alii 2009) but the investigations conducted strictly in Mediterranean environments (BRANDMAYR et alii, 1981a, BRANDMAYR et alii 1981b, BRANDMAYR & PIZZOLOTTO 1988, VIGNA TAGLIANTI et alii 1988, BRANDMAYR & PIZZOLOTTO 1994, PIZZOLOTTO 1994a, PIZZOLOTTO 1994b, BRANDMAYR et alii 2002, BRANDMAYR et alii 2005, PIZZOLOTTO et alii 2005, IANNOTTA 2009) and in Sicily (BRANDMAYR & PIZZOLOTTO 1990, PIZZOLOTTO & BRANDMAYR 1990) are relatively few.

The Staphylinidae communities are studied even less than the Carabidae. In the Mediterranean area, they were the subject of research of OUTELERO DOMINQUEZ (1981), in the Italian area, the research particularly looked at the forest habitats (CHEMINI & ZANETTI 1982, SCHATZ 1988, ZANETTI 1992, ZANETTI et alii 1997, TAGLIAPIETRA & ZANETTI 2002, ZANETTI & MANFRIN 2004, ZANETTI & TAGLIAPIETRA 2005), while the biocoenosis environments of Sicilian forests have been studies in regards to the Nebrodi (SABELLA & ZANETTI 1991), Etna (ADORNO 1995) and Hyblean mountains (ADORNO & SABELLA 1998). In Sicily, ADORNO (2002), has also investigated the effects of soil erosion on the communities of Carabidae, Staphylinidae and Tenebrionidae of Etna and the diversity and flight activity of Staphylinidae in a citrus orchard of the Catania Plain (2012).

The research that has been done portrays the structure of the Coleoptera communities of three patches that were explored, both conventional and organic orchards and wooded remnants. It was then compared to the other patches that were studied with the same methodology at the same altitude of Zone B of the Etna Regional Park, located at the eastern slope of the mountain (BOEMI, 2010). This research aims to define the role and importance of these landscape patches, inserted in an environmental mosaic, to maintain or increase biodiversity. This is done on the basis of scientific criteria, using normalized and statistical data, in order to give indications on measures to be taken to mitigate the effects of habitat fragmentation on biodiversity and to suggest management models necessary for the correct maintenance of hight biodiversity of these ecosystems.

2 THE STUDY AREA

2.1 GENERAL FRAMEWORK

The area is included in longitude between 15°03’58.99”E and 15°04’06.49”E, in latitude between 37°42’09.90”N and 37°42’03.05”N and falls in the IGM map (1: 100:000) 625 sez. IV Sant’Alfio, in the IGM map (1:25.000) 262 III SO “M. Etna Sud” and in the Regional Technical Map (CTR) 1:10.000 625050.

The study area lies on the eastern slope of Etna (fig. 2.1.1) and in Zone B of the Etna Regional Park (figs 2.1.2-2.1.3).

Fig. 2.1.1- Location of the study area (red circle).

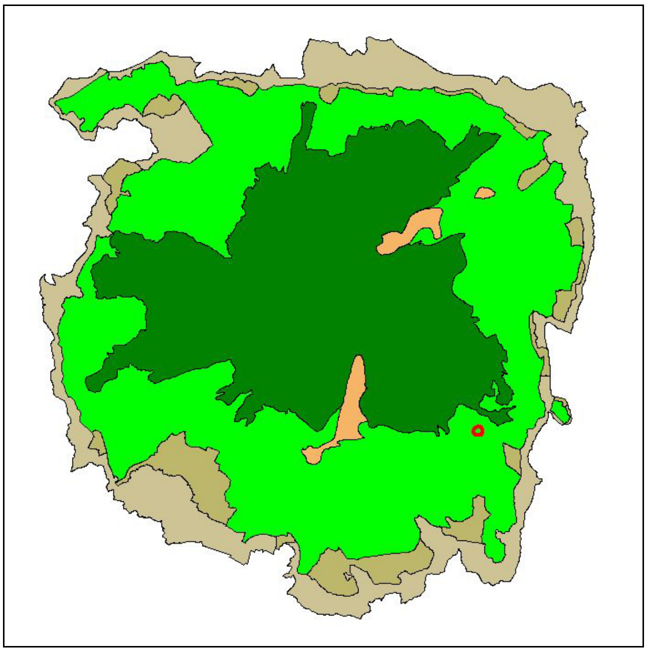


Fig. 2.1.2 - The sampling area is shown with a red circle. It lies entirely in Zone B of the Etna Park

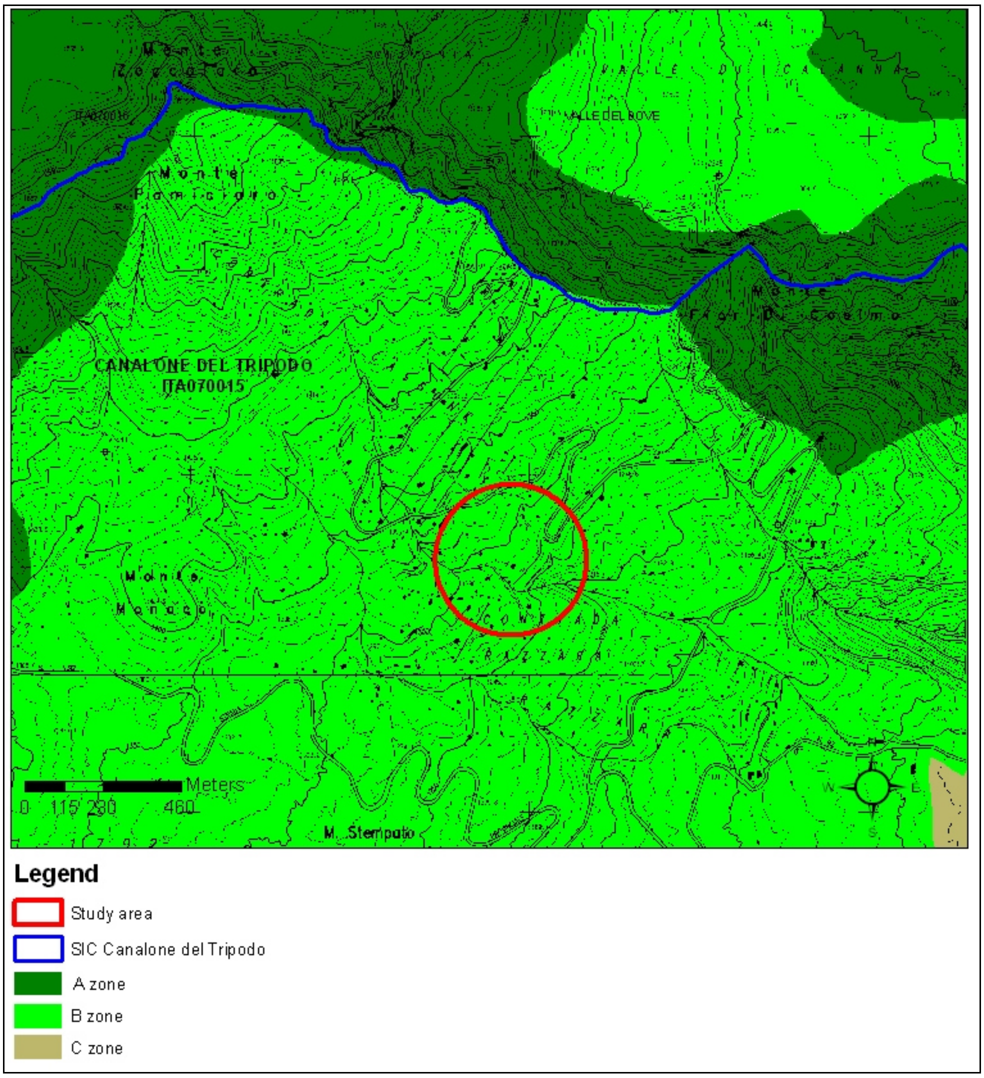
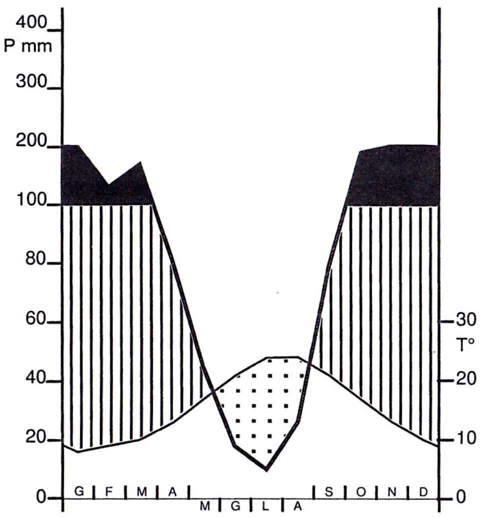


Fig. 2.1.3 - The sampling area is shown with a red circle. It lies entirely in Zone B of the Etna Park

2.2 CLIMATE FRAMEWORK

For the climatic characterization of the study area you can refer to the nearest thermopluviometric station of Zafferana Etnea (590 m), which is located a few kilometers from the district of Cassone (1,250 m) and is managed by the Hydrographer of Sicily.
Looking at the thermopluviometric diagram of Zafferana Etnea (fig. 2.2.1), it shows that the average annual temperature is about 15.7 ° C, with a dry period that goes from June to August.
The average annual rainfall is 1354.0 mm, with a monthly distribution typically Mediterranean, and a concentration of rainfall in autumn, winter and spring and a strong reduction of the same in the summer.



Zafferana Etnea (CT) 590

B.M. Simeto e Alcantara
A.O. P 51 **A.O. T** 26
P 1354.0 **T** 15.7 **E** 8.6
T max ass. 44.0 **M** 34.2
T min ass. - 2.8 **m** 2.1

P (mm)	**T (°C)**
G = 203.9	G = 8.2
F = 125.6	F = 8.8
M = 172.4	M = 10.3
A = 80.8	A = 12.9
M = 45.3	M = 17.1
G = 18.0	G = 21.4
L = 10.4	L = 24.2
A = 25.7	A = 24.3
S = 79.4	S = 21.2
O = 189.3	O = 16.8
N = 202.2	N = 13.0
D = 201.0	D = 9.9

Fig. 2.2.1 – Climate diagram of Zafferana Etnea thermopluviometric station (from ZAMPINO et alii 1997). To the right are the reported elevation characteristics of the station, numbers of years of observation (A.O.), the mean annual and monthly temperature and rainfalls.

Based on the available data, the area of study falls within the bioclimatic range of higher supramediterranean-humid thermotype. It features the highest part of the mountain ranges and is distributed between 900/1,000 m and 1,800/1,900 m. The plant formations that characterize this bioclimatic range are mainly mesophilic deciduous oak of *Erico-Quercion ilicis*, as the *Festuca heterophyllae-Quercetum congestae* and the *Mespilo-Quercetum virgilianae.*

2.3 GEOLOGIC FRAMEWORK

The area of study is located on the eastern slopes of Mount Etna. This developed about 500,000 years ago on the front of the Maghrebian chain at the border between the ionic domain and chain-foreland domain. Etna's foundation lies at the bed of the Hyblaean-Maltese fault system (Malta Escarpment) that separates the Ionian Basin, which is characterized by the composition of oceanic crust (with sediments that date back to the Jurassic Era), from the Plagiano Lock and the Hyblaean Plateau, which are characterized by a carbonate succession of Mesozoic-Neogene continental crust.

The volcano, Etna, rests on a sedimentary bed that dates back about fifteen million years and is composed of sandstones, conglomerates, and carbonates, which are the constituents of the folds (water flow). Prior to settling in the area, these folds gave life to the Madonna and Nebrodi mountains. This sedimentary bed helped to form Etna's foundation. Its origin of creation is very complex because it originated as a result of superposition of products that was issued by several eruptive centers that have taken place over time and space. Currently, the Etna has a subsonic form with a base diameter of about 35 km, which is attributed to the layer volcano category, as it is made from lava flows that are interspersed with banks of incoherent products (pyroclastics).

The activity of the volcano depends on its mineralogical composition. The magma that is produced by Etna has a low amount of silica, which is seen in its lava emissions. There are no shortages of active explosions, especially in the peaks of the craters. Even though Etna's eruptions vary, they are classified into three main types: Final Activity, Side Activity, and Eccentric Activity. Terminal activities is when the magma column reaches up to the craters peak and manufactures explosive manifestations and is accompanied by an overflow of lava. Before reaching the crater's summit, the magma column finds an outlet through a rift that is opened up on the side or flank of the volcano. Explosive events happen on these sides, and as it flows downstream, it expands. This is known as Side Activity. Eccentric activity is when the magma column rises alongside, independent from the main opening of the crater's peak. It then ends up in the same underlying magma basin. The aforementioned activities lead to the formation of the volcanic products, the majority of which have formed and continue to form the volcanic apparatus. These products are of three types: lava flows, loose material, and volatile products.

In regards to its structure, the Etna massif originated from the accumulation of eruptive products that mostly rest on a permeable sedimentary substrate. It is an independent hydrogeological being that is clearly demarcated by the Alcantara and Simeto rivers and come in contact with the volcanic and sedimentary soils of the chain that are along their path. The high permeability of most of the volcanic rocks involve a high percentage of infiltration of rain water, which feed rich aquifers that flow about in radial directions in respect to the axis of the volcanic cone, which tends towards the base level that is represented by riverbeds of the aforementioned rivers or directly from the sea.

The structural layout of the substrate, which reaches its maximum altitude at the summit of the volcano, determines the direction of the underground water flow of the underground water that is at a medium-low depth in comparison to the existing depressions (old valleys), where the waters tend to flow and where tectonic structures act as a geological watershed.

Based on the most obvious fault systems, there are three main hydrogeological structures that make up the entire hydrogeological unit, that are respectively attributed to the Simeto river, the Alcantara river and the Ionian Sea. Within these units lie secondary structures, where the foot of the site is more or less independent and where water sources connect. These can be considered of great importance. They are located in the valleys of the predicted rivers, at the edge of the volcanic cover or along the ionic coast.

In fig. 2.3.1 is shown the geological map of the study area.

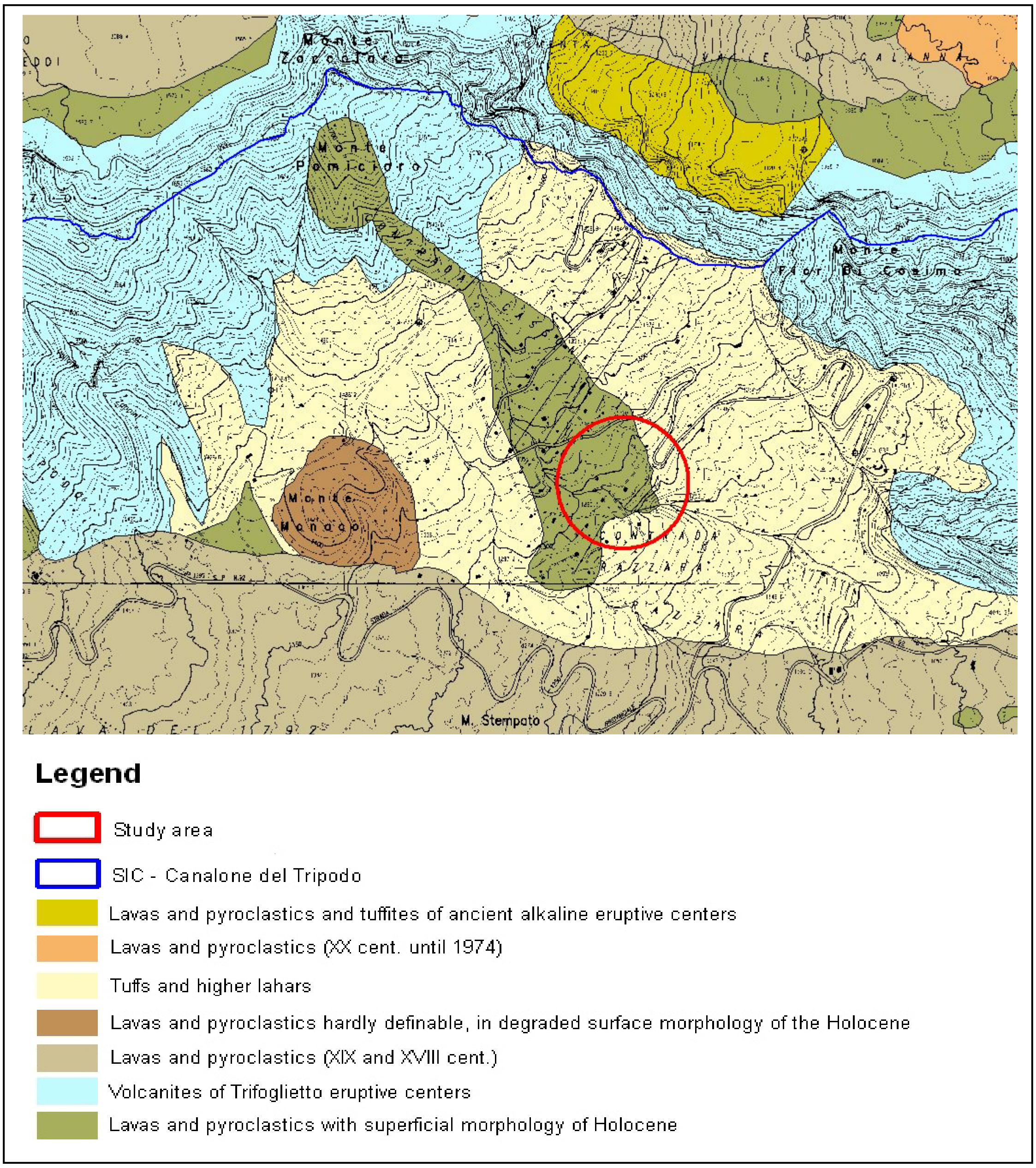


Fig. 2.3.1 - Main geological and geomorphological characteristics of the study area (from draft of Regional Landscape Plan, field 13). The sampling area is shown with a red circle.

2.4 FLORO-VEGETATION FRAMEWORK

Chestnut woods characterize the vegetation of the study area and the cultivated areas are mostly orchards.
Near the study area study, there are features of natural vegetation that vary like the pioneer vegetation from the more or less recent lava flows, the scrublands of the *Genista aetnensis* and beech forests, especially along the ridges overlooking the nearby “Valle del Bove”; further down along the ridges overlooking the “Valle Calanna”, mixed forests of *Quercus congesta*, *Quercus virgiliana* and *Quercus ilex* are present.
In regards to the chestnut, although it is considered an autochthonous species for the Etna, it has been greatly spread by humans to capitalize on timber and fruit. The chestnut woods present on Mount Etna and in the particular area of study are ancient coppice woods.
In general, the chestnut of Etna acts like a mountain or submontane mesophilic species that prefers deep and mature soils. Nevertheless, chestnut woods are repeatedly cropped and show a floristic cortege that is pretty rich of mesophilic nemoral species like *Doronicum orientalis, Lathyrus venetus, Brachypodium sylvaticum, Lathyrus pratensis, Festuca heterophylla, Daphne laureola, Epipactis microphylla, Luzula sieberi, Lamium flexuosum, Viola reichenbachiana,* and *Galium rotundifolium* that lead to frame these semi-natural woods in the class *Querco-Fagetea.*
The chestnut woods have replaced forests of deciduous oaks that are now confined to the most inaccessible areas.
The orchards, mostly cherry or apple, are subject to the workings of the ground like the hoeing and therefore, are characterized by vegetation, mostly annual, of species more or less nitrophilous that belong to the class *Stellarietea mediae. A*mong the most common species are *Rumex bucephalophorus, Echium plantagineum, Lagurus ovatus, Bromus* sp. pl., ecc.
In fig. 2.4.1 is shown the vegetational map of the study area.

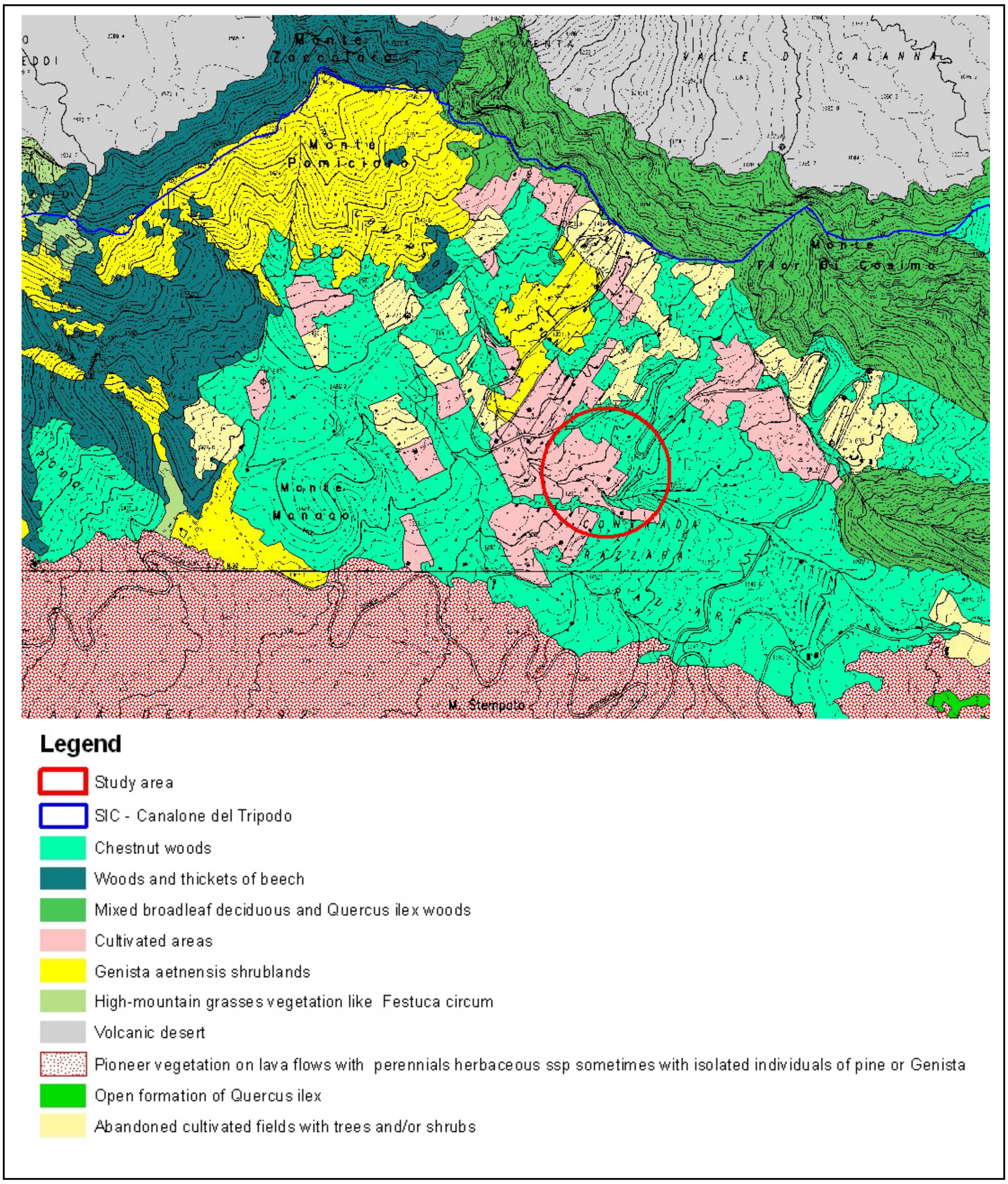


Fig. 2.4.1 – Vegetation map of the study area (from draft of Regional Landscape Plan, field 13). The sampling area is shown with a red circle.

2.5 LAND-USE FRAMEWORK

The distribution of the actual cultivated area of the park is 7,216 ha.

Among the crops, there is a marked predominance of the arboreal species (6,799 ha) over the herbaceous (417 ha) that are represented by arable land and orchards.

Among the arboreal species, (tab. 2.5.1) the vineyard has the most amount of area with 2,482 ha, followed by the olive grove with 1,293 ha, the orchard with 1,196 ha, the hazel with 743 ha, the pistachio grove with 652 ha, the almond with 388 ha, and the *Opuntia ficus-indica* grove, which has just 45 ha.

The partition of area is 27 ha to Zone A (0.4%), 2,211 ha to Zone B (30.6%), 1,011 ha to Zone C (14.0%), and 3,967 ha to Zone D (55.0 %).

The fundamental feature of agriculture is that it is significant in regards to the actual space occupied by agricultural species. This information cannot be inferred from official documentation, but acquired through sectorial reports like the "Territorial Plan", which is based on an extensive survey of the whole territory of the park. These surveys include a starting point of the land use data that is provided by the Etna Park and include aerial photos as a reference of the area that dates back to 1987.

In detail, for the primary purpose of defining the agricultural scenery of the territory, a local investigation was conducted on the real destination of plant species of agricultural areas that fall within the area of the park. The investigation was conducted across the entire area and was focused on recognizing individual plant species and their geographical distribution.

The study above has led to the development of a table, which shows the current consistency of the individual species.

Land Use	Zona A	Zona B	Zona C	Zona D	Totale
Olive grove	-	115	95	1,073	1,293
Vineyard	-	570	341	1,571	2,482
Orchard	24	857	138	177	1,196
Hazel grove	-	235	303	205	743
Pistachio grove	3	287	-	362	652
Almond grove	-	147	-	241	388
Opuntia ficus-indica grove	-	-	-	45	45
Arable crop	-	-	124	288	412
Vegetables	-	-	-	5	5
Abandoned agricultural land	16	1,192	593	1,496	3,297
TOTAL	43	3,403	1,604	5,463	10,513
	0.4%	32.3%	15.3%	52.0%	100.0%

Tab. 2.5.1 - Consistency of plant species of agricultural interest in the areas of the Etna Regional Park (Source: "Territorial Plan").

CORINE LAND COVER		Ha	%	Polygons
21121	Simple arable - Land subject to extensive herbaceous cultivation of cereals, pulses and vegetable crops in the field	98,721	11.672	50
21211	Simple arable - Land, watered regularly and periodically through permanent infrastructure, subject to intensive cultivation of herbaceous cereals, pulses and vegetable crops in the field	2,970	0.351	2
21213	Vegetable-flower-nursery crops	1,176	0.139	1
221	Vineyard	45,744	5.409	15
2221	Chestnut woods	5,449	0.644	1
2222	Hazel grove	34,122	4.034	8
2223	Pistachio grove	142,247	16.819	8
2225	Orchard	126,799	14.992	43
223	Olive grove	14,777	1.747	7
2242	Walnut grove	52,132	6.164	2
242	Complex cropping and particle systems	138,153	16.334	32
321	Meadows, natural pastures and grasslands	183,485	21.694	3
	Total	845,775	100	172

Tab. 2.5.2 – Land use expressed in hectares of the Park of Etna (Source Sector Studies Territorial Plan).

Excluding woodlands and pastures, those covered by herbaceous and woody agricultural species totaled 10,513 ha (from tab. 2.5.2.), distributed to 43 ha in area A (0,4%), 3,403 ha in area B (32,3%), 1,604 in area C (15,3%), 5,463 ha in area D (52,0%).

Of the aforementioned surface, there are almost 3,300 ha that are abandoned because old cultivation practices have not been carried out for years due to the decrease of economic interest.
The dislocation of the different species can be quite widespread in the local land (vineyards, olive groves and orchards) or limited (pistachio grove in the Bronte-Adrano area, hazelnut grove in the S. Alfio-Linguaglossa area, arable on the Bronte-Maletto axis).

The majority of the tree crops are either in full maturity or on the decline for the lack or absence of new implants, with the exception of limited investments in vineyards and, to a lesser extent, in the olive groves and orchards.

We don't observe newer plants, like pistachio, hazelnut, and almond for reasons that relate to the unfavorable trend of the market for its products, which have lasted far too long. There are no interventions, however, for the preservation of the *Opuntia ficus-indica* grove.
A brief analysis of the farms production structures allows to observe states of preservation of the unsatisfactory rural buildings, rare maintenance, abandonment of part of them for reshaping of farming, and the inadequate practice for a more technologically advanced agriculture and livestock, etc. The rooms on the ground floor are made with dry stone walls; many look like they are crumbling or have collapsed and have had minimal interventions to be reconstructed because of the burden they entail or because of the lack of skilled labor.

The present unsatisfactory state of the structures of the production buildings has brought on a high amount of theft. The fence and well-kept buildings do not seem to be efficient in deterring the thieves. The practice of the production processes has even undergone significant changes. Examples of changes would be reduced tillage and the replacement of human labor with a hoe or plow pulled by cattle or horses.

It should be pointed out that the agricultural activities are located on slopes with very irregular planes and with terrain ranging in size and often narrow. All the different types of volcanic and stony terrain are associated with volcanic soils and stony, rocky outcrops (residues even from remote lava flows), so that the operating space not used by crops may also have substantial rates (from 15% to 25% of the total).

In fig. 2.5.1 is shown the land use in the study area.

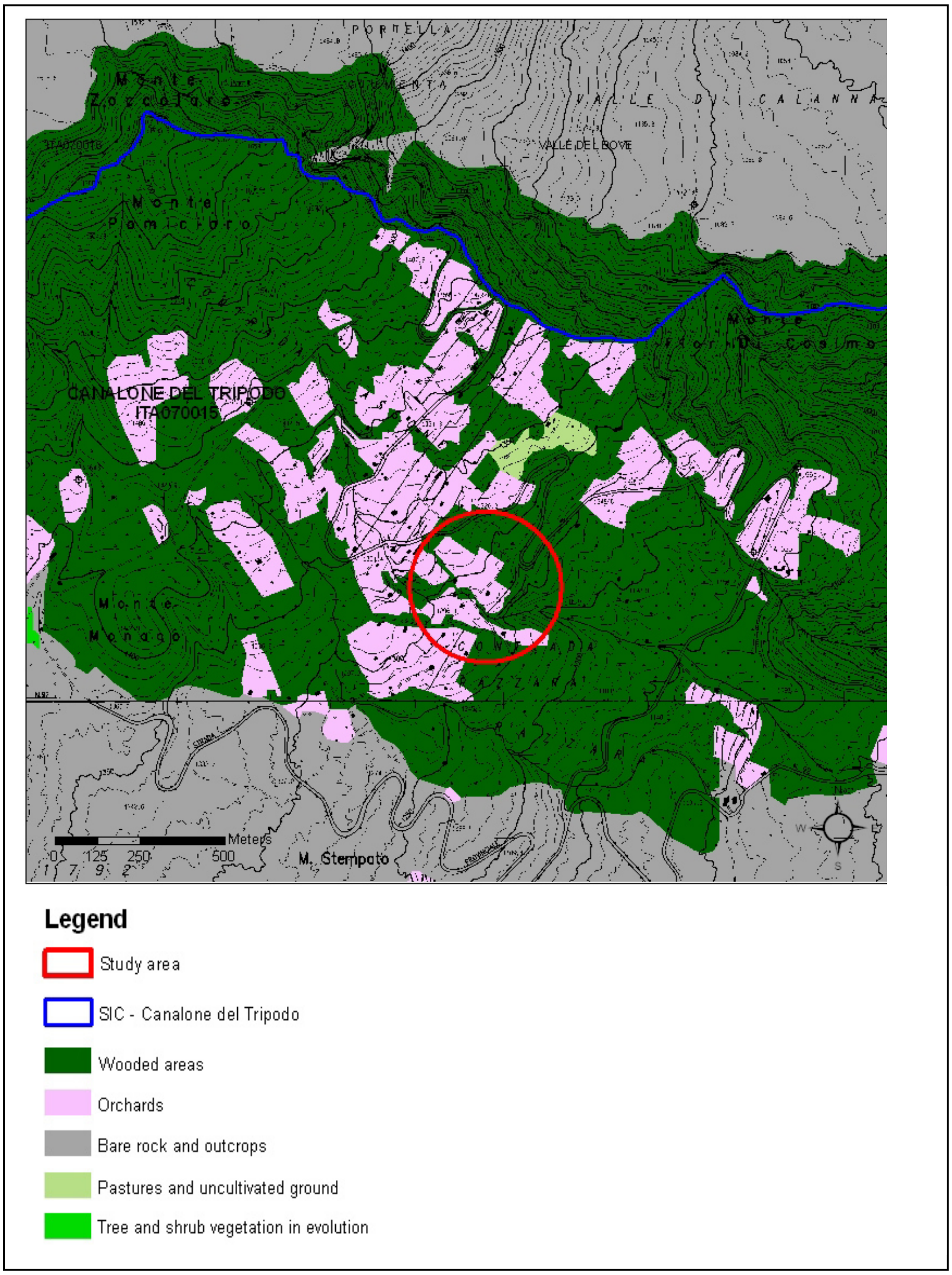


Fig. 2.5.1 – Land use map of the study area (from draft of Regional Landscape Plan, field 13). The sampling area is shown with a red circle.

2.6 FAUNAL FRAMEWORK

The foothills, and to a lesser extent, the hills of Etna, are characterized today by a mosaic structure, whose elements are represented by urban areas that are greatly extended. They also appear as a seemless and dense road network, from agricultural areas and by few, and often isolated and fragmented patches of land, left in its natural conditions or semi-natural conditions (uncultivated or abandoned farmland).

The outcome of these extreme and sometimes dramatic changes made by man in the last two centuries on natural surroundings on Etna's land is evident with the vertebrate fauna. Among these changes are a decrease in the amount of not only the individual species and genus, but also to the orders and families.

A comparison of reports from the first half of the nineteenth century naturalists (RECUPERO 1815; GALVAGNI 1837-1843; SAVA 1844) and the current view of Vertebrate of Etna, highlight the successful local extinction of species such as the Griffon Vulture (*Gyps fulvus*), the Otter (*Lutra lutra*), the Roe Deer (*Capreolus capreolus*), the Fallow Deer (*Dama dama*) and the Wolf (*Canis lupus*). Looking back at how the fauna have dissipated and how they have been lost in a span of just two centuries, one can only feel deeply saddened and hope that humans will not repeat their errors.

Thanks to its small size and its enormous wealth, (not forgetting that 95% of animals are invertebrates), the invertebrate fauna on the other hand, had a greater chance to survive these changes because they were able to also use restricted natural areas. Even if just partially, this fauna has preserved its composition and its structure and thus provides more accurate information on the history and origin of Etna's animal population.

Etna's fauna, compared to other areas of Sicily, includes a relatively small number of exclusive species. This is a plausible explanation for the relative geological "youth" of the volcano, which did not allow for the formation of a native fauna from Etna. The current animal population is a kind that is so exquisitely invasive, having been driven primarily by migration and colonization from neighboring areas, especially from the districts of Peloritani and Nebrodi. The particular ecological conditions, mainly related to the high altitudes, have allowed the district to host some species that are currently present in Sicily, only on Etna's territory. In general, there is a shortage of paleoendemism, unless they migrated there in the last million years from neighboring territories. It is possible, however, to detect the presence of numerous neo-endemic taxa that originated from the isolation of these populations of European species or Apennine thrusts into Sicily caused by the quaternary glaciations. These populations then remained isolated and thus were able to differentiate a specific or subspecific level.

As for the wild vertebrates, this area of Etna still offers opportunities for survival and reproduction of many species that are at risk for extinction on our island. Some of these. Among these species, it is worth mentioning the Wildcat (*Felis silvestris*), the European Pine Marten (*Martes martes*), the Porcupine (*Hystrix cristata*), the Dormouse (*Muscardinus avellinarius*), many large birds of prey, including the Golden Eagle (*Aquila chrysaetos)* and Bonelli's Eagle (*Hieraeatus fasciatus*), the Rock Partridge (*Alectoris graeca withakeri*) and the Tortoise (*Testudo hermanni*). Also of considerable interest are the presence of the Long-tailed Tit of Sicily (*Aegithalos caudatus siculus*), demedeed by PRIOLO (1979) as an endemic subspecies of Sicily, and (*Loxia curvirostra*), the latter extremely located on our island, where it nests only in the pine forest's natural high-altitude, Etna's *Pinus laricio*. The area of Etna represents a strategic place for the protection and conservation of the biodiversity of the vertebrate fauna that live on our island and the protection measures proposed for it appear to be fully justified.

Despite the knowledge on invertebrates, Etna is still far from providing a comprehensive and organic framework. It is still among the latter who found the faunal elements of the greater scientific and zoogeographical significance of the fauna and the exclusive species of Etna.

The narrow endemics of Etna pertains to various animal groups, in particular to the phylum of the Arthropoda. We recall here the three species of Diplopoda: *Brachyiulus aetnensis*, *Cylindroiulus* *aetnensis*, *Buchneria Sicily*, known so far only because of the Etna area. Insects are, however, the group that includes the largest number of endemic taxa of Etna. These include the Blattodea *Ectobius lagrecai* and numerous Heteroptera, among which deserve mention are the *Alloeotomus Aetneus*, *Schirus micans*, *Anthocoris castaneae*, *Orthotylus sicilianus*, *Psallus aetnicola*, *Tuponia hartigi*, *Scioris cursitans pallidicornis*, *Sigara nigrolineata siciliana*; the last of these mentioned is a subspecies of the species of Eurosibiric geonemy. Even among the Homoptera it is possible to indicate a good number of Etna endemics: *Anoplotettix aetnensis*, *Anoplocephalus punctum siculus* and *Rhytistylus proceps lavicus*. The Beetles represent a highly significant portion of this faunal component; a complete list of taxa of the Coleoptera, exclusive to Etna, lie beyond the scope of this paper and will be a limited list. We will, therefore, cite just a few examples that are of particular significance: the Carabidae *Lionychus fleischeri focalirei*, which is found at the summit areas of the volcano and found within the gullies in which the stormwater flows into, the Staphylinidae *Medon perniger fraudulentum*, a subspecies of a species of Apennine geographical distribution, which a is forestial and slightly thermophilic species, the Buprestidae *Buprestis aetnensis*, which is mostly found in the Corsican pines and the Melyridae *Attalus aetnensis*, a honey insect relatively common in open areas of hills and mountains.

There are also many Sicilian endemics that have a distribution more or less restricted to the mountainous areas of the northeastern part of the island. Examples include the Blattodea *Phyllodromica tyrrhenica* and Carabidae *Platyderus canaliculatus*, which live among the leaf litter of the deciduous Nebrodi and Etna forests, and *Chlaenius borgiai*, also present in the Madonie. The Staphylinidae *Megalinus sabellai*, *Leptobium siculum* and *Lomechusoides strumosa sicula* represent neo-endemic taxa from the obvious phylogenetic relationships with species at European and euro-sibiric geonemy. They are not just present in the district of Etna, but also in Nebrodi district. To state again, the Elateridae *Megathous ficuzzensis* and the stag beetle *Lucanus tetraodon sicilianus*, are relatively rare in mountain resorts and woodlands of northern Sicily, and Melolonthidae *Rhizotrogus tarsalis* have a limited distribution around Etna and the Peloritani.

Even more numerous and full of biogeographic meaning are the European and Appenine geonemia species, which are exclusively present on Etna or in the mountainous areas of the north-eastern part of Sicily. Among the most significant, the following examples should be mentioned: the Orthoptera *Leptophyes punctatissima* and *Stenobothrus lineatus*, both present in the Madonie and always found above an altitude of 1,500 m, and the *Poecilimon laevissimus,* a grasshopper that is known throughout Italy for living in few areas on Etna. Another one to mention is the Heteroptera *Cyrtopeltis geniculata*, which shows a strong disjoint distribution and is present exscusively on Etna or in the Alpine areas of Sicily. The Homoptera *Oncopsis subangulata*, an eurosibiric species present exclusively on Mount Etna in Sicily, lives in the woods that contain birch and closely latch onto the birch for food supply. Significant examples are also provided by the Lepidoptera *Anthocaris damone*, a trans-ionic species, present only in the area of Etna in Sicily.

A significant portion of this fauna is, of course, represented by Coleoptera, for which only a few examples will be mentioned. Among the species, whose presence can be detected only on Mount Etna in Sicily, it is worth mentioning the Histeridae *Abraeus parvulus* and Elateridae *Ampedus coenobita*, both of classic European geonemy, the Rutelidae *Exomala leonii*, Buprestidae *Anthaxia giorgioi* and *Agrilus albomarginatus*, all species that have Apennine distribution. Among the species present not only on the Etna, but also in the Nebrodi mountains, we have to remember the Pselafide *Batrisodes adnexus*, which are widely distributed throughout Europe, and the Staphilinidae *Quedius masoni*, a forestry species of the Italian Apennines. The pine forests of *Pinus nigra laricio* of Etna are the only ones in Sicily to offer hospitality to certain species of Cerambycidae, like the *Ergates faber* at euro-anatolian-maghreb distribution, *Spondylis buprestoides*, at eurosiatic distribution geonemy, and *Acanthocinus henschi*, known for many regions of southeast Europe.

The high scientific value of Etna's wildlife is also linked to particular ecological conditions that occur on the volcano by the alternation of two natural processes, partially discontinuous in space

and time. On one hand, volcanic eruptions of short duration (a few years at most), create a strong disturbance, which, on the other hand, is partially offset by recolonization of lava. The latter phenomenon, however, takes a long time, estimated over hundreds and thousands of years.
The Etna is therefore a true natural laboratory, which is very useful for the study of various articulated environmental issues, such as colonization or recolonization of habitats and the effects of fragmentation on their composition, structure and dynamics of communities, that are all important topics and subjects of intense and heated debates within the international scientific community.
In fig. 2.6.1 is shown the wildlife interest areas in the study area.

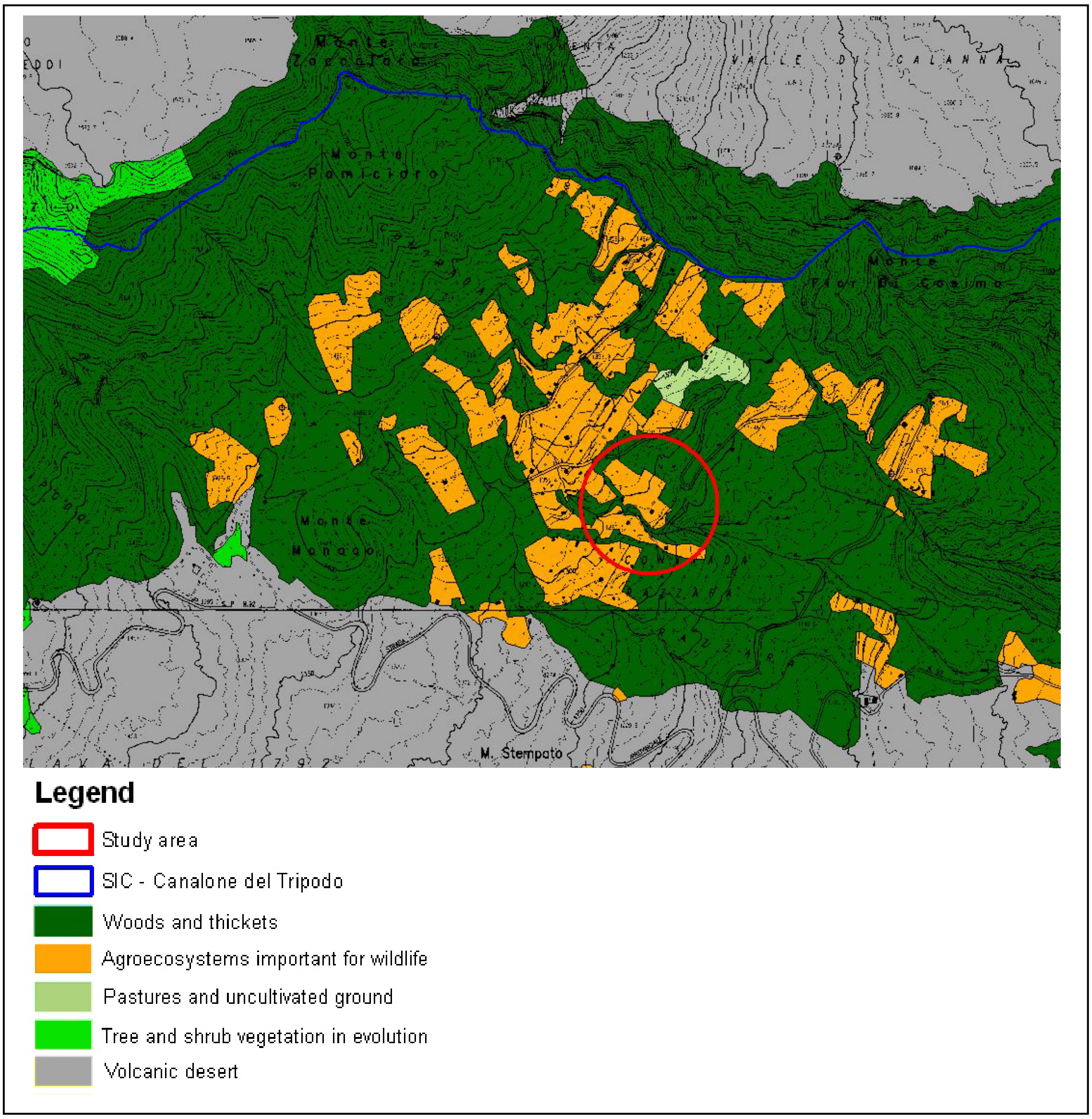


Fig. 2.6.1 Wildlife interest areas in the study area. (from draft of Regional Landscape Plan, field 13). The sampling area is shown with a red circle.

3 MATERIALS AND METHODS

3.1 SAMPLING METHOD

The survey was based on sampling with pit-fall traps. This method, used for many years in researches on ground macro-arthropods, while not being able to provide a complete view of faunal coenosis investigated, has the great advantage of providing comparative qualitative and quantitative data. In addition, the diffusion of its use allows comparisons with the results of a large number of searches.

Within the Etna Park, in Contrada Cassone, Zafferana Etnea, were selected 3 researching stations, corresponding to different enviroments: 2 agro-ecosystems (Orchards) that differ by management methods (organic and conventional) and 1 natural environment (Chestnut forest residues) for comparison (as an area of control); figure 3.1.1 shows the location of these stations.

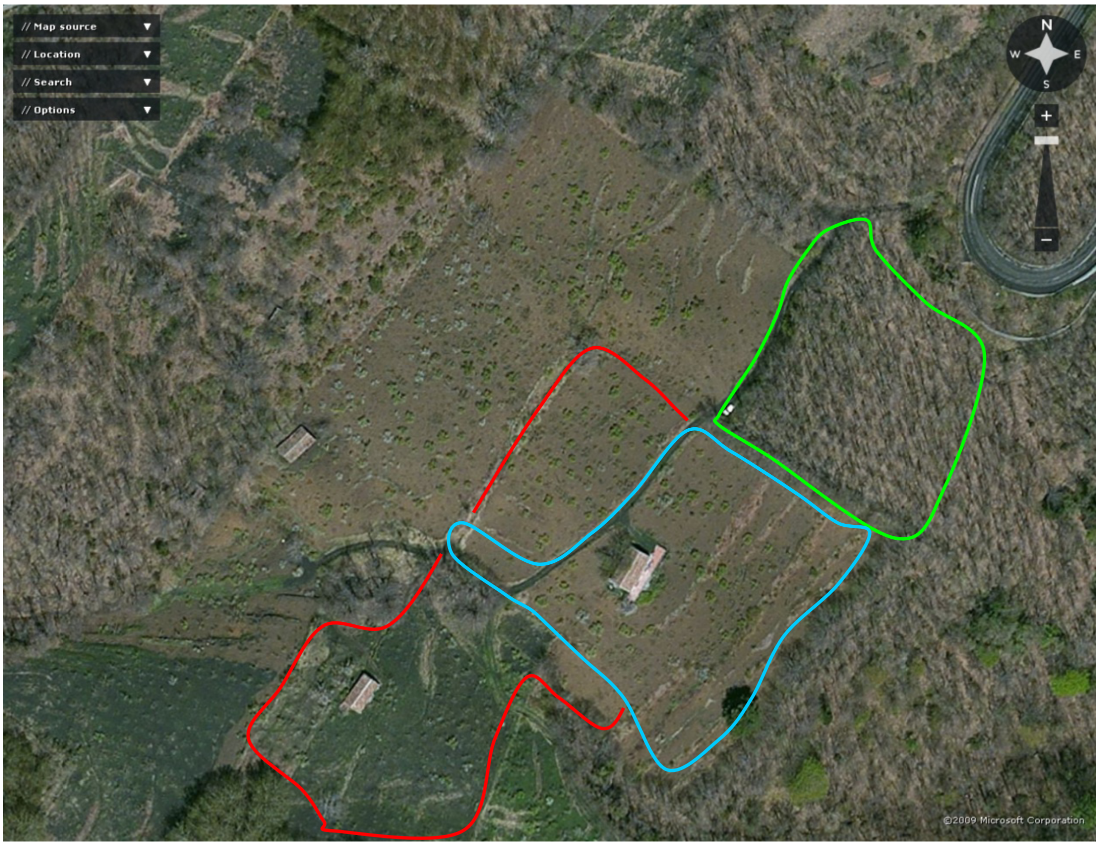


Fig. 3.1.1 – Position of researching stations (Blue: BIO; Red: CON ; Green: BO)

For the collection of specimens were used pit-fall traps, consisting of plastic cups with 8.5 cm superior diameter and 11 cm profundity, filled for two-thirds of a saturated aqueous solution of sodium chloride and vinegar, worked into the ground (fig. 3.1.2) and spaced at least 5 meters from each other.

For agroecosystem stations were placed 8 traps, for the wooded remants 5 traps, whose control with removal of material has been conducted about every 30 days. The positions of the traps are all georeferenced.

Stations differ by management methods, but have similar altitudes (1,300 m a.s.l.) and exposure, so it can reasonably be assumed that the data collected are comparable.

To evaluate the biocenotic structure of the various stations the total duration of sampling was 14 months (14 sampling sessions), from April 2011 to June 2012.

Fig. 3.1.2 – Pit-fall traps.

With regard to the method of pit-fall traps, it is important to remember that some significant distortions of the densities estimation of species are linked to the sampling method itself (SABELLA & ZANETTI, 1991; ZANETTI, 1992):

a) Since catches a function of mobility and amplitude of species movements, small ones are likely to be underestimated compared to those of large size, so the data should be considered in some way related to the biomass of the populations of different species.
b) Species may be attracted or repelled from the trap in different degrees and therefore the method of sampling involves a selection of species. This represents an insurmountable limit.

c) Estimates of the densities of different species can be related very differently to the real populations density.

d) Density estimations of species linked to temporary microhabitats may have very significant changes that do not correspond to real changes in the density of the population.

These considerations lead to remember that, as with any other method of investigation, experimental data deliver us images of communities that are more or less strongly distorted.

3.2 BRIEF DESCRIPTION OF SAMPLING STATIONS

Within the perimeter of the Park, zone B, were thus identified 3 sampling stations, with different characteristics about vegetation or management. The stations are described below, specifying:

1. Geographical location;
2. Mean altitude;
3. Exposure;
4. Inclination;
5. Percentage cover
6. Short description of environmental context;
7. Additional information about the modality of farming.

STATION BIO (ORGANIC ORCHARD)

Geographical coordinates (UTM WGS84): 37°42'6.44"N; 15° 4'3.77"E

Mean altitude: 1,286 m

Patch extension: 0,9 ha

Exposure: S-SE

Orchard coverage: 90%

Short description of the environmental context: Orchard (apples and pear) at organic conducting between plots of residual lava outcrops near Chestnut woods.

Monthly number of traps: 8

Total number of traps: 104

Active traps: 89

Modality of farming: organic conducting;

Soil management: minimum tillage
Number of annual soil treatments: 3 (2 harrowing, 1 fertilization with organic fertilizer)
Period of harrowing: first one on April/May, second one on August
Fertilization: at the beginning of the winter
Removing litter: at the end of the winter
Grassed margins: maintaining margins

Air:
Monitoring: 3 treatments with pheromone traps for *Cyidia pomonella* (Isagro S.p.a.)
Anticryptogamics treatments: 1 treatment with "Bordeaux mixture" (after pruning), 2-3 treatment with proteinate sulfur (before and after flowering)
Microbiological treatments: 2 – 3 *Bacillus thuringiensis*, Spinosad (in enlarged fruits)

Fig. 3.2.3 – Station **BIO** with the eight traps.

Traps coordinates:
BIO-01 N37°42,105’; E 015° 04,056’
BIO-02 N37°42,102’; E 015° 04,050’
BIO-03 N37°42,094’; E 015° 04,048’
BIO-04 N37°42,100’; E 015° 04,059’
BIO-05 N37°42,104’; E 015° 04,036’
BIO-06 N37°42,109’; E 015° 04,032’
BIO-07 N37°42,124’; E 015° 04,060’
BIO-08 N37°42,122’; E 015° 04,074’

STATION CON (CONVENTIONAL ORCHARD)

Geographical coordinates (UTM WGS84): 37°42'4.80"N; 15° 4'0.82"E

Mean altitude: 1,282 m

Exposure: S-SE

Patch extension: 1 ha

Orchard coverage: 90%

Short description of the environmental context: Orchard (apples and pear) at conventional conducting between plots of residual lava outcrops near Chestnut woods.

Monthly number of traps: 8

Total number of traps: 104

Active traps: 94

Modality of farming: conventional conducting;

Soil management:
Number of annual plowing: 2
Period of plowing: first one on April/May, second one on August
Removing litter: at the end of the winter
Grassed margins: maintaining margins

Air:
NN

Fig. 3.2.4 – Station **CON** with the eight traps.

Traps coordinates:

CON-01 N 37°42,090’; E 015°04,020’
CON-02 N 37°42,087’; E 015°04,014’
CON-03 N 37°42,090’; E 015°04,005’
CON-04 N 37°42,089’; E 015°04,000’
CON-05 N 37°42,084’; E 015°03,995’
CON-06 N 37°42,077’; E 015°03,989’
CON-07 N 37°42,098’; E 015°03,035’
CON-08 N 37°42,094’; E 015°04,033’

STATION BOS (WOODED REMNANTS)

Geographical coordinates (UTM WGS84): 37°42'8.32"N; 15° 4'5.99"E

Mean altitude: 1,284 m

Exposure: S-SE

Patch extension: 1 ha

Percentage cover: 95%

Short description of the environmental context: chestnut wood

Monthly number of traps: 5

Total number of traps: 65

Active traps: 56

Fig. 3.2.5 – Station **BOS** with the five traps.

Traps coordinates:

BOS-01 N 37°42,138'; E 015°04,080'
BOS-02 N 37°42,135'; E 015°04,082'
BOS-03 N 37°42,132'; E 015°04,088'
BOS-05S-04 N 37°42,126'; E 015°04,095'
BO N 37°42,124'; E 015°04,095'

3.3 METHOD OF DATA STANDARDIZATION

It appeared appropriate and necessary to standardize the results for a uniform comparison between the stations, eliminating the factors of variability represented by the efficiency of traps (number of "active" traps for sampling) and the number of effective days for each sample: is then proceeded to calculate the Density of Activity (DA) (BRANDMAYR et alii 2005) for each family, as the ratio between the total number of individuals captured during each sampling session and the number of traps found still working, multiplied for the session's days, everything multiplied by 10; this result has applied an additional correction factor (CF) consisting of the ratio between the total of individuals and the DA, thus obtaining the Standard Capture (CS) (ADORNO 1995)

$$DA = [nb.ind. / (nb.trap * dd)] * 10$$

$$FC = nb.TOT.ind. / DA$$

$$CS = [nb.ind. / (nb.trap * dd)] * 10 * FC$$

For an overview of the entire sample relative to the number of traps found in each period at each station and the number of days of exposure of the traps, refer to Table 3.3.1, while the effort to capture relative to each period in each station is shown in Table 3.3.2.

From – to		MONTH	Period	Tot traps per months	Days of exposure	Tot Trap BIO	Tot Trap CON	Tot Trap BOS
01/04/2011	01/05/2011	April	I	18	30	7	6	5
01/05/2011	03/06/2011	May	II	14	33	1	8	5
03/06/2011	02/07/2011	June	III	20	29	8	7	5
02/07/2011	02/08/2011	July	IV	19	31	7	7	5
02/08/2011	30/08/2011	August	V	18	28	7	7	4
30/08/2011	20/09/2011	September	VI	20	21	8	7	5
20/09/2011	22/10/2011	October	VII	19	32	8	7	4
22/10/2011	27/11/2011	November	VIII	15	36	6	7	2
27/11/2011	08/01/2012	January	IX	18	42	7	7	4
08/01/2012	25/02/2012	February	X	4	48	3	1	0
25/02/2012	25/03/2012	March	XI	20	29	8	8	4
25/03/2012	01/05/2012	April	XII	14	37	3	6	5
01/05/2012	27/05/2012	May	XIII	21	26	8	8	5
27/05/2012	29/06/2012	June	XIV	19	33	8	8	3
Total number of traps				**239**	455	89	94	56

Tab. 3.3.1- Overview of the entire sample relative to the number of traps found in each period at each station and the number of days of exposure of the traps.

In the table below (tab. 3.3.2) provides an overview of the entire sample relative to the total number of trap-days / sampling session for the various stations.

From – to		Period	MONTH	DAA BIO	DAA CON	DAA BOS
01/04/2011	01/05/2011	I	April	210	180	150
01/05/2011	03/06/2011	II	May	33	264	165
03/06/2011	02/07/2011	III	June	232	203	145
02/07/2011	02/08/2011	IV	July	217	217	155
02/08/2011	30/08/2011	V	August	196	196	112
30/08/2011	20/09/2011	VI	September	168	147	105
20/09/2011	22/10/2011	VII	October	256	224	128
22/10/2011	27/11/2011	VIII	November	216	252	72
27/11/2011	08/01/2012	IX	January	294	294	168
08/01/2012	25/02/2012	X	February	144	48	0
25/02/2012	25/03/2012	XI	March	232	232	116
25/03/2012	01/05/2012	XII	April	111	222	185
01/05/2012	27/05/2012	XIII	May	208	208	130
27/05/2012	29/06/2012	XIV	June	264	264	99

Tab. 3.3.2 - Capture effort relative to each sampling session in each station.

3.4 METHODS OF EVALUATION FOR THE QUALITY AND QUANTITY COMPARISON

The analysis and comparisons were made both on Coleoptera Families that on the complex of species of Carabidae, Staphylinidae and Tenebrionidae. The indices of diversity and similarity have been elaborated with the software PRIMER 6 and BIODIV 4.2.

3.4.1 SIMILARITY INDEX

Bray-Curtis index

The Bray-Curtis index or coefficient of similarity (a semi-quantitative index) estimates the similarity between pairs of samples taking into account not only the presence / absence, but also the abundances of individual taxa. This was calculated using the formula:

$$BC = 100\frac{\sum_{i=1}^{p} 2\min(y_{ij}, y_{ik})}{\sum_{i=1}^{p}(y_{ij} + y_{ik})}$$

where:

p = total number of taxa
i = taxon
y_{ij} = abundance of the taxon (i) in the first sample (j)
y_{ik} = abundance of the taxon (i) in the second sample (k).

This index takes the value 0 if the two samples have no taxa in common, and is equal to 100 if the two samples are identical.

3.4.2 MULTIVARIATE ANALYSIS OF COMMUNITIES

In order to highlight similarities and differences between the traps and the stations have been used also the multivariate analysis of communities using the methodology of Non-Metric Multidimensional Scaling (NMDS).
This technique is considered by CLARKE & WARWICK (2001), at least from the conceptual point of view, the easier to apply; it keeps a clear and direct link with the original data. It is also very flexible as it requires no assumptions about the form of the data distribution.
This methodology has been applied both to Families and species of Coleoptera, after a square-root transformation of abundance data of each taxon. The data thus treated were then used to obtain a Bray-Curtis similarity matrix. Referring to that it was possible to construct a series of plots that allow to show the similarities between the various units of sampling (traps and stations). Each point on the graphs represents a single sampling unit, whose position is determined by all the taxa and the number of specimens collected for each of them.
In this way, homogeneous groups can be observed between the sampling units. Since the graphs projected a multidimensional space in two-dimensions or three-dimensions, the technique provides a measure of "stress" or the "forcing" of the plot. CLARKE & WARWICK (2001) suggest not to consider plots with stress values higher than 0,18 as being unrepresentative.
This sorting technique has been associated with a specific test, ANalysis Of Similarity (ANOSIM), which provides a measure of the significance of differences between the groups identified a priori (CLARKE & WARWICK 2001) The test results is a value, called R, which reflects the difference observed between the distances of the points belonging to each of the groups compared, with respect to the distance of the points belonging to other groups:

$$R = r_b - r_w / 1/4\ [n\ (n-1)]$$

where:

r_b = mean diversity within the group;
r_w = mean diversity with the other groups;
n= total number of sample units.

The value of R (R observed) can vary between -1 and 1 and assumes the value 0 when the null hypothesis (H_0: no difference between the sampling units) is true, and takes the value 1 when all replies of a certain sampling unit are more similar together than to all other replicas of the sampling units. Values less than zero, represent the opposite case.
The ANOSIM test, using a predetermined number of times, recalculates the value of R randomly permuting membership group of each replication. In this way it is obtained a distribution of R simulated with which to compare the value of R observed.
The null hypothesis is rejected when R observed falls outside the distribution of the R simulated: the higher the R observed value is away from that of R simulated values, the more likely that the clusters on the plot of the representations are not random.
Together with the calculation of R is produced an estimation of the significance that allows to evaluate the possibility of making a mistake in interpreting R.
It was also estimated the statistical significance of differences between stations using the Parwise tests, based on the value of R observed between pairs of stations.

4 GENERAL ANALYSIS OF SAMPLING REGARDING THE FAMILIES OF COLEOPTERA

During the sampling period in the whole 3 investigated stations within the Etna Regional Park where censed **11,765** Coleoptera specimens, belonging to **32** Families and a Superfamily Curculionoidea. Table 4.1 shows the capture amount for the Coleoptera Families (express as total number of specimens) for each station, with the relative percentage.
The classification of the families of Coleoptera is according to BOUCHARD et alii 2011.
Staphylinidae and Carabidae cumulate more than **70%** of the whole captures.

Taxa	BIO	BOS	CON	Total	Percentage of total
Staphylinidae	1182	1718	1386	4286	36,55%
Carabidae	672	2703	631	4006	34,25%
Anthicidae	437	2	500	939	7,93%
Tenebrionidae	212	26	300	538	4,42%
Melyridae	367	1	127	495	4,18%
Cryptophagidae	16	231	113	360	3,04%
Zopheridae	62	147	30	239	2,01%
Ptinidae	21	141	25	187	1,57%
Nitidulidae	74	18	69	161	1,36%
Curculionoidea	46	7	94	147	1,24%
Oedemeridae	16		42	58	0,49%
Kateretidae	19		21	40	0,33%
Leiodidae	26	5	9	40	0,33%
Elateridae	13	10	9	32	0,27%
Latridiidae	8	18	6	32	0,27%
Chrysomelidae	16	1	14	31	0,26%
Mordellidae	15	2	14	31	0,26%
Endomychidae	2	12	14	28	0,23%
Scarabeidae	7		14	21	0,17%
Coccinellidae	9		11	20	0,16%
Corylophidae	8	1	3	12	0,10%
Cerambycidae	6	2	3	11	0,09%
Mycetophagidae	4	3	4	11	0,09%
Cantharidae	4	1	5	10	0,08%
Buprestidae	4		3	7	0,05%
Ptiliidae	2		5	7	0,05%
Lucanidae	2	3	1	6	0,05%
Throscidae	3			3	0,02%
Phalacridae	1		1	2	0,01%
Silvanidae			2	2	0,01%
Cebrionidae	1			1	0,01%
Dermestidae			1	1	0,01%
Scirtidae		1		1	0,01%
Total	3255	5053	3457	11765	100%
% of total	27,66%	43,94%	28,38%	100%	
Total number of Families	*29*	*22*	*30*	*33*	

Tab. 4.1 - Results trends in catches of the Coleoptera Families in each station, expressed as total number of the sampled specimens. The percentages refer to the total of the entire sampling.

Table 4.1 clearly shows that Staphylinidae is the Family with the highest number of surveyed specimens with 36,55%, followed by Carabidae, with 34,25% (fig. 4.1). These two Families resulted present in all three stations.
The third Family in order of abundance is represented by Anthicidae, 7,93%, with more than 53,25% of the catch concentrated in the **BIO** station.
Tenebrionidae with 524 specimens, approximately 4,5 % of the entire sampling, are the fourth Family in order of abundance. Tenebronidae specimens were sampled in all stations, although catches most abundant, accounting for 55,5% of the sample, are relative to the **CON** station. Staphylinidae are characterized by species with articulated and varied ecological requirements, being able to inhabit different terrestrial environments. Carabidae are tipical predators in the ground fauna, for which the use of pit-fall traps is a well-established and widespread collecting technique.
Then, among Tenebrionidae there is a quite number of thermophilic species typical of xeric and sub-xeric environments.
After Staphylinidae, Carabidae, Anthicidae and Tenebrionidae, in order of abundance follow:

Melyridae, present as well in all stations with the 4,18% of captured specimens, are Coleoptera associated with flowers and living on the vegetation; Cryptophagidae, with 3,04%, generally in decaying plant material, in rotting wood, associated with fungi, and on shed fur or feathers; consuming decaying plant material and mycetophagous.

Other Families that, even though with lower numbers of specimens, were found in all the stations are Zopheridae (2,01%), Ptinidae (1,57%), Nitidulidae (1,36%), and the Superfamily Curculionoidea (1,24%).

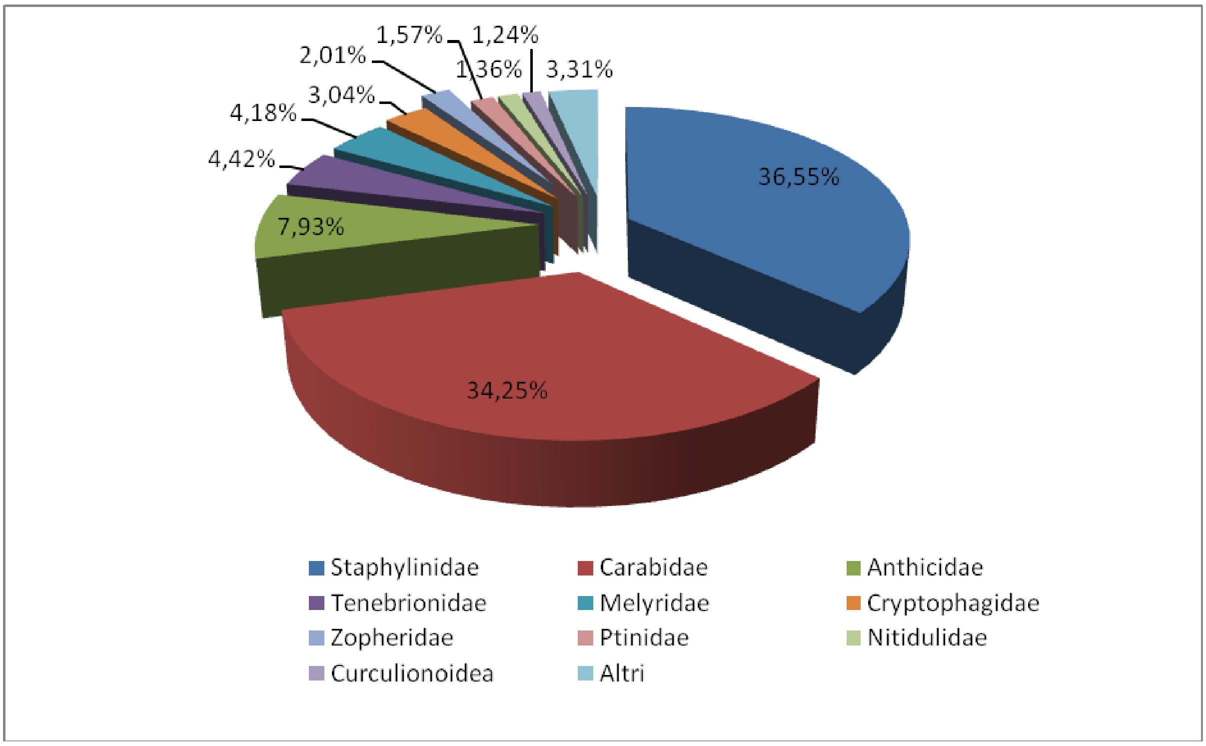


Fig. 4.1- Overall trend (number of individual and percentage of total) of catches for the most abundant sampled Coleoptera Families.

The remaining Families show capture abundances below 1% of the entire sampling of the Coleoptera and have been counted in all stations, in two stations or into one.

In all tables and figures that follow, the trend of the catch is expressed as the CS value (standard catch) in order to make statistically significant comparisons.

TAXA	BIO	BOS	CON	Tot_CS	Percentage of total
Carabidae	34,69	231,82	32,21	298,71	41,31%
Staphylinidae	57,89	130,00	61,91	249,80	34,55%
Anthicidae	22,09	0,16	22,30	44,55	6,16%
Tenebrionidae	10,61	2,24	13,57	26,42	3,65%
Melyridae	15,87	0,06	5,69	21,63	2,99%
Cryptophagidae	0,71	15,48	4,68	20,88	2,89%
Zopheridae	3,19	10,07	1,33	14,59	2,02%
Ptinidae	0,91	9,18	1,28	11,37	1,57%
Nitidulidae	3,27	1,34	3,26	7,87	1,09%
Curculionoidea	2,28	0,48	4,25	7,00	0,97%
Oedemeridae	0,67		1,84	2,51	0,35%
Leiodidae	1,23	0,39	0,40	2,01	0,28%
Latridiidae	0,34	1,27	0,26	1,88	0,26%
Kateretidae	1,04		0,82	1,87	0,26%
Elateridae	0,63	0,75	0,41	1,79	0,25%
Endomychidae	0,08	0,81	0,69	1,57	0,22%
Chrysomelidae	0,88	0,06	0,59	1,54	0,21%
Mordellidae	0,59	0,12	0,62	1,34	0,19%
Scarabeidae	0,34		0,61	0,95	0,13%
Coccinellidae	0,44		0,49	0,93	0,13%
Mycetophagidae	0,23	0,35	0,20	0,78	0,11%
Cerambycidae	0,27	0,18	0,15	0,59	0,08%
Corylophidae	0,36	0,09	0,14	0,59	0,08%
Cantharidae	0,14	0,08	0,22	0,43	0,06%
Lucanidae	0,09	0,22	0,05	0,36	0,05%
Buprestidae	0,22		0,12	0,35	0,05%
Ptiliidae			0,23	0,23	0,03%
Throscidae	0,12			0,12	0,02%
Scirtidae		0,10		0,10	0,01%
Silvanidae			0,10	0,10	0,01%
Phalacridae	0,05		0,05	0,09	0,01%
Cebrionidae	0,05			0,05	0,01%
Dermestidae			0,04	0,04	0,01%
Tot_CS	159,28	405,24	158,50	723,02	100%
Total number of Families	*29*	*22*	*30*	*33*	

Tab. 4.2 - Trends in catches of the Coleoptera Families in each station expressed as CS values. The percentages refer to the entire sampling.

For subsequent analysis are taken into account the CS values (chapter 3), as standardized values that make significant comparisons between stations and traps.
Using the CS values, the results outlined above slightly varies, but without substantial changes (fig. 4.3).

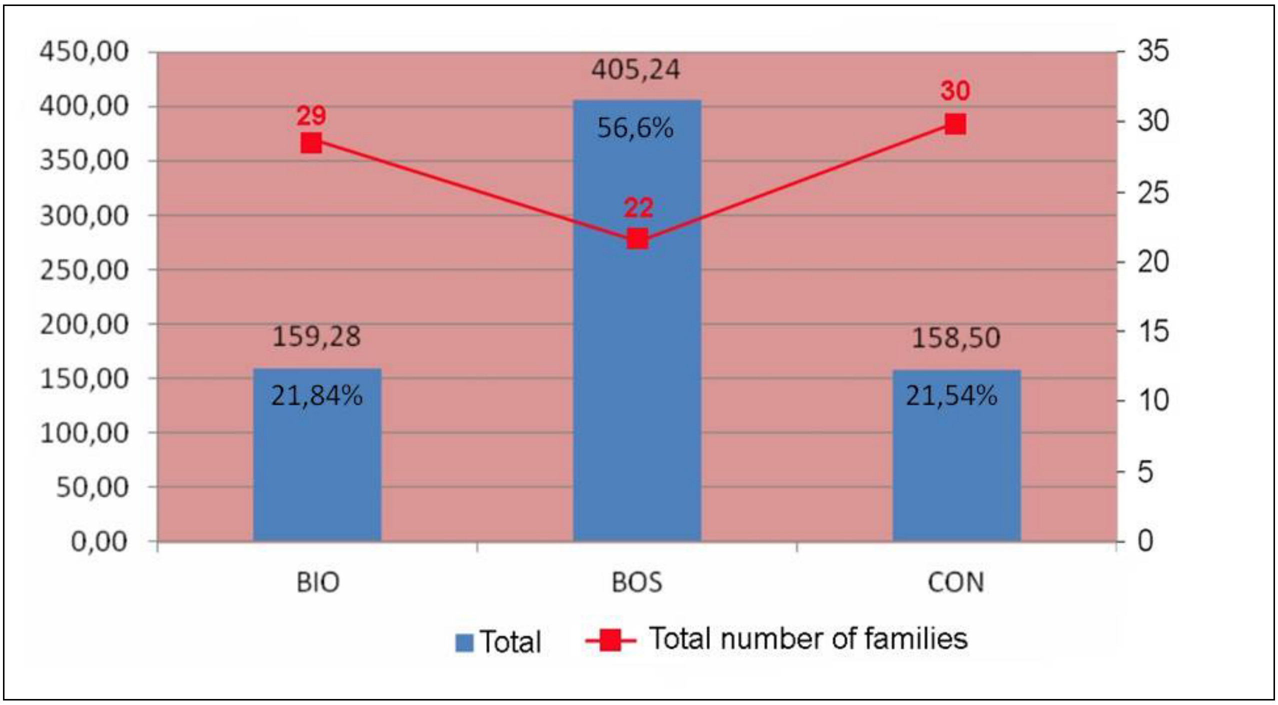


Fig. 4.2 - Overall trend in the capture frequency (CS) of the Coleoptera specimens and number of the sampled Coleoptera Families in each station.

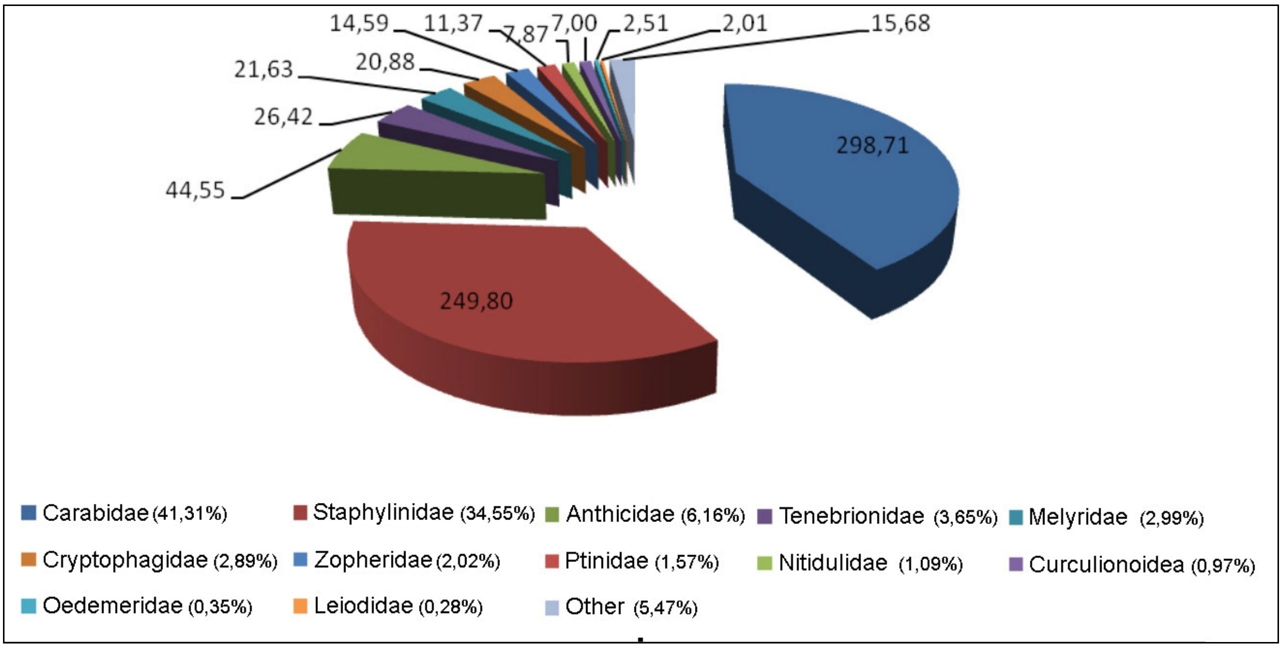


Fig. 4.3 - Overall trend (number of individual and percentage of total, uniformed with CS) of catches for the principal Families.

It should be noted that there isn't a correlation between the capture frequency and the number of sampled Families (fig. 4.2).

Table 4.3 shows the results for the 21 Coleoptera Families found in all stations. The Families exclusive to a single station does not show in any case significant CS values.

TAXA	BIO	BOS	CON	Tot_CS	Percentage of total
Carabidae	34,69	231,82	32,21	298,71	41,74%
Staphylinidae	57,89	130,00	61,91	249,80	34,90%
Anthicidae	22,09	0,16	22,30	44,55	6,22%
Tenebrionidae	10,61	2,24	13,57	26,42	3,69%
Melyridae	15,87	0,06	5,69	21,63	3,02%
Cryptophagidae	0,71	15,48	4,68	20,88	2,92%
Zopheridae	3,19	10,07	1,33	14,59	2,04%
Ptinidae	0,91	9,18	1,28	11,37	1,59%
Nitidulidae	3,27	1,34	3,26	7,87	1,10%
Curculionoidea	2,28	0,48	4,25	7,00	0,98%
Leiodidae	1,23	0,39	0,40	2,01	0,28%
Latridiidae	0,34	1,27	0,26	1,88	0,26%
Elateridae	0,63	0,75	0,41	1,79	0,25%
Endomychidae	0,08	0,81	0,69	1,57	0,22%
Chrysomelidae	0,88	0,06	0,59	1,54	0,22%
Mordellidae	0,59	0,12	0,62	1,34	0,19%
Mycetophagidae	0,23	0,35	0,20	0,78	0,11%
Cerambycidae	0,27	0,18	0,15	0,59	0,08%
Corylophidae	0,36	0,09	0,14	0,59	0,08%
Cantharidae	0,14	0,08	0,22	0,43	0,06%
Lucanidae	0,09	0,22	0,05	0,36	0,05%

Tab. 4.3 – The Coleoptera Families present in all investigated stations with relative CS values.

Fig. 4.4.1 shows the CS values of the first four Families in order of abundance in each station. The higher CS value are recorded in the **BOS** station for Carabidae and Staphylinidae and in **BIO** and **CON** stations for Anthicidae and Tenebrionidae.

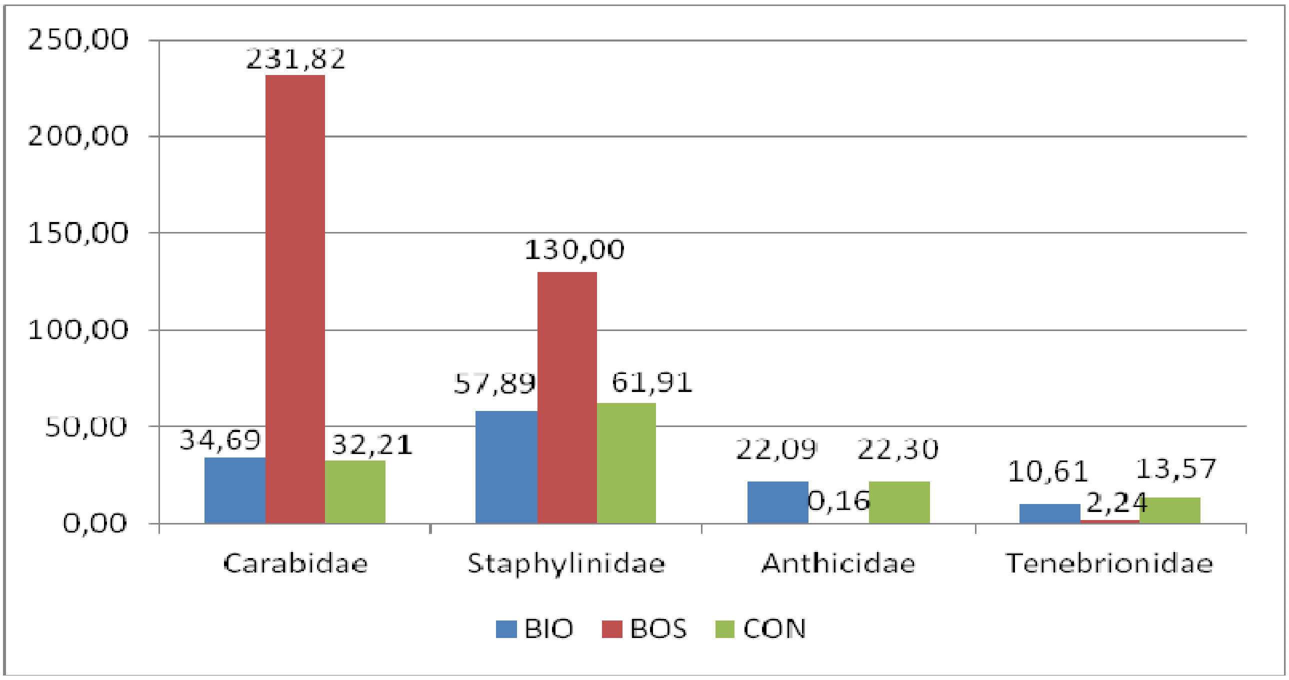


Fig. 4.4 - Overall trend (number of individual ad percentage of total, uniformed with CS) of catches for Carabidae, Staphylinidae, Anthicidae and Tenebrionidae in each station.

Moving on to the examination of capture frequency trend for the Coleoptera Families in single months of the sampling period (tab. 4.4 and fig. 4.5), it is evident that the higher CS value is recorded in September, while between November and February are recorded very low CS values.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Total_CS
TAXA	01/05/2011	03/06/2011	02/07/2011	02/08/2011	30/08/2011	20/09/2011	22/10/2011	27/11/2011	08/01/2012	25/02/2012	25/03/2012	01/05/2012	27/05/2012	29/06/2012	
Carabidae	7,95	13,94	19,76	17,84	76,08	97,63	16,98	2,07	2,56	2,22	3,06	5,68	17,15	15,77	298,71
Staphylinidae	20,43	20,92	32,66	9,52	6,49	24,52	6,51	1,41	1,90	0,42	12,20	29,80	57,54	25,48	249,80
Anthicidae	6,09	7,16	6,63	1,34	0,92	3,16	0,66	0,05	0,03	0,07	0,30	3,20	12,40	2,54	44,55
Tenebrionidae	3,38	3,24	6,51	2,30	0,63	1,07	2,09	0,05			0,30	2,25	3,10	1,50	26,42
Melyridae		0,30	17,34	0,16		0,07							1,83	1,93	21,63
Cryptophagidae	2,26	4,90	4,02	0,13	0,09	0,10	3,56	0,19	1,96		0,69	2,04	0,40	0,54	20,88
Zopheridae	4,96	2,24	2,54	1,03	0,56	0,38	0,20				0,13	0,78	1,06	0,71	14,59
Ptinidae	1,84	1,14	1,05	1,06	0,28		0,12		1,08	0,21	0,65	2,05	0,97	0,93	11,37
Nitidulidae	1,39	0,23	1,45	0,72	0,51	0,93	0,04		0,03		0,52	0,05	0,56	1,44	7,87
Curculionoidea	0,42	0,89	1,23	0,61	0,05	0,07	0,80	0,36	0,31	0,28	0,60	0,41	0,41	0,57	7,00
Oedemeridae		0,08	0,95	0,32	0,15								0,10	0,91	2,51
Leiodidae	0,29	0,08	0,51	0,37		0,10	0,20			0,07	0,22	0,14	0,05		2,01
Latridiidae		0,14	0,90	0,13	0,09		0,28					0,05	0,30		1,88
Kateretidae												0,59	0,14	1,14	1,87
Elateridae	0,05	0,08	0,26	0,68								0,09	0,29	0,34	1,79
Endomychidae	0,44	0,08	0,37				0,04		0,43		0,17			0,04	1,57
Chrysomelidae	0,05	0,11	0,19	0,20	0,10		0,04		0,07	0,07	0,04	0,41	0,14	0,11	1,54
Mordellidae		0,04	0,22	0,14	0,10							0,05	0,14	0,64	1,34
Scarabeidae		0,15	0,14		0,05		0,47					0,09	0,05		0,95
Coccinellidae		0,08	0,28	0,14							0,04	0,09	0,19	0,11	0,93
Mycetophagidae	0,11		0,07					0,28			0,04	0,14	0,14		0,78
Cerambycidae			0,23	0,05	0,14						0,13		0,05		0,59
Corylophidae	0,10		0,26	0,09							0,09		0,05		0,59
Cantharidae		0,04	0,04	0,09									0,22	0,04	0,43
Lucanidae			0,07	0,20	0,09										0,36
Buprestidae				0,05								0,09	0,10	0,11	0,35
Ptiliidae	0,06		0,05	0,05								0,05		0,04	0,23
Throscidae				0,05										0,08	0,12
Scirtidae														0,10	0,10
Silvanidae													0,10		0,10
Phalacridae				0,09											0,09
Cebrionidae				0,05											0,05
Dermestidae		0,04													0,04
Tot_CS	49,80	55,87	97,73	37,40	86,34	128,02	31,99	4,39	8,37	3,33	19,18	48,03	97,48	55,08	723,02
Num_Fam	16	21	25	26	16	10	14	7	9	7	16	20	25	22	33

Tab. 4.4 - Trends in the capture frequencies (CS) of the Coleoptera Families during the sampling period.

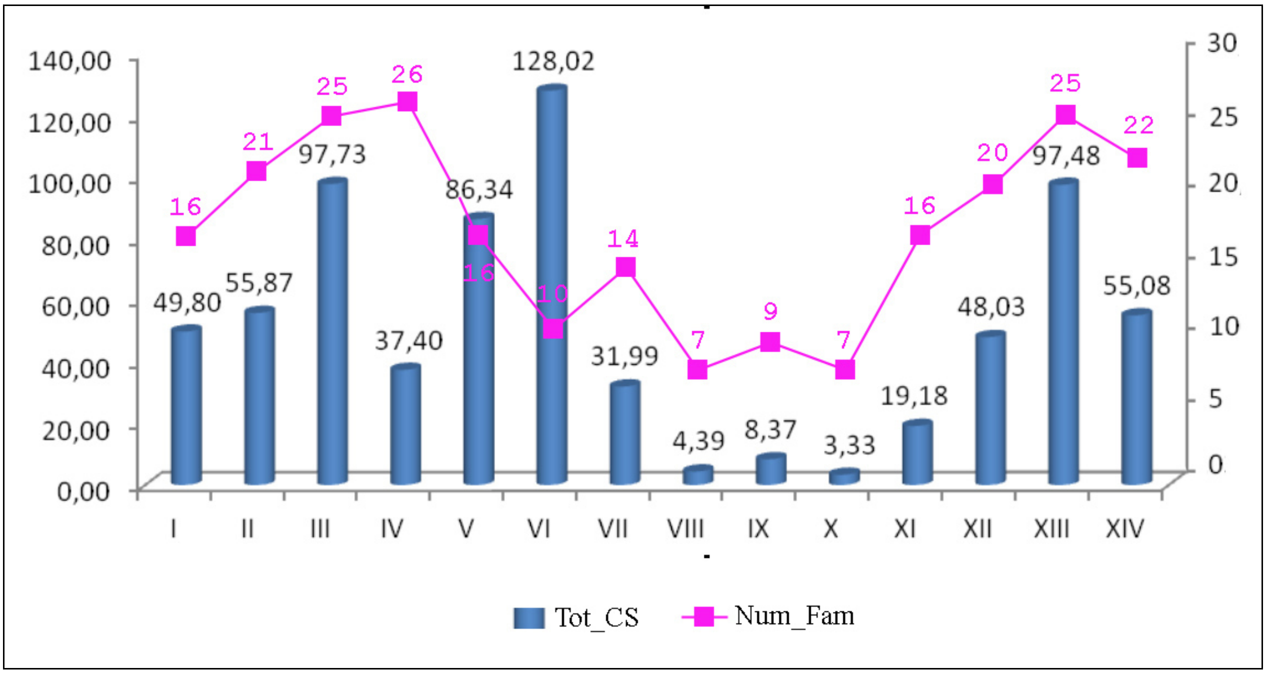


Fig . 4.5 – Overall trend of the capture frequencies (CS) and number of the sampled Coleoptera Families in each period.

4.1 ANALYSIS OF THE STATIONS FOR COLEPTERA FAMILIES

Station BIO (Organic orchard)

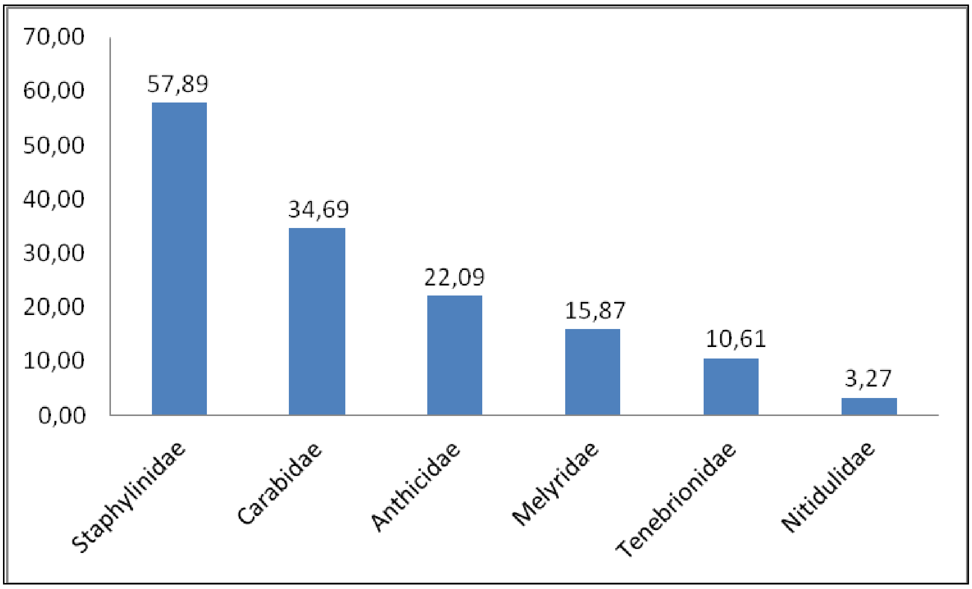
The trend in the capture frequency for the Coleoptera Families in the 8 **BIO** station's traps is shown in table 4.1.1. This station has a slightly higher CS value than the **CON** station.

TAXA	BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	Tot_CS
Staphylinidae	8,54	12,14	5,28	4,94	5,46	8,96	3,05	9,52	57,89
Carabidae	3,63	11,91	2,81	6,07	4,12	1,41	3,01	1,72	34,69
Anthicidae	0,66	1,75	2,51	3,97	2,58	1,67	2,32	6,63	22,09
Melyridae	0,09	0,18	0,67	1,90	0,30	1,34	1,35	10,05	15,87
Tenebrionidae	0,31	1,72	1,11	0,98	1,86	1,40	0,96	2,27	10,61
Nitidulidae	0,29	1,63	0,29	0,15	0,19	0,22	0,36	0,13	3,27
Zopheridae	0,71	1,39	0,09	0,23	0,18	0,23		0,37	3,19
Curculionoidea	0,30	0,86	0,08	0,18	0,34	0,17	0,23	0,13	2,28
Leiodidae	0,14	0,60	0,18	0,13		0,09		0,09	1,23
Kateretidae	0,31		0,08	0,04		0,62			1,04
Ptinidae	0,33	0,41	0,04	0,04	0,04			0,05	0,91
Chrysomelidae	0,05	0,08	0,10	0,18	0,09	0,38			0,88
Cryptophagidae	0,04	0,29	0,08		0,18	0,05	0,08		0,71
Oedemeridae		0,16	0,05	0,16	0,08	0,08	0,13		0,67
Elateridae	0,09	0,17	0,10	0,05	0,09	0,05	0,09		0,63
Mordellidae	0,10	0,34				0,08		0,08	0,59
Coccinellidae	0,05	0,18			0,04	0,09	0,09		0,44
Corylophidae	0,10	0,26							0,36
Latridiidae		0,30		0,04					0,34
Scarabeidae		0,05				0,09	0,08	0,13	0,34
Cerambycidae	0,09					0,04	0,09	0,05	0,27
Mycetophagidae		0,05		0,04		0,09	0,05		0,23
Buprestidae						0,13	0,10		0,22
Cantharidae		0,04				0,09			0,14
Throscidae	0,05					0,08			0,12
Lucanidae				0,05		0,05			0,09
Endomychidae		0,04					0,03		0,08
Phalacridae							0,05		0,05
Cebrionidae		0,05							0,05
Tot_CS	15,86	34,62	13,44	19,15	15,56	17,39	12,06	31,20	159,28
Num_Fam	*19*	*23*	*16*	*17*	*14*	*23*	*17*	*13*	*29*

Table 4.1.1 - Trend of the capture frequency (CS) of the Coleoptera Families in the traps of the **BIO** station.

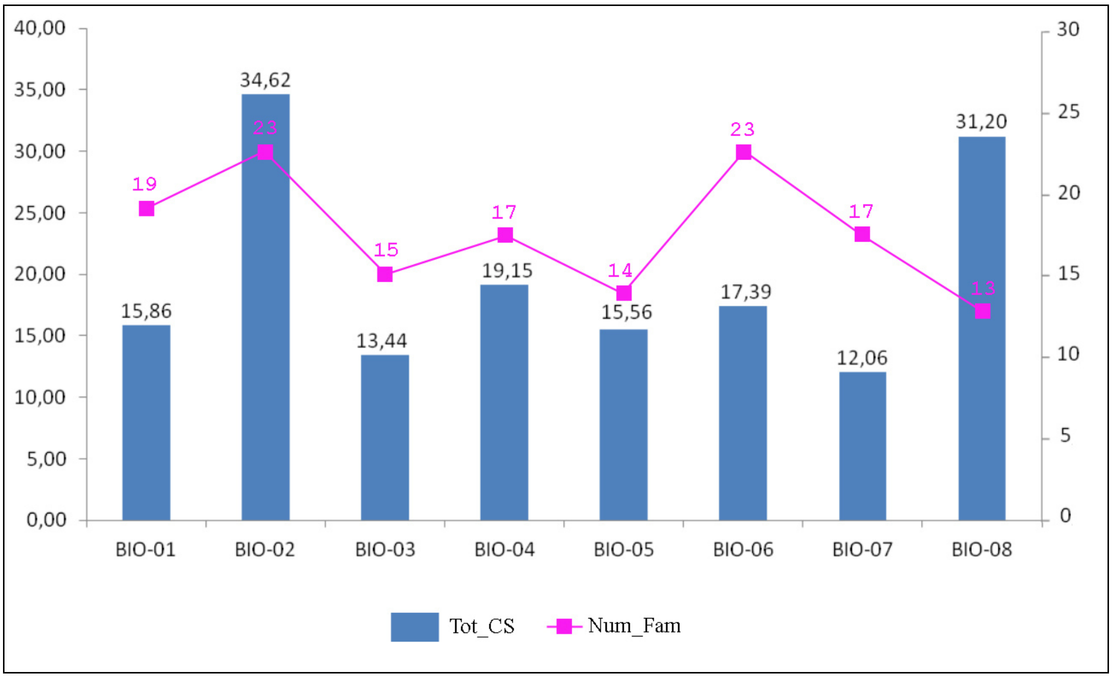
In this station 29 Families of 33 are sampled, 1 Family more than in the **CON** station.
Staphylinidae are predominant with 36,34% of the CS total value and they represent the Family most sampled in all traps except in the **BIO-04**, where the Family most represented is Carabidae (see tab. 4.1.1). The Staphylinidae captures frequencies in traps are similar, although it is possible to highlight some significant differences, in particular the trap **BIO-07** presents CS values of equal to about 1/4 compared to the trap **BIO-02**, which also shows the peak capture frequencies.
In order of the capture frequency, follow Carabidae (21,77%), Anthicidae (13,86%), and Melyridae (9,96%). Significant differences are in the CS values according to the considered traps. The fifth most abundant capture frequency is shown by the Family of Tenebrionidae, which has not significantly different CS values, thus showing a relatively smooth trend of catches.

No trap has collected all 29 sampled Families in the station, although those more abundantly surveyed are present in all traps. The traps **BIO-02** and **BIO-06** have intercepted 23 Families, while **BIO-08** only 13.
It has to be noted that the **BIO** station was the only one that has recorded the Family of Throscidae represented by three specimens and Cebrionidae represented by only one specimen.
For a summary of the capture frequency of the most abundantly sampled Coleoptera Families in the **BIO** station, refer to the graph 4.1.1.



Graph 4.1.1 - Frequency of capture (CS) of the most abundantly sampled Coleoptera Families in the **BIO** station.

Moving on to discuss the frequency of the Families capture in regards to traps in the sampling period (graph 4.1.2 and tab. 4.1.2), it must be emphasized that the traps **BIO-02** and **BIO-07** show significantly higher CS values to all others traps, which instead have registered similar trapping frequencies between them.
The sampled Families number did not appear in this case positively correlated to the CS values.
It notes that the sampling in the **BIO** station in 03/06/2011 and 01/05/2012 have suffered damage due to the plowing. This has been considered in terms of final statistical operations.



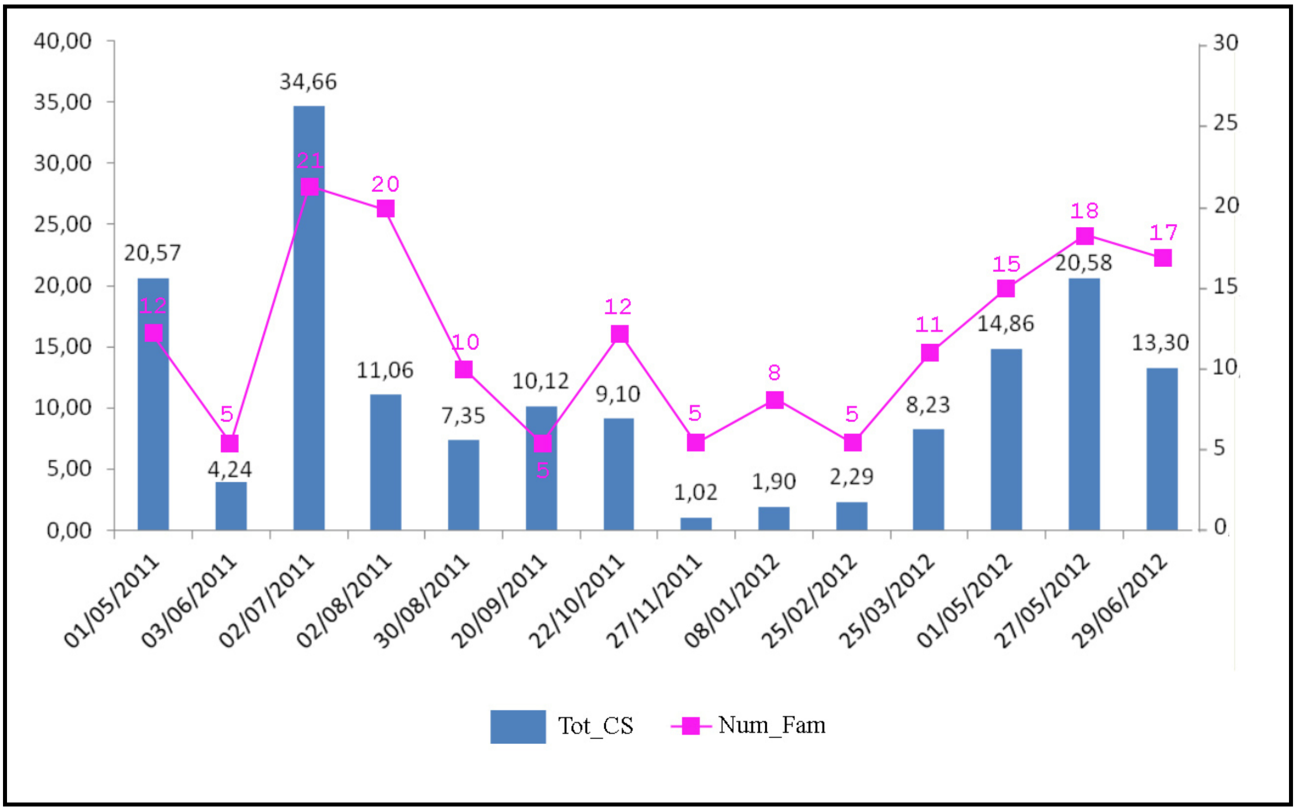
Graph. 4.1.2 - Capture frequency (CS) of the specimens in the traps of the **BIO** station, and number of the sampled Families.

	Traps									
Date of sampling	**BIO-01**	**BIO-02**	**BIO-03**	**BIO-04**	**BIO-05**	**BIO-06**	**BIO-07**	**BIO-08**	**Tot_CS**	**N_Fam**
01/05/2011	3,33	3,43	5,24	2,48	3,38		1,14	1,57	20,57	*12*
03/06/2011		4,24							4,24	*5*
02/07/2011	2,93	5,69	1,51	3,19	1,59	3,49	2,46	13,79	34,66	*21*
02/08/2011	1,52	2,86	1,84	1,71	0,74	0,92	0,69	0,78	11,06	*20*
30/08/2011	1,22	2,19	0,20	2,19	0,20	0,15	0,66	0,51	7,35	*10*
20/09/2011	1,19	3,51	0,48	1,19	0,89	1,19	0,89	0,77	10,12	*5*
22/10/2011	0,70	2,81	1,25	0,74	0,59	0,63	1,33	1,05	9,10	*12*
27/11/2011	0,09	0,56	0,19		0,09	0,05	0,05		1,02	*5*
08/01/2012	0,07	0,37	0,07	0,14		0,37	0,71	0,17	1,90	*8*
25/02/2012		1,11	0,28	0,42	0,14	0,07	0,28		2,29	*5*
25/03/2012	0,39	2,07	0,22	1,47	1,25	1,42	0,26	1,16	8,23	*11*
01/05/2012					2,88	5,41		6,58	14,86	*15*
27/05/2012	2,55	2,40	1,15	2,98	2,55	2,40	2,98	3,56	20,58	*18*
29/06/2012	1,86	3,37	1,02	2,65	1,25	1,29	0,61	1,25	13,30	*17*
Tot_CS	15,86	34,62	13,44	19,15	15,56	17,39	12,06	31,20	159,28	-
N_Fam	*19*	*23*	*15*	*17*	*14*	*23*	*17*	*13*	-	*29*

Table 4.1.2 - Trends of capture frequencies (CS) for the Coleoptera Families in regards to each trap during the sampling period in the **BIO** station. Highlighted in green are the highest CS values and the greatest number of sampled Families, in light blue the lowest CS values and the lowest number of sampled Families.

Looking at the trend of the Families capture frequency in the traps during the entire sampling (tab. 4.1.2 and graph. 4.1.3), it is clear that the 47,59 % of catches is concentrated in the months of April 2011 (date of sampling: 01/05/2011), June 2011 (date of sampling: 02/07/2011) and May 2012 (date of sampling: 27/05/2012). Lower CS values are recorded instead in the months of November, December, January and February because of the snows.

June 2011 is the month in which was recorded the highest number of Families (21) followed by July (20), while November 2011, September 2011 and February 2012 are the months with the lowest number of censed Families (5). The traps of May 2011 (date of sampling: 03/06/2011) were damaged by plowing.



Graph. 4.1.3 - Trends of capture frequencies (CS) for the Coleoptera specimens in the **BIO** station in the months of sampling and number of the sampled Families.

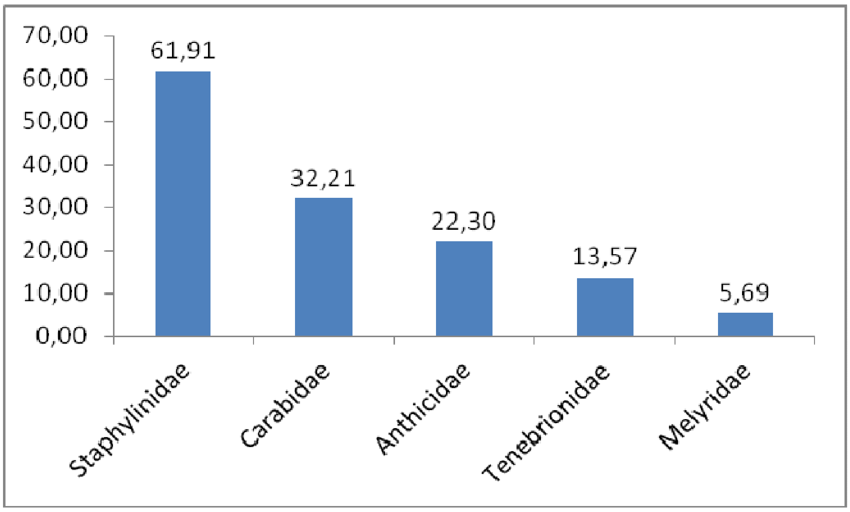
Station CON (Conventional orchard)

The trend in the capture frequency for the Coleoptera Families in the 8 **CO** station's traps is shown in table 4.1.3.

TAXA	**CON-01**	**CON-02**	**CON-03**	**CON-04**	**CON-05**	**CON-06**	**CON-07**	**CON-08**	**Tot_CS**
Staphylinidae	10,01	4,13	6,62	13,65	2,61	8,35	6,69	9,85	61,91
Carabidae	5,98	3,64	4,34	4,35	2,54	7,24	0,77	3,35	32,21
Anthicidae	3,10	2,82	2,16	2,29	2,07	5,78	1,26	2,82	22,30
Tenebrionidae	1,66	1,77	1,55	0,86	3,15	2,88	0,42	1,28	13,57
Melyridae	0,46	2,27	1,16	0,10	0,20	0,10	0,92	0,49	5,69
Cryptophagidae	0,30	0,22	3,05	0,62	0,18	0,05		0,25	4,68
Curculionoidea	0,52	0,60	0,50	0,49	1,38	0,55		0,22	4,25
Nitidulidae	0,73	0,06	0,27	0,33	0,14	0,46	0,18	1,10	3,26
Oedemeridae	0,13	0,74	0,05	0,17	0,16	0,40	0,19		1,84
Zopheridae	0,30		0,25	0,19	0,04	0,17	0,09	0,29	1,33
Ptinidae	0,04	0,37	0,21	0,09	0,18	0,14		0,25	1,28
Kateretidae	0,11			0,05		0,04	0,15	0,47	0,82
Endomychidae		0,06	0,41	0,06		0,07	0,04	0,05	0,69
Mordellidae	0,09	0,05	0,14		0,09		0,09	0,17	0,62
Scarabeidae		0,27		0,13	0,16	0,05			0,61
Chrysomelidae	0,17			0,14	0,05	0,16	0,04	0,04	0,59
Coccinellidae	0,23	0,05	0,04		0,05	0,05	0,08		0,49
Elateridae	0,09		0,04		0,05	0,09	0,04	0,10	0,41
Leiodidae	0,13	0,04	0,04	0,09	0,09				0,40
Latridiidae	0,08	0,05			0,04	0,10			0,26
Ptiliidae	0,05			0,04				0,15	0,23
Cantharidae	0,08		0,09		0,05				0,22
Mycetophagidae	0,05		0,11	0,05					0,20
Cerambycidae		0,10	0,05						0,15
Corylophidae		0,05	0,05					0,05	0,14
Buprestidae		0,08					0,05		0,12
Silvanidae							0,10		0,10
Lucanidae						0,05			0,05
Phalacridae			0,05						0,05
Dermestidae	0,04								0,04
Tot_CS	24,34	17,35	21,18	23,69	13,21	26,70	11,09	20,93	158,50
Num_Fam	*22*	*19*	*21*	*18*	*19*	*19*	*16*	*17*	*30*

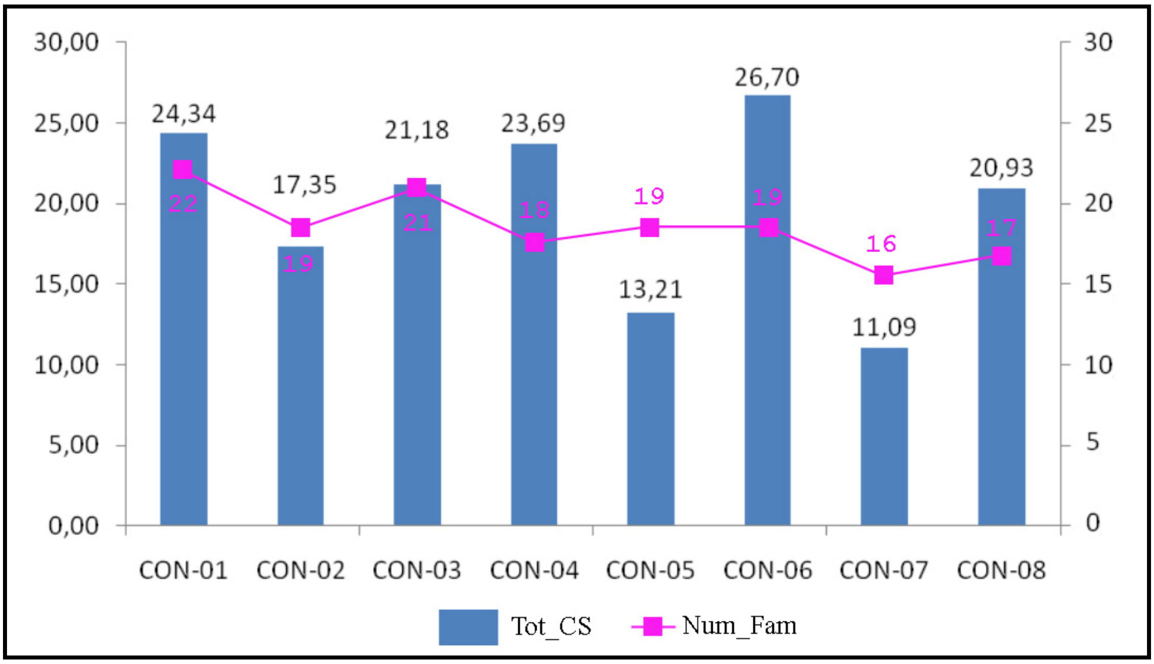
Table 4.1.3 - Trend of the capture frequency (CS) of the Coleoptera Families in the traps of the **CON** station.

This is the station that has recorded the highest number of Families (30 of 33). However, not any trap has collected all sampled Families in the station, although those more abundantly surveyed are present in all traps.
For a summary of the capture frequency for those more abundantly sampled Coleoptera Families in the **CON** station, refer to the graph. 4.1.4.
The examination of the graph shows how Staphylinidae characterize this station. They include the 39,05% of the CS total value and they represent the Family the most sampled in all traps (see tab. 4.1.3). In order of frequency of capture, follow Carabidae (20,32% of the CS values), Anthicidae (14,06%), Tenebrionidae (8,56%), and Melyridae (3,58%). It has to be noted that the **CON** station was the only one where has recorded the Family of Silvanidae represented by three specimens and Dermestidae represented by only one specimen.



Graph. 4.1.4 – Capture frequency (CS) for the more abundantly sampled Coleoptera Families in the **CON** station.

Looking at the trend of capture frequency for the Families in the single traps (graph. 4.1.5) it can be seen as the trap **CON-06** shows higher CS values (26,70), while traps **CON-07** and **CON-05** record the lowest CS values; the other traps show similar captures frequencies between 17,35 and 24,24. The sampled Families number does not seem to correlate positively with the measured CS values.



Graph. 4.1.5 – Capture frequency (CS) of the Coleoptera specimens in the traps of the **CON** station and number of the sampled Families.

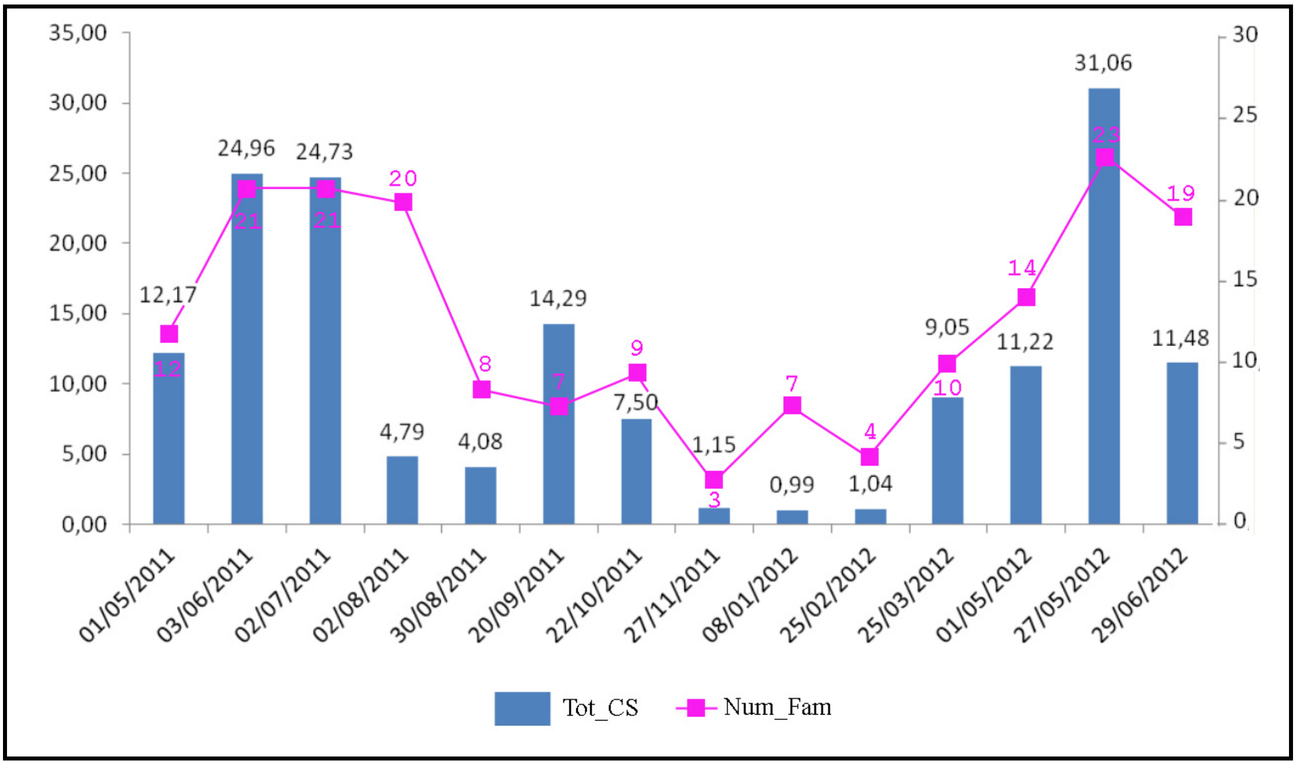
Looking at the trend of the Families capture frequency in the traps during the entire sampling (tab. 4.1.4 and graph. 4.1.6), it is clear that the 31,3,% of catches is concentrated in the months of May (date of sampling: 3/06/2011), and June (date of sampling: 02/07/2011), followed by 19.59 % of May 2012 (date of sampling: 27/05/2012). Lower CS values are recorded instead in the months of November, December, January and February because of the snows.

May 2012 is the month in which was recorded the highest number of Families (23) followed by May 2011 (21), June 2011 (21), and July 2011 (20). November is the one with the lowest number of censed families (3) followed by February (4).

The traps of April 2011 (date of sampling: 01/05/2011) were damaged by the plowing.

	Traps									
Date of sampling	**CON-01**	**CON-02**	**CON-03**	**CON-04**	**CON-05**	**CON-06**	**CON-07**	**CON-08**	**Tot_CS**	**N_Fam**
01/05/2011	0,78	3,00	2,39	1,39		2,89		1,72	12,17	12
03/06/2011	5,61	2,99	3,26	2,08	2,05	3,41	2,54	3,03	24,96	21
02/07/2011	3,50	3,79	4,04	2,66	3,05	3,84		3,84	24,73	21
02/08/2011	0,92	0,41	0,28	0,14	0,28	0,41	0,28	2,07	4,79	20
30/08/2011	0,41	0,46	1,28	0,41		0,46	0,26	0,82	4,08	8
20/09/2011	2,72	1,02	1,90	4,69	1,09	2,52		0,34	14,29	7
22/10/2011	1,29	0,89	1,07	0,94	1,38	0,54	0,54	0,85	7,50	9
27/11/2011	0,04	0,16	0,08	0,08	0,20	0,28	0,32		1,15	3
08/01/2012	0,03	0,07	0,03	0,07	0,34	0,34	0,10		0,99	7
25/02/2012	0,21		0,21	0,21	0,21	0,21			1,04	4
25/03/2012	0,34	0,26	1,72	2,93	0,95	0,78	0,56	1,51	9,05	10
01/05/2012	2,70	0,68		2,66	0,32	2,43	1,04	1,40	11,22	14
27/05/2012	3,89	2,60	4,09	4,90	2,40	7,16	2,93	3,08	31,06	23
29/06/2012	1,89	1,02	0,83	0,53	0,95	1,44	2,54	2,27	11,48	19
Tot_CS	24,34	17,35	21,18	23,69	13,21	26,70	11,09	20,93	**158,50**	
N_Fam	*22*	*19*	*21*	*18*	*19*	*19*	*16*	*17*	-	*30*

Tab. 4.1.4 - Trends of capture frequencies (CS) for the Coleoptera Families in regards to each trap during the sampling period in the **CON** station. Highlighted in green are the highest CS values and the greatest number of the sampled Families, in light blue the lowest CS values and the lowest number of the sampled Families.



Graph. 4.1.6 - Trends in capture frequencies (CS) for the Coleoptera specimens in the **CON** station in the months of sampling and number of the sampled Families.

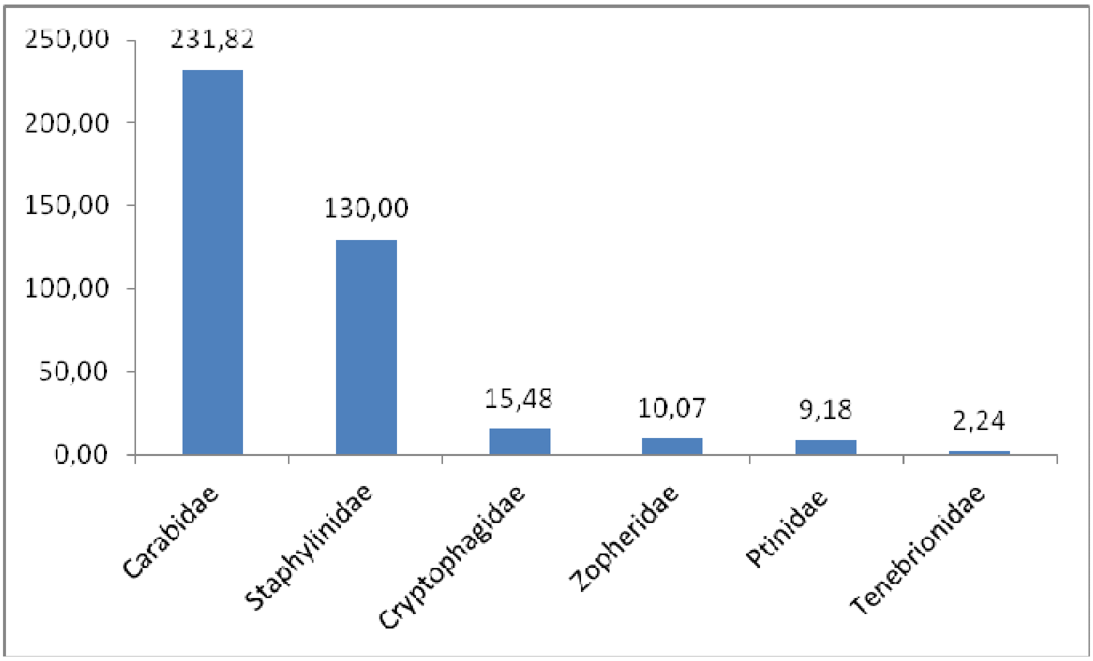
Station BOS (Chestnut wood)

The trend in the capture frequency for the Coleoptera Families in the 5 **BOS** station's traps is shown in table 4.1.5.

TAXA	**BOS-01**	**BOS-02**	**BOS-03**	**BOS-04**	**BOS-05**	Tot_CS
Carabidae	59,79	72,78	52,20	19,38	27,66	231,82
Staphylinidae	32,01	26,84	23,93	23,11	24,12	130,00
Cryptophagidae	3,45	5,53	3,03	1,63	1,84	15,48
Zopheridae	3,47	2,97	0,47	2,39	0,76	10,07
Ptinidae	0,68	2,39	2,22	2,66	1,23	9,18
Tenebrionidae	0,10	0,38	0,70	0,74	0,32	2,24
Nitidulidae	0,14	0,47	0,51	0,16	0,06	1,34
Latridiidae	0,21	0,59		0,15	0,33	1,27
Endomychidae	0,06	0,12	0,06	0,19	0,38	0,81
Elateridae		0,06	0,06	0,50	0,13	0,75
Curculionoidea		0,27	0,06	0,15		0,48
Leiodidae	0,16	0,07			0,16	0,39
Mycetophagidae			0,35			0,35
Lucanidae	0,09		0,06	0,07		0,22
Cerambycidae				0,09	0,09	0,18
Anthicidae			0,08	0,08		0,16
Mordellidae		0,12				0,12
Scirtidae				0,10		0,10
Corylophidae			0,09			0,09
Cantharidae			0,08			0,08
Melyridae				0,06		0,06
Chrysomelidae		0,06				0,06
Tot_CS	100,15	112,66	83,90	51,45	57,08	405,24
Tot_Fam	*11*	*14*	*15*	*16*	*12*	*22*

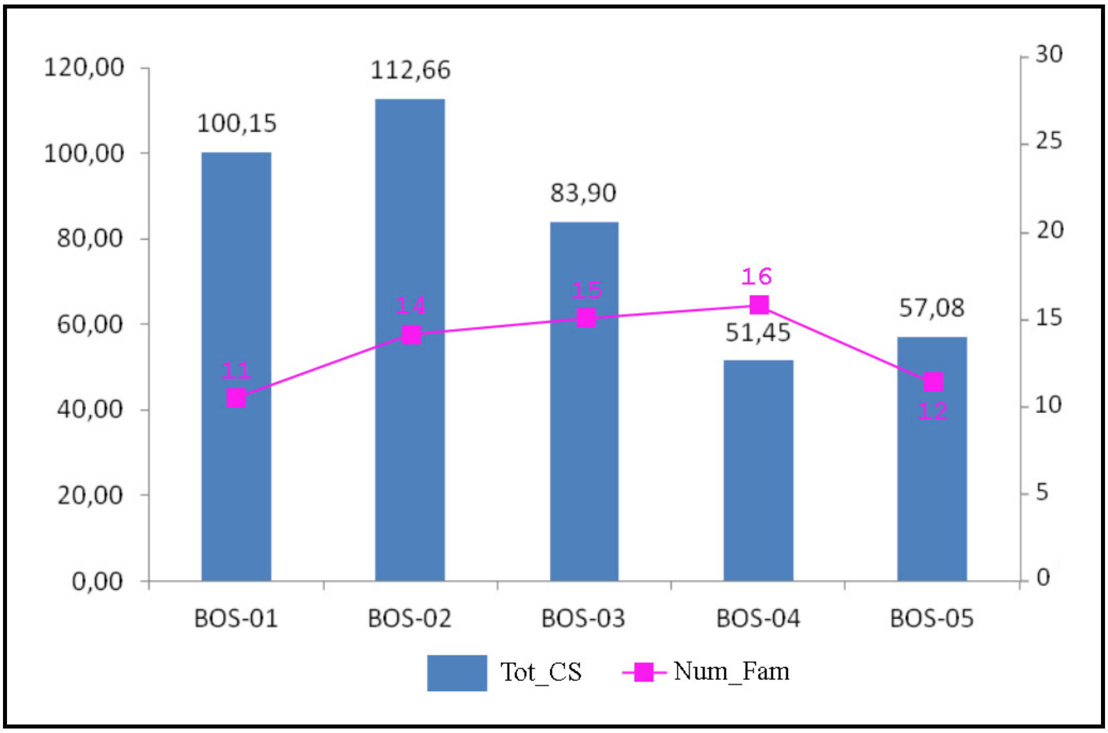
Tab. 4.1.5 - Trends in capture frequencies (CS) for the Coleoptera Families in the traps of the **BOS** station.

In the station were surveyed 22 Families of 33 of the total sampling. Not any trap has collected all the sampled Families in the station, although those more abundantly surveyed are present in all the traps. For a summary of the capture frequency for those more abundantly sampled Coleoptera Families in the **BOS** station, refer to the graph. 4.1.7.
The examination of the graphic shows that in this station Carabidae show higher CS values, with 57,20% of the total and they represent the more abundantly sampled Family in all traps except **BOS-04**, where Staphylinidae is the most represented Family. In order of capture frequency, follow Staphylinidae (32,07%), Cryptophagidae (3,81%), Zopheridae (2,48%), and Ptinidae (2.26%). It has to be noted that the **BOS** station was the only one that has recorded the Family of Scirtidae represented by only one specimen.



Graph. 4.1.7 - Capture frequency (CS) for the more abundantly sampled Coleoptera Families in the **BOS** station.

The trend of capture frequency for the Families in the single traps (fig. 4.1.8) shows that the traps **BOS-02** and **BOS-01** have significantly higher CS values than all the others, while the traps **BOS-04** and **BOS-05** show significantly lower capture frequencies. The number of sampled Families does not seem to correlate positively with the measured CS values.



Graph. 4.1.8 - Capture frequency (CS) of the Coleoptera specimens in the traps of the **BOS** station and number of the sampled Families

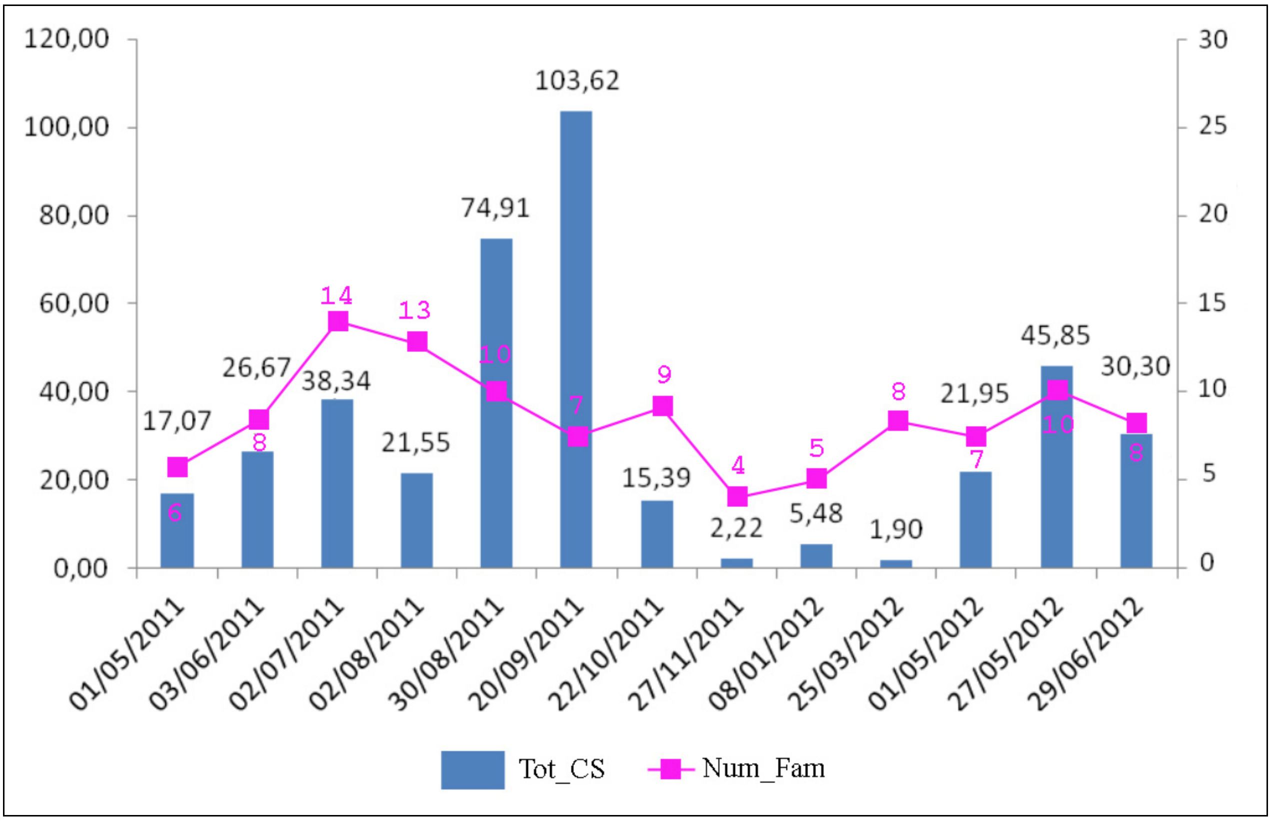
Looking at the trend of the Families capture frequency in the traps during the entire sampling (tab. 4.1.6 and graph. 4.1.9), it is clear that about 44% of the catches is concentrated in the months of August 2011 and September 2011, followed by 18,79% of May 2012 and June 2012. Lower CS values are recorded instead in the months of November, December, January, and February.

June is the month in which was recorded the highest number of Families (14), followed by July (13), while November is the one with the lowest number of censed Families (6) followed by December (5).

Date of sampling	BOS-01	BOS-02	BOS-03	BOS-04	BOS-05	Tot_CS	Num_Fam
01/05/2011	0,73	8,73	2,67	3,13	1,80	17,07	6
03/06/2011	6,55	5,27	2,73	4,42	7,70	26,67	8
02/07/2011	8,97	8,48	7,93	6,97	6,00	38,34	14
02/08/2011	2,90	7,16	5,10	3,16	3,23	21,55	13
30/08/2011	26,79	21,96	21,43	4,73		74,91	10
20/09/2011	27,24	37,52	14,67	4,95	19,24	103,62	7
22/10/2011	4,77	3,83	3,44	3,36		15,39	9
27/11/2011	0,56		1,67			2,22	4
08/01/2012	0,95	1,37	0,65	1,79	0,71	5,48	5
25/03/2012		0,17	0,95	0,34	0,43	1,90	8
01/05/2012	7,78	6,92	2,22	2,65	2,38	21,95	7
27/05/2012	12,92	11,23	10,15	5,85	5,69	45,85	10
29/06/2012			10,30	10,10	9,90	30,30	8
Tot_CS	100,15	112,66	83,90	51,45	57,08	405,24	-
Num_Fam	*11*	*14*	*16*	*16*	*12*	-	*22*

Tab. 4.1.6 - Trends of capture frequencies (CS) for the Coleoptera Families in regards to each trap during the sampling period in the **BOS** station. Highlighted in green are the highest CS values and the greatest number of the sampled Families, in light blue the lowest CS values and the lowest number of the sampled Families.

August and September 2011 shows the peak for CS values for trap **BOS-02** and **BOS-01**. A clear reduction of CS is registered for **all traps** from November to February because of the snows.



Graph. 4.1.9 - Trends in capture frequencies (CS) for the Coleoptera specimens in the **BOS** station in the months of sampling and number of the sampled Families.

5 GENERAL ANALYSIS OF SAMPLING FOR SPECIES OF CARABIDAE, TENEBRIONIDAE AND STAPHYLINIDAE

The analysis of species of Coleoptera has focused on families Carabidae, Tenebrionidae and Staphylinidae (excluding Scydmenidae and Aleocharinae). These three families, as already mentioned in chapter 4, represent more than 75% of specimens amount of coleopters collected during the entire sampling period. Their taxonomy is quite well known as well as their biology. These families also, as noted in the introduction, are widely used for biocoenotic studies, both in Europe and Mediterranean, and that makes possible any comparisons with previous research conducted using the pit-fall traps methodology.

5.1 COLEOPTERA CARABIDAE

In total were surveyed a total of **21** species of Coleoptera Carabidae that are reported in table 5.1.1.
For the nomenclature, reference is made to the checklist of the Italian fauna (VIGNA TAGLIANTI 1993) modified according to VIGNA TAGLIANTI 2005 (in BRANDMAYR et alii 2005) and updated to 2013 according to the Checklist of Carabidae of Fauna Europaea Project (VIGNA TAGLIANTI 2013) (www.faunauer.org).
For chorological categories it was referred to VIGNA TAGLIANTI et alii 1992 and VIGNA TAGLIANTI 2005. The distribution in Italy is taken from the checklist of the Italian fauna (VIGNA TAGLIANTI 1993) updated according to VIGNA TAGLIANTI (2000 e 2005).

	Species	**Chorology**	**Italy**
	Calathus (*Neocalathus*) *ambiguus* (Paykull, 1790)	ASE	N S Si Sa?
	Calathus (*Neocalathus*) *cinctus* Motschulsky 1850	WPA	N S Si Sa
	Calathus (*Calathus*) *fuscipes graecus* Dejean 1831	EUM	N S Si Sa?
	Calathus (*Calathus*) *montivagus* Dejean, 1831	SEU(APPE)	S Si
	Carabus (*Chaetocarabus*) *lefebvrei lefebvrei* Dejean, 1826	SEU(APPE)	S Si
	Cymindis (*Cymindis*) *axillaris* (Fabricius, 1794)	WPA	N S Si Sa
	Cymindis (*Menas*) *miliaris* (Fabricius, 1801)	TUE	N S Si
	Harpalus (*Harpalus*) *atratus* Latreille, 1804	EUR	N S Si Sa?
	Harpalus (*Harpalus*) *decipiens* Dejean, 1829	WEU	S Si
	Harpalus (*Harpalus*) *distinguendus distinguendus* (Duftschmid 1812)	PAL	N S Si Sa
	Harpalus (*Harpalus*) *sulphuripes sulphuripes* Germar, 1824	EUM	N S Si
	Laemostenus (*Pristonychus*) *algerinus algerinus* (Gory 1833)	WME	N S Si Sa
	Leistus (*Pogonophorus*) *spinibarbis fiorii* Lutshnik, 1913	EUR	S Si
	Microlestes luctuosus Holdhaus in Apfelbeck, 1904	TUM	N S Si Sa
	Notiophilus rufipes Curtis, 1829	EUR	N S Si Sa
	Notiophilus substriatus G.R. Waterhouse, 1833	EUR	N S Si Sa
	Ocys harpaloides (Audinet-Serville 1821)	EUM	N S Si Sa
N, E	*Platyderus* sp. (*in litteris* Sciaky & Pavesi)	SEU	Si
	Syntomus obscuroguttatus (Duftschmid, 1812)	EUM	N S Si Sa
	Synuchus vivalis (Illiger, 1798)	ASE	N S Si

Tab. 5.1.1 – List of species and subspecies of Carabidae surveyed. In the first column with letter **E** are indicated the endemic sicilian taxa and with letter **N** those new for sicilian fauna. For each taxon is also reported the chorological category and distribution in Italy following the symbology used in the checklist of the Italian fauna. For further explanations and clarifications refer to the text.

Three taxa, *Calathus* (*Calathus*) *montivagus* Dejean, 1831, *Carabus* (*Chaetocarabus*) *lefebvrei lefebvrei* Dejean, 1826 and *Platyderus* sp. (*in litteris* Sciaky & Pavesi) are endemic of southern Italy and/or Sicily.

***Calathus* (*Calathus*) *montivagus* Dejean, 1831**

Pre-Quaternary relict species with Western affinities. It lives in rich and well structured thermo-mesophilous forest of the plains and sub-mountain areas. It reaches mountain formations in the southern stations.

***Carabus* (*Chaetocarabus*) *lefebvrei lefebvrei* Dejean, 1826**

Thermophilous and forestry species, with trans-adriatic origin (postglacial relict), related to Dinaric–Balkan forms of *Chaetocarabus*. In Sicily is widespread in moist forests (beech, chestnut, oak) of northern mountainous areas, where it is found under stones, fallen trees or in old stumps in which often overwinter in small colonies. It feeds on gastropods.

***Platyderus* sp.** (*in litteris* Sciaky & Pavesi)

Forest species endemic to the north-eastern Sicily. At present in study.

Some other species deserves a brief comment in relation to its ecology or distribution:

***Leistus (Pogonophorus) spinibarbis fiorii* Lutshnik, 1913**

This subspecies is endemic of Apennine, and is a mountain, mesophilic, and forestry element. It lives at the foot of trees, under fallen leaves on the ground, rocks, and debris. It feeds on Collembola, which are able to capture thanks to a cavity surrounded by long bristles, located on the underside of the head.

***Harpalus* ssp.**

Species that feeds on seeds and live mainly in cultivated fields.

The sampled species and subspecies of Carabidae and the number of the collected specimens in the 3 stations are shown in table 5.1.2 (the subgenera are not mentioned).

Species	BIO	BOS	CON	Tot_Nb_specimens
Calathus montivagus	68	1990	64	2.122
	1,70	*49,67*	*1,60*	*52,97*
Calathus fuscipes graecus	203	486	300	989
	5,07	*12,13*	*7,49*	*24,69*
Synthomus obscuroguttatus	296	3	86	385
	7,39	*0,07*	*2,15*	*9,61*
Laemostenus algerinus	45	162	84	291
	1,12	*4,04*	*2,10*	*7,26*
Harpalus decipiens	12		43	55
	0,30		*1,07*	*1,37*
Calathus ambiguus	24	2	29	55
	0,60	*0,05*	*0,72*	*1,37*
Carabus lefebvrei	1	29	8	38
	0,02	*0,72*	*0,20*	*0,95*
Synuchus vivalis	7	20	1	28
	0,17	*0,50*	*0,02*	*0,70*
Calathus cinctus	10	3	4	17
	0,25	*0,07*	*0,10*	*0,42*
***Platyderus* sp.**	2	2	1	5
	0,05	*0,05*	*0,02*	*0,12*
Harpalus sulphuripes	1		3	4
	0,02		*0,07*	*0,10*
Cymindis axillaris	1	1	2	4
	0,02	*0,02*	*0,05*	*0,10*
Leistus spinibarbis fiorii		3		3
		0,07		*0,07*
Notiophilus rufipes		2		*2*
		0,05		*0,05*
Harpalus atratus			2	2
			0,05	*0,05*
Cymindis miliaris	1		1	2
	0,02		*0,02*	*0,05*
Ocys harpaloides			*1*	1
			0,02	*0,02*
Notiophilus substriatus			1	1
			0,02	*0,02*
Microlestes luctuosus			1	1
			0,02	*0,02*
Harpalus distinguendus	1			1
	0,02			*0,02*
Tot_Nb_specimens	**672**	**2703**	**631**	**4006**
	16,77	***67,47***	***15,75***	***100***

Tab. 5.1.2 - Trends in catches of the Coleoptera Carabidae in each station expressed as total number (top row) and percentage (bottom row) of the sampled specimens. The percentages refer to the total of the entire Carabidae sampling.

During the sampling period, in the 3 investigated stations within the Etna Regional Park a total of **4,006** specimens of Carabidae, belonging to **21** species, were surveyed.

The most abundant species resulted: *Calathus* (*Calathus*) *montivagus* (**2,122** specimens), which alone accounts for about 53% of the total catches, *Calathus* (*Calathus*) *fuscipes graecus* (**989** specimens), *Syntomus obscuroguttatus* (**385** specimens), *Laemostenus* (*Pristonychus*) *algerinus algerinus* (**291** specimens), *Harpalus* (*Harpalus*) *decipiens* (**55** specimens), *Calathus* (*Neocalathus*) *ambiguus* (**55** specimens), *Carabus* (*Chaetocarabus*) *lefebvrei lefebvrei* (**38** specimens), *Synuchus vivalis* (**28** specimens), *Calathus* (*Neocalathus*) *cinctus* (**17** specimens) representing the **33,62%** of the total sampled specimens of Coleoptera and about the **99,35%** of the total sampled Carabidae.
In fig. 5.1.1 are shown the percentages of the surveyed specimens for the more abundantly sampled Carabidae species compared to the total Family sampling.

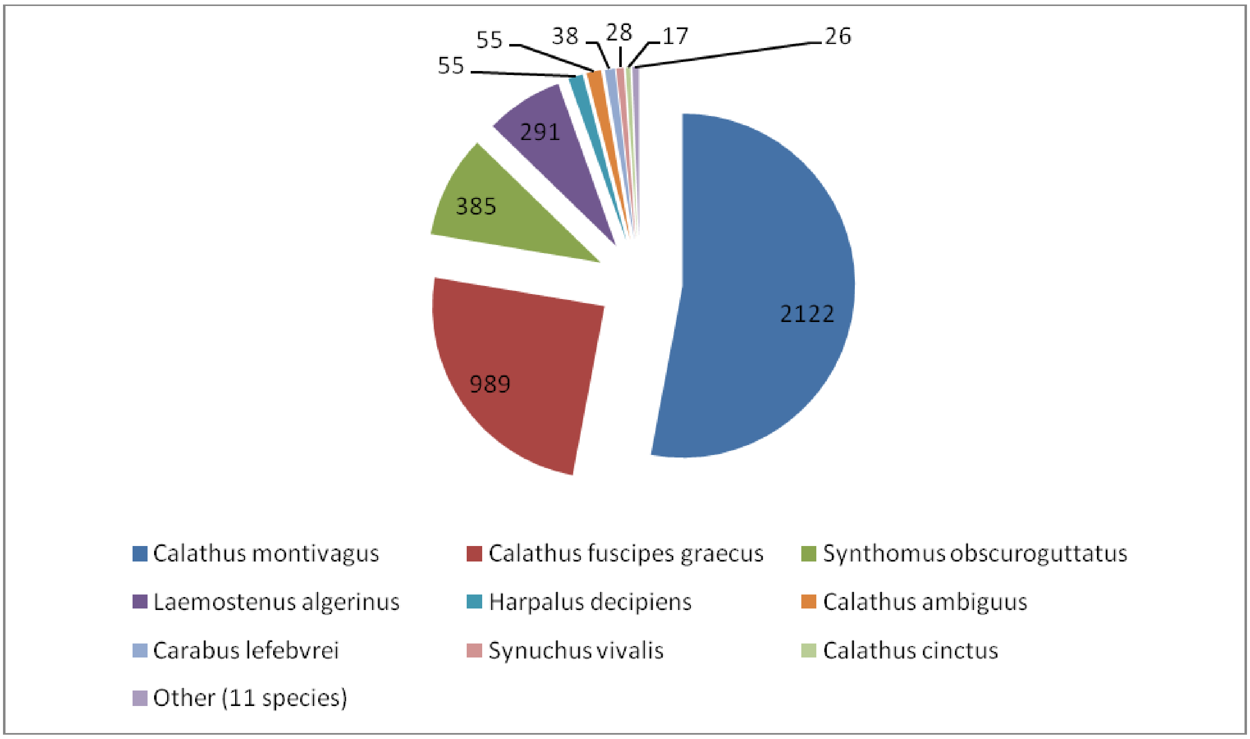


Fig. 5.1.1 - Overall trend (number of individual and percentage of total) of the catches of the more abundant Carabidae species.

Table 5.1.3 shows the CS values of the counted species within the individual stations.

SPECIES	BIO	BOS	CON	Tot_CS
Calathus montivagus	3,53	169,94	3,33	176,80
Calathus fuscipes graecus	9,82	41,76	15,73	67,30
Laemostenus algerinus algerinus	3,62	12,52	3,82	19,96
Synthomus obscuroguttatus	14,55	0,20	4,60	19,36
Calathus ambiguus	1,30	0,17	1,76	3,22
Harpalus decipiens	0,54		2,03	2,58
Carabus lefebvrei	0,04	2,09	0,37	2,49
Synuchus vivalis	0,32	1,76	0,05	2,13
Calathus cinctus	0,43	0,19	0,35	0,97
***Platyderus* sp.**	0,13	0,17	0,06	0,35
Harpalus sulphuripes	0,05		0,14	0,18
Cymindis axillaris	0,04	0,06	0,09	0,19
Leistus spinibarbis fiorii		0,20		0,20
Notiophilus rufipes		0,16		0,16
Harpalus atratus			0,10	0,10
Cymindis miliaris	0,06		0,05	0,11
Ocys harpaloides			0,04	0,04
Notiophilus substriatus			0,05	0,05
Microlestes luctuosus			0,05	0,05
Harpalus distinguendus	0,09			0,09
Tot_CS	**34,52**	**229,20**	**32,60**	**296,32**
Percentage of CS	**11,65**	**77,35**	**11**	**100**
Nb species	**14**	**12**	**17**	**21**

Tab. 5.1.3 - Trends in catches of the Coleoptera Carabidae in each station expressed as CS.

The analysis of the table 5.1.3 and fig. 5.1.2 shows how the **BOS** station presents a very sharp peak of the capture frequencies (equivalent to 77.35% of total), while the **BIO** and **CON** stations show similar values of about 11% of the total.
Regarding the table 5.1.3 it can observe that 10 species, resulted present in all the stations: *Calathus montivagus, Calathus fuscipes graecus, Synthomus obscuroguttatus, Laemostenus algerinus algerinus, Calathus ambiguus, Carabus lefebvrei lefebvrei, Synuchus vivalis, Calathus cinctus, Platyderus* sp., *Cymindis axillaris*; 3 species are present in two stations (**BIO** and **CON**): *Harpalus decipiens, Harpalus sulphuripes,* and *Cymindis miliaris.* The other species are present only in one station.

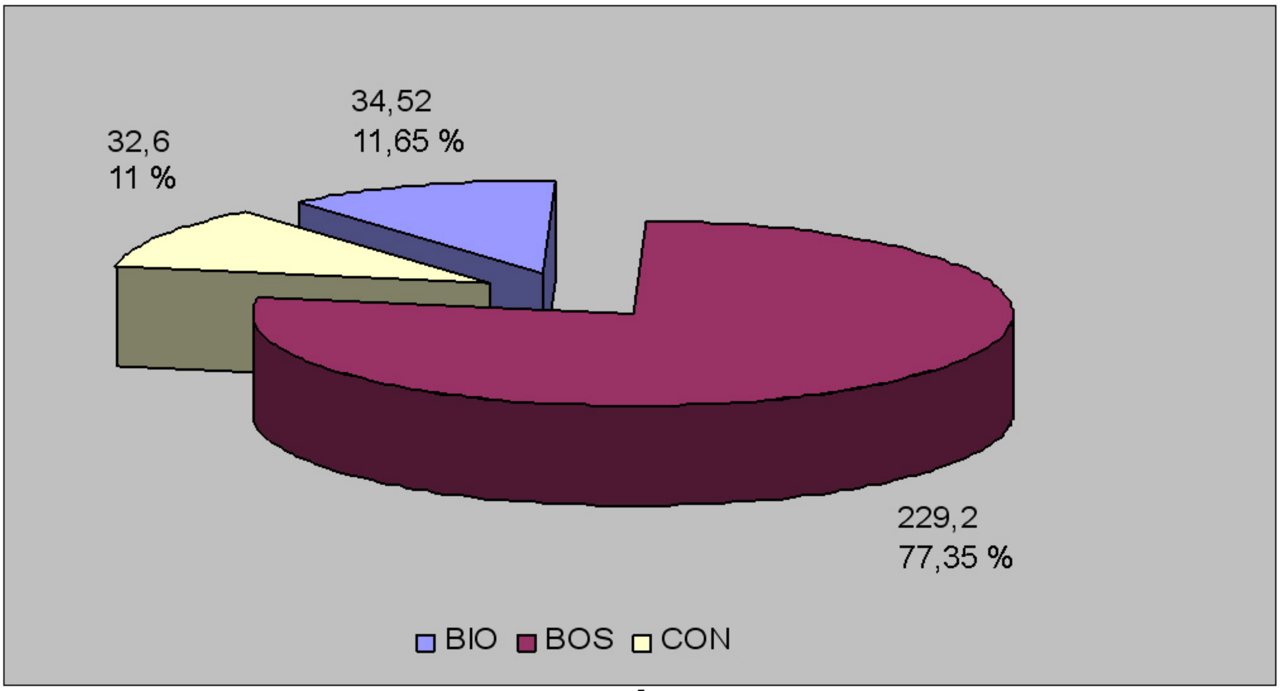
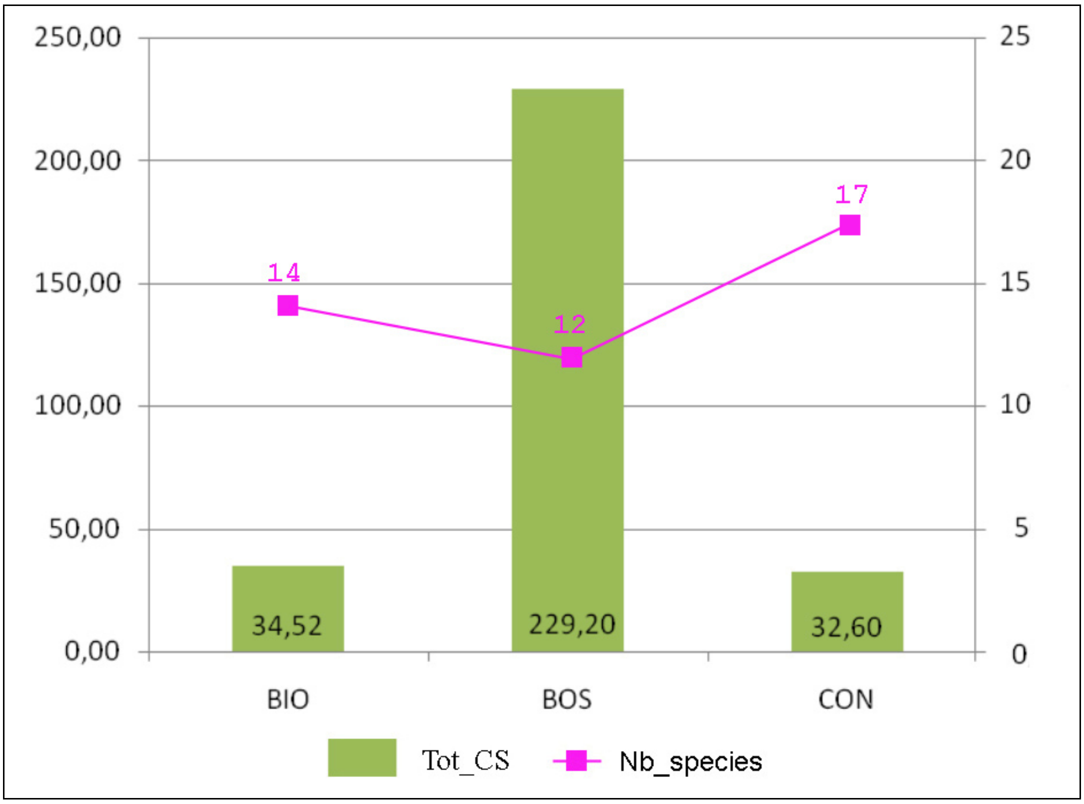


Fig. 5.1.2 – Capture frequency of the Coleoptera Carabidae in the stations and their percentage of the total CS value.

Considering the general trend of the Coleoptera Carabidae capture frequency within the stations and the number of the sampled species (graph. 5.1.1) is observed that the greatest number of species (**17**) has been surveyed in the **CON** station and the minimum (**12**) in the **BOS** station, passing through the **BIO** station (**14**).

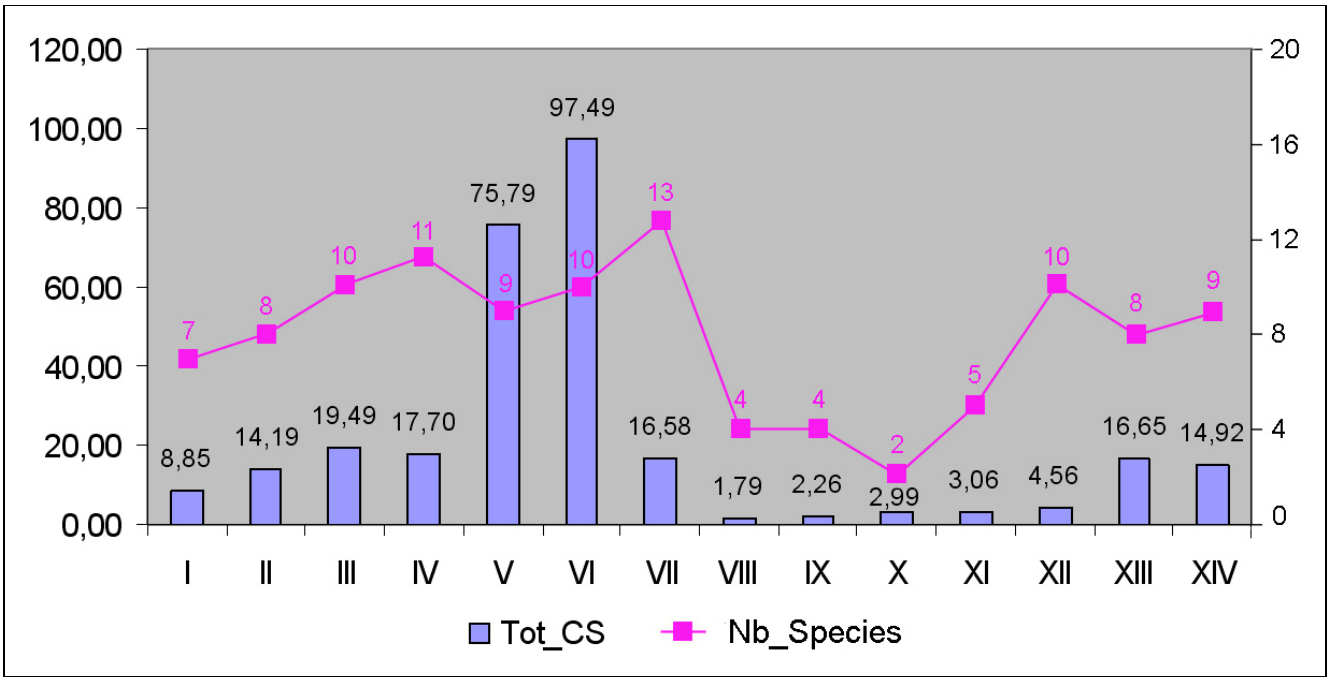


Graph. 5.1.1 - Overall trend of the Coleoptera Carabidae catches (Tot_CS) and sampled species number (Nb_species) in each station.

Looking at the trend of the species capture frequency (reported without the subgenus) distributed in the single sampling periods (tab. 5.1.4 and graph. 5.1.2), is observed that the 58,47% of catches is concentrated in the period V and VI (August and September). The periods VIII, IX, X (November, December, January and February) register the minimum CS values (2,37%).
Regarding the species number, the highest (**13** of **21**) is recorded in the VII period (October) and the minimum in the X period (February) with only 2 species.

Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Tot_CS
Calathus montivagus	0,50	4,92	9,16	11,72	54,35	65,84	7,38	0,18	0,99			0,86	11,28	9,62	176,80
Calathus fuscipes graecus	0,66	2,78	3,98	2,55	18,13	24,67	5,95	0,46			0,04	0,48	3,77	3,84	67,30
Laemostenus algerinus	1,00	4,81	3,75	0,69	1,52	3,07	2,06	1,12			0,04	0,29	0,98	0,63	19,96
Synthomus obscuroguttatus	6,55	0,61	0,62	1,24	0,36	0,18	0,25	0,04	1,05	2,78	2,89	2,57	0,14	0,08	19,36
Calathus ambiguus	0,05	0,15	0,05		0,19	2,38	0,32						0,05	0,04	3,22
Harpalus decipiens		0,34	0,80	0,28	0,66	0,07	0,04					0,05	0,34		2,58
Carabus lefebvrei		0,46	0,89	0,39	0,09	0,10	0,04						0,05	0,48	2,49
Synuchus vivalis			0,14	0,40	0,45	1,01	0,04							0,10	2,13
Calathus cinctus	0,05		0,05	0,13		0,12	0,12		0,16	0,21	0,04		0,05	0,04	0,97
***Platyderus* sp.**	0,06			0,06							0,04	0,09		0,10	0,35
Harpalus sulphuripes				0,18											0,18
Cymindis axillaris							0,08		0,06			0,05			0,19
Leistus spinibarbis fiorii		0,12					0,08								0,20
Notiophilus rufipes							0,16								0,16
Harpalus atratus			0,05	0,05											0,10
Cymindis miliaris					0,05	0,06									0,11
Ocys harpaloides							0,04								0,04
Notiophilus substriatus												0,05			0,05
Microlestes luctuosus												0,05			0,05
Harpalus distinguendus												0,09			0,09
Tot_CS	8,85	14,19	19,49	17,70	75,79	97,49	16,58	1,79	2,26	2,99	3,06	4,56	16,65	14,92	**296,32**
Nb_species	7	8	10	11	9	10	13	4	4	2	5	10	8	9	**21**

Tab. 5.1.4 - Trends in capture rates of the Coleoptera Carabidae species spread over the individual sampling periods.

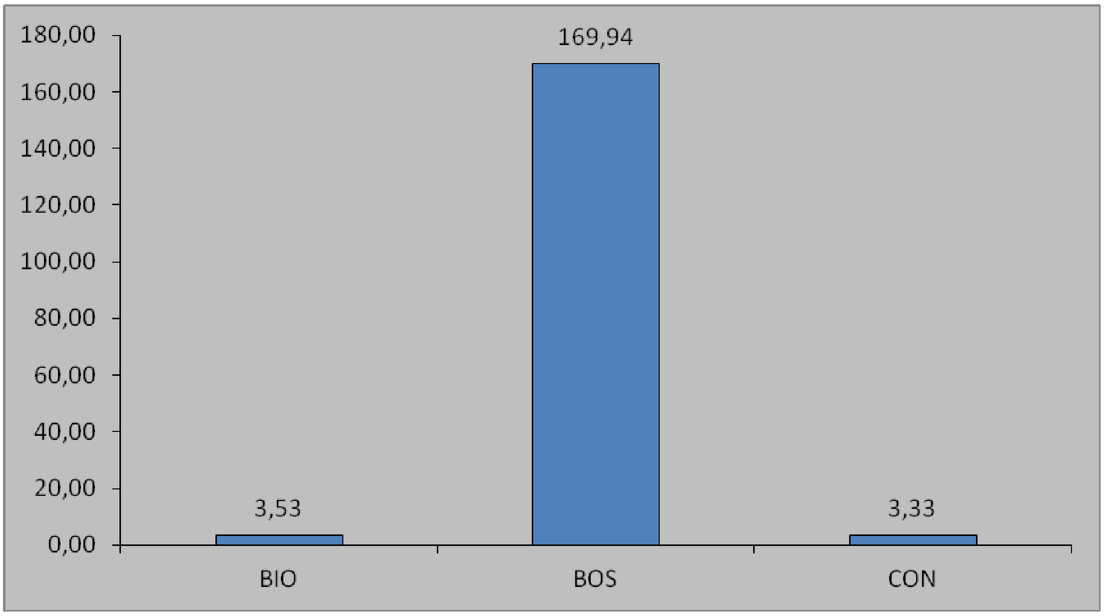


Graph. 5.1.2 - Trends in capture frequencies (CS) of the Coleoptera Carabidae in individual sampling periods and sampled species number.

Below are considered the most abundant sampled Carabidae species in regards to their distribution in the stations and to their capture frequency during the sampling period.

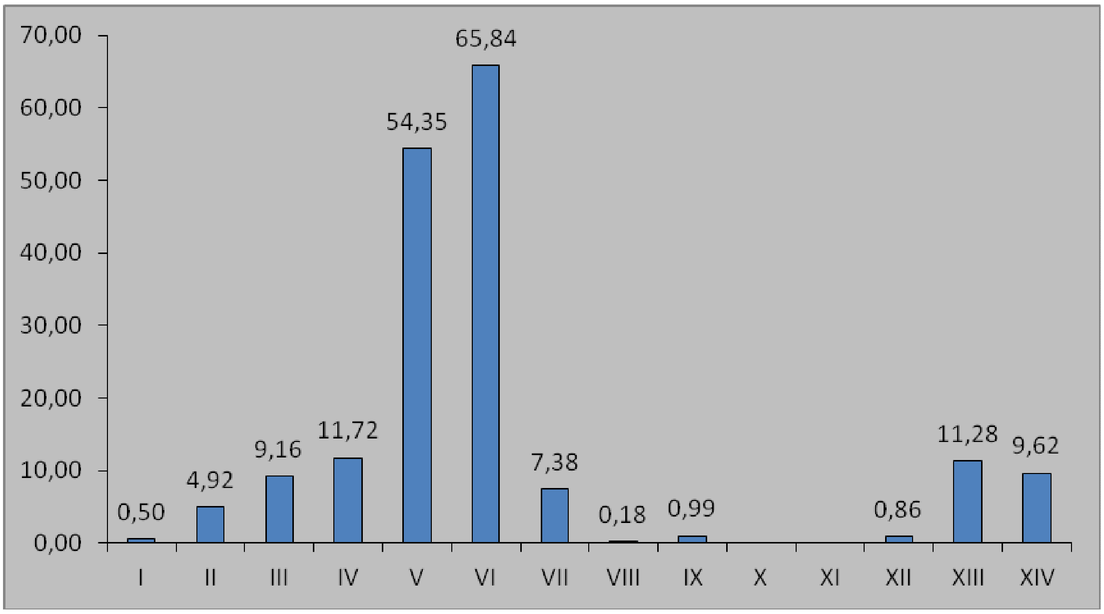
Calathus* (*Calathus*) *montivagus

This is the species with the highest CS value, which represents just over 59,66% of the entire Coleoptera Carabidae sampling. Were surveyed specimens of this species in all stations, but 96,11% of the catch was recorded in the **BOS** station, while the other two stations register only 3,88% of the total (graph. 5.1.3).



Graph. 5.1.3 - Trend of capture frequency (CS) of *Calathus* (*Calathus*) *montivagus* within the single station.

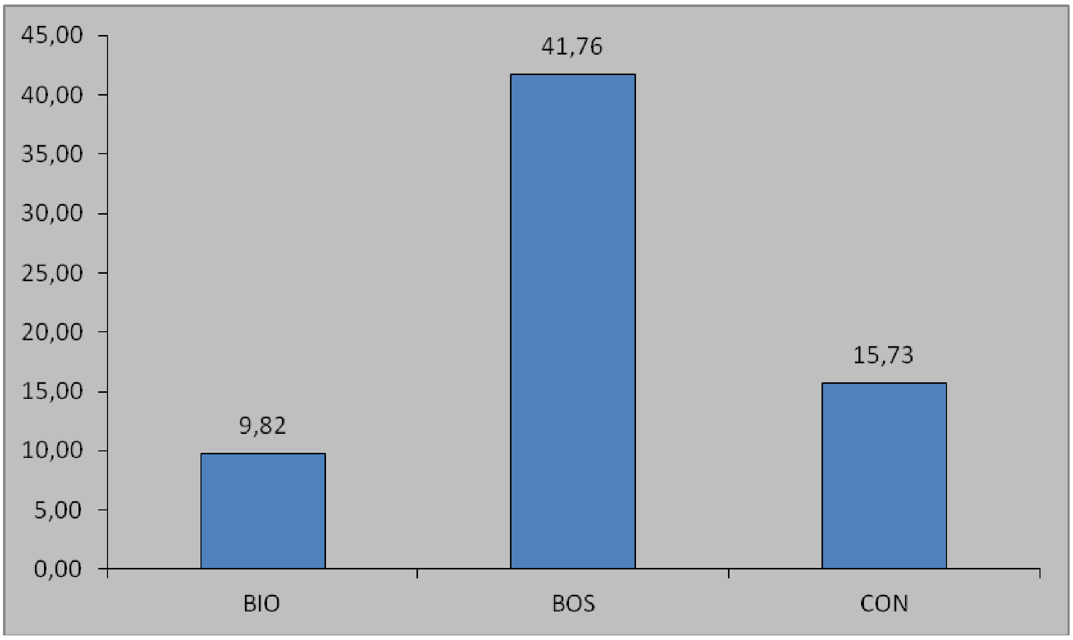
The trend of the capture frequency in the sampling period (graph. 5.1.4) shows that about the 84% of them are concentrated between June and October, with a sharp peak in the month of September (37,2%) follow by the month of Agust (30,7%) and lower value in other months, with little or null (February and March) values in the months between November and March.



Graph. 5.1.4 - Trends in capture frequencies (CS) of *Calathus* (*Calathus*) *montivagus* in individual sampling periods.

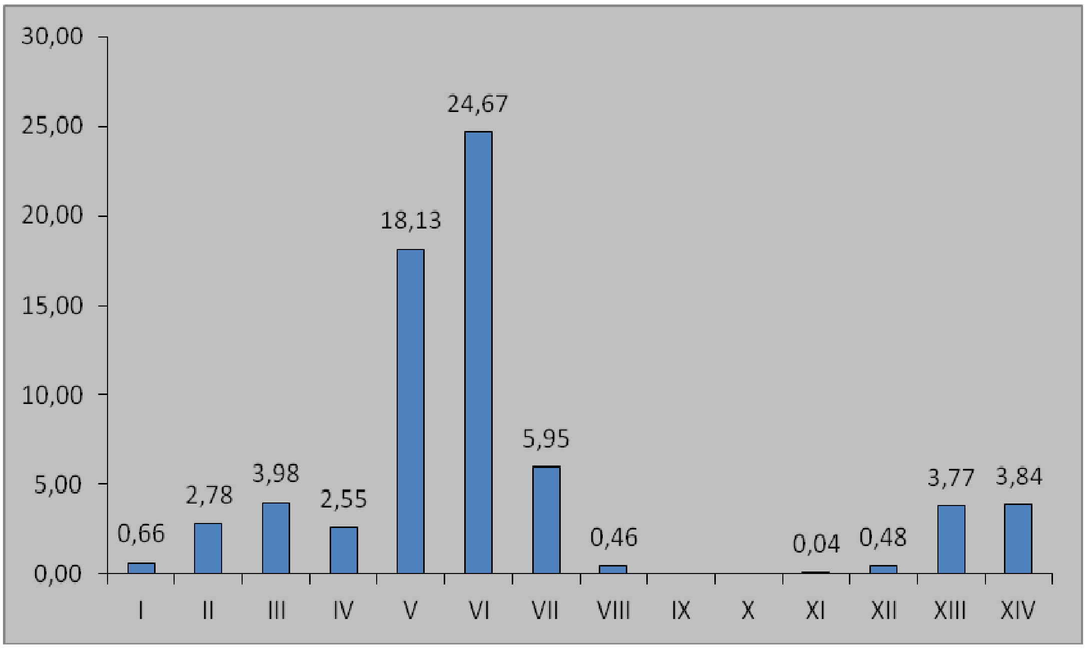
Calathus (*Calathus*) *fuscipes graecus*

This is the species with the second CS value, which represents more than 22,71% of the Coleoptera Carabidae sampling. Were surveyed specimens of this species in all stations, but 62% of captures was recorded in the **BOS** station, while the minimum is found in the **BIO** station (14.59%) (graph. 5.1.5).



Graph. 5.1.5 - Trend of capture frequency (CS) of *Calathus* (*Calathus*) *fuscipes graecus* in the single station.

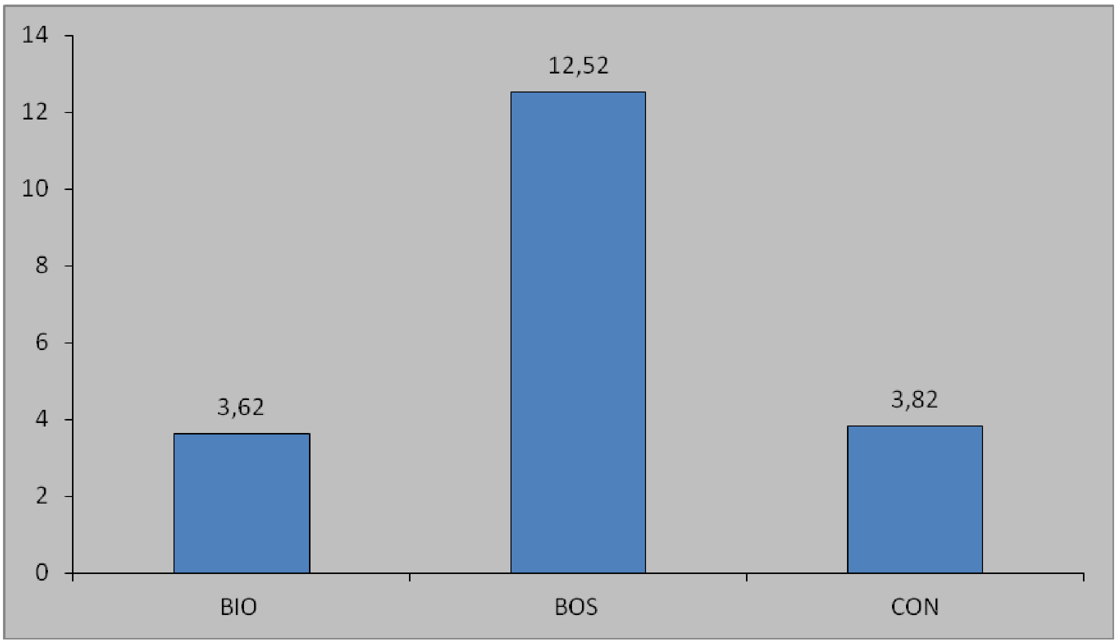
The trend of capture frequency in the sampling period (graph. 5.1.6) shows that more than 66% of them are concentrated between V (August, 26,9%) and VI (September, 36,6%) periods, while they are significantly lower in the other months with little or null value in the periods between January and March.



Graph. 5.1.6 - Trends in capture frequencies (CS) of *Calathus* (*Calathus*) *fuscipes graecus* in individual sampling periods.

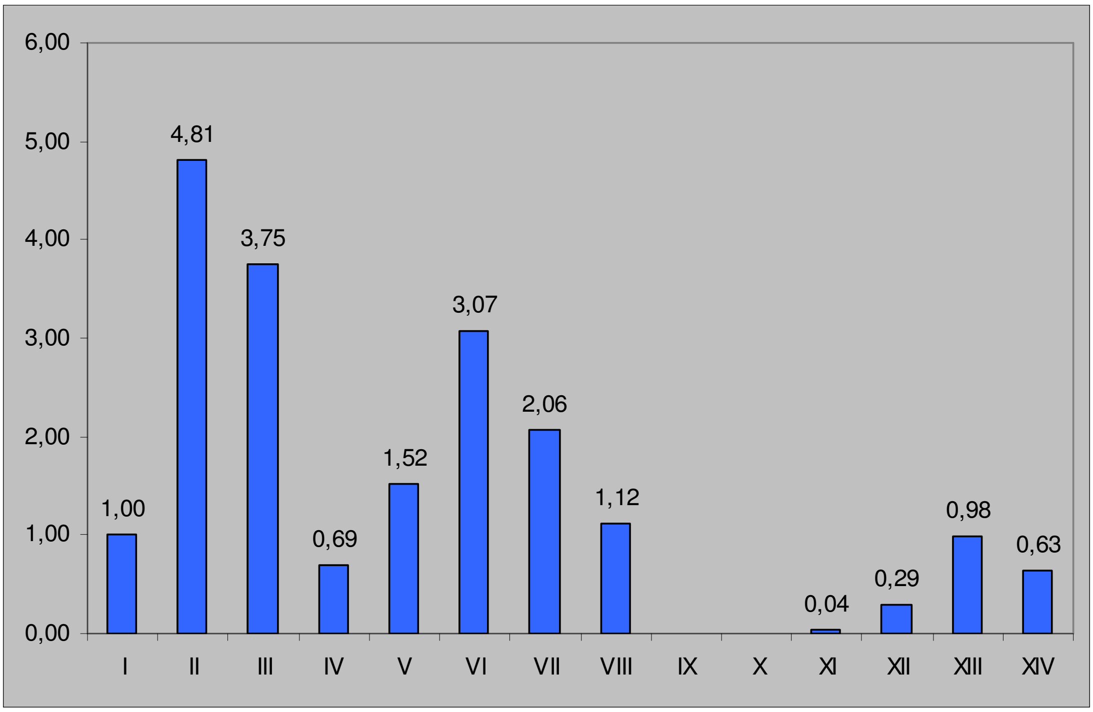
Laemostenus (*Pristonychus*) *algerinus algerinus*

It presents the third CS value, which corresponds to more than 6,73% of the entire Coleoptera Carabidae sampling. The species was recorded in all stations: in the **BOS** station 62,72% of capture frequencies, in the **CON** station 19,14% and in **BIO** station 18,14% (graph. 5.1.7).



Graph. 5.1.7 - Trend of capture frequency (CS) for *Laemostenus* (*Pristonychus*) *algerinus algerinus* within the single station.

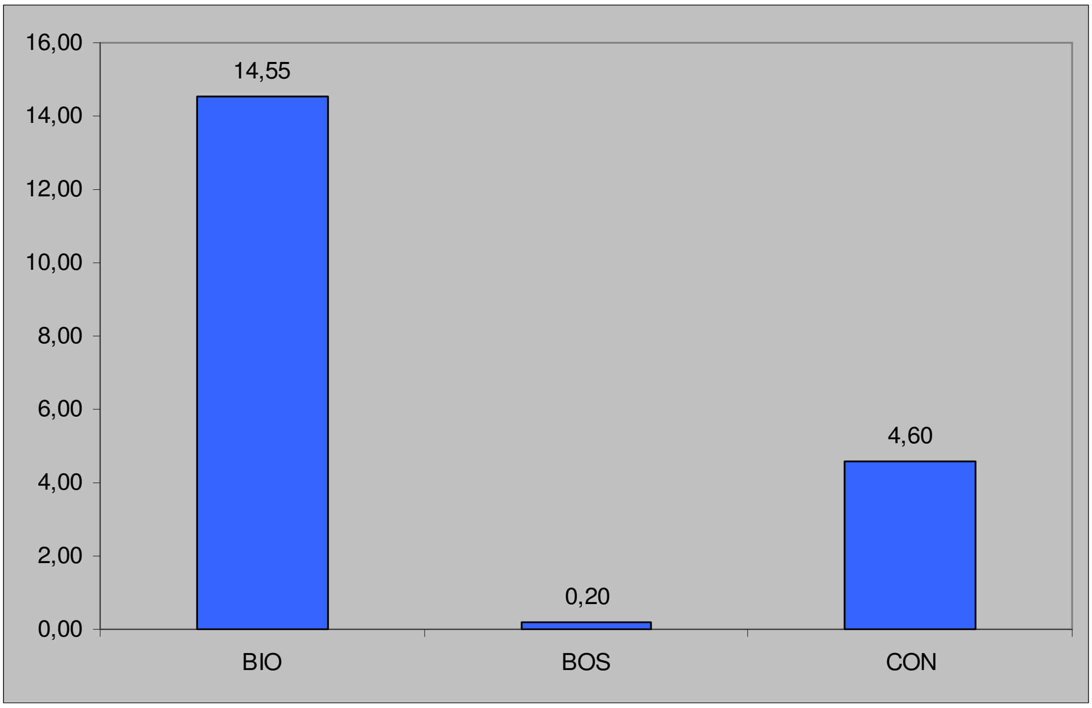
The trapping frequencies in the sampling period are concentrated (43%) in May and June (graph. 5.1.8). The species is absent in January and February, and shows very low CS values in March.



Graph. 5.1.8 - Trends in capture frequencies (CS) of *Laemostenus* (*Pristonychus*) *algerinus algerinus* in individual sampling periods.

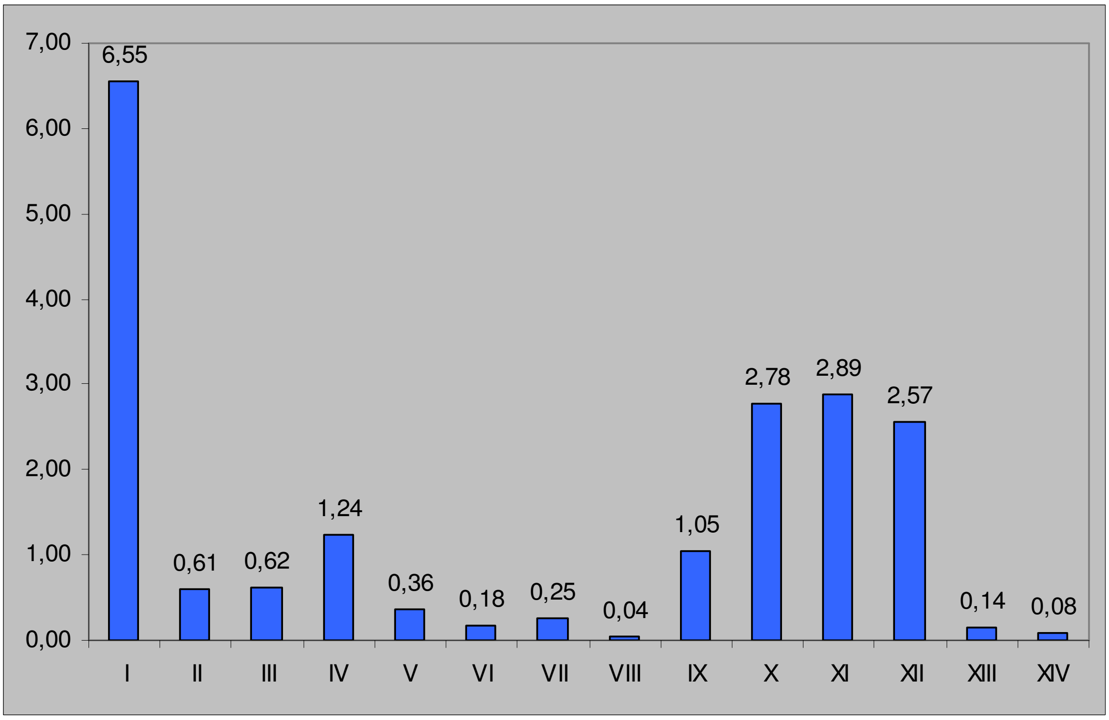
Syntomus obscuroguttatus

This is the species with the fourth CS value, which represents about 6,53% of the entire Coleoptera Carabidae sampling. The catches have been registered in all stations: in **BIO** with 75,15% of capture frequencies, in **CON** with 23,76% and in **BOS** with 1,03% (graph. 5.1.9).



Graph. 5.1.9 - Trend of capture frequency (CS) for *Syntomus obscuroguttatus* within the single station.

The trend of capture frequency in the sampling period (graph. 5.1.10) shows that about 34% of them are concentrated in April and are significantly lower between May and November with medium CS values in January, February and March.



Graph. 5.1.10 - Trends in capture frequencies (CS) of *Syntomus obscuroguttatus* in individual sampling periods.

Calathus (*Neocalathus*) *ambiguus*

It presents the fifth CS value, which corresponds to 1,08% of the entire Coleoptera Carabidae sampling. The species was recorded in all stations (graph. 5.1.11) with the maximum in **CON** station (54,65% of capture frequencies) and the minimum in **BOS** station.

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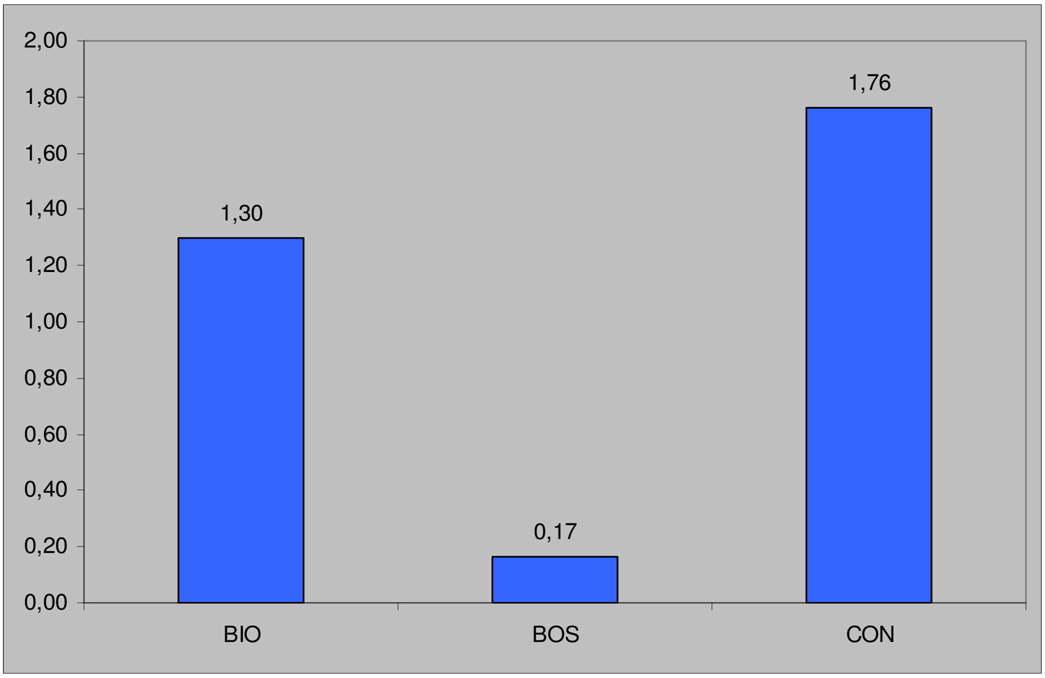
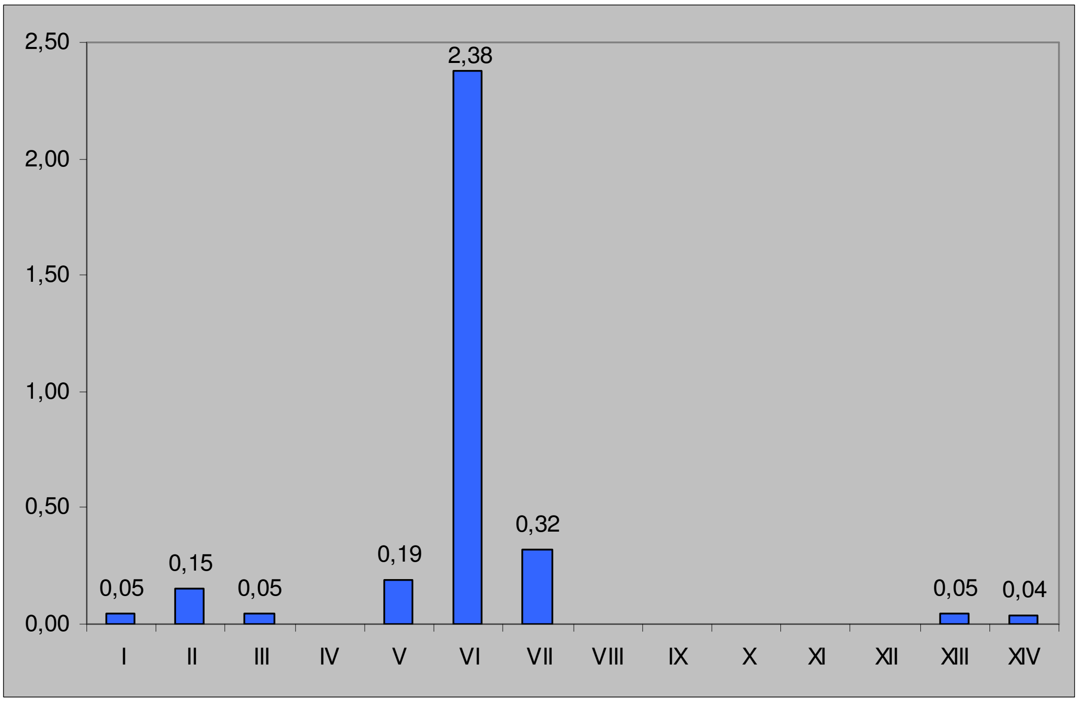


Graph. 5.1.11 - Trend of capture frequency (CS) for *Calathus* (*Neocalathus*) *ambiguus* within the single station.

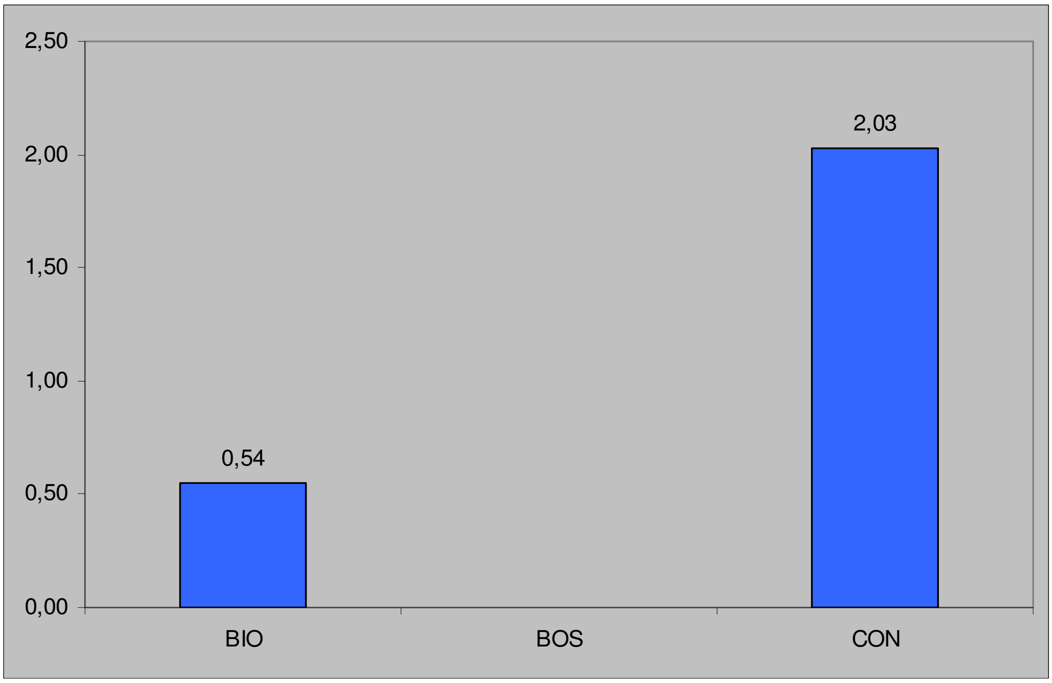
The trend of the capture frequency in the sampling period (graph. 5.1.12) shows that about 74% of them are concentrated in September with significantly lower CS values in other periods, and null values in July , and between November and April.



Graph. 5.1.12 - Trends in capture frequencies (CS) of *Calathus* (*Neocalathus*) *ambiguus* in individual sampling periods.

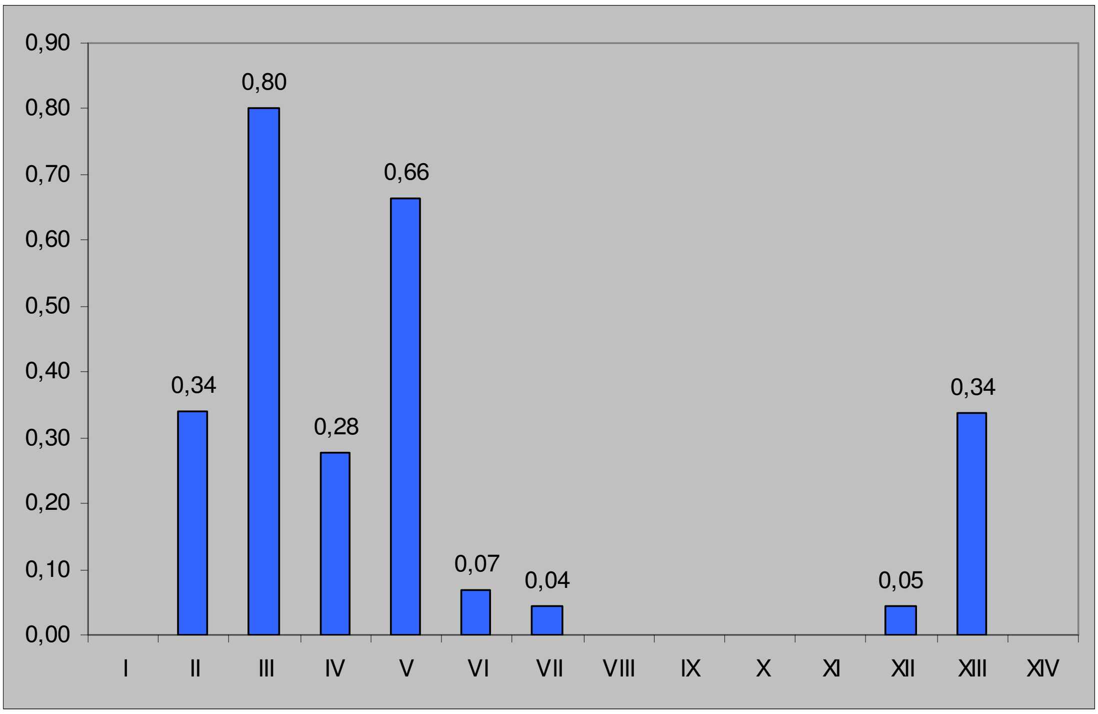
Harpalus (*Harpalus*) *decipiens*

It presents the sixth CS value, which corresponds to 0,87% of the entire Coleoptera Carabidae sampling. The species was not recorded in the **BOS** station (graph. 5.1.13). It shows a clear CS value peak (78,7%) in the **CON** station.



Graph. 5.1.13 - Trend of capture frequency (CS) for *Harpalus* (*Harpalus*) *decipiens* within the single station.

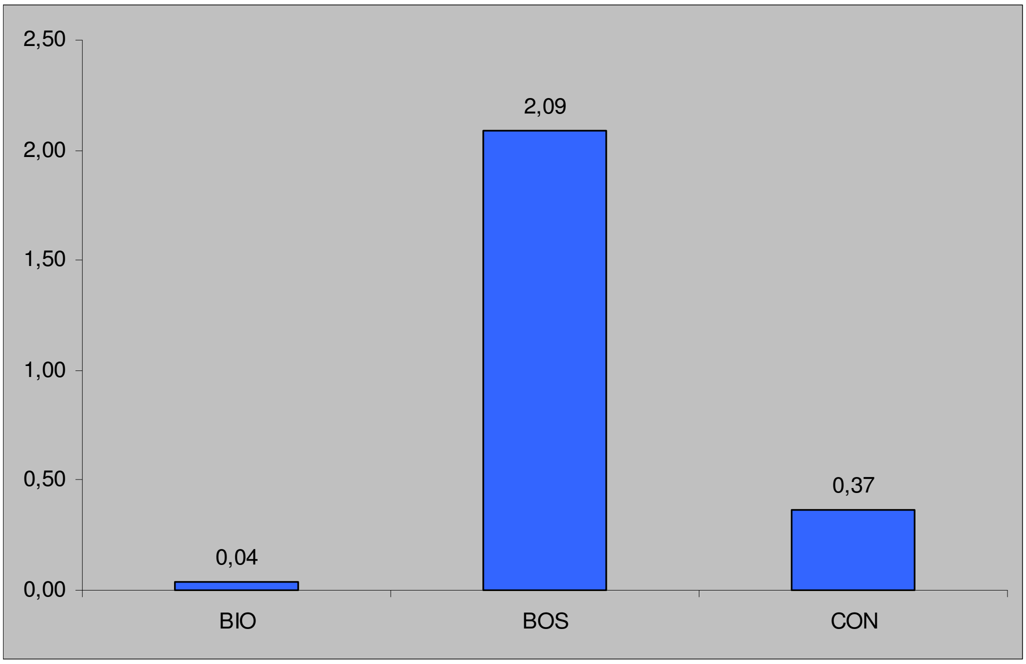
The trend of capture frequency in the sampling period (graph. 5.1.14), shows that more than 56% of them are concentrated in June and August with significantly lower CS values in other periods, and null values from November to March.



Graph. 5.1.14 - Trends in capture frequencies (CS) of *Harpalus* (*Harpalus*) *decipiens* in individual sampling periods.

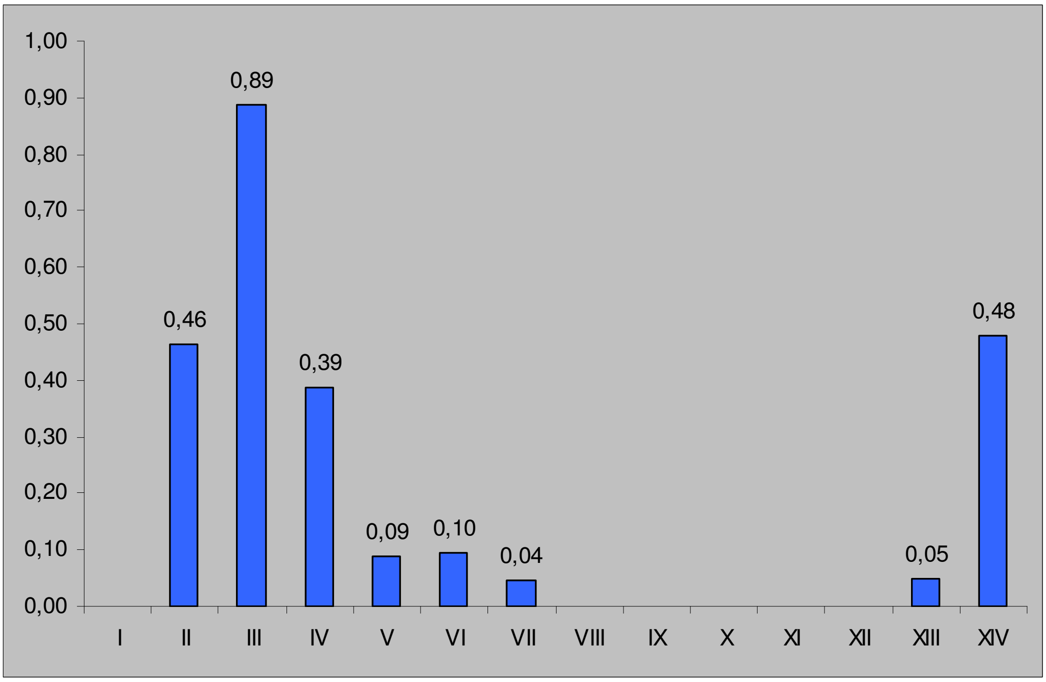
Carabus (*Chaetocarabus*) *lefebvrei lefebvrei*

It presents the seventh CS value, which represents approximately 0,9% of the entire Coleoptera Carabidae sampling. The species was sampled in all stations (graph. 5.1.15), and shows the highest CS values (84% of total) in the **BOS** station and the lowest in the **BIO** station..



Graph. 5.1.15 - Trend of capture frequency (CS) for *Carabus* (*Chaetocarabus*) *lefebvrei lefebvrei* within the single station.

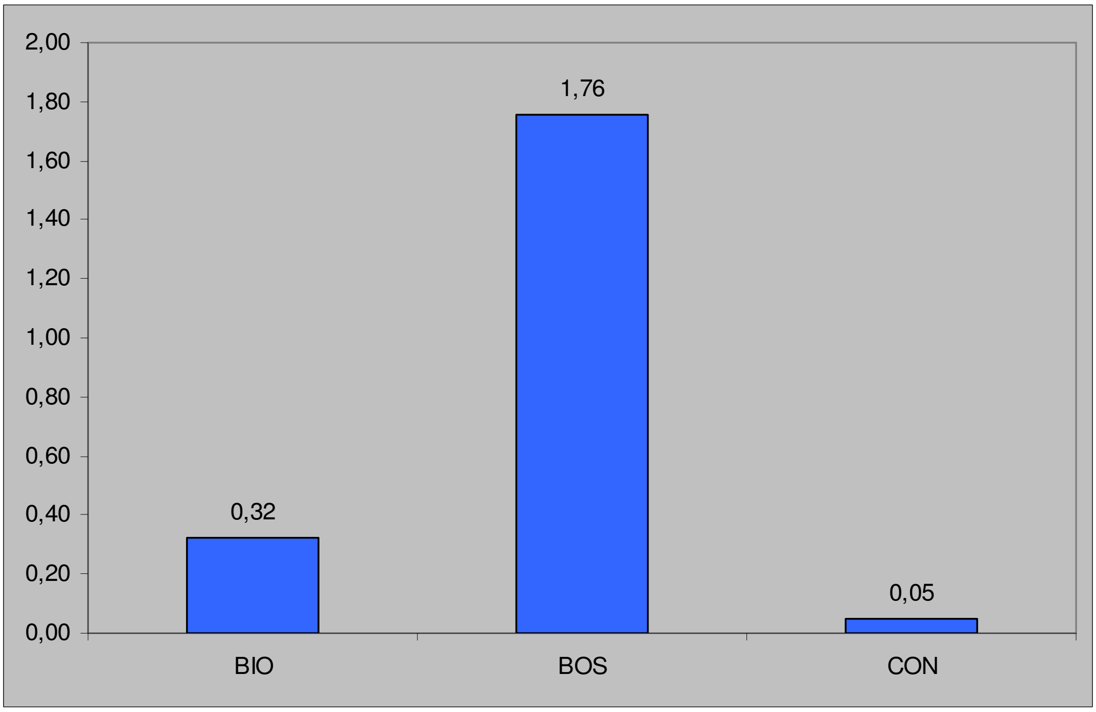
The trend of the capture frequency in the sampling period (graph. 5.1.16), shows that about 70% of them are concentrated between May and July with a peak in June (36%). The CS values are significantly lower in other periods, with null values from November to April.



Graph. 5.1.16 - Trends in capture frequencies (CS) of *Carabus* (*Chaetocarabus*) *lefebvrei lefebvrei* in individual sampling periods.

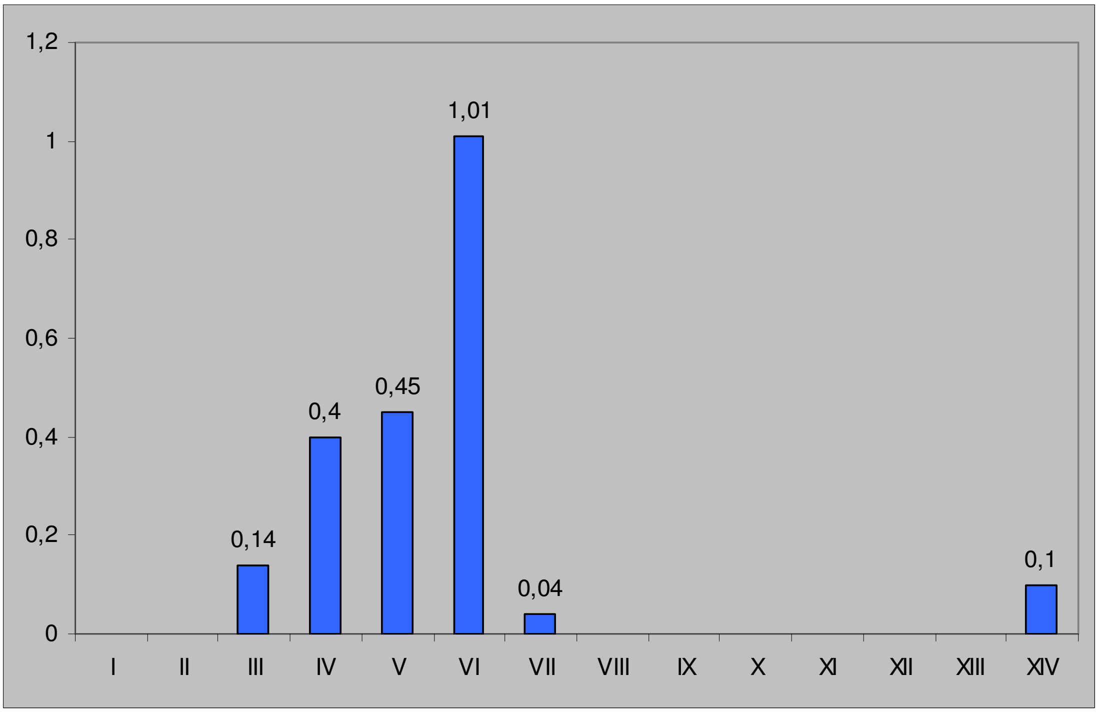
Synuchus vivalis

It presents the eighth value of CS, which represents more than 0,7% of the entire Coleoptera Carabidae sampling. The species was sampled in all stations, but it shows significant CS values in the **BOS** (82,62 % of total) and **BIO** (15 % of total) stations (graph. 5.1.17).



Graph. 5.1.17 - Trend of capture frequency (CS) for *Synuchus vivalis* within the single station.

The trend of the capture frequencies in the sampling period (graph. 5.1.18) shows that more than 87,3% is concentrated from July to September, with the highest CS value in this latter month, and lower values in the other months, with null values in April-May and between November and April.



Graph. 5.1.18 - Trends in capture frequencies (CS) of *Synuchus vivalis* in individual sampling periods.

5.2 COLEOPTERA TENEBRIONIDAE

In total were surveyed a total of **14** species of Coleoptera Tenebrionidae that are reported in table 5.2.1.
For the nomenclature, reference is made to the checklist of the Italian fauna (GARDINI 1995) modified according ALIQUÒ & SOLDATI (2010) and according to the Checklist of Tenebrionidae of Fauna Europaea Project (FATTORINI 2013) (www.faunauer.org), except for *Lagria rugosula* Rosenhauer, 1856 and *Accanthopus velikensis* (Piller & Mitterpacher, 1783) which reference is made to ALIQUÒ & SOLDATI (2010) according to LÖEBL & SMETANA (2008).
For chorological categories it was referred to VIGNA TAGLIANTI et alii 1992 and ALIQUÒ & SOLDATI (2010). The distribution in Italy is taken from the checklist of the Italian fauna (GARDINI 1995) updated according to the project CKmap (GARDINI 2004).

	Species	**Chorology**	**Italy**
	Accanthopus velikensis (Piller & Mitterpacher, 1783)	SEU (with exct. Anatolia)	N, S, Si
	Blaps gibba Laporte de Castelnau, 1840	SEU	N, S, Si, Sa
	Dendarus lugens (Mulsant & Rey 1854)	WME	S Si
	Gonodera metallica (Küster, 1850)	SEU	N, S, Si
	Helops rossii (Germar, 1817)	EME	N, S, Si
	Isomira ferruginea (Küster, 1850)	WME	S, Si, Sa
	Isomira murina (Linné, 1758)	SIE	N, S, Si, Sa
	Isomira sp.		
	Lagria hirta (Linné, 1758)	CAE	N, S, Si, Sa
	Lagria rugosula Rosenhauer, 1856	WME	N, S, Si, Sa
	Opatrum verrucosum Germar, 1817	EME	S Si
	Pachychila dejeani dejeani Besser 1832	NAF	S Si
	Pimelia rugulosa rugulosa Germar, 1824	WME	S Si
	Stenosis sardoa ardoini Canzoneri, 1970	WME	S Si

Tab. 5.2.1 – List of species and subspecies of surveyed Tenebrionidae. In the first column with letter **E** are indicated the endemic sicilian taxa. For each taxon is also reported the chorological category and distribution in Italy following the symbology used in the checklist of the Italian fauna. For further explanations and clarifications please refer to the text.

Two taxa, ***Pimelia rugulosa rugulosa*** Germar, 1824 and ***Stenosis sardoa ardoini*** Canzoneri, 1970 are endemic of southern Italy and Sicily.

Some other species deserves some further comment:

***Gonodera metallica* (Küster, 1850)**
Species distributed along the Alps and the Apennines. In Sicily it is rare and so far found only on the Madonie and Nebrodi areas. This is the first finding for Etna.

***Dendarus lugens* Mulsant & Rey, 1854**
Thermophilic and xerophilic species has the capability of pushing up high elevations to about 1,500 m asl. It can be found in isolated specimens under stones and sometimes found walking on the walls. This species is distributed in Tyrrhenian Italy, Sicily and Malta.

***Lagria rugosula* Rosenhauer, 1856**
The species is distributed in the western Mediterranean. Sicily had been reported so far on Nebrodi and Madonie, therefore is the first finding for Etna. It's a summer species, uncommon, living on herbaceous and shrubby plants.

SPECIES	*BIO*	*BOS*	*CON*	**Tot_Nb_specimens**
Pimelia rugulosa rugulosa	151	2	258	411
	28,06	*0,37*	*47,95*	*76,39*
Blaps gibba	21	2	13	36
	3,90	*0,37*	*2,41*	*6.69*
Opatrum verrucosum	14		5	19
	2,60		*0,93*	*3,53*
Accanthopus velikensis		15		15
		2,79		*2,79*
Pachychila dejeani	8		7	15
	1,49		*1,30*	*2,79*
Stenosis sardoa ardoini	7	1	7	15
	1,30	*0,18*	*1,30*	*2,79*
Lagria atripes	5		2	7
	0,93		*0,37*	*1,30*
Helops rossii		5	1	6
		0,93	*0,18*	*1,11*
Lagria hirta	4		1	5
	0,74		*0,18*	*0,93*
Isomira ferruginea			4	4
			0,74	*0,74*
Isomira murina			2	2
			0,37	*0,37*
Dendarus lugens	1			1
	0,18			*0,18*
Gonodera metallica		1		1
		0,18		*0,18*
***Isomira* sp.**	1			1
	0,18			*0,18*
Tot_Nb_specimens	212	26	300	538
	39,40	*4,83*	*55,76*	*100*
Tot_Nb_species	**9**	**6**	**10**	**14**

Tab. 5.2.2 - Trends in catches of the Coleoptera Tenebrionidae in each station expressed as total number (top row) and percentage (bottom row) of the sampled specimens. The percentages refer to the total of the entire Tenebrionidae sampling.

During the sampling period, in the 3 investigated stations within the Etna Regional Park, a total of **538** specimens of Tenebrionidae, belonging to **14** species, were surveyed.
The most abundant species resulted: *Pimelia rugulosa rugulosa* (**411** specimens) which alone accounts for 76,39% of the total catches, *Blaps gibba* (**36** specimens), *Opatrum verrucosum* (**19** specimens), *Accanthopus velikensis* (**15** specimens), *Pachychila dejeani* (**15** specimens), *Stenosis sardoa ardoini* (**15** specimens), representing the **4,31%** of the total sampled Coleoptera specimens and about the **95%** of the total sampled Tenebriobidae.
In fig. 5.2.1 are shown the percentages of the surveyed specimens for the more abundantly sampled Tenebrionidae species compared to the total Family sampling.

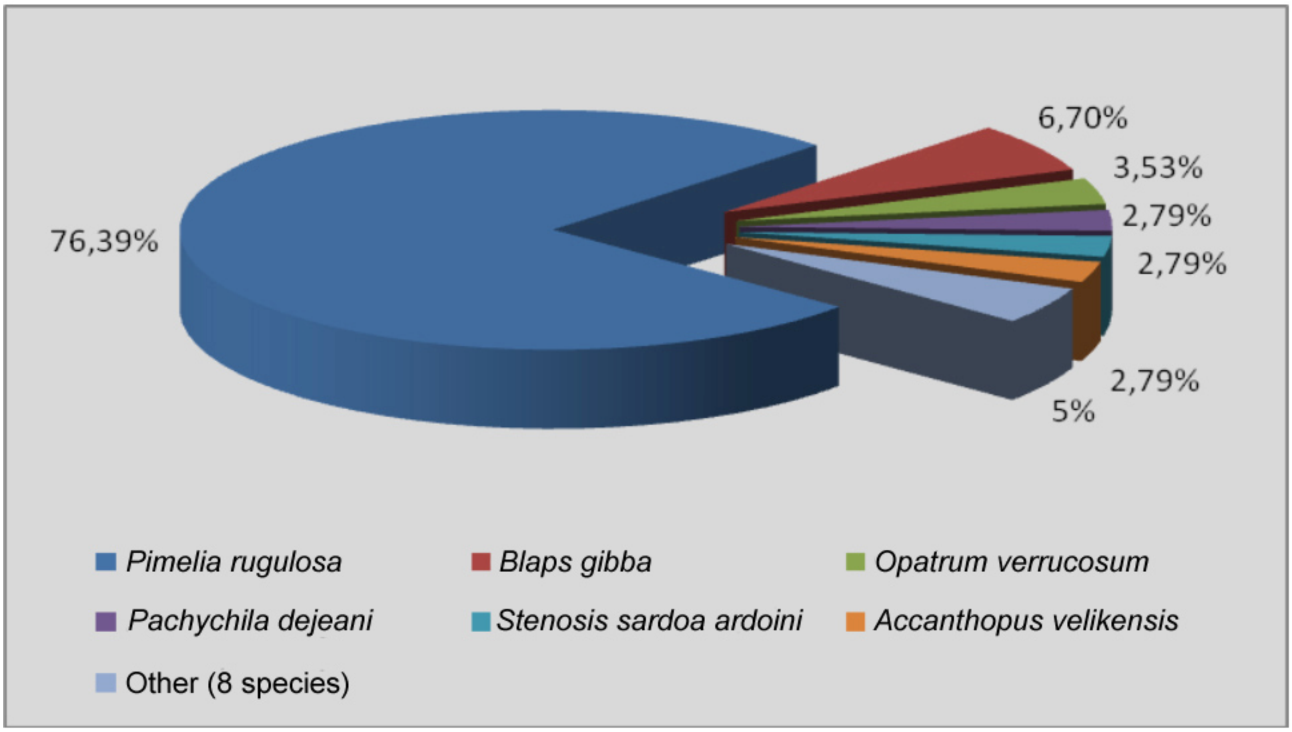


Fig. 5.2.1 - Overall trend (number of individual and percentage of total) of the catches for more abundant Tenebrionidae species.

Table 5.2.3 shows the CS values of the counted species within the individual stations.

SPECIES	BIO	BOS	CON	Tot_CS
Pimelia rugulosa rugulosa	7,28	0,13	11,92	19,33
Blaps gibba	0,93	0,18	0,68	1,79
Accanthopus velikensis		1,32		1,32
Lagria hirta	0,95		0,04	0,99
Opatrum verrucosum	0,69		0,21	0,90
Stenosis sardoa ardoini	0,34	0,08	0,34	0,76
Pachychila dejeani	0,37		0,35	0,72
Helops rossii		0,36	0,07	0,43
Lagria atripes	0,24		0,10	0,33
Isomira ferruginea			0,19	0,19
Isomira murina			0,10	0,10
Gonodera metallica		0,07		0,07
Dendarus lugens	0,05			0,05
***Isomira* sp.**	0,05			0,05
Tot_CS	10,89	2,14	14,00	**27,02**
Percentage of CS	*40,30*	*7,92*	*51,81*	***100***
Tot_Nb_species	9	6	10	**14**

Tab. 5.2.3 - Trends in catches of the Coleoptera Tenebrionidae in each station expressed as CS.

The analysis of the table 5.2.3 and fig. 5.2.2 shows how the **CON** station presents a peak of the capture frequencies (equivalent to 51,81% of total), while the **BIO** station shows a CS value of 40,30 % of the total, and the **BOS** station the lowest CS value of 7,92% of the total.
Examining the table 5.2.3 it observes that only 3 species, *Pimelia rugulosa rugulosa, Blaps gibba* and *Stenosis sardoa ardoini* were found in all stations; 4 species are present in **BIO** and **CON** stations: *Lagria hirta*, *Opatrum verrucosum, Pachychila dejeani,* while *Helops rossii* is present in **BOS** and **CON** stations. The other species are present in only one station.

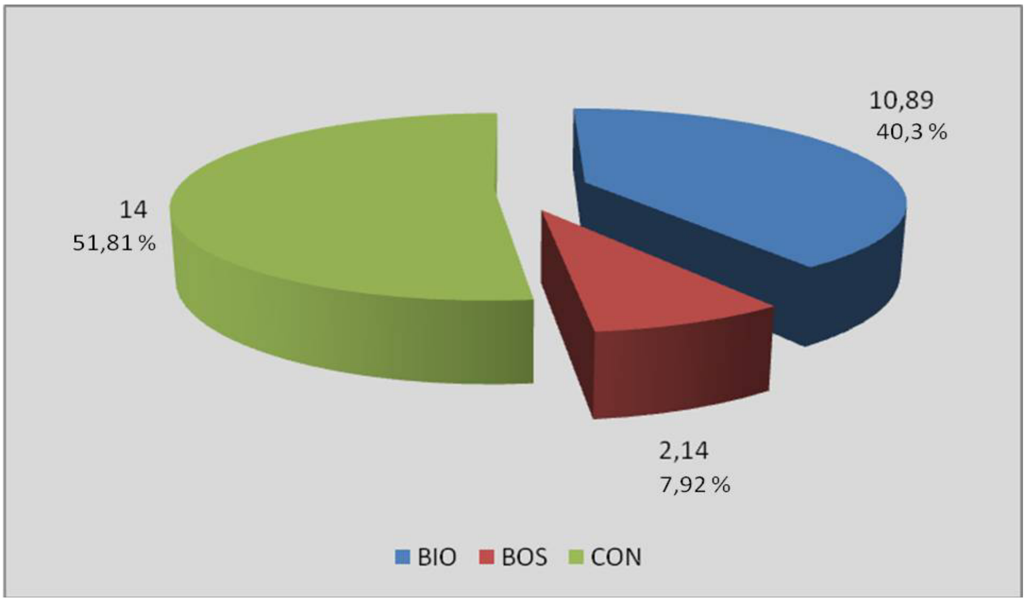
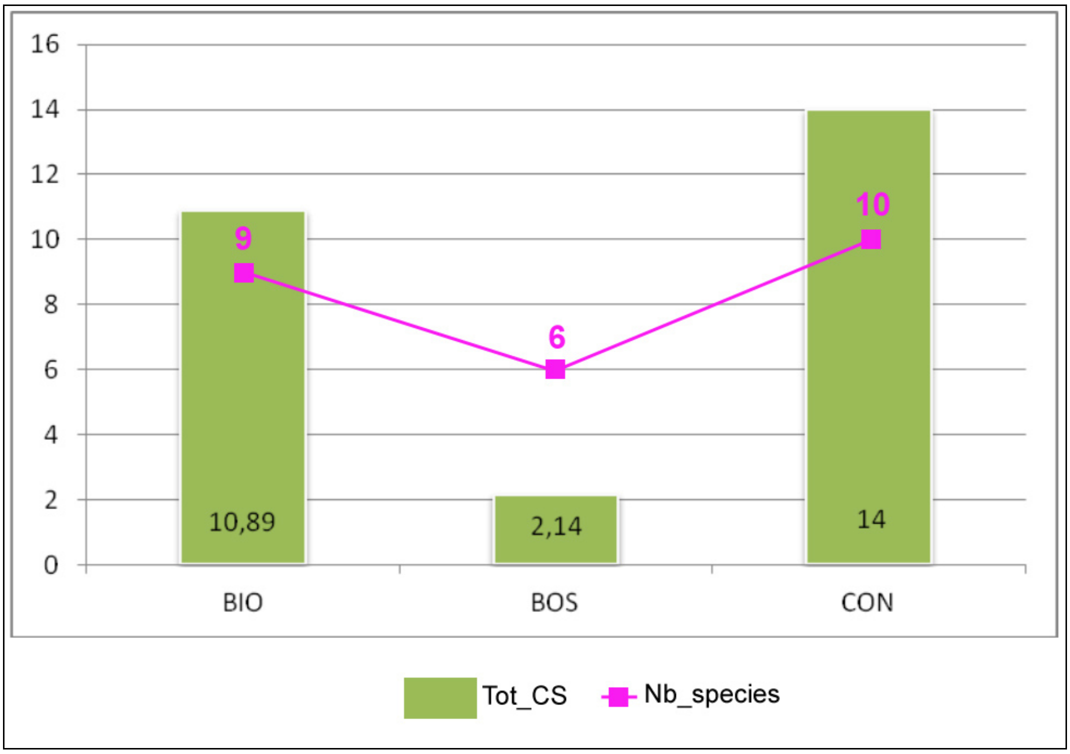


Fig. 5.2.2 – Capture frequency of the Coleoptera Tenebrionidae in the stations and their percentage of the total CS value.

Considering the general trend of the Coleoptera Tenebrionidae capture frequency within the stations and the number of the sampled species (graph. 5.2.1) is observed that the greatest number of species (**10**) has been surveyed in the **CON** station and the minimum (**6**) in **BOS** station, passing through the **BIO** station (**9**).

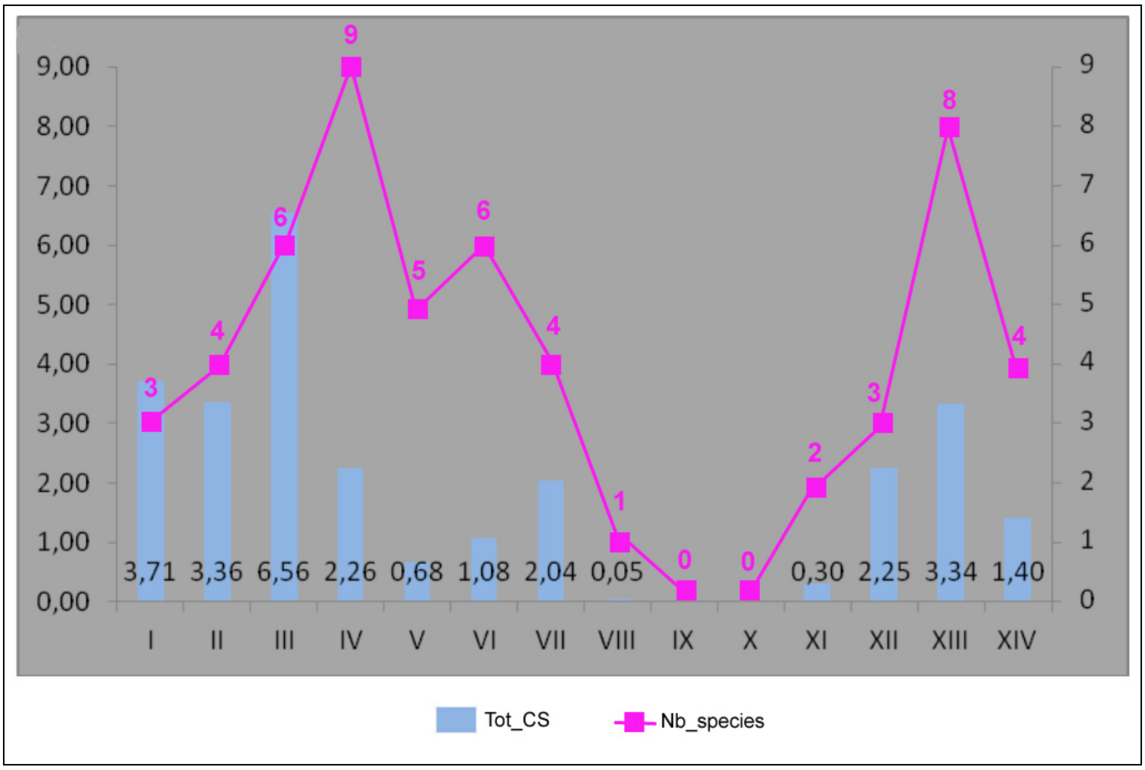


Graph. 5.2.1 - Overall trend of the Coleoptera Tenebrionidae catches (Tot_CS) and sampled species number (Nb_species) in each station.

Looking at the trend of the species capture frequency distributed in the single sampling periods (tab. 5.2.4 and graph. 5.2.2), is observed that the 24,27% of the catches is concentrated in the III period (June), while in the VIII period (November) were recorded the minimum CS values and a single species. In the periods IX and X (January and Frebuary) there aren't any specimens. Regarding the species number, the highest (**9** of **14**) is recorded in IV period (July).

SPECIES	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Tot_CS
Pimelia rugulosa	3,24	2,33	5,73	1,20	0,05	0,26	1,62				0,13	1,98	2,21	0,57	**19,33**
Blaps gibba		0,04	0,18	0,18	0,26	0,27	0,26	0,05					0,27	0,29	**1,79**
Accanthopus velikensis			0,07	0,13	0,18	0,29	0,08						0,08	0,51	**1,32**
Lagria hirta		0,91	0,04											0,04	**0,99**
Opatrum verrucosum	0,43	0,08									0,17	0,23			**0,90**
Stenosis sardoa ardoini			0,47	0,09		0,12							0,08		**0,76**
Pachychila dejeani	0,05			0,14		0,07	0,08					0,05	0,34		**0,72**
Helops rossii				0,19	0,09	0,07							0,08		**0,43**
Lagria atripes				0,23	0,10										**0,33**
Isomira ferruginea													0,19		**0,19**
Isomira murina													0,10		**0,10**
Gonodera metallica			0,07												**0,07**
Dendarus lugens				0,05											**0,05**
Isomira sp				0,05											**0,05**
Tot_CS	**3,71**	**3,36**	**6,56**	**2,26**	**0,68**	**1,08**	**2,04**	**0,05**			**0,30**	**2,25**	**3,34**	**1,40**	**27,02**
Nb_species	**3**	**4**	**6**	**9**	**5**	**6**	**4**	**1**			**2**	**3**	**8**	**4**	**14**

Tab. 5.2.4 - Trends in capture rates of the Coleoptera Tenebrionidae species spread over the individual sampling periods.

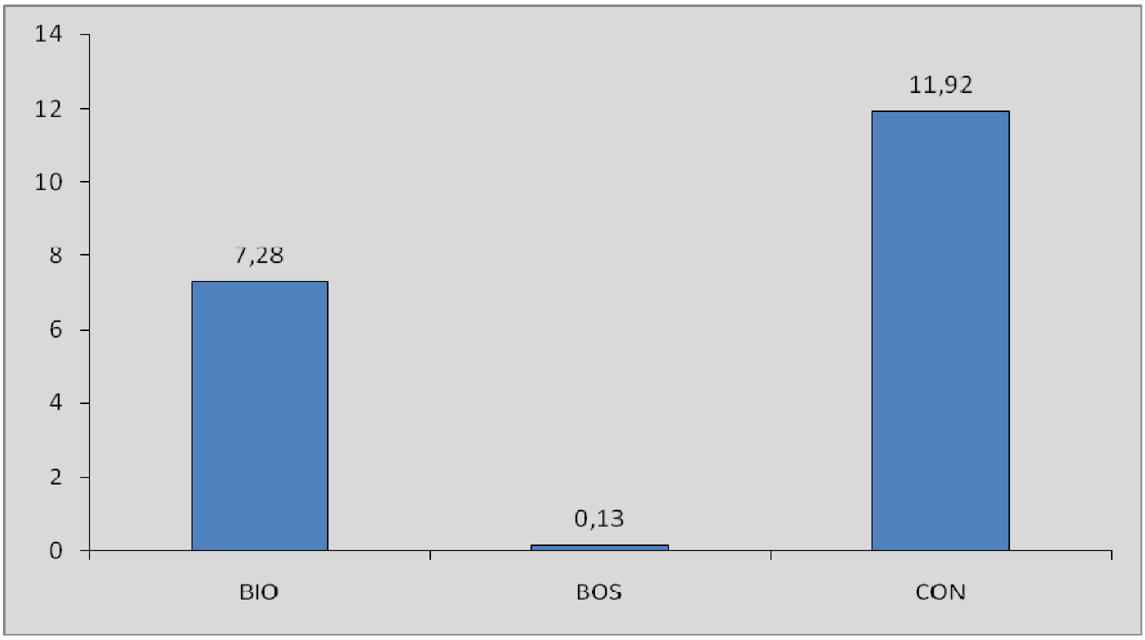


Graph. 5.2.2 - Trends in capture frequencies (CS) of the Coleoptera Tenebrionidae in individual sampling periods and sampled species number.

Below are considered the most abundant sampled Tenebrionidae species in regards to their distribution in the stations and to their capture frequency during the sampling period.

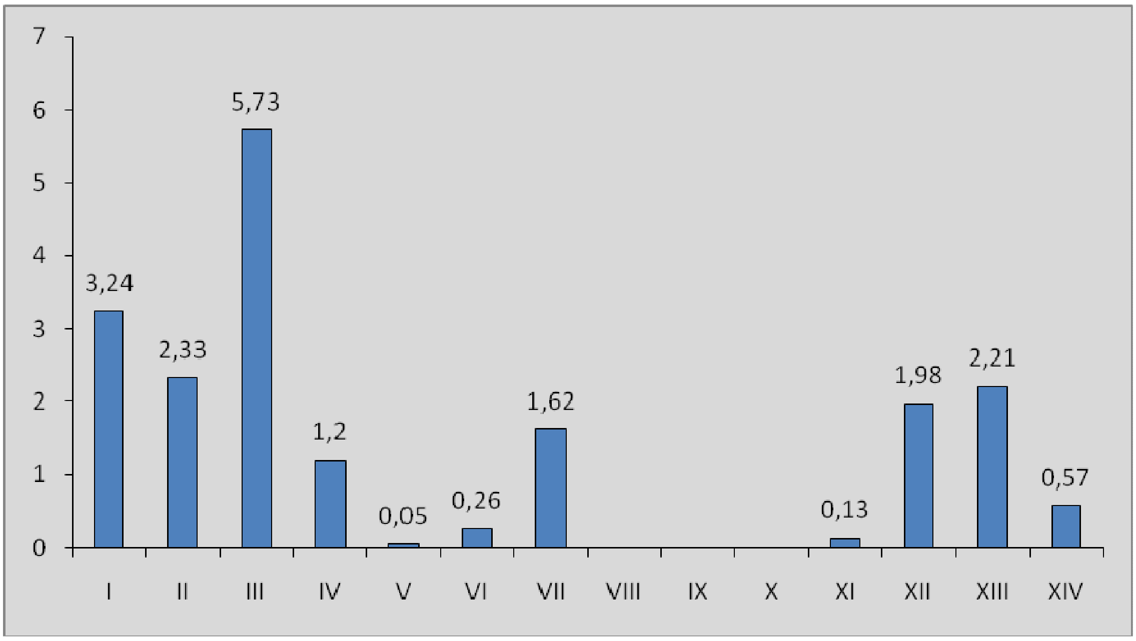
Pimelia rugulosa rugulosa

This is the species with the highest CS value, which represents just over 71,5% of the entire Coleoptera Tenebrionidae sampling. Were surveyed specimens of this species at all stations with 61,66% of the catches concentrated in the **CON** station (graph. 5.2.3), while the CS value in the **BOS** station is very low.



Graph. 5.2.3 – Trend of capture frequency (CS) of *Pimelia rugulosa rugulosa* within the single station.

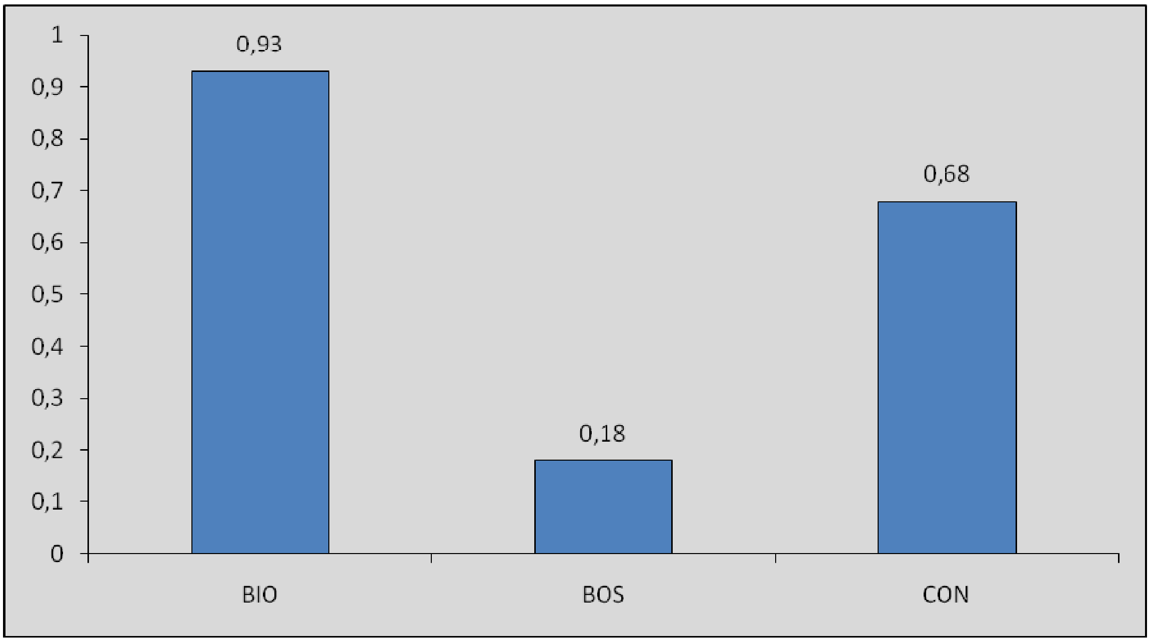
The trend of the capture frequency in the sampling period (graph. 5.2.4) shows that more than 29,64% of them are concentrated between April and June, with a peak in June, and result significantly lower in the other periods (July, August, and October) or null (from November to February).



Graph. 5.2.4 - Trends in capture frequencies (CS) of *Pimelia rugulosa rugulosa* in individual sampling periods.

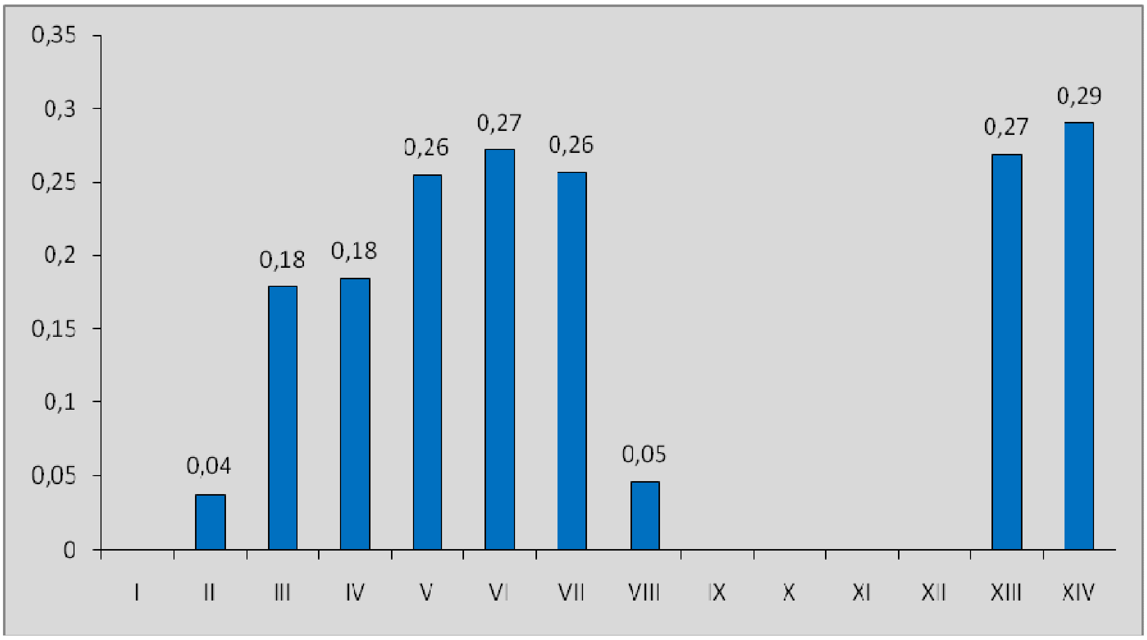
Blaps gibba

This is the species with the second CS value, which represents about 6,62% of the entire Coleoptera Tenebrionidae sampling. Were surveyed specimens of this species in all stations, with 51,95% of the catches recorded in the **BIO** station, while the minimum is found in the **BOS** station (10%) (graph. 5.2.5).



Graph. 5.2.5 - Trend of capture frequency (CS) of *Blaps gibba* within the single station.

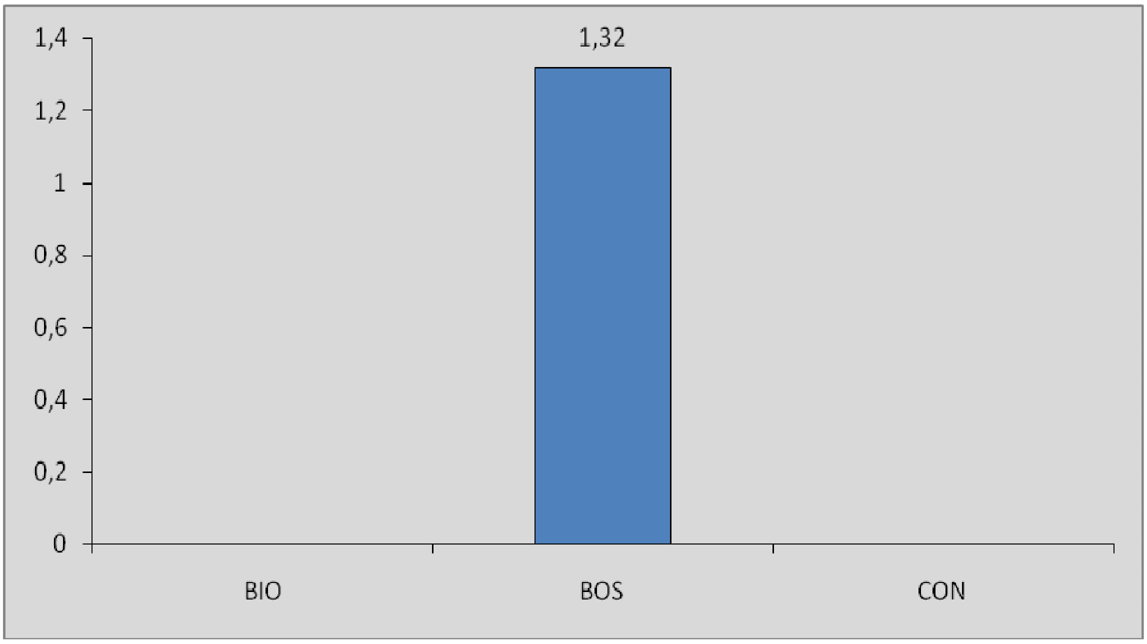
The trend of the capture frequency in the sampling period (graph. 5.2.6) shows that more than 64,2% of them are concentrated between June and October, with a peak in September, with little or null value in the periods between November and April.



Graph. 5.2.6 - Trends in capture frequencies (CS) of *Blaps gibba* in individual sampling periods.

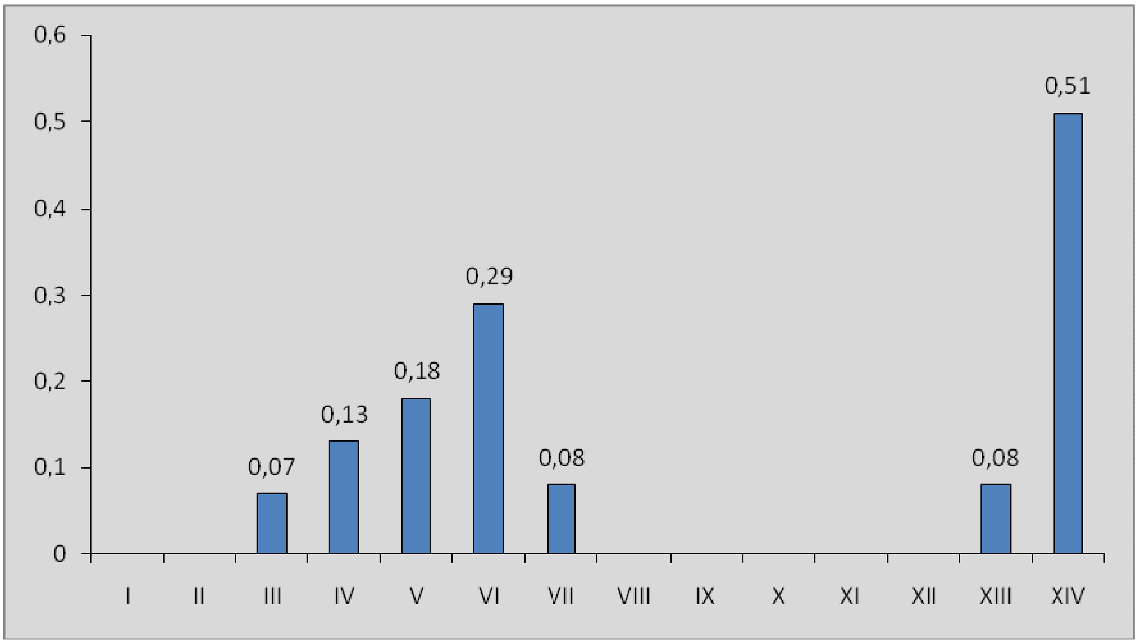
Accanthopus velikensis

This is the species with the third CS value, with 4,88% of the entire Coleoptera Tenebrionidae sampling; it was present only in the **BOS** station (graph. 5.2.7).



Graph. 5.2.7 - Trend of capture frequency (CS) of *Accanthopus velikensis* within the single station.

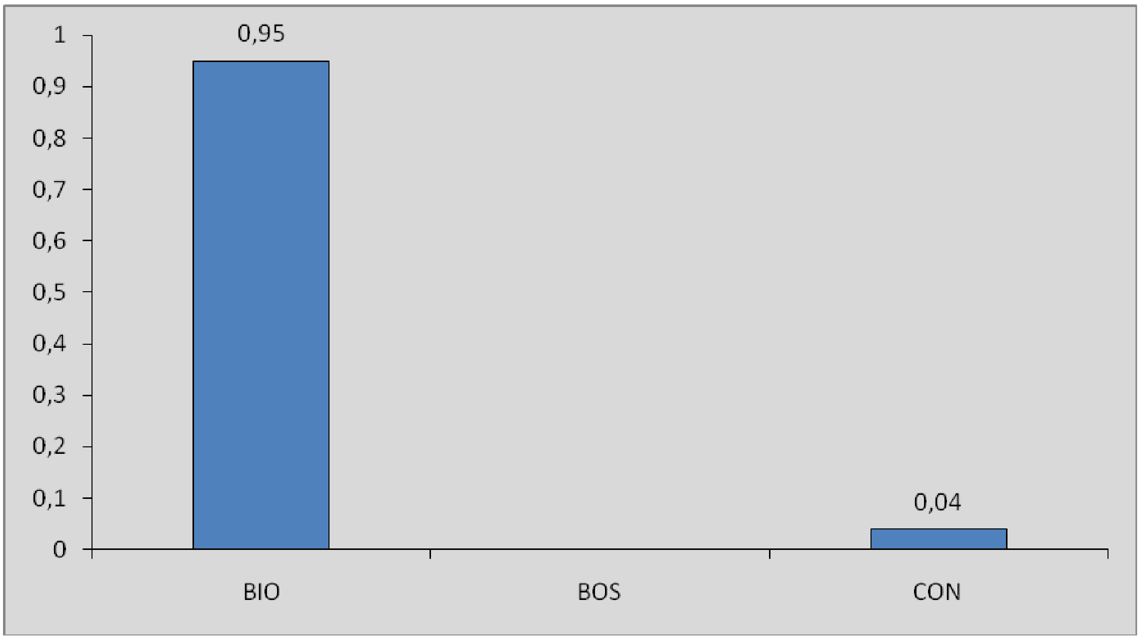
The trend of capture frequency in the sampling period (graph. 5.2.8) shows that the species is present from June to October.



Graph. 5.2.8 - Trends in capture frequencies (CS) of *Accanthopus velikensis* in individual sampling periods.

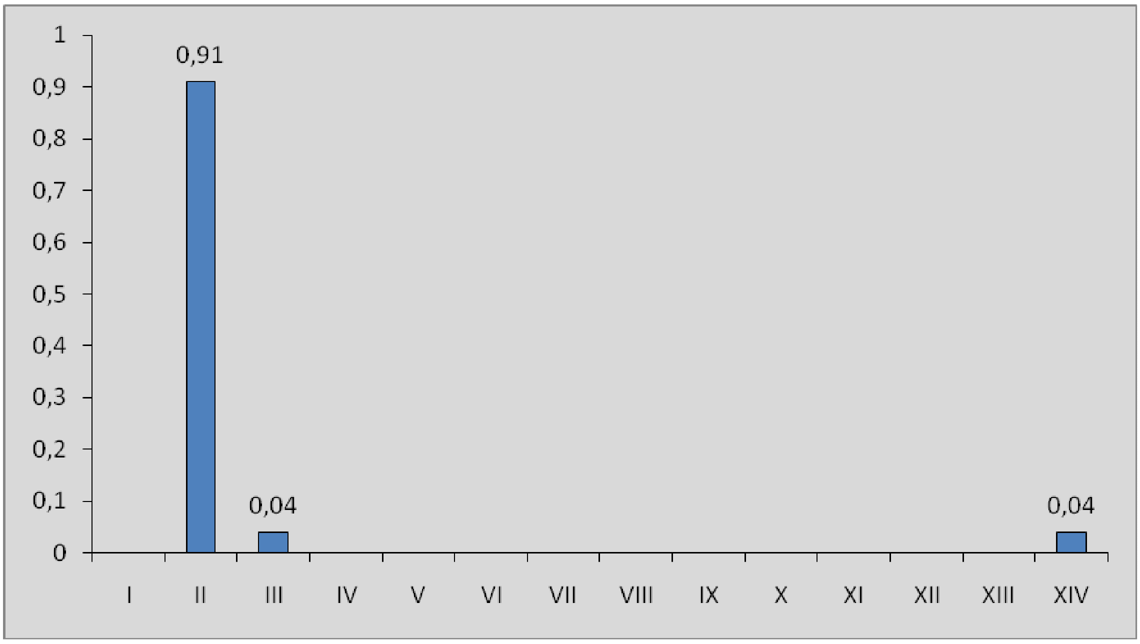
Lagria hirta

This is the species with the fourth CS value, which represents 3,66% of the entire Coleoptera Tenebrionidae sampling, and it was found in the **BIO** and **CON** stations. The station with the highest CS value is **BIO** (95,95%), while the **CON** station records only 4,04% (graph. 5.2.9).



Graph. 5.2.9 - Trend of capture frequency (CS) of *Lagria hirta* within the single station.

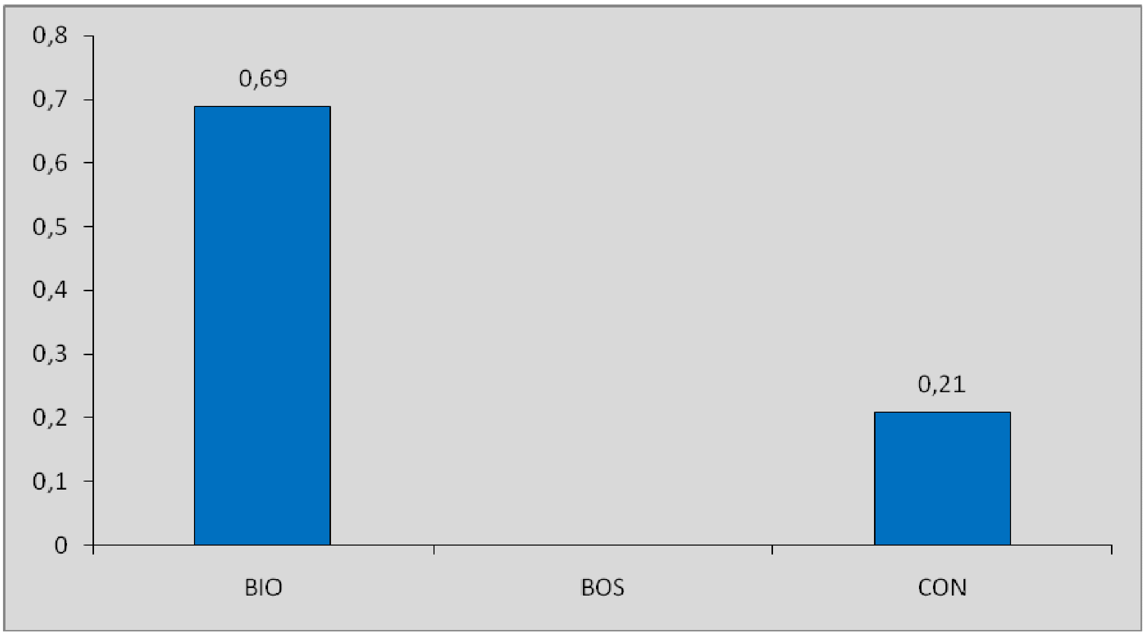
The trapping frequencies in the sampling period are concentrated (91,91%) in May (graph. 5.2.10). The species is absent in the other periods, recording lower CS values in June.



Graph. 5.2.10 - Trends in capture frequencies (CS) of *Lagria hirta* in individual sampling periods.

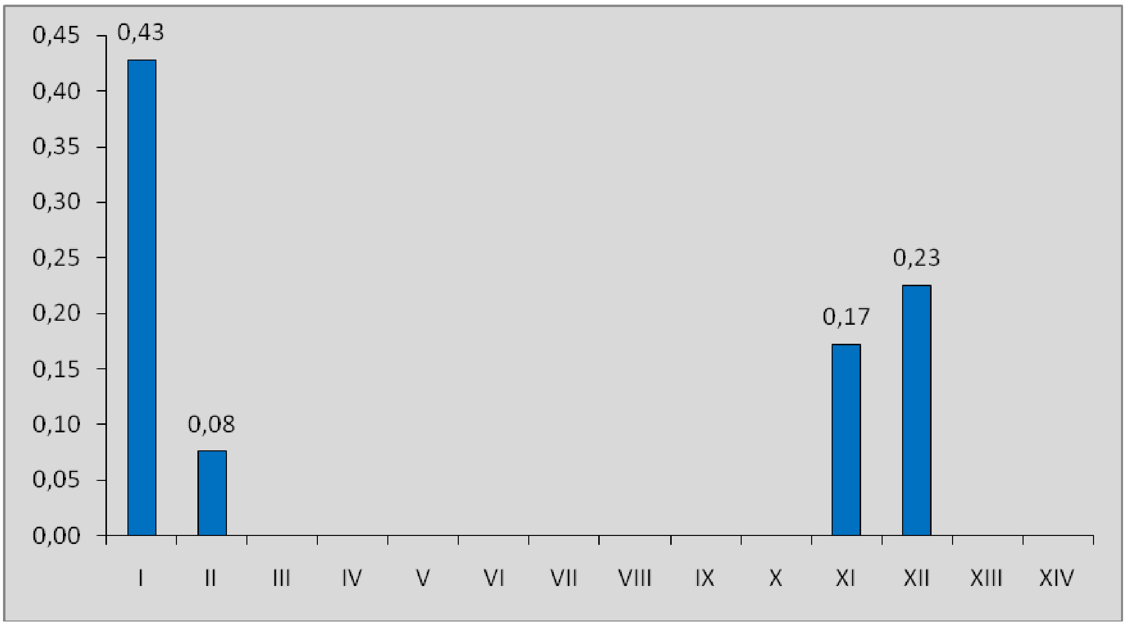
Opatrum verrucosum

It shows the fifth CS value, which accounts for 3,33% of the entire Coleoptera Tenebrionidae sampling. The species was only sampled in the **BIO** and **CON** stations (graph. 5.2.11), with a peak of CS values (76,66%) in the **BIO** station.



Graph. 5.2.11 - Trend of capture frequency (CS) of *Opatrum verrucosum* within the single station.

The trend of capture frequency in the sampling period (graph. 5.2.12) shows that more than 47% of them are concentrated in April, and that are significantly lower in other periods, with null values between June and February.



Graph. 5.2.12 - Trends in capture frequencies (CS) of *Opatrum verrucosum* in individual sampling periods.

5.3 COLEOPTERA STAPHYLINIDAE (WITH EXCLUSION OF ALEOCHARINAE)

From the discussion of this Family were excluded Scydmaeninae and Aleocharinae subfamilies. Aleocharinae represents a large and certainly very important taxa, but still too little known both taxonomic and ecological point of view, to be used for biocoenotic studies in the Mediterranean.
Excluding Aleocharinae (**3,956** specimens) and Scydmaeninae (**5** specimens), in total were surveyed **325** specimens of Coleoptera Staphylinidae, belonging to **38** species. These are reported in table 5.3.1.

	Species	**Chorology**	**Italy**
	Acidota cruentata Mannerheim 1830	EUR	N S Si
	Anotylus intricatus (Erichson 1840)	PAL	N S Si
	Anotylus inustus (Gravenhorst 1806)	PAL	N S Si Sa
	Astenus sp.		
	Bisnius fimetarius (Gravenhorst 1802)	EUR	N S Si Sa
	Gyrohypnus fracticornis (O. Muller 1776)	CAENi AURi NARi NTRi	N S Si Sa
	Heterothops praevius Erichson 1839	PAL	N S Si
	Lordithon exoletus (Erichson 1839)	EUM	N S Si Sa
	Mycetoporus angularis Mulsant & Rey 1853	CEM	N S Si Sa
	Mycetoporus mulsanti Ganglbauer 1895	PAL	N S Si
	Mycetoporus rufescens (Stephens 1832)	PAL	N S Si Sa
	Ocypus mus (Brullé 1832)	EME	S Si
	Ocypus olens (O. Muller 1764)	EUM NARi	N S Si Sa
	Omalium excavatum Stephens 1834	EUM NAR	N S Si Sa
	Omalium poggii Zanetti 1985	Tirr	Si Sa
	Omalium rivulare (Paykull 1789)	EUM	N S Si Sa
	Omalium rugatum Mulsant & Rey 1880	EUM	N S Si Sa
	Othius laeviusculus Stephens 1833	EUM	N S Si Sa
	Paraphloeostiba gayndahensis (MacLeay 1873)	ias	N S Si Sa
	Philonthus debilis (Gravenhorst 1802)	PAL NARi	N S Si Sa
	Philonthus jurgans Tottenham 1937	EUR NAR	N S Si
	Philonthus tenuicornis Mulsant & Rey 1853	OLA	N S Si
	Phyllodrepa floralis (Paykull 1789)	EUM	N S Si Sa
	Proteinus atomarius Erichson 1840	OLA	N S Si Sa
	Proteinus brachypterus (Fabricius 1792)	OLA	N S Si Sa
	Quedius boops (Gravenhorst 1802)	PAL	N S Si
	Quedius cruentus (Olivier 1795)	OLA	N S Si
	Quedius fumatus (Stephens 1833)	EUM	N S Si
	Quedius latinus Gridelli 1938	WME	N S Si
	Quedius levicollis (Brullé, 1832)	EUM	N S Si Sa
	Sepedophilus nigripennis (Stephens 1832)	EUM	N S Si Sa
E	*Sepedophilus sicilianus* (Bernhauer 1917)	SIC	Si
	Stenus aceris Stephens 1833	TEM	N S Si Sa
	Tachyporus abner Saulcy 1864	MED	N S Si Sa
	Tachyporus nitidulus (Fabricius 1781)	COS	N S Si Sa
	Tachyporus pusillus Gravenhorst 1806	PAL	N S Si Sa
	Tachyporus sp.		
	Xantholinus sp.		

Tab. 5.3.1 – List of species and subspecies of surveyed Staphylinidae. In the first column with letter **E** are indicated the endemic sicilian taxa. For each taxon is also reported the chorological category and distribution in Italy following the symbology used in the checklist of the Italian fauna. For further explanations and clarifications please refer to the text.

For the nomenclature, reference is made to the checklist of the Italian fauna (CICERONI, PUTHZ & ZANETTI 1995) updated to 2013 according to the Checklist of Staphylinidae of Fauna Europaea Project (SMETANA 2013) (www.faunauer. org).
For chorological categories it was referred to VIGNA TAGLIANTI et alii 1992, PILON (2004) and ZANETTI (2004). The distribution in Italy is taken from the checklist of the Italian fauna (CICERONI, PUTHZ & ZANETTI 1995) updated according to the project CKmap (PILON 2004, ZANETTI 2004).

Only ***Sepedophilus sicilianus*** (Bernhauer 1917) is a sicilian endemism. It is a silvicolous species that lives in the litter of oak forest, but also in the litter of beech forest.

Some other species deserves some further comment:

Ocypus mus (Brullé 1832)
Species with an eastern-European distribution. In Italy, it has a distribution restricted to southern regions and Sicily. Like other representatives of the subgenus *Pseudocypus* could be presumably a eurytopic species, and in fact in Sicily it is relatively frequent in both the Nebrodi Mountains oak woods of that in many extra-silvicolous environments, while in the eastern regions of southern Europe is reported in dry deciduous forests (KOCH 1989).

Ocypus olens (O. Muller 1764)
Species with Euro-Mediterranean distribution (HERMAN 2001), widely distributed in Italy and tendentially synanthropic. Detriticolous and hygrophil, lives in natural open environments, sometimes also present in other environments (margins of dry forests, swamps), which only in Sicily can be considered as sylvicolous (SABELLA & ZANETTI 1991). In the rest of Europe seems to be less widely distributed, and preferably associated with forest habitats rather than open areas (HORION 1965, KOCH 1989). It is present and usually abundant in all investigated Sicilian forests.

Omalium poggii Zanetti 1985
Species described on specimens of Sardinia, where it is known from various localities (ZANETTI, 1987), but is also present in southern and central France. It is probably a predator species that lives in the decaying debris.

Quedius latinus Gridelli 1938
Sylvicolous species of litter, distributed along the Appennines and in Sicily, while in the Alps is limited to the thermophilic sites of the southern slope; it is also reported in the far south-east of France and south-central Spain (COIFFAIT 1978). Its ideal habitat is represented by oak and thermophilic beech forests of the southern Apennines.

Paraphloeostiba gayndahensis (MacLeay 1873)
Cosmopolitan species native to Australia, which has appeared in Italy around 1988.
It lives in decomposing material of vegetal origin, anthropophilic also in cultivated environments to plain from low altitude. His diet is mixed (it feeds on decomposing material, nematodes, etc.). It is currently one of the most abundant Staphylinidae beetles in Italy. In North America is considered an assist in agriculture as a pollinator of Araceae and Annonaceae (see http://eol.org/data_objects/17719792).

The sampled Staphylinidae species (with exception of Aleocharinae and Scydmaeninae), and the number of collected specimens in the 3 stations are shown in table 5.3.2.

TAXA	BIO	BOS	CON	Tot_Nb_specimens
Ocypus olens	31	64	23	118
	9,53	*19,69*	*7,07*	*36,30*
Ocypus mus	11	22	10	43
	3,38	*6,76*	*3,07*	*13.23*
Paraphloeostiba gayndahensis	12	4	26	42
	3,69	*1,23*	*8,00*	*12,92*
Quedius latinus		22		22
		6,76		*6,76*
Tachyporus pusillus	12	2	4	18
	3,69	*0,61*	*1,23*	*5,53*
Tachyporus nitidulus	8	2	6	16
	2,46	*0,61*	*1,84*	*4,92*
Omalium rugatum	7	4	2	13
	2,15	*1,23*	*0,60*	*4,00*
Quedius levicollis	6		1	7
	1,84		*0,30*	*2,15*
Mycetoporus mulsanti	1	2	2	5
	0,30	*0,61*	*0,61*	*1,53*
***Xantholinus* sp.**	3			3
	0,92			*0,92*
Sepedophilus nigripennis	1		2	3
	0,30		*0,61*	*0,92*
Proteinus brachypterus		1	1	2
		0,30	*0,30*	*0,61*
Othius laeviusculus	1	1		2
	0,30	*0,30*		*0,61*
Quedius fumatus		2		2
		0,61		*0,61*
Philonthus debilis	1		1	2
	0,30		*0,30*	*0,61*
Lordithon exoletus		2		2
		0,61		*0,61*
Tachyporus abner	2			2
	0,61			*0,61*
Mycetoporus angularis		1	1	2
		0,30	*0,30*	*0,61*
Acidota cruentata	1		1	2
	0,31		*0,30*	*0,61*
Sepedophilus sicilianus	1			1
	0,30			*0,30*
Philonthus jurgans	1			1
	0,30			*0,30*
Quedius boops			1	1
			0,30	*0,30*
***Tachyporus* sp.**	1			1
	0,30			*0,30*
Quedius cruentus			1	1
			0,30	*0,30*
Gyrohypnus fracticornis	1			1
	0,30			*0,30*
***Astenus* sp.**			1	1
			0,30	*0,30*
Omalium excavatum	1			1
	0,30			*0,30*

Mycetoporus rufescens	1			1
	0,30			*0,30*
Proteinus atomarius			1	1
			0,30	*0,30*
Philonthus tenuicornis	1			1
	0,30			*0,30*
Bisnius fimetarius			1	1
			0,30	*0,30*
Heterothops praevius	1			1
	0,30			*0,30*
Stenus aceris	1			1
	0,30			*0,30*
Phyllodrepa floralis	1			1
	0,30			*0,30*
Omalium poggii			*1*	*1*
			0,30	*0,30*
Omalium rivulare			1	1
			0,30	*0,30*
Anotylus intricatus			1	1
			0,30	*0,30*
Anotylus inustus			1	1
			0,30	*0,30*
Tot_Nb_specimens	107	129	89	**325**
	32,92	*39,69*	*27,38*	***100***
Tot_Nb_species	25	13	23	**39**

Tab. 5.3.2 - Trends in catches of the Coleoptera Staphylinidae in each station expressed as total number (top row) and percentage (bottom row) of the sampled specimens. The percentages refer to the total of the entire Staphylinidae sampling.

During the sampling period in the 3 stations investigated within the Etna Regional Park, a total of **325** specimens of Staphylinidae (with exception of Aleocharinae and Scydmaeninae), belonging to **38** species were surveyed. The most abundant species resulted: *Ocypus olens* (**118** specimens) which alone accounts for about 36% of the total Staphylinidae catch, *Ocypus mus* (**43** specimens), *Paraphloeostiba gayndahensis* (**42** specimens), *Quedius latinus* (**22** specimens), *Tachyporus pusillus* (**18** specimens), *Tachyporus nitidulus* (**16** specimens), *Omalium rugatum* (**13** specimens), *Quedius levicollis* (**7** specimens), *Mycetoporus mulsanti* (**5** specimens), representing the **2,40%** of the total sampled Coleoptera specimens and about the **87%** of the total sampled Staphylinidae.
In fig. 5.3.1 are shown the percentages of the surveyed specimens for the more abundantly sampled Staphylinidae species compared to the total Family sampling.

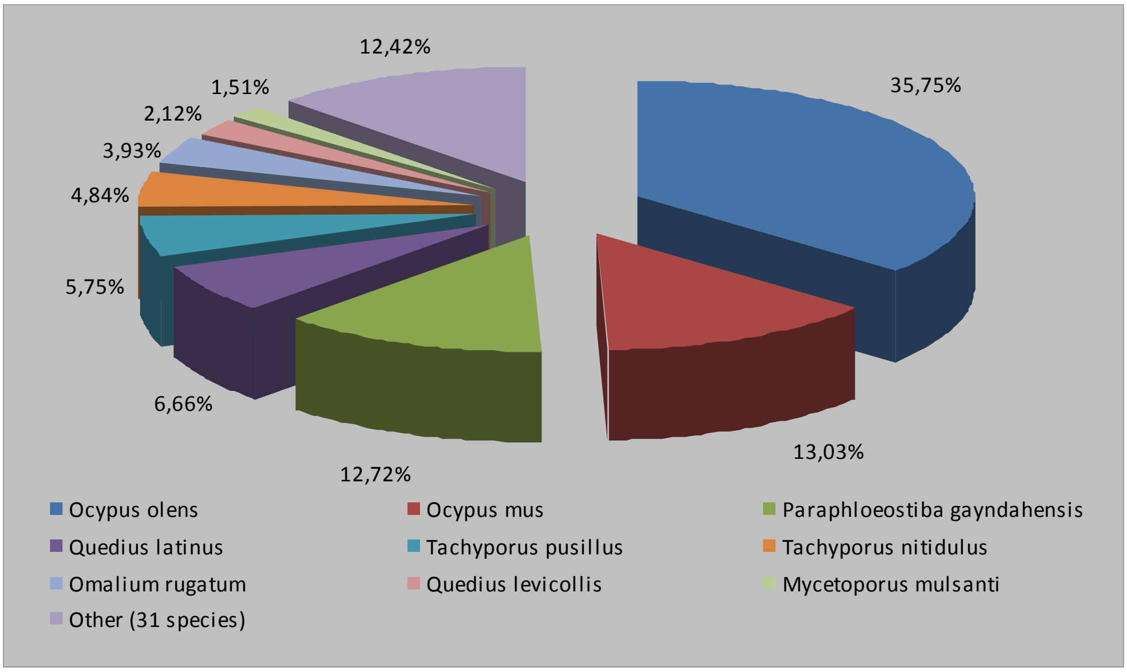


Fig. 5.3.1 - Overall trend (number of individual and percentage of total) of the catches for more abundant Staphylinidae species.

Table 5.3.3 shows the values of CS for species counted within the individual stations.

Species	BIO	BOS	CON	Tot_CS
Ocypus olens	1,60	5,74	1,17	8,51
Ocypus mus	0,51	1,81	0,42	2,73
Paraphloeostiba gayndahensis	0,60	0,32	1,23	2,15
Quedius latinus		1,76		1,76
Tachyporus pusillus	0,52	0,13	0,16	0,81
Tachyporus nitidulus	0,34	0,13	0,26	0,72
Omalium rugatum	0,33	0,25	0,11	0,69
***Xantholinus* sp.**	0,39			0,39
Quedius levicollis	0,24		0,04	0,29
Mycetoporus mulsanti	0,04	0,14	0,09	0,27
Lordithon exoletus		0,20		0,20
Quedius fumatus		0,20		0,20
Sepedophilus nigripennis	0,05		0,09	0,14
Othius laeviusculus	0,04	0,10		0,13
Proteinus brachypterus		0,07	0,06	0,12
Mycetoporus angularis		0,06	0,05	0,10
***Tachyporus* sp.**	0,09			0,09
Philonthus debilis	0,04		0,04	0,08
Tachyporus abner	0,08			0,08
Acidota cruentata	0,03		0,03	0,07
***Astenus* sp.**			0,06	0,06
Proteinus atomarius			0,06	0,06
Bisnius fimetarius			0,05	0,05
Omalium excavatum	0,05			0,05
Phyllodrepa floralis	0,05			0,05
Quedius boops			0,04	0,04
Philonthus jurgans	0,04			0,04
Philonthus tenuicornis	0,04			0,04
Omalium rivulare			0,04	0,04
Mycetoporus rufescens	0,04			0,04
Anotylus intricatus			0,04	0,04
Anotylus inustus			0,04	0,04
Gyrohypnus fracticornis	0,04			0,04
Omalium poggii			0,04	0,04
Stenus aceris	0,04			0,04
Sepedophilus sicilianus	0,04			0,04
Quedius cruentus			0,04	0,04
Heterothops praevius	0,03			0,03
Tot_CS	**5,27**	**10,90**	**4,17**	**20,34**
Nb_species	**24**	**13**	**22**	**38**

Tab. 5.3.3 - Trends in catches of Coleoptera Staphylinidae in each station expressed as CS.

The analysis of the table 5.3.3 and fig. 5.3.2 shows how the **BOS** station present a capture frequencies peak (equivalent to 52,37% of total), while the **BIO** station shows a value of 27,33% of the total and the **CON** station presents the lowest CS values with 20,23% of the total.

Examining the table 5.3.3 we observe that only 7 species: *Ocypus olens*, *Ocypus mus, Paraphloeostiba gayndahensis, Tachyporus pusillus*, *Tachyporus nitidulus, Omalium rugatum*, *Mycetoporus mulsanti* were observed in all stations; 7 species are present in two stations: *Quedius levicollis, Sepedophilus nigripennis, Sepedophilus nigripennis, Othius laeviusculus, Proteinus brachypterus, Mycetoporus angularis, Philonthus debilis, Acidota cruentata.* The other species are present only in one station.

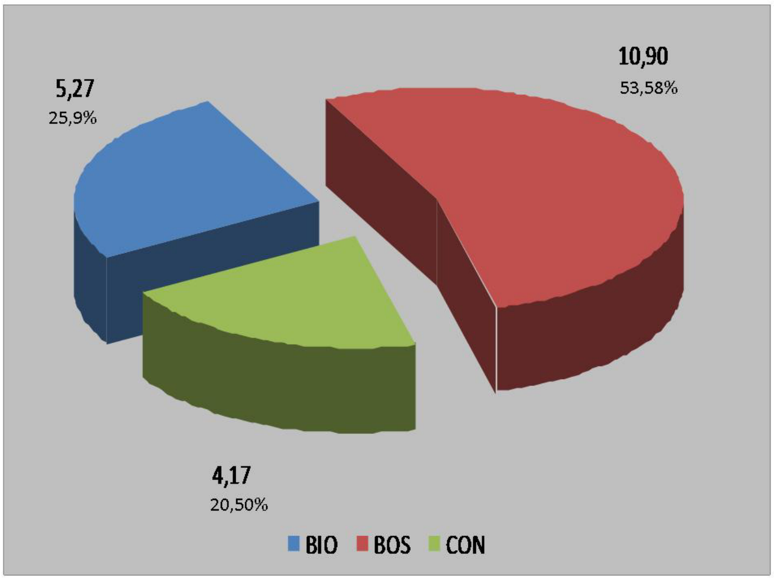
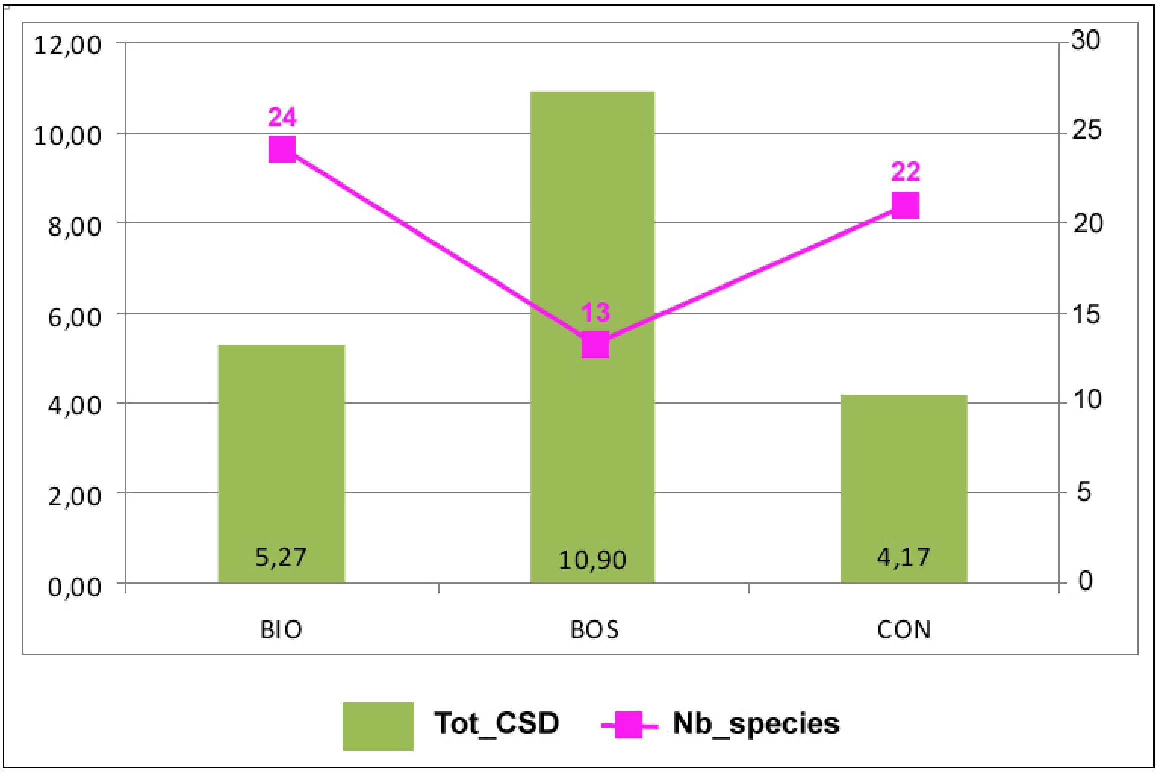


Fig. 5.3.2 – Capture frequency of the Coleoptera Staphylinidae in the stations and their percentage of the total CS value.

Considering the general trend of the Coleoptera Staphylinidae capture frequency within the stations and the sampled species number (graph. 5.3.1) is observed that the greatest number of taxa (**24**) has been surveyed in the **BIO** station and the minimum (**13**) in the **BOS** station, passing through the **CON** station (**22**).



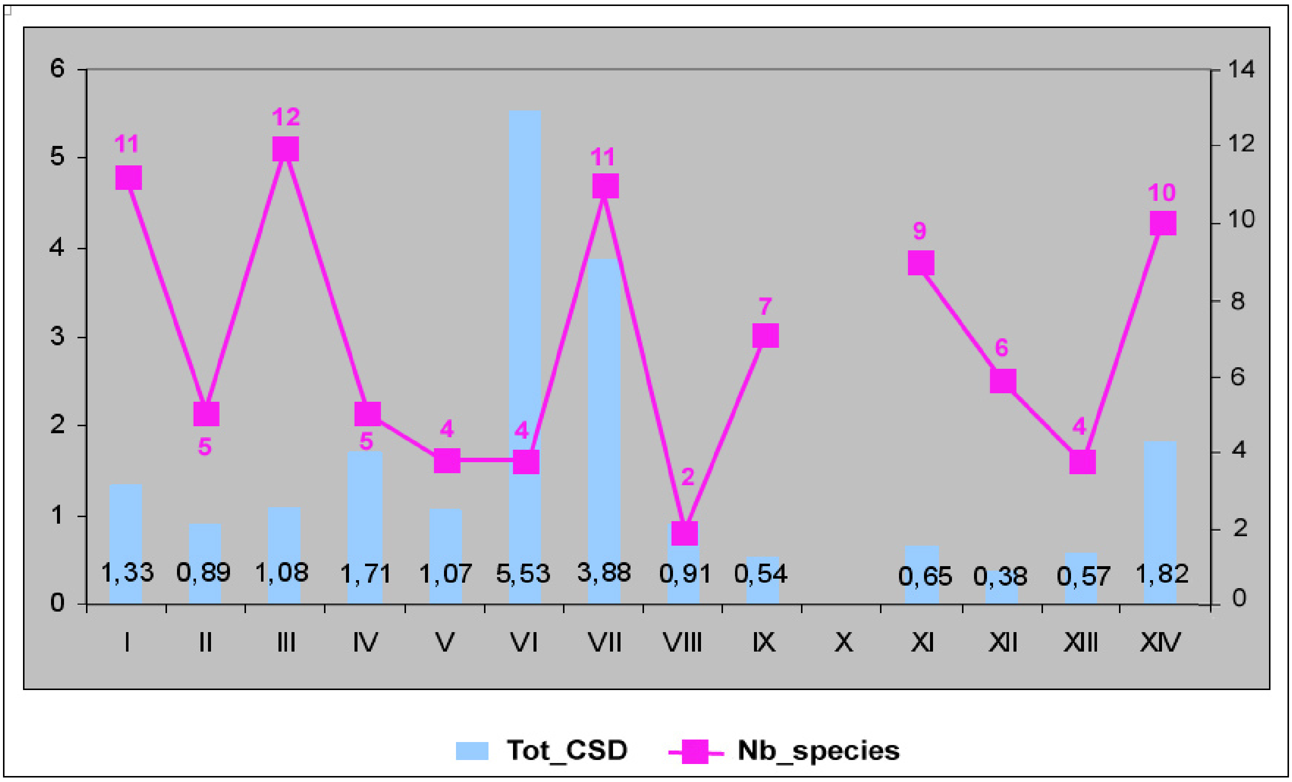
Graph. 5.3.1 - Overall trend of the Coleoptera Staphylinidae catches (Tot_CS) and sampled species number (Nb_species) in each station.

SPECIES	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	Tot_CS
Ocypus olens	0,10	0,36	0,23	0,18	0,59	4,60	1,46	0,48			0,04	0,05	0,23	0,20	8,51
Ocypus mus			0,07		0,09	0,60	1,55	0,43							2,73
Paraphloeostiba gayndahensis			0,09	1,28	0,34	0,25						0,05		0,14	2,15
Quedius latinus	0,13	0,12	0,21				0,31		0,18					0,81	1,76
Tachyporus pusillus	0,11	0,04	0,14	0,11					0,03		0,30			0,08	0,81
Tachyporus nitidulus	0,11		0,04	0,09			0,08		0,13				0,19	0,08	0,72
Omalium rugatum	0,50										0,04	0,05	0,10		0,69
***Xantholinus* sp.**		0,30			0,05		0,04								0,39
Quedius levicollis			0,09				0,16							0,04	0,29
Mycetoporus mulsanti		0,06					0,12					0,09			0,27
Lordithon exoletus														0,20	0,20
Quedius fumatus														0,20	0,20
Sepedophilus nigripennis	0,05			0,05							0,04				0,14
Othius laeviusculus						0,10	0,04								0,13
Proteinus brachypterus	0,12														0,12
Mycetoporus angularis									0,06			0,05			0,10
***Tachyporus* sp.**												0,09			0,09
Philonthus debilis			0,04											0,04	0,08
Tachyporus abner			0,04						0,03						0,08
Acidota cruentata									0,07						0,07
***Astenus* sp.**	0,06														0,06
Proteinus atomarius	0,06														0,06
Bisnius fimetarius													0,05		0,05
Omalium excavatum	0,05														0,05
Phyllodrepa floralis	0,05														0,05
Quedius boops							0,04								0,04
Philonthus jurgans			0,04												0,04
Philonthus tenuicornis			0,04												0,04
Omalium rivulare											0,04				0,04
Mycetoporus rufescens			0,04												0,04
Anotylus intricatus											0,04				0,04
Anotylus inustus											0,04				0,04
Gyrohypnus fracticornis											0,04				0,04
Omalium poggii											0,04				0,04
Stenus aceris							0,04								0,04
Sepedophilus sicilianus							0,04								0,04
Quedius cruentus														0,04	0,04
Heterothops praevius									0,03						0,03
Tot_CS	1,33	0,89	1,08	1,71	1,07	5,53	3,88	0,91	0,54		0,65	0,38	0,57	1,82	**20,34**
Nb_species	11	5	12	5	4	4	11	2	7		9	6	4	10	**38**

Tab. 5.3.4 - Trends in capture rates of the Coleoptera Staphylinidae species spread over the individual sampling periods.

Looking at the trend of the species capture frequency distributed in the single sampling periods (tab. 5.3.4 e graph. 5.3.2), is observed that the 46,26% of the catches is concentrated in the periods VI and VII (September and October), while in the period XII (April) was recorded the minimum CS value. No specimens are collected in period X (February).

Regarding the species number, the highest (12 of 38) is recorded in period III (June). In period VIII (November), the species number is the lowest, while in period X (February) no species are recorded because of the snow that damaged the traps. In the remaining periods, these values amounted to be between 4 and 11.



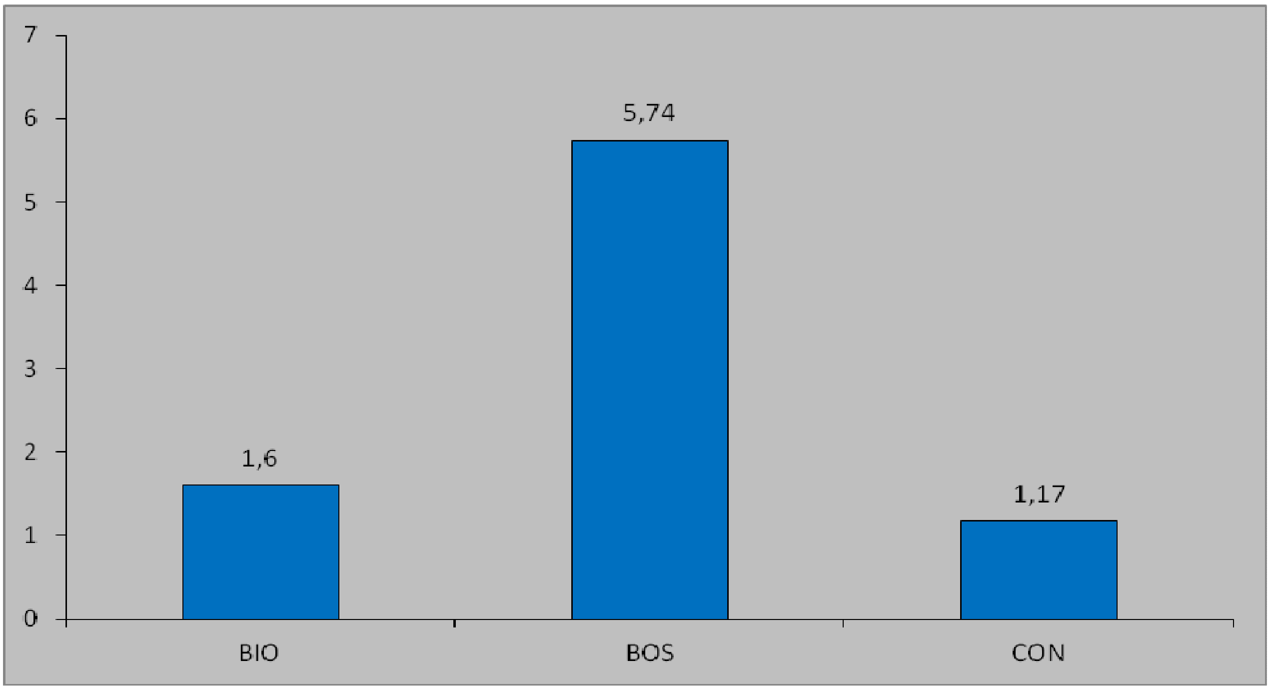
Graph. 5.3.2 - Trends in capture frequencies (CS) of the Coleoptera Staphylinidae in individual sampling periods and sampled species number.

Below are considered the most abundant sampled species of Staphylinidae (excluding Aleocharinae and Scydmaeninae) in regards to their distribution in the stations and their capture frequency during the sampling period.

It is to note that in II period BIO station registered only one active traps because of the plowing and in the X period the traps of all station were damaged by snow.

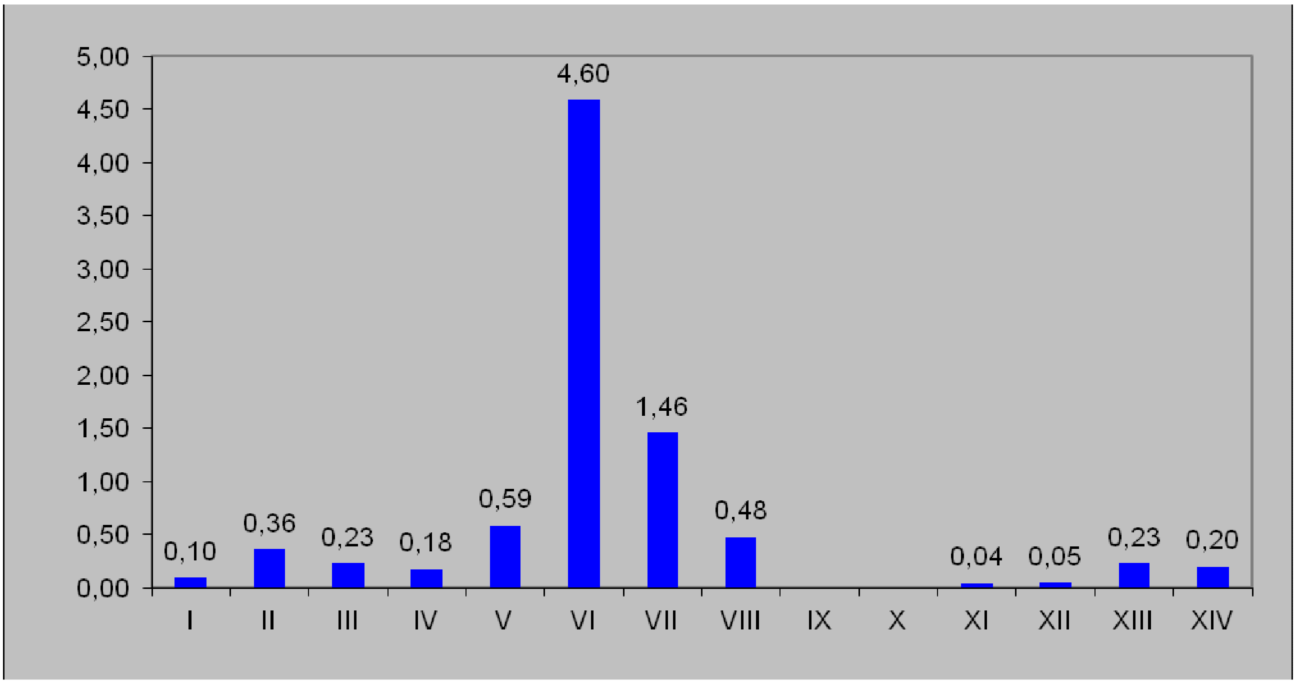
Ocypus olens

This is the species with the highest CS value, which represents just about 42% of the entire Coleoptera Staphylinidae sampling. Were surveyed specimens of this species in all stations with 65,9% of the captures concentrated in the **BOS** station (graph. 5.3.3).



Graph. 5.3.3 - Trend of capture frequency (CS) of *Ocypus olens* within the single station.

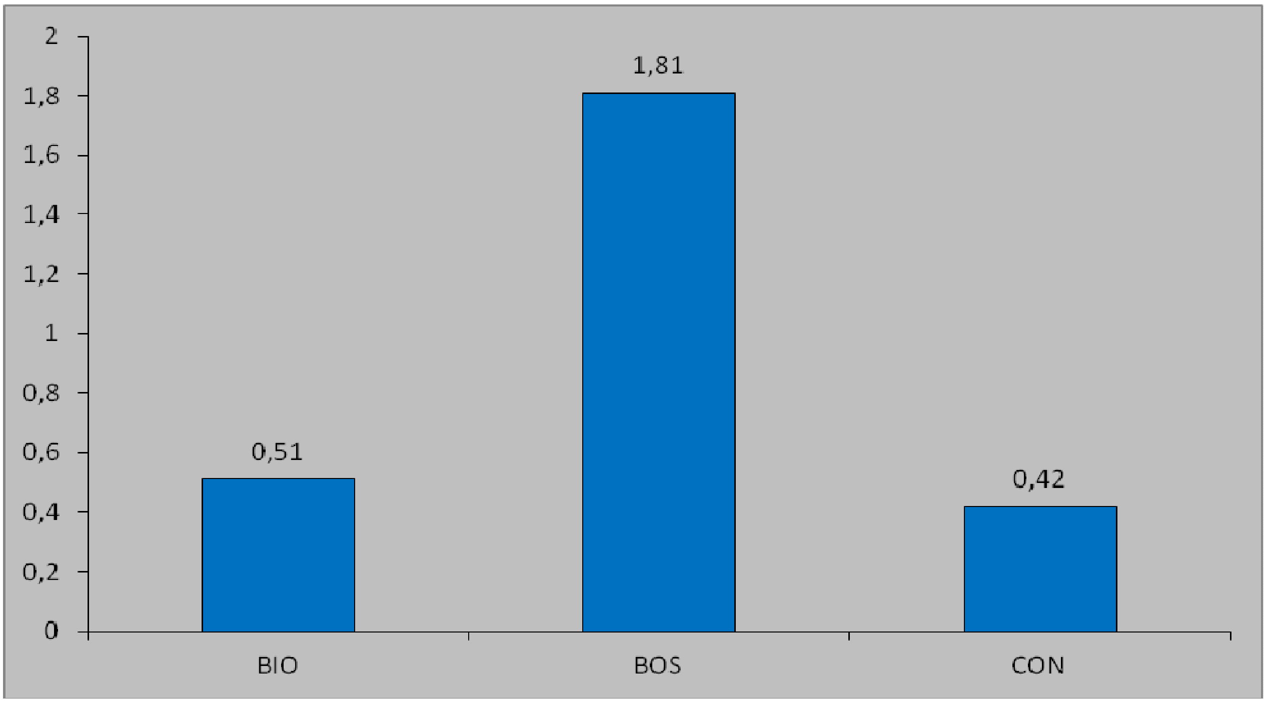
The trend of the capture frequency in the sampling period (graph. 5.3.4) shows that more than 54% of them are concentrated in September and that are significantly lower in other periods, with minimum (March and April) or null (January and February) values.



Graph. 5.3.4 - Trends in capture frequencies (CS) of *Ocypus olens* in individual sampling periods.

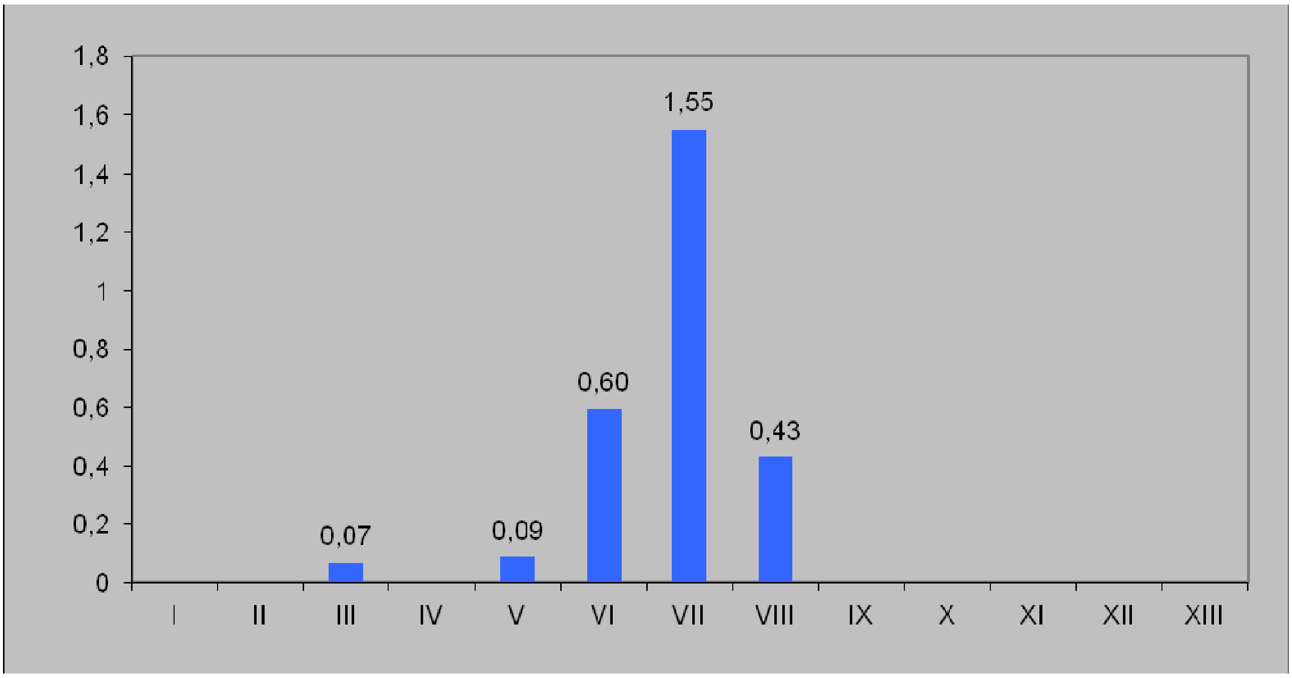
Ocypus mus

This is the species with the second CS value, which represents 13,42% of the entire Coleoptera Staphylinidae sampling. Were captured specimens of this species in all the stations, with 66,3% of the catches recorded in the **BOS** station and 18,68%, in **BIO** station, while the minimum is found in the **CON** station (15,38%) (graph. 5.3.5).



Graph. 5.3.5 - Trend of capture frequency (CS) of *Ocypus mus* within the single station.

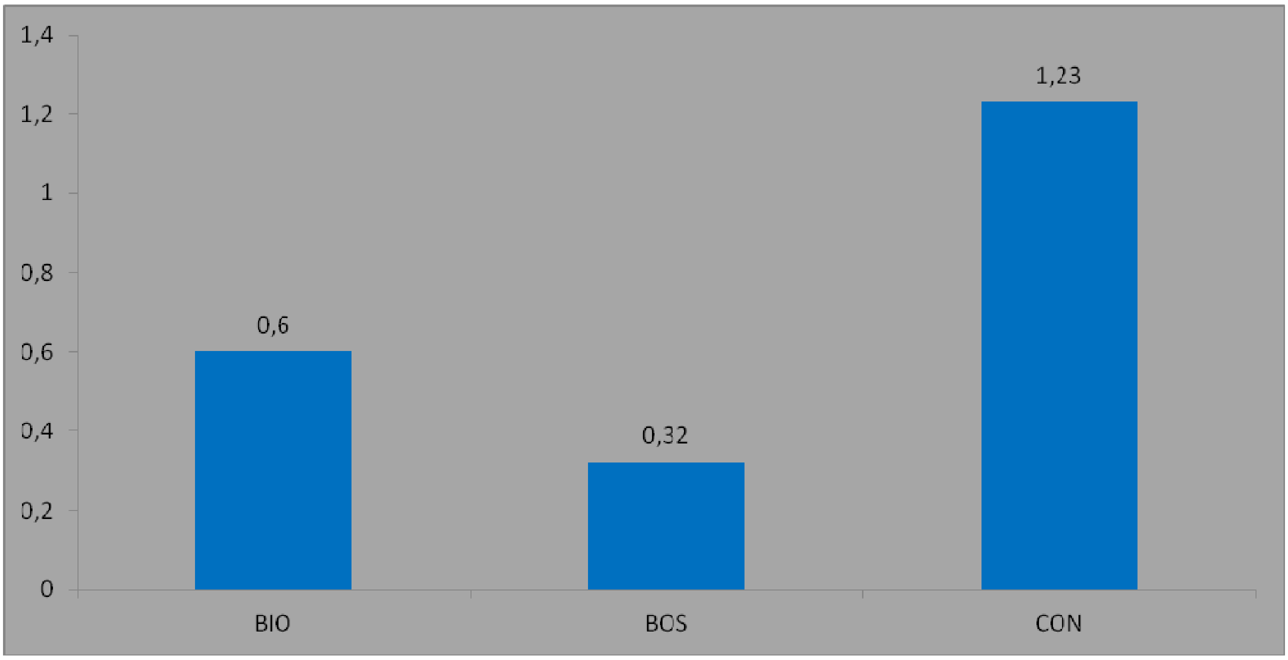
The trend of the capture frequency in the sampling period (graph. 5.3.6) shows high values in autumn (September, October, November), including 94,5% of the total CS. The species was not sampled from January to May.



Graph. 5.3.6 - Trends in capture frequencies (CS) of *Ocypus mus* in individual sampling periods.

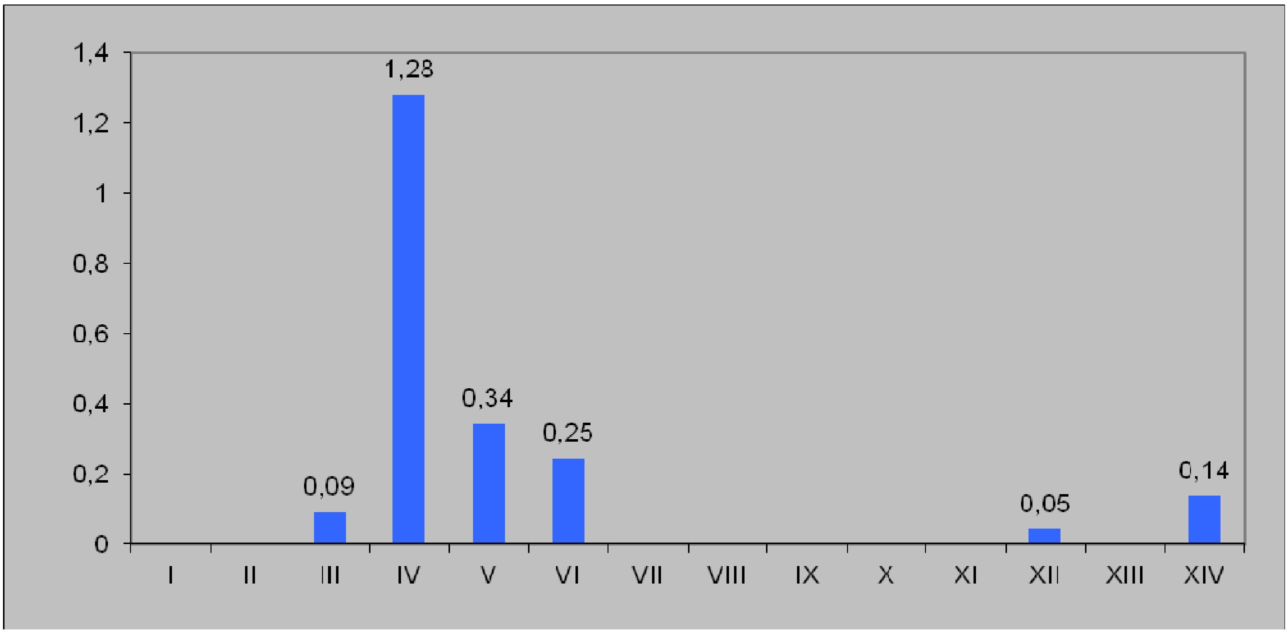
Paraphloeostiba gayndahensis

This is the species with the third CS value, which represents 10,74% of the entire Coleoptera Staphylinidae sampling. It resulted present in all the stations. The maximum CS value is recorded in the **CON** station (57,2%), and the minimum in the **BOS** station (14,88%) (graph. 5.3.7).



Graph. 5.3.7 - Trend of capture frequency (CS) of *Paraphloeostiba gayndahensis* within the single station.

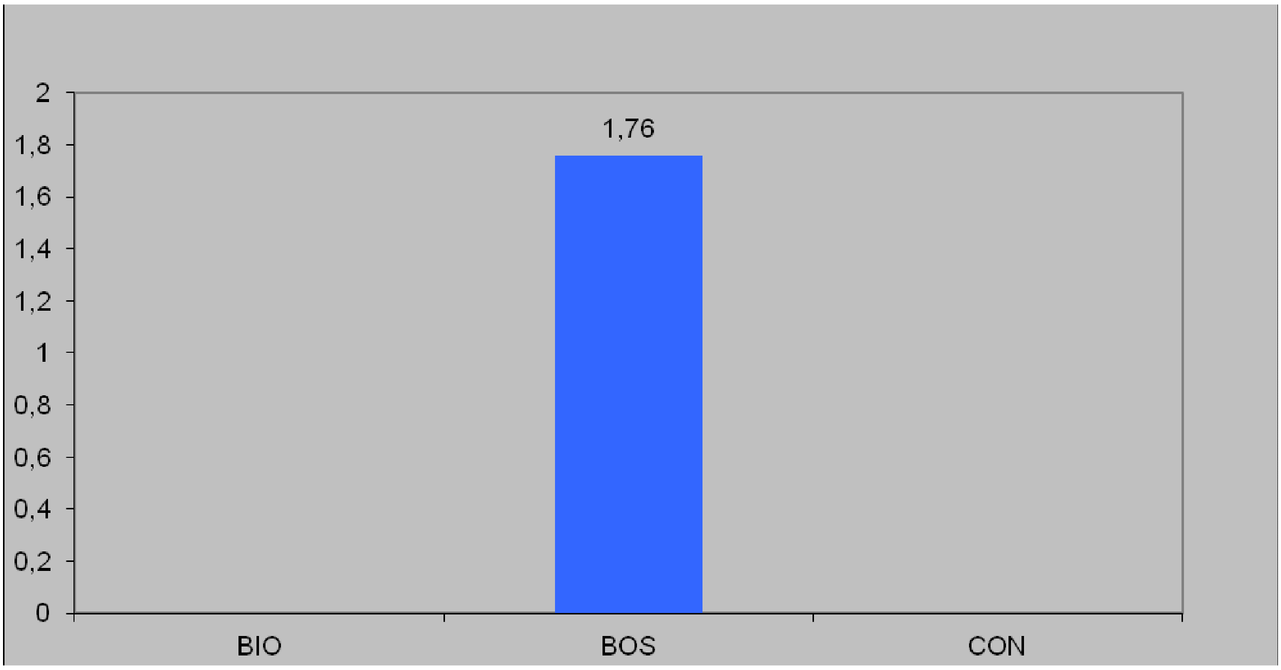
The trend of the capture frequency in the sampling period (graph. 5.3.8) shows that the catches are concentrated from June to September (III-VI periods) with a peak in July that recorded about 60% of the total CS value. The species is absent in April-May and from October to March.



Graph. 5.3.8 - Trends in capture frequencies (CS) of *Paraphloeostiba gayndahensis* in individual sampling periods.

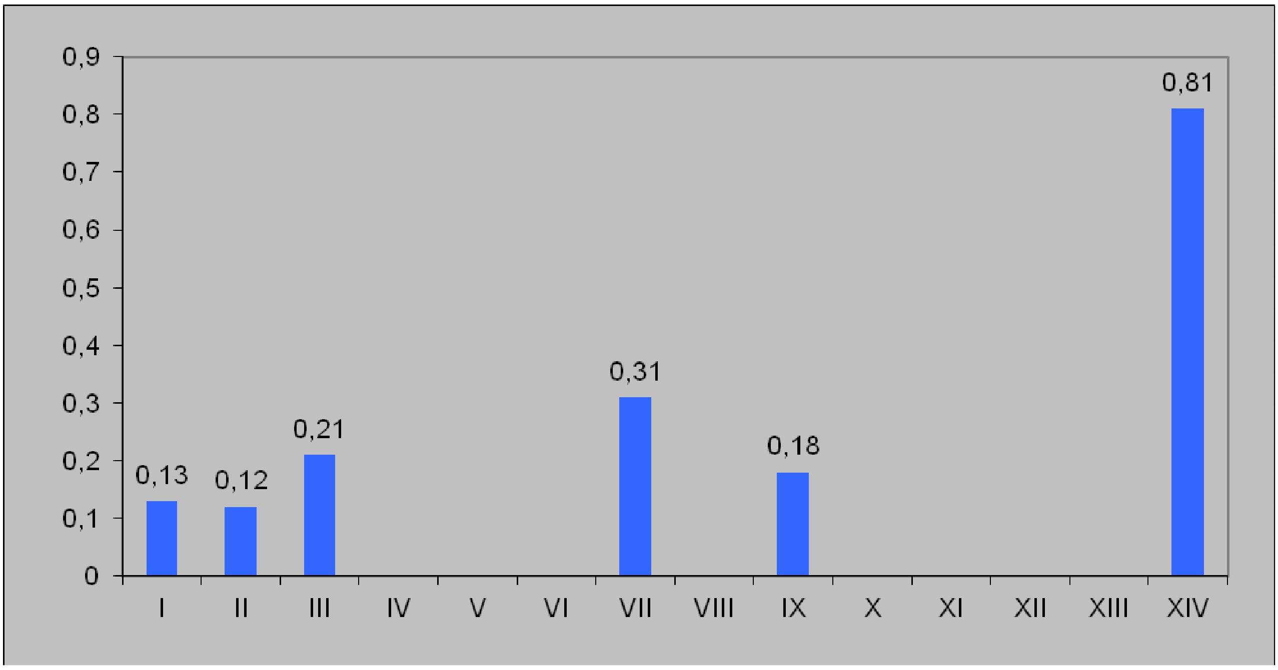
Quedius latinus

It present the fourth CS value, with 8,65% of the entire Coleoptera Staphylinidae sampling. It resulted present only in the **BOS** station (graph. 5.3.9).



Graph. 5.3.9 - Trend of capture frequency (CS) of *Quedius latinus* within the single station.

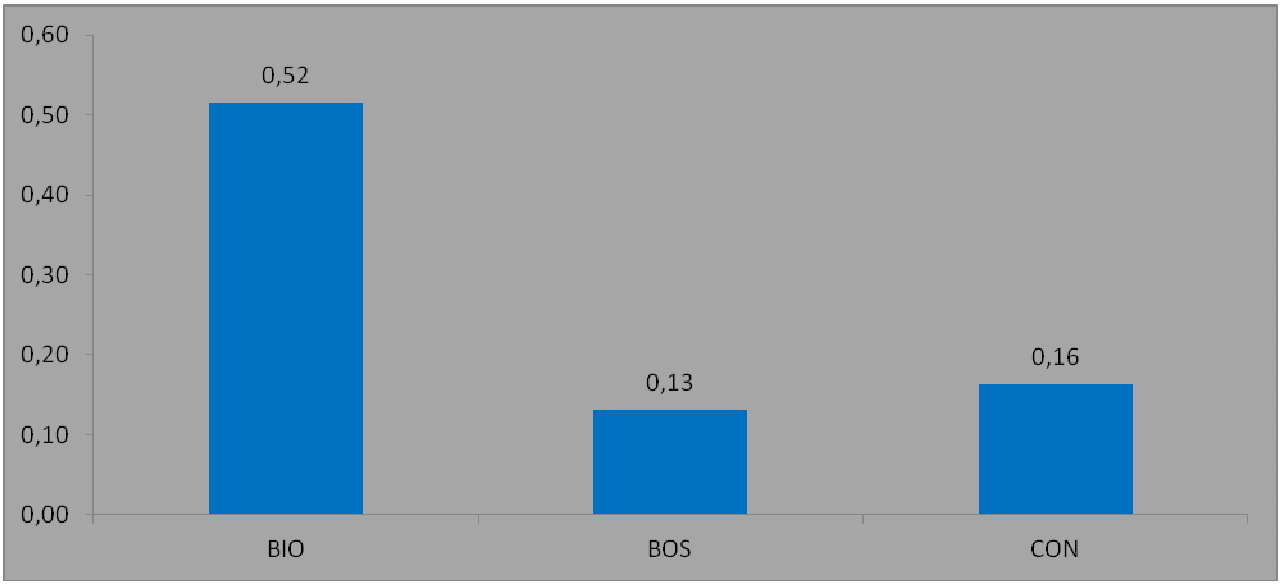
The trend of the capture frequency in the sampling period (graph. 5.3.10) shows the catches in I, II, and III periods (April, May, June 2011), VII and IX periods (October, January) with a sharp peak in XIV period (June 2012) that recorded 46% of the total CS value. The species is absent in periods IV, V, VI, VIII, X-XII.



Graph. 5.3.10 - Trends in capture frequencies (CS) of *Quedius latinus* in individual sampling periods.

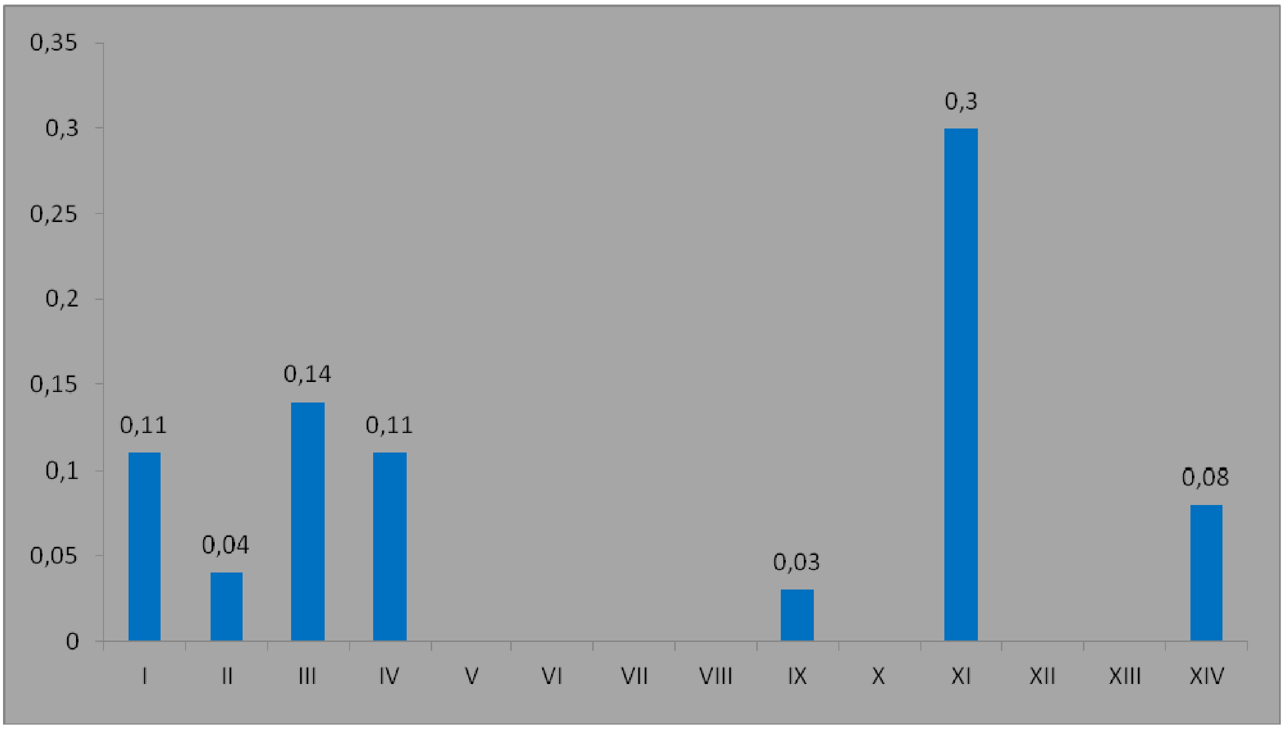
Tachyporus pusillus

It has the fifth CS value, which represents about 4% of the entire Coleoptera Staphylinidae sampling. The species has been sampled in all stations (graph. 5.3.11), with a clear CS value peak (64,19%) in the **BIO** station and a minimum (16,04%) in the **BOS** station.



Graph. 5.3.11 - Trend of capture frequency (CS) of *Tachyporus pusillus* within the single station.

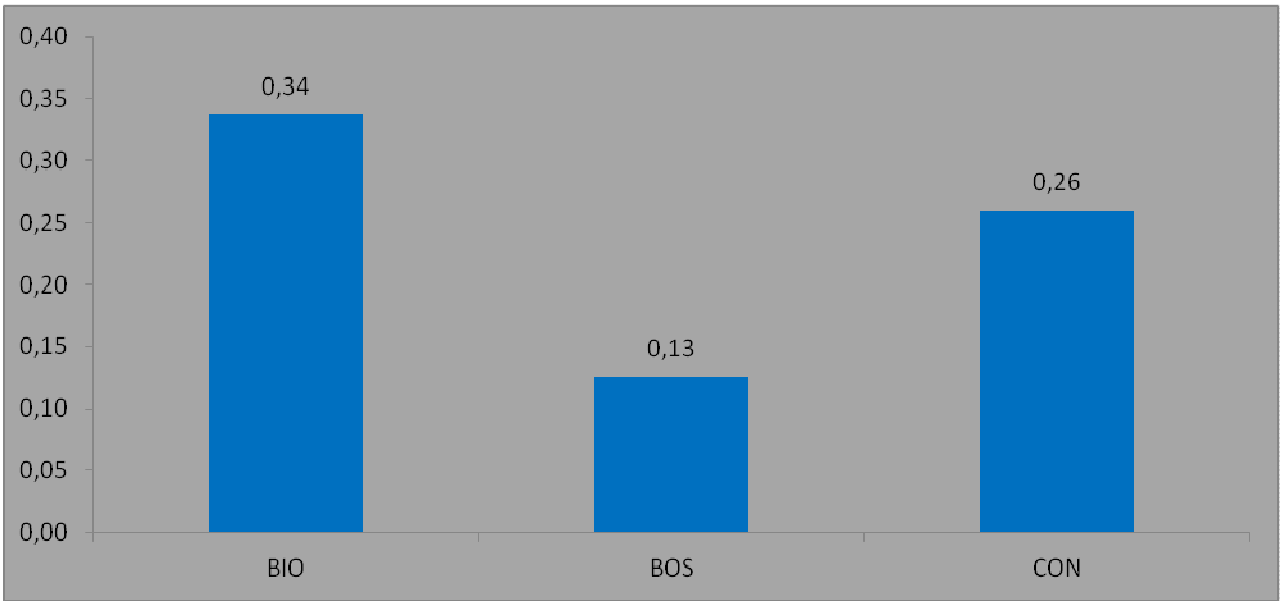
The trend of the capture frequency in the sampling period (graph. 5.3.12) shows that they are concentrated between I and IV periods (April-July), IX period (January) and XIV period (June 2012), but the maximum CS value is in the XI period (March) with 37% of the total CS value.



Graph. 5.3.12 - Trends in capture frequencies (CS) of *Tachyporus pusillus* in individual sampling periods.

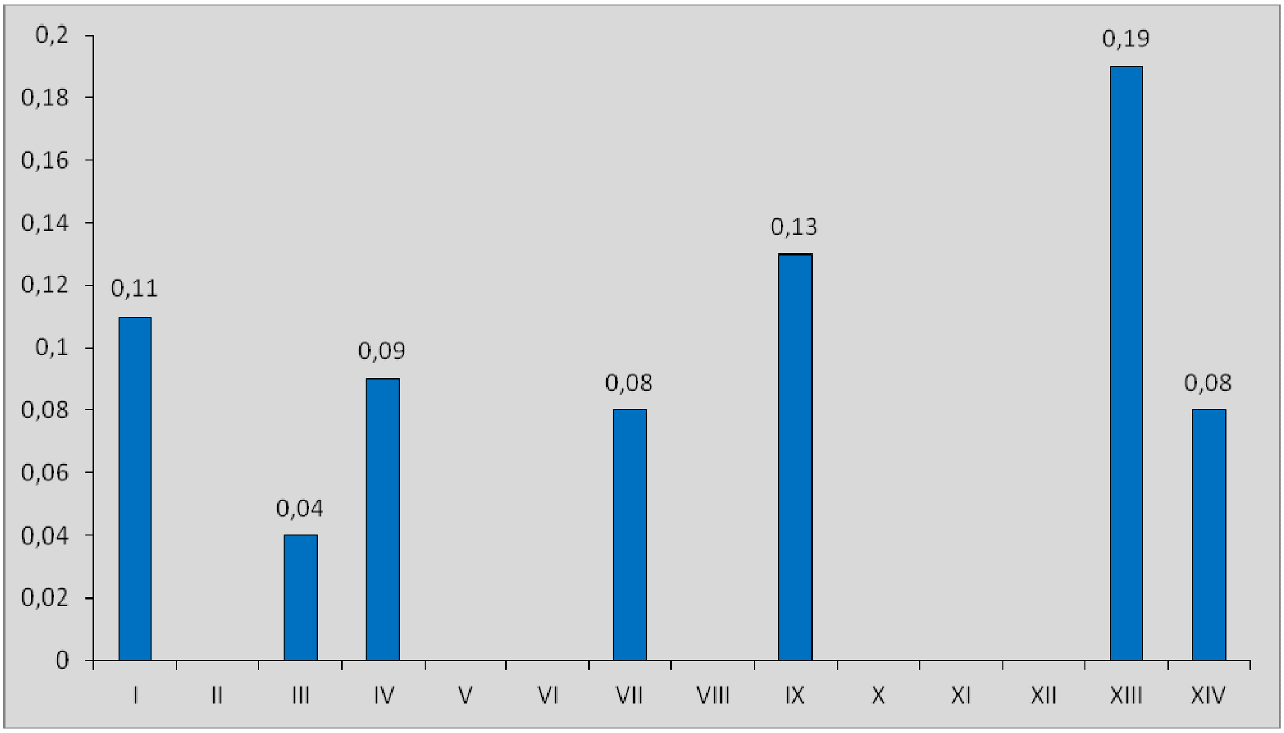
Tachyporus nitidulus

It presents the sixth CS value, which represents approximately 3,5% of the entire Coleoptera Staphylinidae sampling. The species was sampled in all stations (graph. 5.3.13), with significant CS values in the **BIO** and **CON** stations, while the **BOS** station records the minimum (18% of total CS).



Graph. 5.3.13 - Trend of capture frequency (CS) of *Tachyporus nitidulus* within the single station.

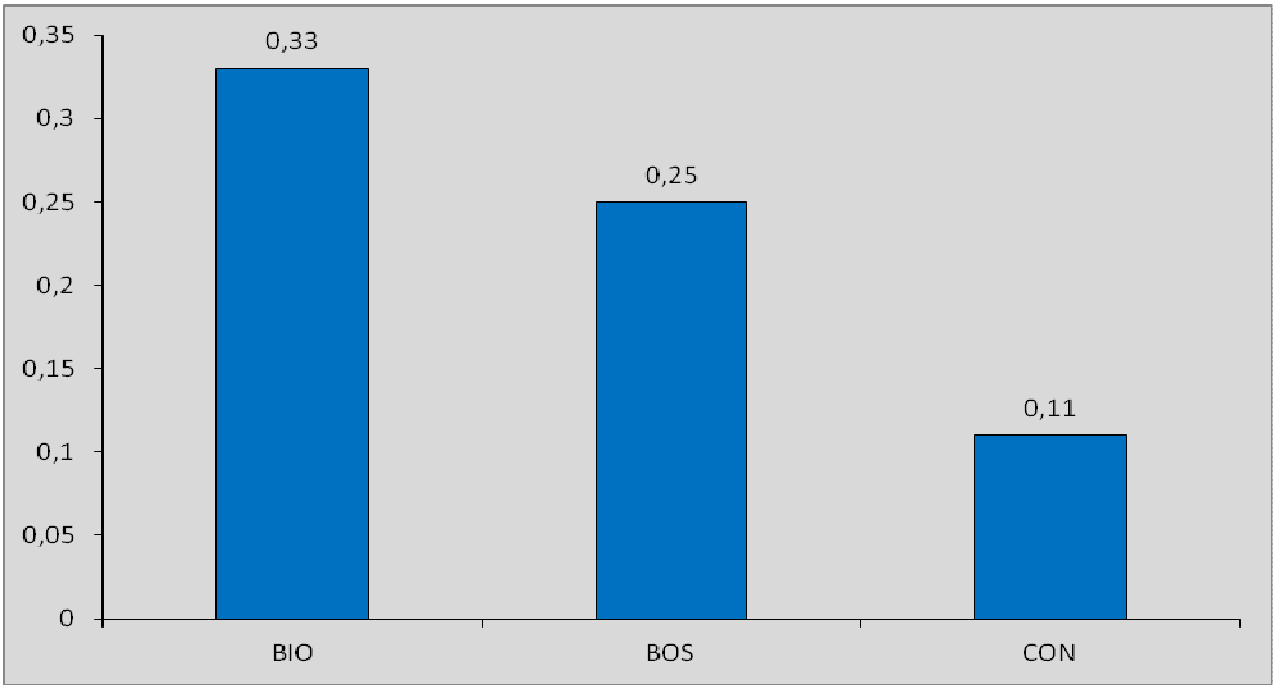
The trend of the CS values over the sample period (graph. 5.3.14), shows a concentration of capture frequencies in the periods I (April 2011), III (June 2011), IV (July), VII (October), IX (January), XIV (May 2012), peaking in XIII (June 2012), and with null CS values in other periods.



Graph. 5.3.14 - Trends in capture frequencies (CS) of *Tachyporus nitidulus* in individual sampling periods.

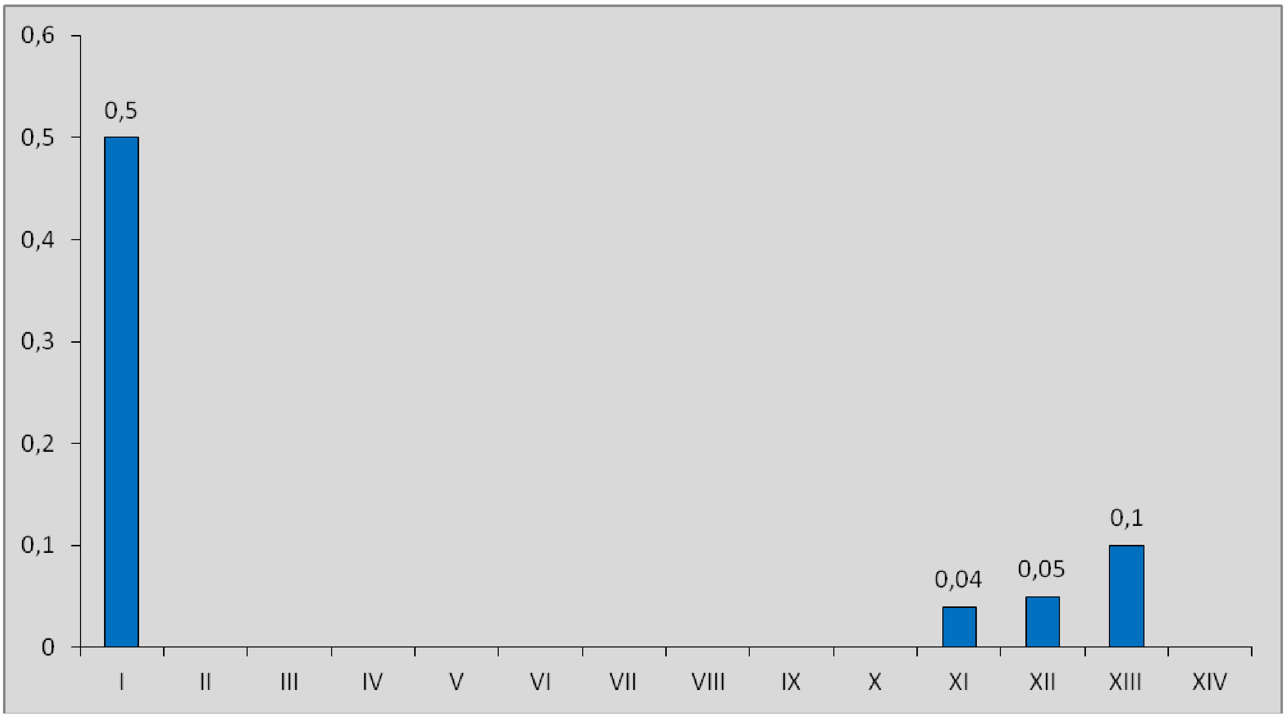
Omalium rugatum

It presents the seventh CS value, representing 3,39% of the entire Coleoptera Staphylinidae sampling. The species was sampled in all stations (graph. 5.3.15) with the maximum CS value in the **BIO** station (52,38%) and the minimum CS value in the **CON** station (15,94%). The station **BOS** registered 39,68%.



Graph. 5.3.15 - Trend of capture frequency (CS) of *Omalium rugatum* within the single station.

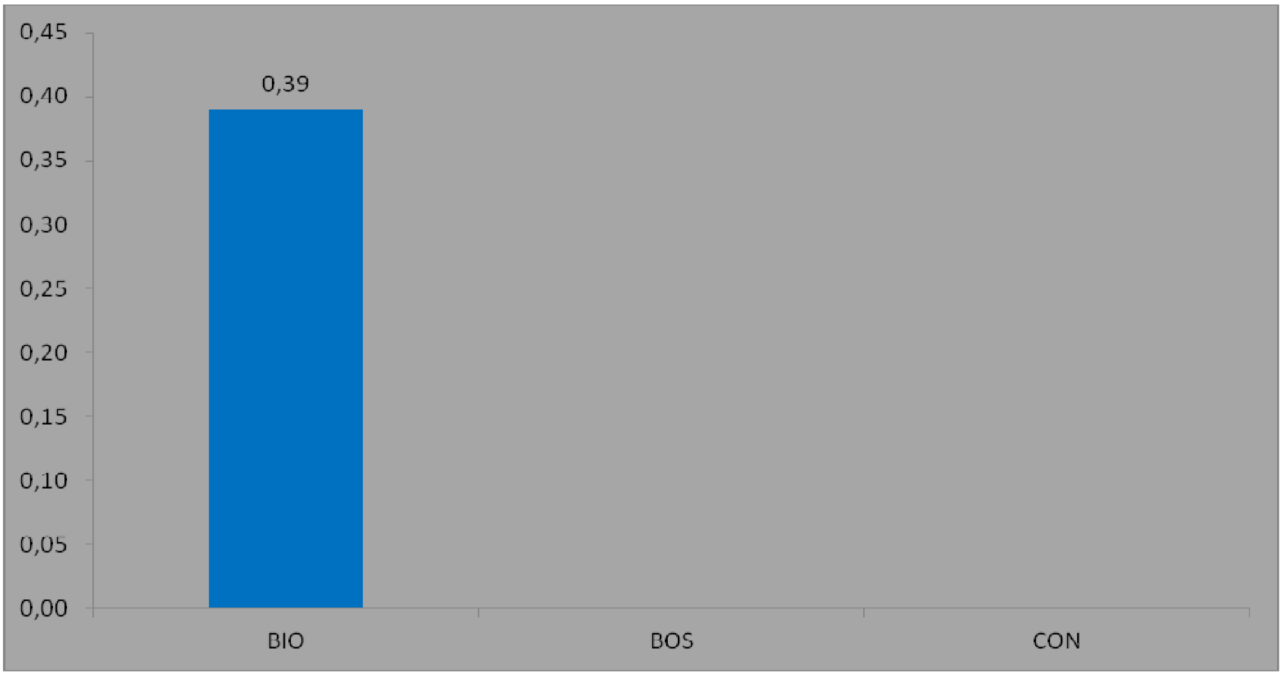
The trend of the capture frequency in the sampling period (graph. 3.5.16), shows how these are distributed in increasing between XI, XII, XIII periods (March, April and May); the species is absent in all other periods except the first period (April 2011) that registered the peak of the total CS value with 72,46%.



Graph. 5.3.16 - Trends in capture frequencies (CS) of *Omalium rugatum* in individual sampling periods.

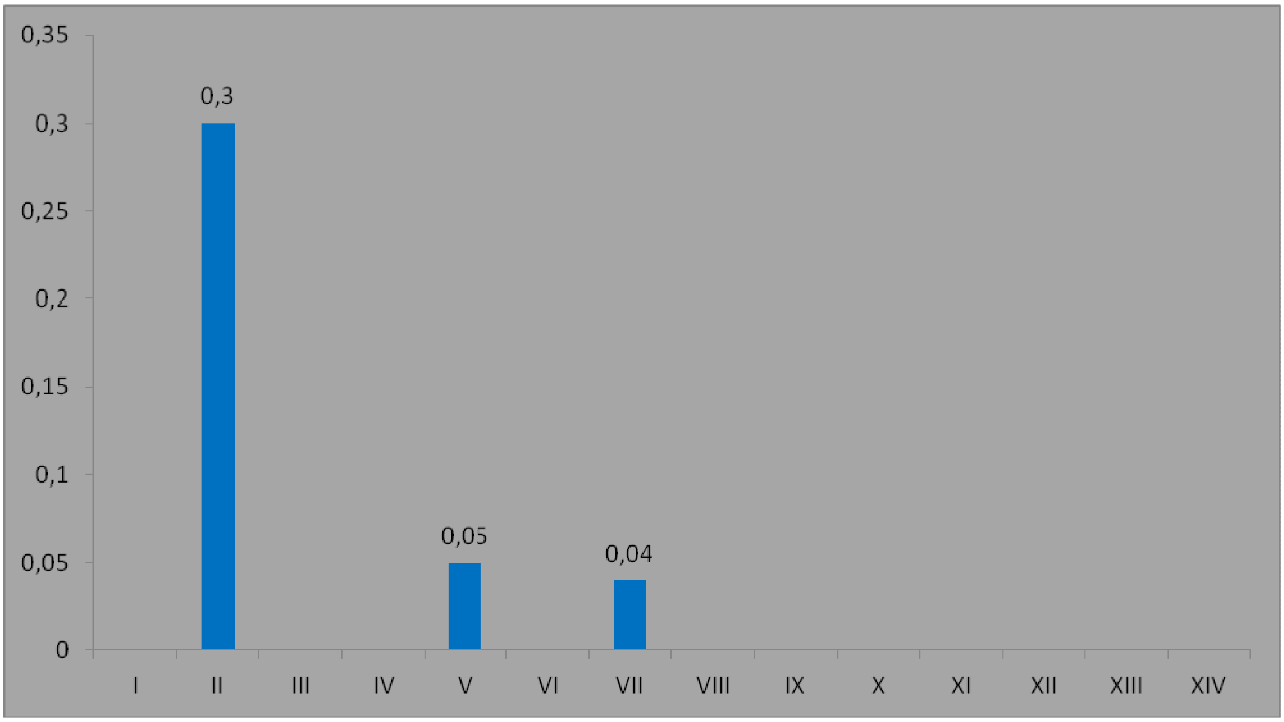
Xantholinus sp.

It presents the eighth CS value, representing 1,91% of the entire Coleoptera Staphylinidae sampling. The species resulted sampled only in the **BIO** station (graph. 5.3.17).



Graph. 5.3.17 - Trend of capture frequency (CS) of *Xantholinus* sp. within the single station.

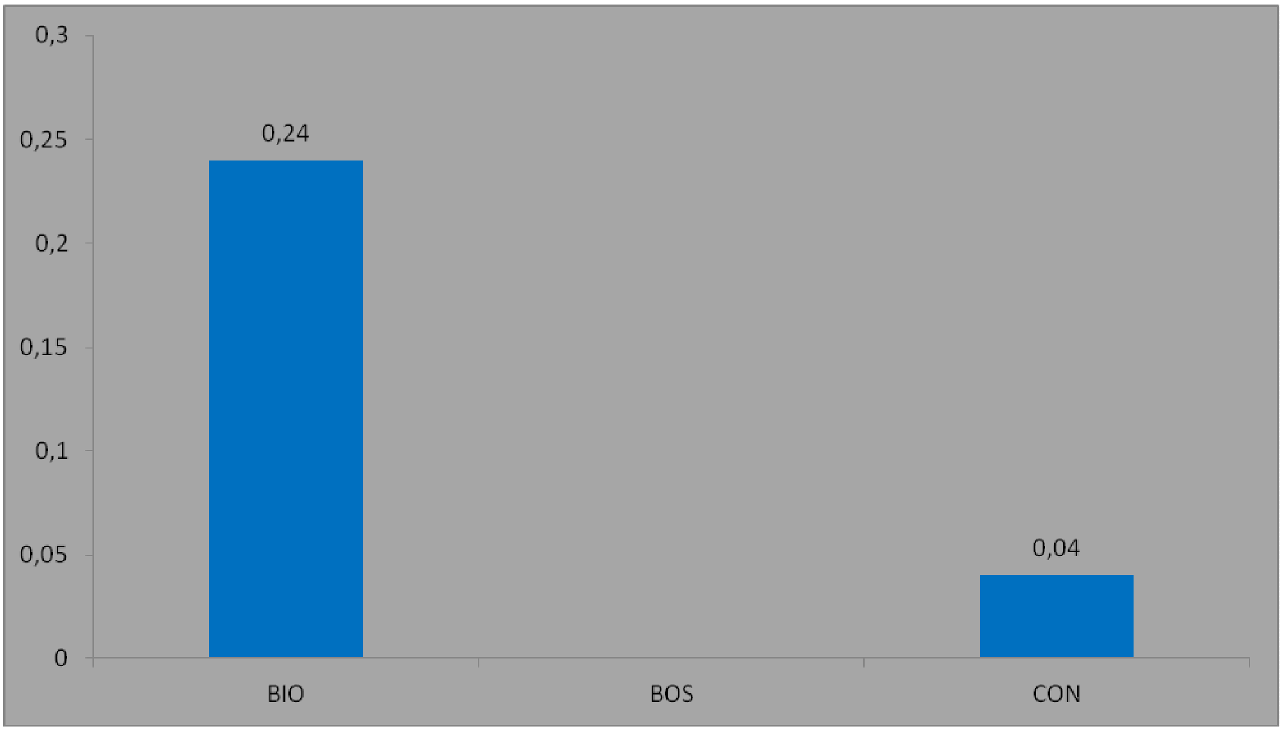
The trend of the capture frequency in the sampling period (graph. 5.3.18) shows that all catches have occurred during the II (May) (76,92 %), V (August) and VII (October) periods.



Graph. 5.3.18 - Trends in capture frequencies (CS) of *Xantholinus* sp. in individual sampling periods.

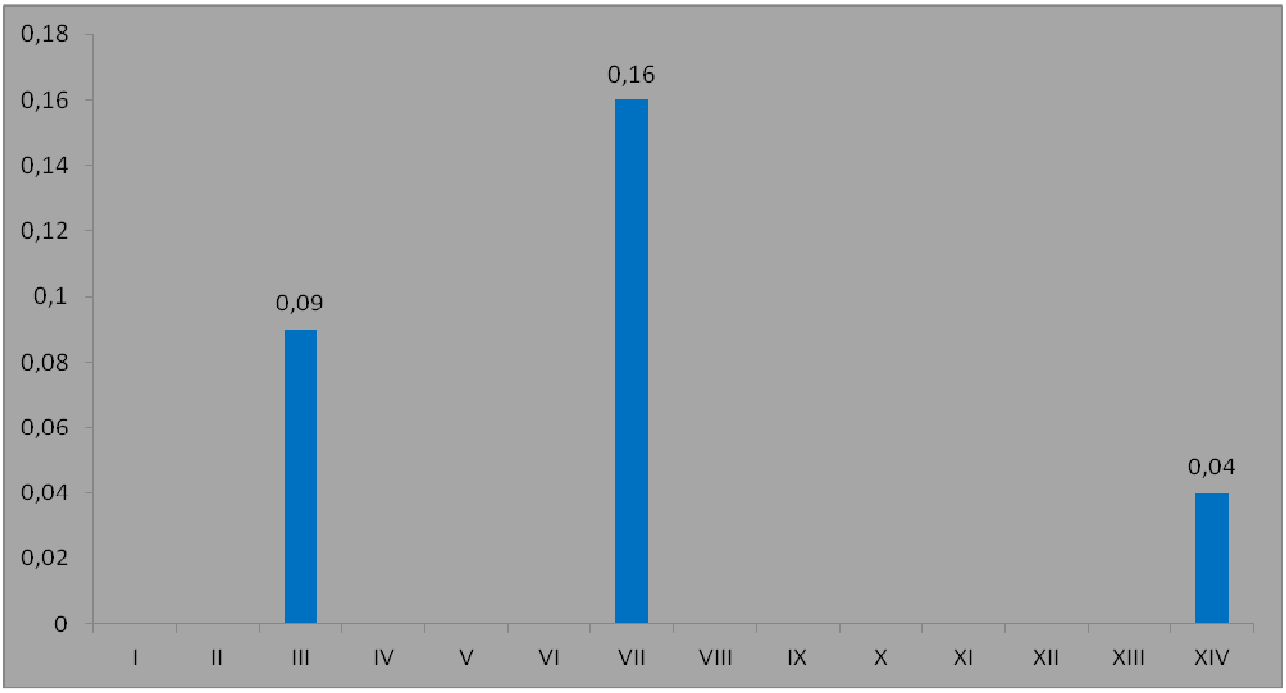
Quedius levicollis

It shows the ninth CS value, representing 1,42% of the entire Coleoptera Staphylinidae sampling. The species resulted sampled just in the **BIO** station with 82,75% of the total CS value and in the **CON** station (graph. 5.3.19).



Graph. 5.3.19 - Trend of capture frequency (CS) of *Quedius levicollis* within the single station.

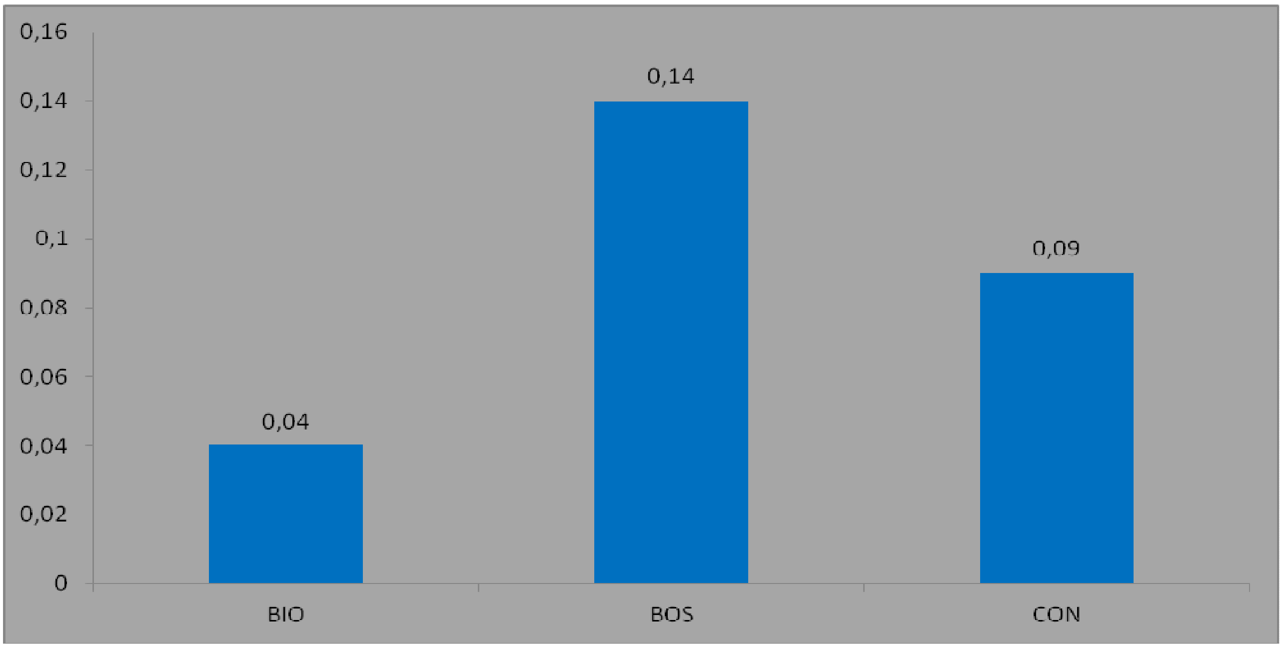
The trend of the capture frequency in the sampling period (graph. 5.3.20) shows three periods of activity: the greatest in VII (October), the lowest in XIV (June 2012) and the medium value in III (June 2011); in the remaining periods the species resulted absent.



Graph. 5.3.20 - Trends in capture frequencies (CS) of *Quedius levicollis* in individual sampling periods.

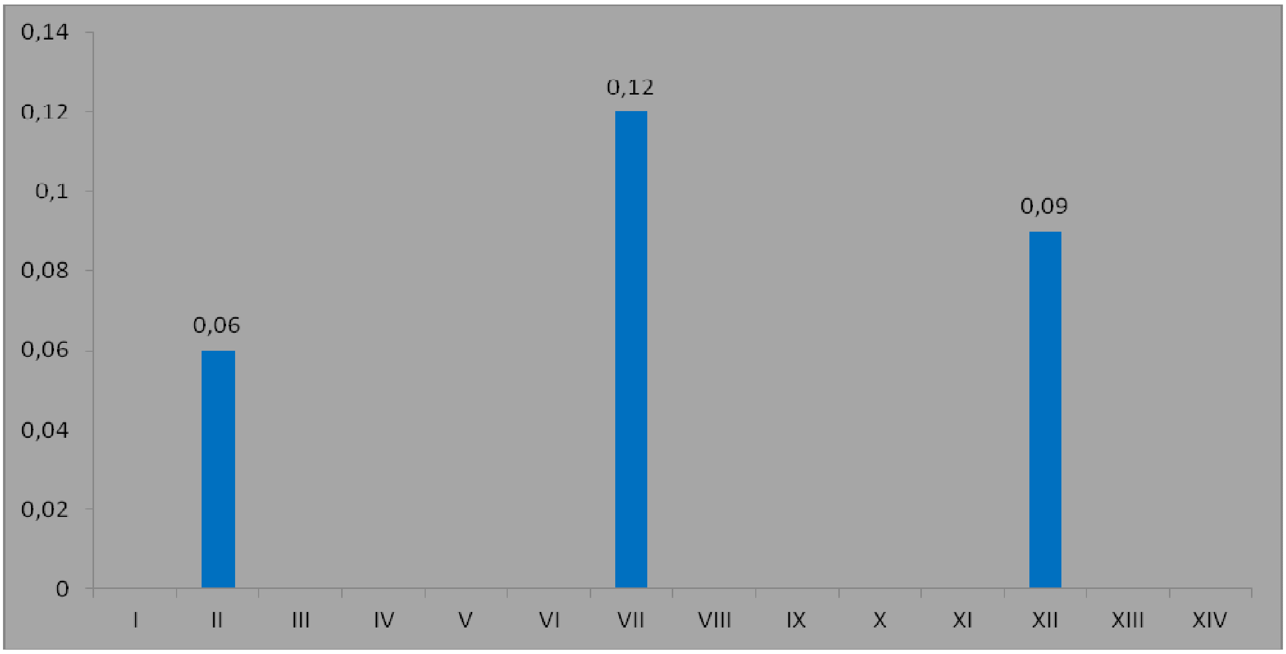
Mycetoporus mulsanti

It shows the tenth CS value, representing 1,32% of the entire Coleoptera Staphylinidae sampling. The species was sampled in all stations, with the maximum CS value in the **BOS** station (graph. 5.3.21).



Graph. 5.3.21 - Trend of capture frequency (CS) of *Mycetoporus mulsanti* within the single station.

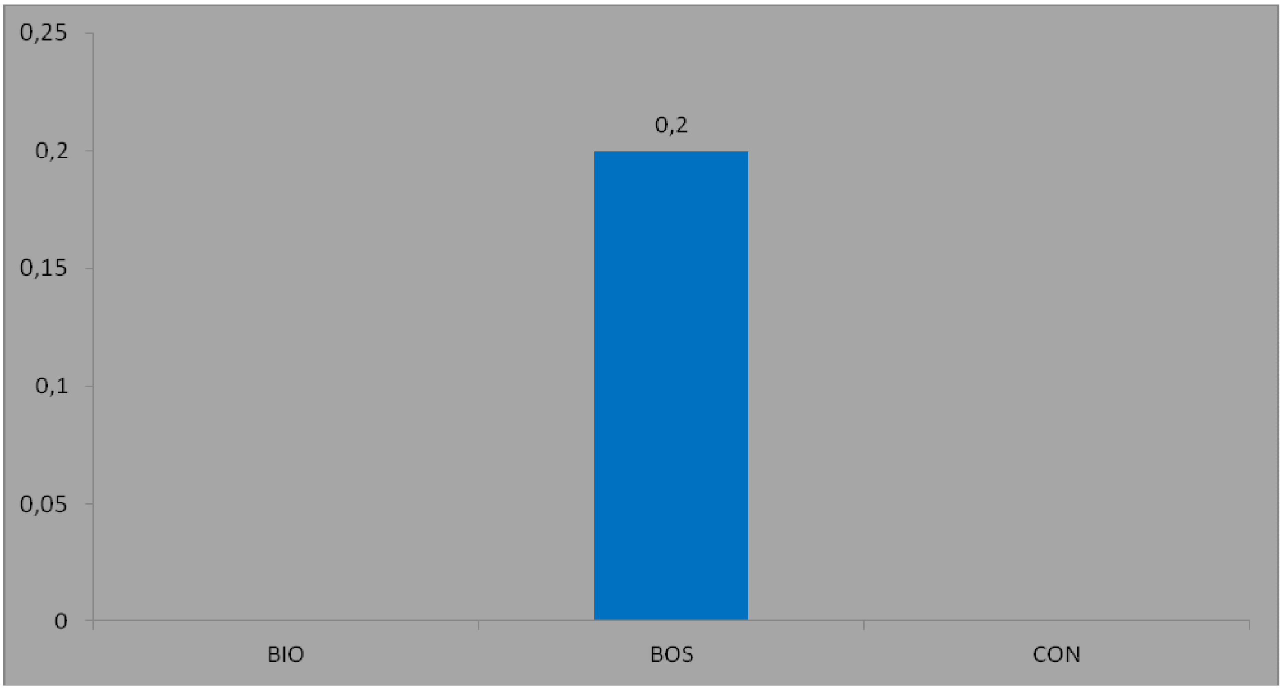
The trend of the capture frequency in the sampling period (graph. 5.3.22) is quite irregular with the greatest number of catches in the periods II (May), VII (October), and XII (April 2012).



Graph. 5.3.22 - Trends in capture frequencies (CS) of *Mycetoporus mulsanti* in individual sampling periods.

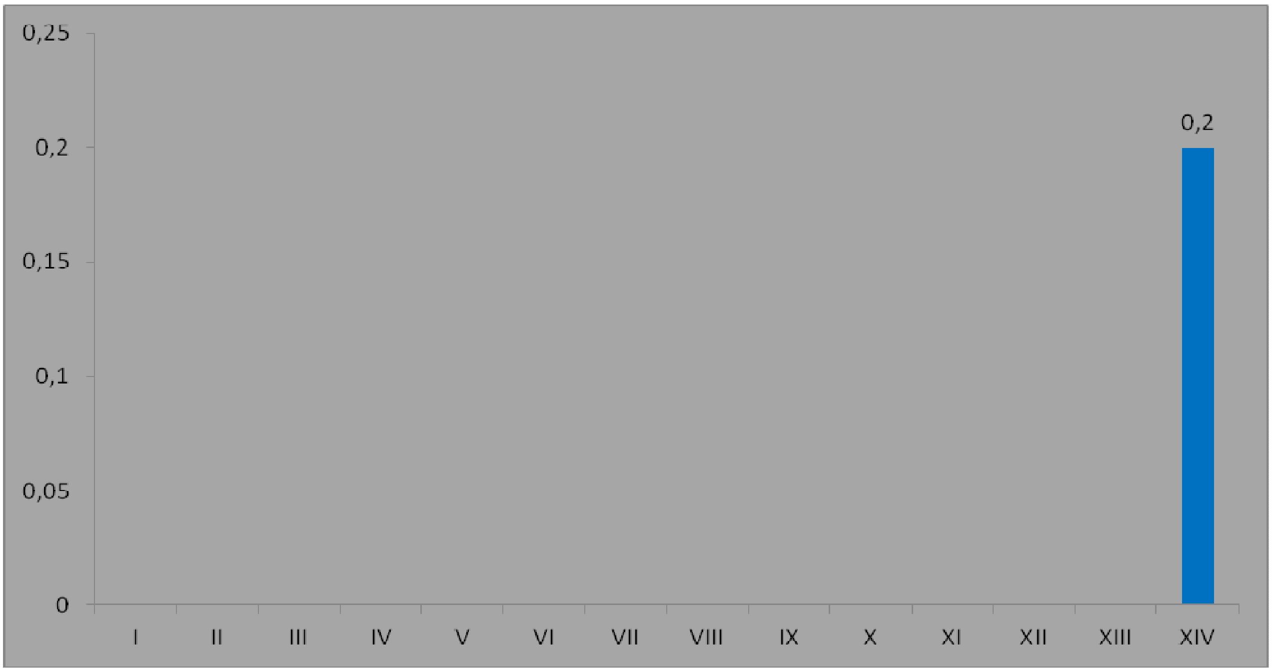
Lordithon exoletus

It shows the eleventh CS value, representing 0,98% of the entire Coleoptera Staphylinidae sampling. The species was sampled just in the **BOS** station (graph. 5.3.23).



Graph. 5.3.23 - Trend of capture frequency (CS) of *Lordithon exoletus* within the single station.

The trend of the capture frequency in the sampling period (graph. 5.3.24) shows that the species is present only the XIV period (June 2012).



Graph. 5.3.24 - Trends in capture frequencies (CS) of *Lordithon exoletus* in individual sampling periods.

6 ANALYSIS PER STATION FOR SPECIES OF CARABIDAE, TENEBRIONIDAE, STAPHILINIDAE

6.1 CARABIDAE

Station BIO (Orchard)

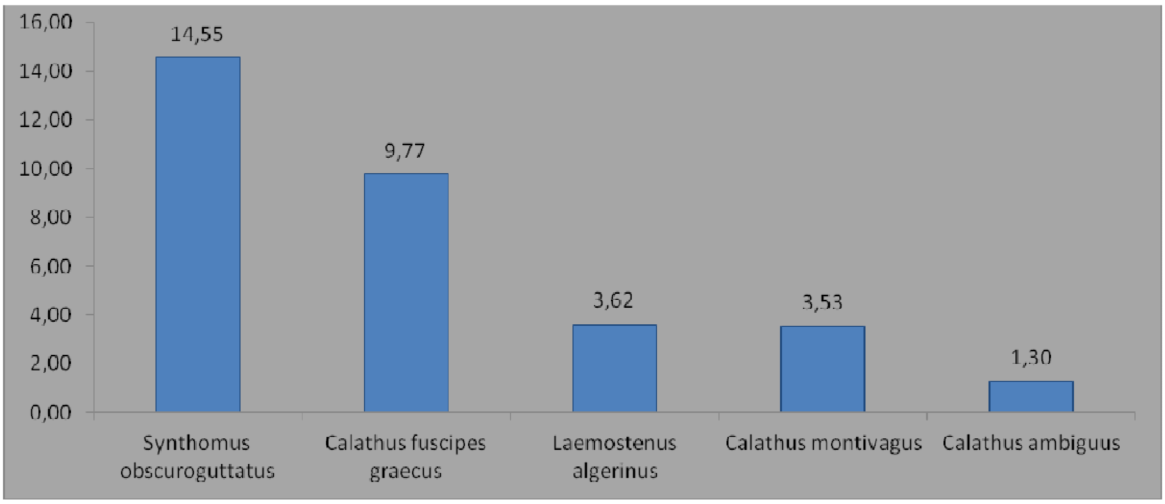
In the **BIO** station a total of **14** Carabidae species was sampled with a CS value of **34,52**.
Synthomus obscuroguttatus (CS: 14,55) and ***Calathus fuscipes graecus*** (CS: 9,82) strongly characterize this station regarding the capture frequency; other species with relatively higher CS values are (see also graph. 6.1.1):

Laemostenus algerinus: CS 3,62
Calathus montivagus: CS 3,53
Calathus ambiguus: CS 1,30

These fifth species represent the 95% of the total CS value of the station, with ***Synthomus obscuroguttatus*** and ***Calathus fuscipes graecus*** that account the 70,45% of the total catches.
The trend of the Carabidae species captures frequency in the 8 **BIO** station traps is shown in table 6.1.1.

Species	BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	Tot_CS
Synthomus obscuroguttatus	1,09	4,16	1,47	2,67	2,25	0,99	1,20	0,74	14,55
Calathus fuscipes graecus	2,01	2,29	0,44	2,67	0,53	0,45	0,79	0,58	9,77
Laemostenus algerinus	0,24	2,16	0,33	0,05	0,21	0,23	0,22	0,17	3,62
Calathus montivagus	0,66	1,90	0,04	0,72		0,04	0,17		3,53
Calathus ambiguus			0,04	0,10	0,81	0,26		0,09	1,30
Harpalus decipiens	0,05	0,18	0,09	0,18	0,04				0,54
Calathus cinctus	0,08	0,20	0,04	0,04			0,07		0,43
Synuchus vivalis		0,22	0,04		0,06				0,32
Platyderus sp.				0,04	0,09				0,13
Harpalus distinguendus					0,09				0,09
Cymindis miliaris						0,06			0,06
Harpalus sulphuripes						0,05			0,05
Carabidae sp.		0,04							0,04
Cymindis axillaris		0,04							0,04
Carabus lefebvrei			0,04						0,04
Tot_CS	4,13	11,20	2,52	6,48	4,09	2,07	2,44	1,58	**34,52**
Nb_species	6	9	9	8	8	7	5	4	**14**

Tab. 6.1.1 - Trend of the Carabidae species captures frequency (CS) in the **BIO** station traps.



Graph. 6.1.1 - Captures frequency (CS) of the more abundantly Carabidae species sampled in the **BIO** station.

Among the sampled species, just 3, *Synthomus obscuroguttatus*, *Calathus fuscipes graecus* and *Laemostenus algerinus,* are present in all traps, although sometimes with different CS values; *Calathus montivagus* is absent in the traps **BIO-05** and **BIO-08**, *Calathus ambiguus* is absent in the traps **BIO-01**, **BIO-02**, **BIO-07**, *Harpalus decipiens* is absent in the traps **BIO-06**, **BIO-07**, **BIO-08** and *Calathus cinctus* is absent in the traps **BIO-05**, **BIO-06** and **BIO-08**.

In the table below (tab. 6.1.2) are indicated the rank/abundance species in the individual traps considering the species with CS values ≥ 0.1 (7 in **BIO-02**, 5 in **BIO-01** and **BIO-04**, 4 in **BIO-05**, **BIO-06** and **BIO-07** and 3 in **BIO-03** and **BIO-08**).

Synthomus obscuroguttatus ranks first in all traps except in the traps **BIO-01** and **BIO-04** (where it ranks second) in which the first is *Calathus fuscipes graecus* that ranks second in traps **BIO-02**, **BIO-3**, **BIO-6**, **BIO-07**, **BIO-08** and third in **BIO-05**; *Calathus ambiguus* (absent in traps **BIO-01**, **BIO-02**, and **BIO-07**) ranks second in trap **BIO-05**, and third in **BIO-06**.

BIO-01	BIO-02
Calathus fuscipes graecus	*Synthomus obscuroguttatus*
Synthomus obscuroguttatus	*Calathus fuscipes graecus*
Calathus montivagus	*Laemostenus algerinus*
Laemostenus algerinus	*Calathus montivagus*
Calathus cinctus	*Synuchus vivalis*
	Calathus cinctus
	Harpalus decipiens

BIO-03	BIO-04
Synthomus obscuroguttatus	*Calathus fuscipes graecus*
Calathus fuscipes graecus	*Synthomus obscuroguttatus*
Laemostenus algerinus	*Calathus montivagus*
	Harpalus decipiens
	Calathus ambiguus

BIO-05	BIO-06
Synthomus obscuroguttatus	*Synthomus obscuroguttatus*
Calathus ambiguus	*Calathus fuscipes graecus*
Calathus fuscipes graecus	*Calathus ambiguus*
Laemostenus algerinus	*Laemostenus algerinus*

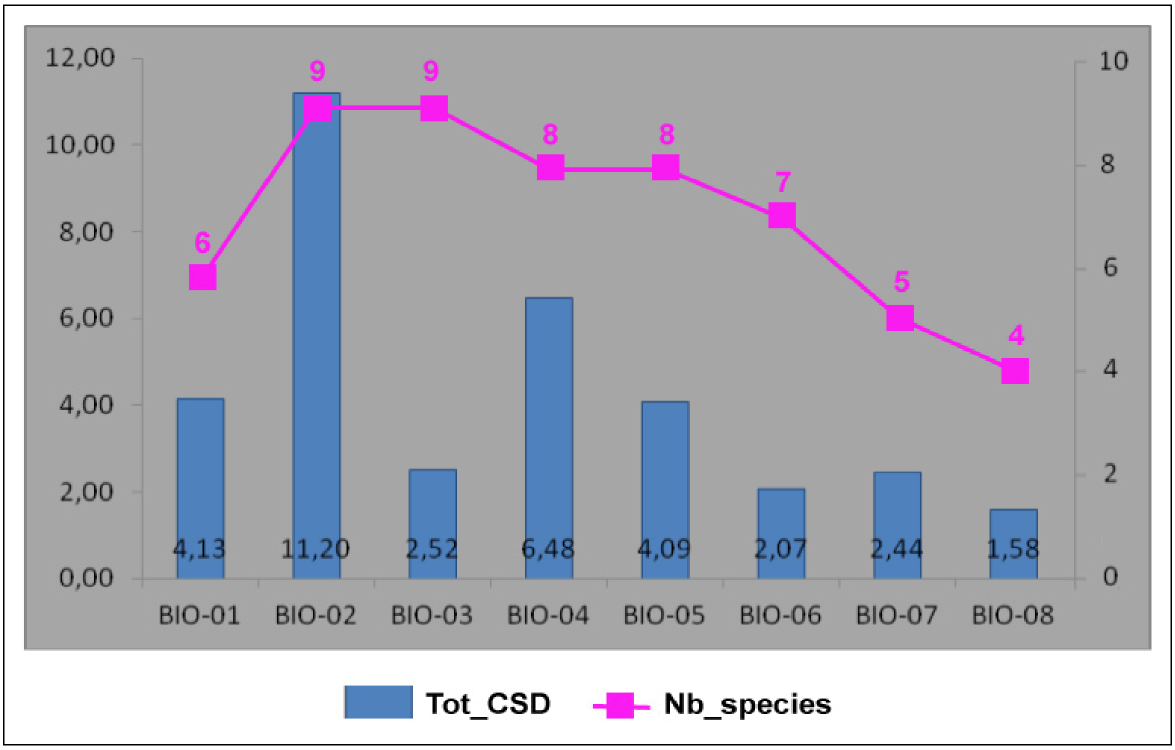
BIO-07	BIO-08
Synthomus obscuroguttatus	*Synthomus obscuroguttatus*
Calathus fuscipes graecus	*Calathus fuscipes graecus*
Laemostenus algerinus	*Laemostenus algerinus*
Calathus montivagus	

Tab. 6.1.2 – Rank/abundance of the Carabidae species in the **BIO** station traps.

The graph. 6.1.2 represents Carabidae capture frequencies and sampled species number in each trap of the **BIO** station.

The CS values found in the individual traps, present the highest value in the trap **BIO-02** and the lowest value in the trap **BIO-08**.

No trap has collected all **14** species sampled in the station. The greatest species number (**9**) was recorded in the traps **BIO-02** and **BIO-03**, the minimum (**4**) in the trap **BIO-08**.



Graph. 6.1.2 – Captures frequency (CS) and number of the Carabidae species in the **BIO** station traps.

Station BOS (WOODED REMNANTS)

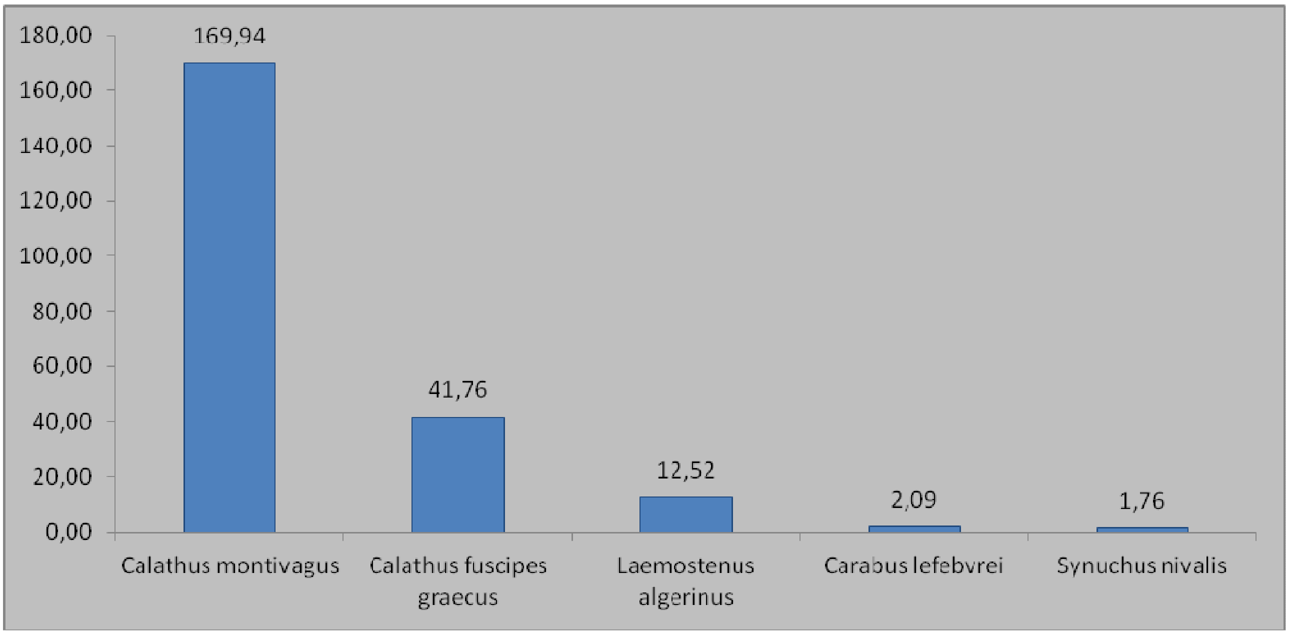
In the **BOS** station a total of **12** Carabidae species was sampled with a CS value of **229,20**.
Calathus montivagus (CS: 169,94) strongly characterizes this station regarding the capture frequency (74,14%); other species that show significant values of CS (see also graph. 6.1.3) are:

Calathus fuscipes graecus: CS 41,76
Laemostenus algerinus: CS 12,52
Carabus lefebvrei: CS 2,09
Synuchus nivalis: CS 1,76

The trend of the Carabidae species captures frequency in the 5 **BOS** station traps is shown in table 6.1.3.

Species	BOS-01	BOS-02	BOS-03	BOS-04	BOS-05	Tot_CS
Calathus montivagus	41,46	51,15	45,60	11,42	20,32	169,94
Calathus fuscipes graecus	12,33	17,15	3,73	4,49	4,05	41,76
Laemostenus algerinus	4,13	3,14	2,08	1,17	2,01	12,52
Carabus lefebvrei	0,20	0,77	0,70	0,35	0,06	2,09
Synuchus vivalis	0,83	0,45	0,15		0,33	1,76
Synthomus obscuroguttatus		0,20				0,20
Leistus spinibarbis fiorii	0,06		0,14			0,20
Calathus cinctus	0,06		0,12			0,19
Calathus ambiguus	0,09			0,08		0,17
***Platyderus* sp.**	0,06			0,10		0,17
Notiophilus rufipes	0,16					0,16
Cymindis axillaris			0,06			0,06
Tot_CS	59,38	72,85	52,59	17,61	26,76	**229,20**
Nb_species	10	6	8	6	5	**12**

Tab. 6.1.3 - Trend of the Carabidae species captures frequency (CS) in the **BOS** station traps.



Graph. 6.1.3 – Captures frequency (CS) of the more abundantly Carabidae species sampled in the **BOS** station.

Among sampled species, four are present in all traps: *Calathus montivagus, Calathus fuscipes graecus, Laemostenus algerinus, Carabus lefebvrei; Synuchus vivalis* is absent in trap **BOS-04**, while the other species are present in only one or two traps.

In the following table (tab. 6.1.4) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.1 (6 in **BOS-01, BOS-02,** and **BOS-03**, 5 in **BOS-04**, 4 in **BOS-05**). *Calathus montivagus* ranks first, *Calathus fuscipes graecus* ranks second and *Laemostenus algerinus* third in all traps.

BOS-01
Calathus montivagus
Calathus fuscipes graecus
Laemostenus algerinus
Synuchus vivalis
Carabus lefebvrei
Notiophilus rufipes

BOS-02
Calathus montivagus
Calathus fuscipes graecus
Laemostenus algerinus
Carabus lefebvrei
Synuchus vivalis
Synthomus obscuroguttatus

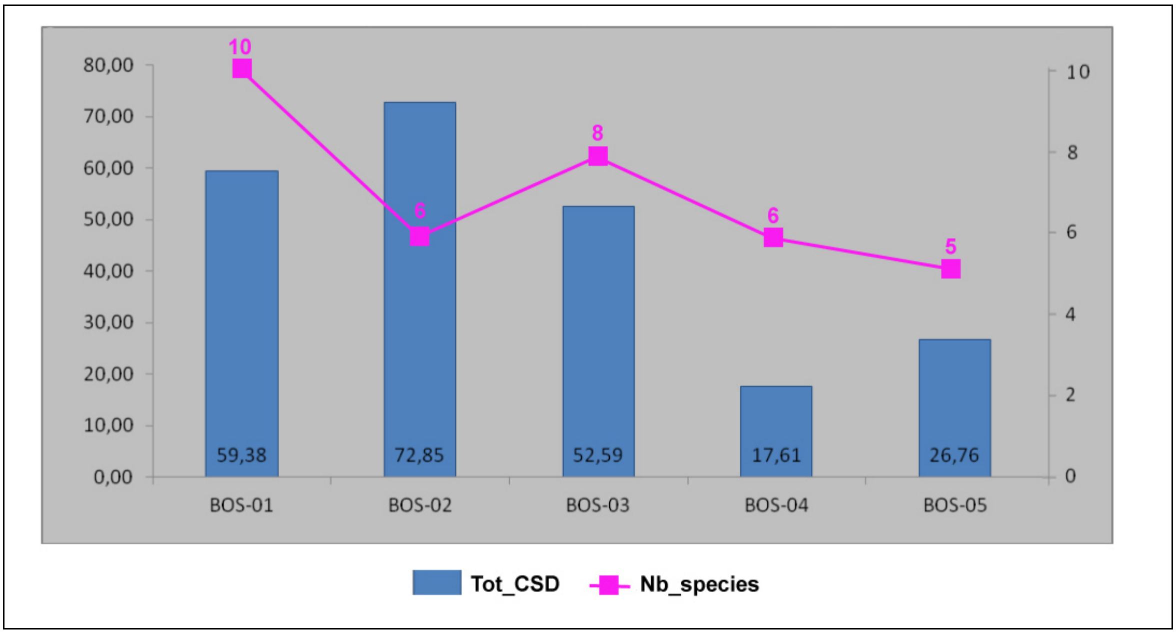
BOS-03
Calathus montivagus
Calathus fuscipes graecus
Laemostenus algerinus
Carabus lefebvrei
Synuchus vivalis
Calathus cinctus

BOS-04
Calathus montivagus
Calathus fuscipes graecus
Laemostenus algerinus
Carabus lefebvrei
Platyderus sp.

BOS-05
Calathus montivagus
Calathus fuscipes graecus
Laemostenus algerinus
Synuchus vivalis

Tab. 6.1.4 – Rank/abundance of the Carabidae species in the **BOS** station traps.

The graph. 6.1.4 represents Carabidae capture frequencies and sampled species number in each trap of the **BOS** station.
The CS values found in the individual traps, present the highest value in the trap **BOS-02** and the lowest value in the trap **BOS-04**.
No trap has collected all **12** species sampled in the station. The greatest number of species (**10**) was recorded in the trap **BIO-1** and the minimum (**5**) in the traps **BOS-05**.



Graph. 6.1.4 – Captures frequency (CS) and Carabidae species number in the **BOS** station traps.

Station CON (Orchard)

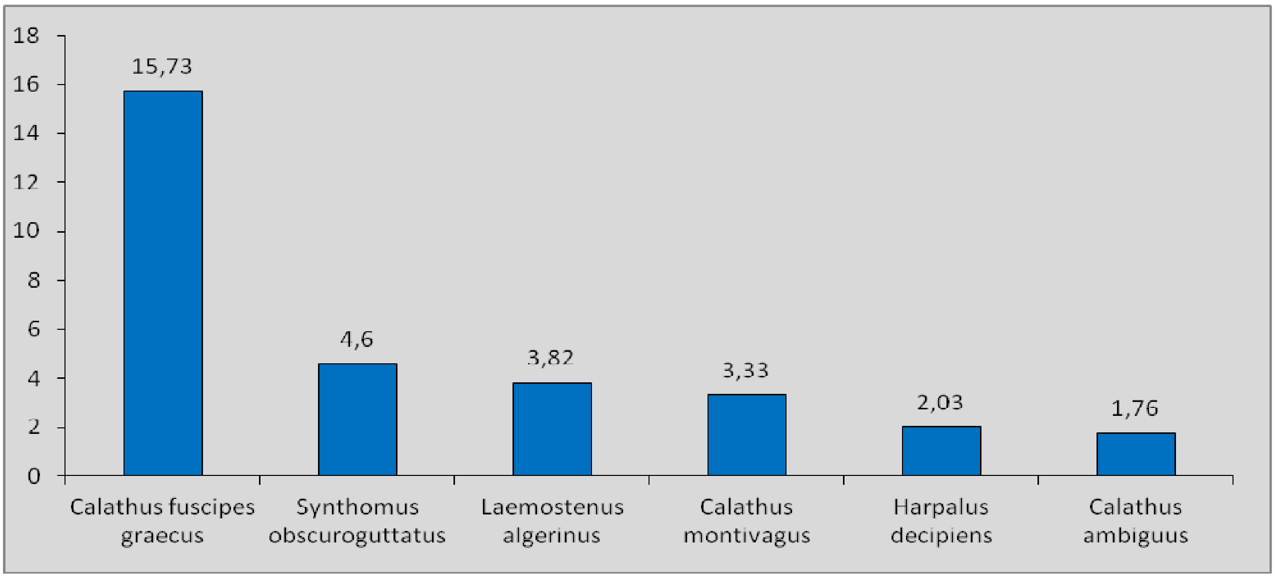
In the **CON** station a total of **17** Carabidae species was sampled with a CS value of **32,60**. ***Calathus fuscipes graecus*** (CS: 15,73) characterizes this station regarding the capture frequency (48,25%); other species that show significant values of CS (see also graph. 6.1.5) as follows:

Synthomus obscuroguttatus: CS 4,60
Laemostenus algerinus: CS 3,82
Calathus montivagus: CS 3,33
Harpalus decipiens: CS 2,03
Calathus ambiguus:CS 1,76

The trend of the Carabidae species captures frequency in the 8 **CON** station traps is shown in table 6.1.5.

Species	CON-01	CON-02	CON-03	CON-04	CON-05	CON-06	CON-07	CON-08	Tot_CS
Calathus fuscipes graecus	2,39	1,97	1,60	2,99	1,22	4,60	0,31	0,66	15,73
Synthomus obscuroguttatus	0,59	0,71	0,18	0,25	0,99	0,80	0,13	0,95	4,60
Laemostenus algerinus	0,99	0,36	0,67	0,36	0,45	0,25	0,12	0,62	3,82
Calathus montivagus	1,33		0,50	0,25	0,04	0,11	0,08	1,02	3,33
Harpalus decipiens	0,15	0,43	0,48	0,26	0,20	0,42	0,05	0,05	2,03
Calathus ambiguus	0,14	0,14	0,88	0,20	0,04	0,24	0,04	0,07	1,76
Carabus lefebvrei	0,08	0,05		0,04	0,10			0,10	0,37
Calathus cinctus	0,21				0,04	0,10			0,35
Harpalus sulphuripes					0,14				0,14
Harpalus atratus	0,05	0,05							0,10
Cymindis axillaris		0,05			0,04				0,09
***Platyderus* sp.**						0,06			0,06
Cymindis miliaris			0,05						0,05
Synuchus vivalis						0,05			0,05
Notiophilus substriatus						0,05			0,05
Microlestes luctuosus								0,05	0,05
Ocys harpaloides							0,04		0,04
Tot_CS	5,93	3,74	4,36	4,35	3,27	6,66	0,78	3,50	**32,60**
Nb_species	9	8	7	7	10	10	7	8	**17**

Tab. 6.1.5 - Trend of the Carabidae species captures frequency (CS) in the **CON** station traps.



Graph. 6.1.5 - Captures frequency (CS) of the more abundantly Carabidae species sampled in the **CON** station.

Among sampled species just 5, *Calathus fuscipes graecus, Synthomus obscuroguttatus, Laemostenus algerinus, Harpalus decipiens, Calathus ambiguus* are present in all traps; *Calathus montivagus* is present in all traps except **CON-02**; *Carabus lefebvrei* is present in traps **CON-01, CON-02, CON-04, CON-05, CON-08**. The other species are present in only three, two or one traps.
In the table below (tab. 6.1.6) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.1 (7 in **CON-01** and **CON-06**; 6 in **CON-03**, **CON-04**, and **CON-05**; 5 in **CON-02** and **CON-08** and 3 in **CON-07**). *Calathus fuscipes graecus* ranks first in all traps except in the trap **CON-8**; *Synthomus obscuroguttatus* ranks second in the traps **CON-2, CON-5, CON-6, CON-7, CON-2,** while is fourth in the trap **CON-04** and sixth in the trap **CON-03**; *Calathus montivagus*, present in all traps, ranks first in the trap **CON-08**, second in the trap **CON-01,** fourth in the trap **CON-03**, fifth in the trap **CON-04** and in sixth position in the trap **CON-06**.

CON-01
Calathus fuscipes graecus
Calathus montivagus
Laemostenus algerinus
Synthomus obscuroguttatus
Calathus cinctus
Harpalus decipiens
Calathus ambiguus

CON-2
Calathus fuscipes graecus
Synthomus obscuroguttatus
Harpalus decipiens
Laemostenus algerinus
Calathus ambiguus

CON-3
Calathus fuscipes graecus
Calathus ambiguus
Laemostenus algerinus
Calathus montivagus
Harpalus decipiens
Synthomus obscuroguttatus

CON-4
Calathus fuscipes graecus
Laemostenus algerinus
Harpalus decipiens
Synthomus obscuroguttatus
Calathus montivagus
Calathus ambiguus

CON-5
Calathus fuscipes graecus
Synthomus obscuroguttatus
Laemostenus algerinus
Harpalus decipiens
Harpalus sulphuripes
Carabus lefebvrei

CON-6
Calathus fuscipes graecus
Synthomus obscuroguttatus
Harpalus decipiens
Laemostenus algerinus
Calathus ambiguus
Calathus montivagus
Calathus cinctus

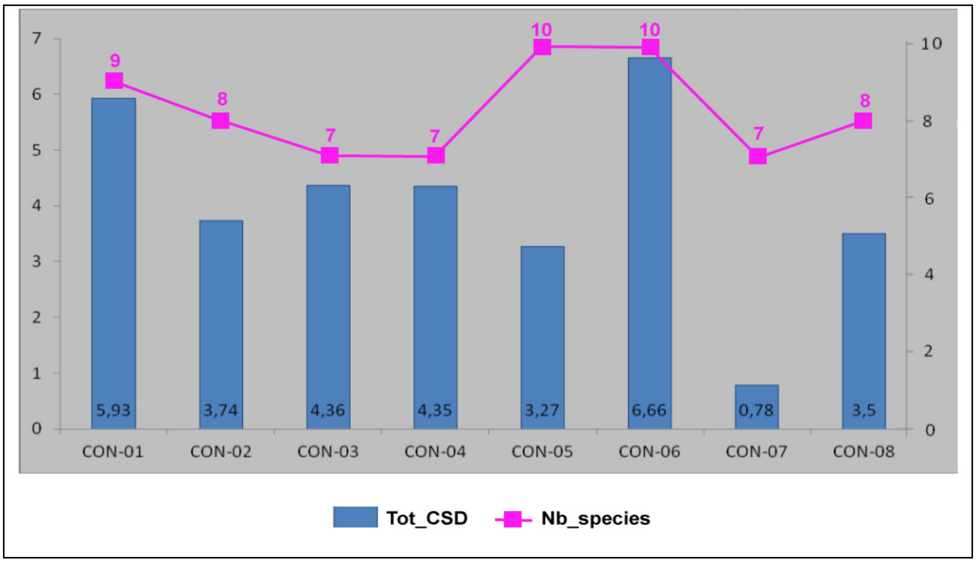
CON-7
Calathus fuscipes graecus
Synthomus obscuroguttatus
Laemostenus algerinus

CON-8
Calathus montivagus
Synthomus obscuroguttatus
Calathus fuscipes graecus
Laemostenus algerinus
Carabus lefebvrei

Tab. 6.1.6 – Rank/abundance of the Carabidae species in the **CON** station traps.

The graph. 6.1.6 represents Carabidae capture frequencies and number of species sampled in each trap of the **CON** station.
The CS values found in the individual traps, present the highest value in the trap **CON-01** and the lowest value in the trap **CON-07**.

No trap has collected all the **17** species sampled in the station. The greatest number of species (**10**) was recorded in the trap **CON-5** and **CON-06**, the minimum (**7**) in the traps **CON-03**, **CON-04** and **CON-07**.



Graph. 6.1.6 – Captures frequency (CS) and Carabidae species number in the **CON** station traps.

6.2 TENEBRIONIDAE

Station BIO (Orchard)

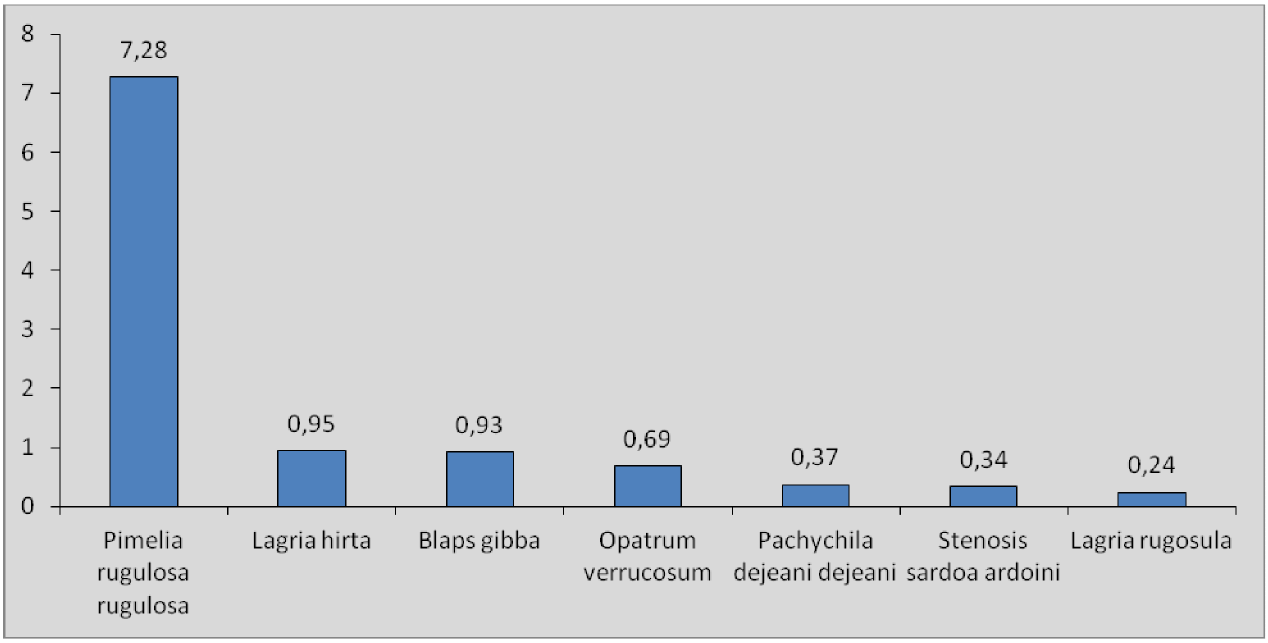
In the **BIO** station a total of **9** Tenebrionidae species was sampled with a CS value of **10,89**. ***Pimelia rugulosa rugulosa*** (CS: 7,28) strongly characterizes this station regarding the capture frequency (66,85%); other species with relatively higher CS values are (see also graph. 6.2.1):

Lagria hirta: CS 0,95
Blaps gibba: CS 0,93
Opatrum verrucosum: CS 0,69

These 4 species represent 90,44% of the CS total value of the station.
The trend of the Tenebrionidae species captures frequency in the 8 **BIO** station traps is shown in table 6.2.1.

TAXA	BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	Tot_CS
Pimelia rugulosa rugulosa	0,08	0,23	0,88	0,80	1,72	1,30	0,46	1,81	7,28
Lagria hirta		0,91			0,04				0,95
Blaps gibba		0,39				0,13	0,33	0,09	0,93
Opatrum verrucosum		0,04	0,14	0,04	0,10	0,19	0,04	0,14	0,69
Pachychila dejeani dejeani			0,05			0,09	0,04	0,19	0,37
Stenosis sardoa ardoini	0,19	0,06		0,05				0,04	0,34
Lagria rugosula		0,05		0,09		0,05	0,05		0,24
***Isomira* sp.**			0,05						0,05
Dendarus lugens		0,05							0,05
Tot_CS	0,27	1,72	1,11	0,98	1,86	1,77	0,91	2,27	**10,89**
Nb_Species	2	7	4	4	3	5	5	5	**9**

Tab. 6.2.1 - Trend of the Tenebrionidae species captures frequency (CS) in the **BIO** station traps.



Graf. 6.2.1 - Captures frequency (CS) of the more abundantly Tenebrionidae species sampled in the **BIO** station.

Among the sampled species only 1, *Pimelia rugulosa rugulosa,* is present in all traps, although with different CS values. *Opatrum verrucosum* is absent in the trap **BIO-01**; *Lagria hirta* is present just in the traps **BIO-02** and **BIO-05** and *Blaps gibba* is absent in the traps **BIO-01**, **BIO-03**, **BIO-04** and **BIO-05**.

In the table below (tab. 6.2.2) are indicated the rank/abundance species in the individual traps considering the species with CS values ≥ 0.06 (4 in **BIO-02**, **BIO-06** and **BIO-08**; 2 in **BIO-01**, **BIO-03**, **BIO-04**, **BIO-05** and **BIO-07**). *Pimelia rugulosa rugulosa* ranks first in all traps except in the traps **BIO-01** and **BIO-02**, where ranks second in the trap **BIO-1** and third in the trap **BIO-02**; *Lagria hirta* ranks first in the trap **BIO-02**, third in the traps **BIO-05** and it is absent in other traps. *Stenosis sardoa ardoini* (absent in the traps **BIO-03**, **BIO-05**, **BIO-06** and **BIO-07**) is first in the trap **BIO-01**, and fourth in the trap **BIO-02**.

BIO-01
Stenosis sardoa ardoini
Pimelia rugulosa rugulosa

BIO-02
Lagria hirta
Blaps gibba
Pimelia rugulosa rugulosa
Stenosis sardoa ardoini

BIO-03
Pimelia rugulosa rugulosa
Opatrum verrucosum

BIO-04
Pimelia rugulosa
Lagria rugosula

BIO-05
Pimelia rugulosa rugulosa
Opatrum verrucosum

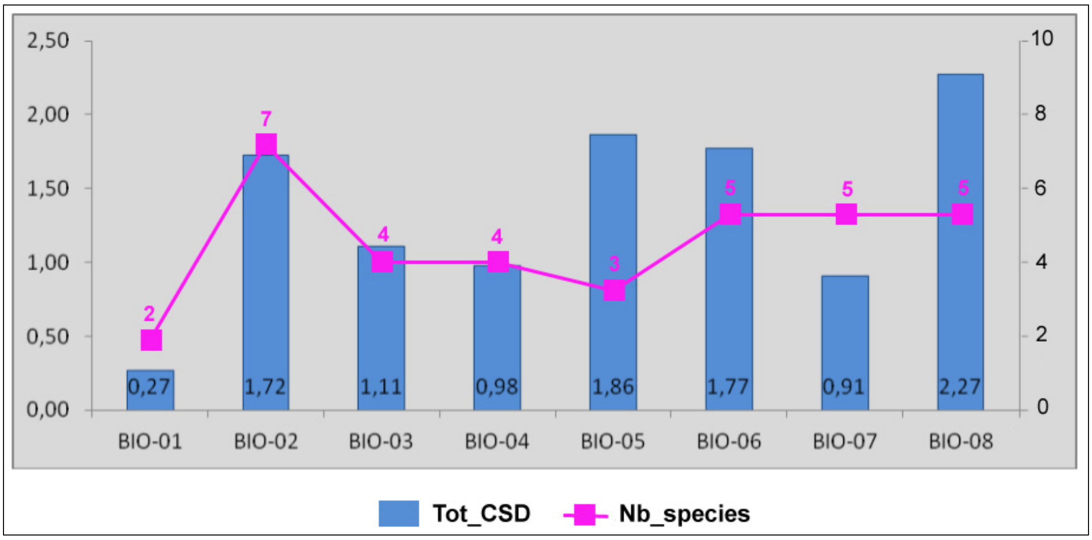
BIO-06
Pimelia rugulosa rugulosa
Opatrum verrucosum
Blaps gibba
Pachychila dejeani dejeani

BIO- 07
Pimelia rugulosa rugulosa
Blaps gibba

BIO-08
Pimelia rugulosa rugulosa
Pachychila dejeani dejeani
Opatrum verrucosum
Blaps gibba

Tab. 6.2.2 – Rank/abundance of the Tenebrionidae species in the **BIO** station traps.

The graph. 6.2.2 represents Tenebrionidae capture frequencies and sampled species number in each trap of the **BIO** station.
The CS values found in the individual traps, present the highest value in the trap **BIO-08** and the lowest value in the trap **BIO-01**.
No trap has collected all **9** species sampled in the station. The greatest number of species (**7**) was recorded in the trap **BIO-02** and the minimum (**2**) in the trap **BIO-01**.



Graph. 6.2.2 - Captures frequency (CS) and number of the Tenebrionidae species in the **BIO** station traps.

Station BOS (Chestnut wood)

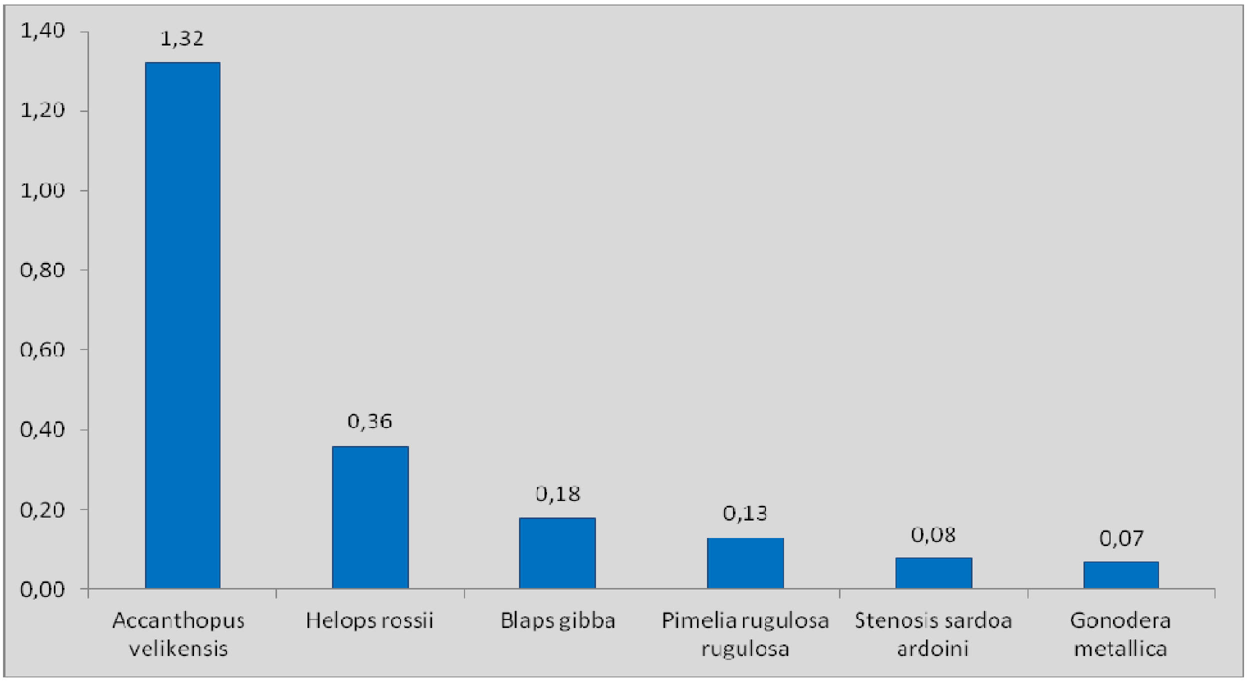
In the **BOS** station a total of **6** Tenebrionidae species was sampled with a CS value of **2,14**. ***Accanthopus velikensis*** (CS: 1,32) strongly characterizes this station regarding the captures frequency (61,68%); other species that show significant CS values (see also graph. 6.2.3) are:

Helops rossii: CS 0,36
Blaps gibba: CS 0,18
Pimelia rugulosa: CS 0,13

These four species represent 92,99% of total CS for the station.
The trend of the Tenebrionidae species captures in the 5 **BOS** station traps is shown in table 6.2.3.

Species	BOS-01	BOS-02	BOS-03	BOS-04	BOS-05	Tot_CS
Accanthopus velikensis	0,10	0,17	0,54	0,25	0,26	1,32
Helops rossii		0,06	0,09	0,21		0,36
Blaps gibba		0,08		0,10		0,18
Pimelia rugulosa rugulosa		0,07			0,06	0,13
Stenosis sardoa ardoini				0,08		0,08
Gonodera metallica			0,07			0,07
Tot_CS	0,10	0,38	0,70	0,64	0,32	**2,14**
Nb_species	1	4	3	4	2	**6**

Tab. 6.2.3 - Trend of the Tenebrionidae species captures frequency (CS) in the **BOS** station traps.



Graf. 6.2.3 - Captures frequency (CS) of the more abundantly Tenebrionidae species sampled in the **BOS** station.

Among sampled species just 1, *Accanthopus velikensis,* is present in all traps; *Helops rossii* is absent in the traps **BOS-01** and **BOS-02**; *Blaps gibba* is present in the traps **BOS-02** and **BOS-04**; *Pimelia rugulosa rugulosa* is present in the traps **BOS-02** and **BOS-05**, while the other two species are present in only one trap.
In the following table (tab. 6.2.4) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.06. *Accanthopus velikensis* ranks first in all traps;

Helops rossii ranks second in the trap **BOS-03** and **BOS-04**, fourth in the traps **BOS-02** and it is absent in traps **BOS-01** and **BOS-05**.

BOS-1
Accanthopus velikensis

BOS-2
Accanthopus velikensis
Blaps gibba
Pimelia rugulosa rugulosa
Helops rossii

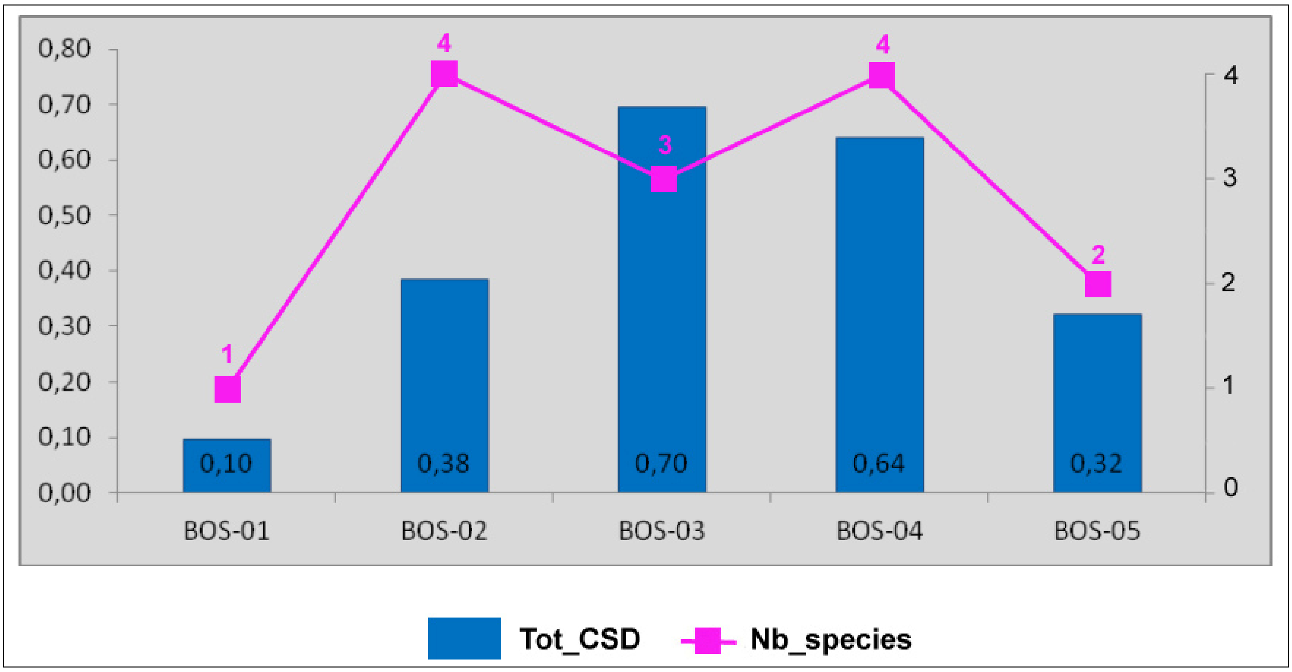
BOS -3
Accanthopus velikensis
Helops rossii
Gonodera metallica

BOS -4
Accanthopus velikensis
Helops rossii
Blaps gibba
Stenosis sardoa ardoini

BOS -5
Accanthopus velikensis
Pimelia rugulosa rugulosa

Tab. 6.2.4 – Rank/abundance of the Tenebrionidae species in the **BOS** station traps.

The graph. 6.2.4 represents Tenebrionidae capture frequencies and sampled species number in each trap of the **BOS** station.
The CS values found in the individual traps, present the highest value in the trap **BOS-03** and the lowest value in the trap **BOS-01**.
No trap has collected all **6** species sampled in the station. The greatest number of species (**4**) was recorded in the traps **BOS-02** and **BOS-04**, the minimum (**1**) in the trap **BOS-01**.



Graf. 6.2.4 - Captures frequency (CS) and Tenebrionidae species number in the **BOS** station traps.

Station CON (Orchard)

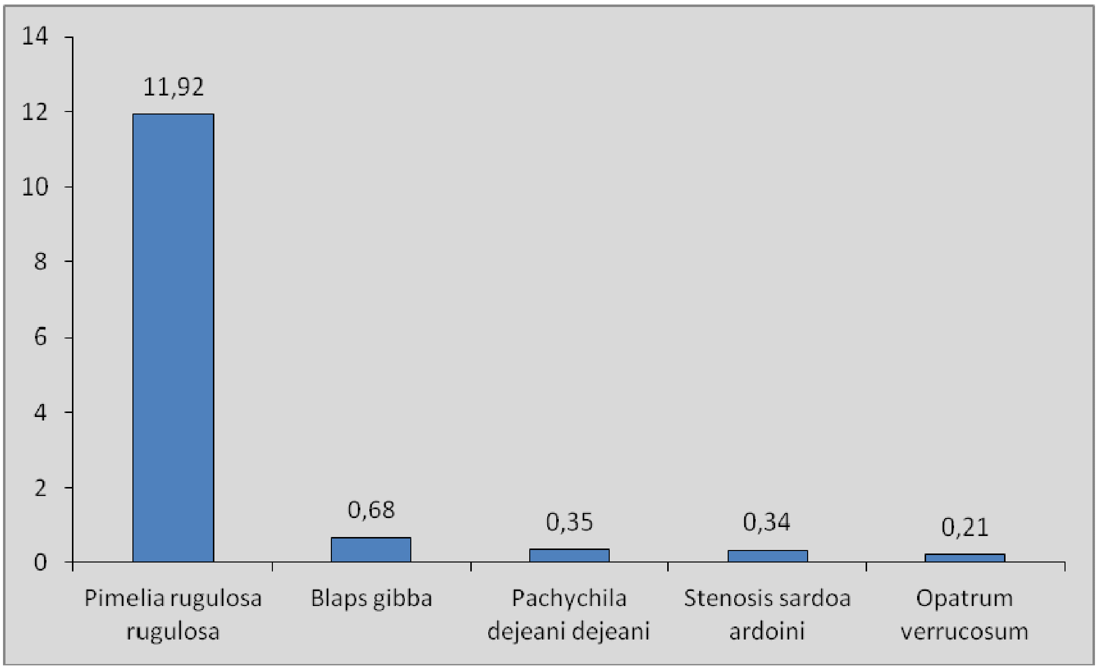
In the **CON** station a total of **10** Tenebrionidae species was sampled with a CS value of **14**. ***Pimelia rugulosa rugulosa*** (CS: 11,92) strongly characterizes this station regarding the captures frequency (85,14%); other species show significant CS values (see also graph. 6.2.5) are following:

Blaps gibba: CS 0,68
Pachychila dejeani dejeani: CS 0,35
Stenosis sardoa ardoini: CS 0,34

These four species represent 96,92% of total CS of the station.
The trend of the Tenebrionidae species captures frequency in the 8 **CON** station traps is shown in table 6.2.5.

Species	**CON-01**	**CON-02**	**CON-03**	**CON-04**	**CON-05**	**CON-06**	**CON-07**	**CON-08**	**Tot_CS**
Pimelia rugulosa rugulosa	1,24	1,55	1,49	0,81	2,50	2,75	0,44	1,14	11,92
Blaps gibba	0,04	0,13		0,05	0,41	0,05			0,68
Pachychila dejeani dejeani		0,14	0,07		0,05			0,10	0,35
Stenosis sardoa ardoini	0,10	0,05			0,15			0,05	0,34
Opatrum verrucosum	0,13					0,08			0,21
Isomira ferruginea	0,10	0,10							0,19
Lagria rugosula	0,05						0,05		0,10
Isomira murina		0,10							0,10
Helops rossii				0,07					0,07
Lagria hirta						0,04			0,04
Tot_CS	1,66	2,06	1,55	0,93	3,10	2,92	0,49	1,28	**14,00**
Nb_species	6	6	2	3	4	4	2	3	**10**

Tab. 6.2.5 - Trend of the Tenebrionidae species captures frequency (CS) in the **CON** station traps.



Graf. 6.2.5 - Captures frequency (CS) of the more abundantly Tenebrionidae species sampled in the **CON** station.

Among the sampled species just 1 (*Pimelia rugulosa rugulosa*) is present in all the traps; *Blaps gibba* is absent in 3 traps (**CON-01**, **CON-03** and **CON-07**); *Pachychila dejeani dejeani* is present in **CON-02**, **CON-03**, **CON-05** and **CON-08**; *Stenosis sardoa ardoini* is present in **CON-01**, **CON-02**, **CON-05** and **CON-08**. The other species are present in only one or two traps.

In the following table (tab. 6.2.6) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.06 (5 in **CON-02**; 4 in **CON-01**; 3 in **CON-05**; 2 in **CON-03**, **CON-04**, **CON-06** and **CON-08**; 1 in **CON-07**). *Pimelia rugulosa rugulosa* ranks first in all traps; *Pachychila dejeani dejeani* ranks second in the traps **CON-02**, **CON-03** and **CON-08**; *Opatrum verrucosum* is second in the traps **CON-01** and **CON-06** and absent in the other traps; *Helops rossii* ranks the second in trap **CON-04**, the only trap where that species is present.

CON-1
Pimelia rugulosa rugulosa
Opatrum verrucosum
Stenosis sardoa ardoini,
Isomira ferruginea

CON-2
Pimelia rugulosa rugulosa
Pachychila dejeani dejeani
Blaps gibba
Isomira ferruginea
Isomira murina

CON-3
Pimelia rugulosa rugulosa
Pachychila dejeani dejeani

CON-4
Pimelia rugulosa rugulosa
Helops rossii

CON-5
Pimelia rugulosa rugulosa
Blaps gibba
Stenosis sardoa ardoini

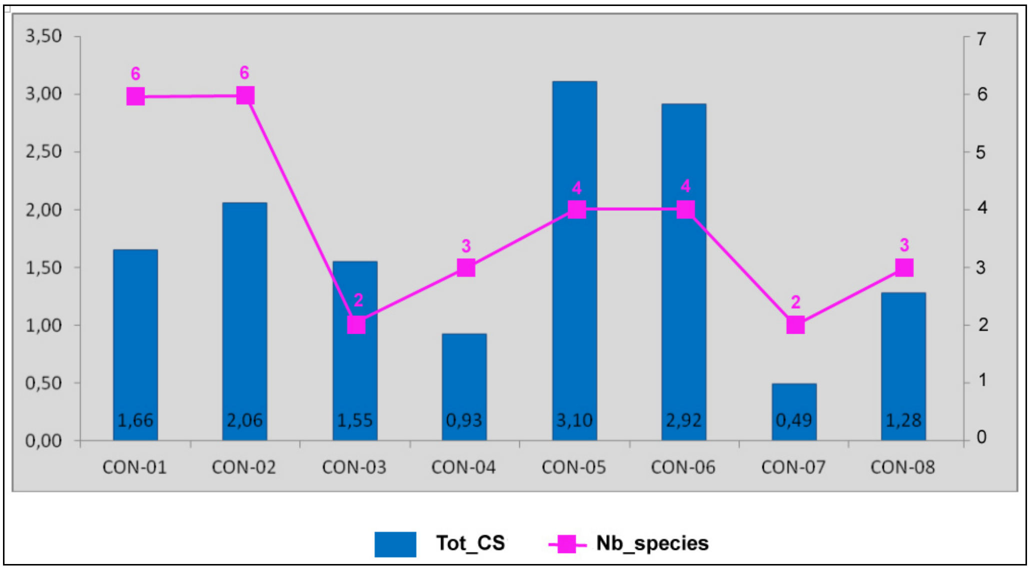
CON-6
Pimelia rugulosa rugulosa
Opatrum verrucosum

CON-7
Pimelia rugulosa rugulosa

CON-8
Pimelia rugulosa rugulosa
Pachychila dejeani dejeani

Tab. 6.2.6 – Rank/abundance of the Tenebrionidae species in the **CON** station traps.

The graph. 6.2.6 represents Tenebrionidae capture frequencies and number of species sampled in each trap of the **CON** station.
The CS values found in the individual traps, present the highest value in the trap **CON-05** and the lowest value in the trap **CON-07**.
No trap has collected all **10** species sampled in the station. The greatest number of species (**6**) was recorded in the traps **CON-01** and **CON-02**, the minimum (**2**) in the traps **CON-03** and **CON-07**.



Graph. 6.2.6 - Captures frequency (CS) and Tenebrionidae species number in the **CON** station traps.

6.3 STAPHYLINIDAE

Station BIO (Orchard)

In the **BIO** station a total of **23** Staphylinidae species was sampled with a CS value of **5,27**.
Ocypus olens (CS: 1,60) characterizes this station regarding the captures frequency (30,36%); other species show significant CS values (see also graph. 6.3.1) as follows:

Paraphloeostiba gayndahensis: CS 0,6
Tachyporus pusillus: CS 0,52
Ocypus mus: CS 0,51

These four species represent the 61,29% of the total CS of the station.
The trend of the Staphylinidae species captures frequency in the 8 **BIO** station traps is shown in table 6.3.1.

Species	BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	Tot_CS
Ocypus olens		1,13	0,04		0,05		0,38		1,60
Paraphloeostiba gayndahensis		0,30	0,10	0,05	0,05	0,05	0,04		0,60
Tachyporus pusillus	0,17	0,09		0,09	0,09		0,04	0,03	0,52
Ocypus mus		0,38	0,05				0,08		0,51
***Xantholinus* sp.**		0,34		0,05					0,39
Tachyporus nitidulus	0,08			0,05	0,05	0,09	0,04	0,03	0,34
Omalium rugatum	0,19	0,05		0,05	0,04				0,33
Quedius levicollis		0,20				0,04			0,24
***Tachyporus* sp.**								0,09	0,09
Tachyporus abner		0,04		0,03					0,08
Sepedophilus nigripennis				0,05					0,05
Omalium excavatum		0,05							0,05
Phyllodrepa floralis						0,05			0,05
Philonthus tenuicornis	0,04								0,04
Gyrohypnus fracticornis						0,04			0,04
Mycetoporus rufescens		0,04							0,04
Philonthus jurgans	0,04								0,04
Philonthus debilis	0,04								0,04
Sepedophilus sicilianus							0,04		0,04
Stenus aceris			0,04						0,04
Othius laeviusculus	0,04								0,04
Mycetoporus mulsanti	0,04								0,04
Acidota cruentata							0,03		0,03
Heterothops praevius		0,03							0,03
Tot_CS	0,65	2,67	0,23	0,37	0,27	0,27	0,65	0,16	**5,27**
Num_Species	8	11	4	7	5	5	7	3	**23**

Tab. 6.3.1 - Trend of the Staphylinidae species captures frequency (CS) in the **BIO** station traps.

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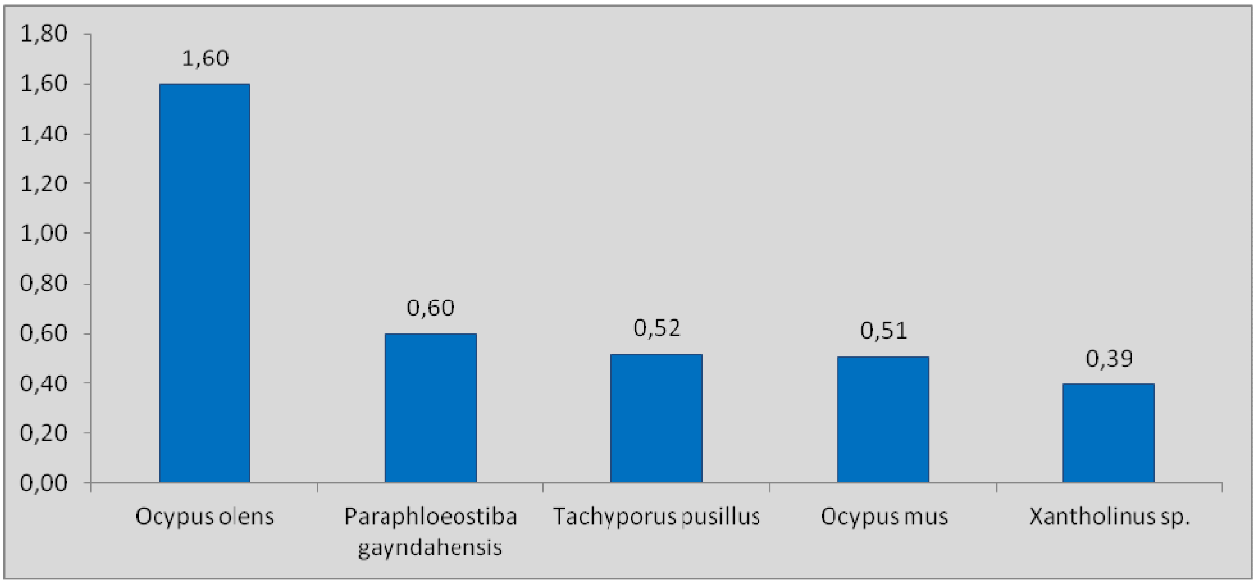


Graph. 6.3.1 - Captures frequency (CS) of the more abundantly Staphylinidae species sampled in the **BIO** station.

Among sampled species, none is present in all stations, while *Ocypus olens* is present in the traps **BIO-02**, **BIO-03**, **BIO-05** and **BIO-07**; *Paraphloeostiba gayndahensis* is absent in the traps **BIO-01** and **BIO-08**; *Tachyporus pusillus* is absent in the traps **BIO-03** and **BIO-06**; *Ocypus mus* is present in the traps **BIO-02**, **BIO-03**, **BIO-07**; *Tachyporus nitidulus* is absent in the traps **BIO-01** and **BIO-03** and *Omalium rugatum* is present in the traps **BIO-01**, **BIO-02, BIO-04** and **BIO-05**. The other species are present in only one or two traps.
In the table below (tab. 6.3.2) are indicated the rank/abundance species in the individual traps considering the species with CS values ≥ 0.06 (6 in **BIO-02**; 3 in **BIO-01**; 2 in **BIO-07** and 1 in other stations). *Ocypus olens* ranks first in the traps **BIO-02 and BIO-07**; *Omalium rugatum* ranks first in the trap **BIO-01**; *Tachyporus pusillus* ranks first in the traps **BIO-04** and **BIO-05** and second in trap **BIO-01**; *Paraphloeostiba gayndahensis* ranks first in traps **BIO-3**.

BIO-01
Omalium rugatum
Tachyporus pusillus
Tachyporus nitidulus

BIO-2
Ocypus olens
Ocypus mus
Xantholinus sp.
Paraphloeostiba gayndahensis
Quedius levicollis
Tachyporus pusillus

BIO-3
Paraphloeostiba gayndahensis

BIO-4
Tachyporus pusillus

BIO-5
Tachyporus pusillus

BIO-06
Tachyporus nitidulus

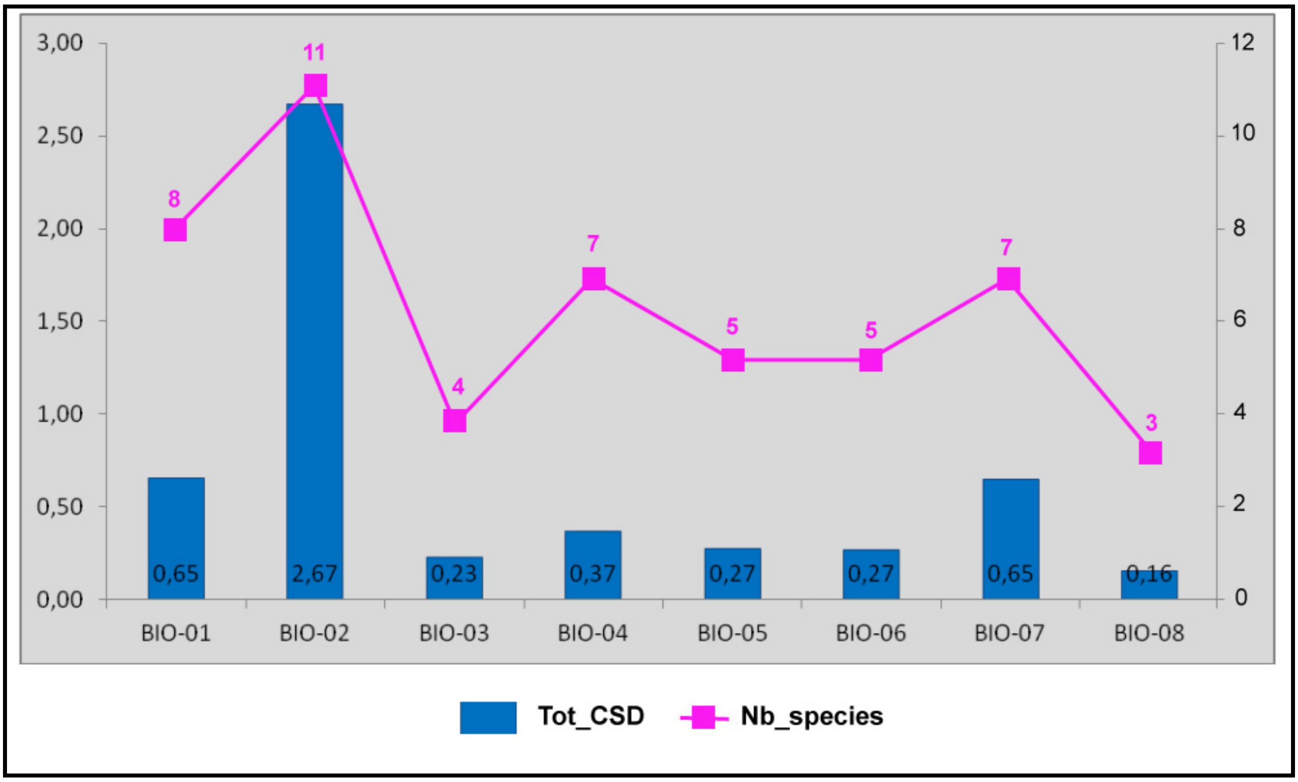
BIO-07
Ocypus olens
Ocypus mus

BIO-08
Tachyporus sp.

Tab. 6.3.2 – Rank/abundance of the Staphylinidae species in the **BIO** station traps.

The graph. 6.3.2 represents Staphylinidae capture frequencies and number of species sampled in each trap of the **BIO** station.

The CS values found in the individual traps, present the highest value in the trap **BIO-02** and the lowest value in the trap **BIO-08**.
No trap has collected all **23** species sampled in the station. The greatest number of species (**11**) was recorded in the trap **BIO-2** and the minimum (**3**) in the trap **BIO-08**.



Graph. 6.3.2 - Captures frequency (CS) and number of the Staphylinidae species in the **BIO** station traps.

Station BOS (Chestnut wood)

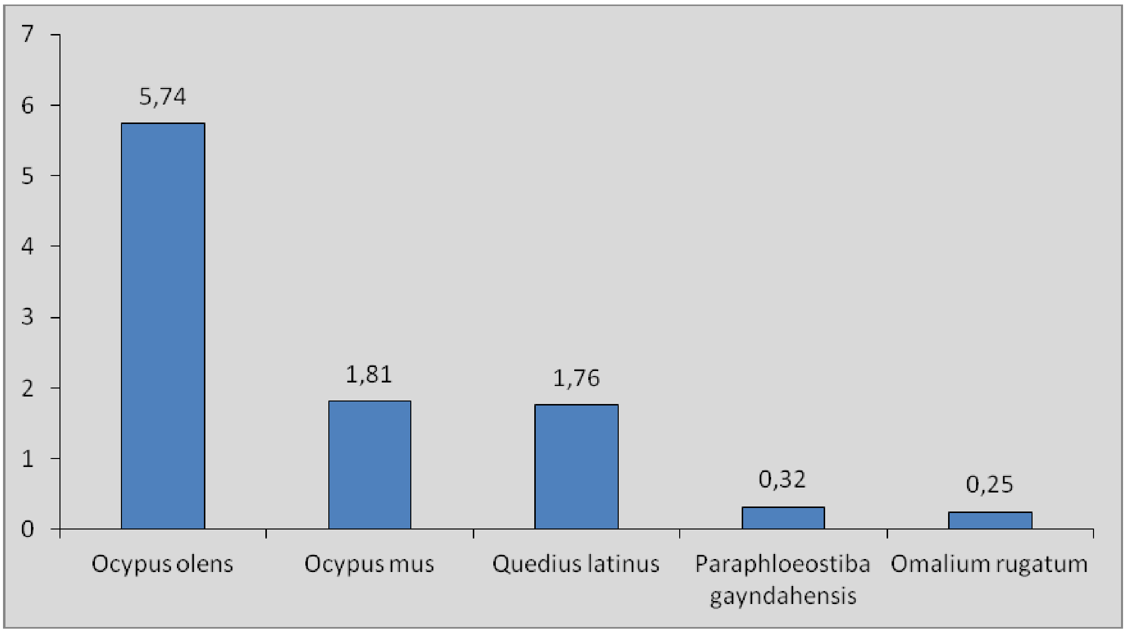
In the **BOS** station a total of **13** Staphylinidae species was sampled with a CS value of **10,90**. ***Ocypus olens*** (CS: 5,74) strongly characterize this station regarding the captures frequency (52,66%); other species that show significant CS values (see also graph. 6.3.3) as follows:

Ocypus mus: CS 1,81
Quedius latinus: CS 1,76
Paraphloeostiba gayndahensis: CS 0,32
Omalium rugatum: CS 0,25

These five species represent the 90,64% of the total CS of the station.
The trend of the Staphylinidae species captures frequency in the 5 **BOS** station traps is shown in table 6.3.3.

Species	BOS-01	BOS-02	BOS-03	BOS-04	BOS-05	Tot_CS
Ocypus olens	0,84	2,52	1,23	0,48	0,66	5,74
Ocypus mus	0,55	0,48	0,77			1,81
Quedius latinus	0,07	0,27	0,87	0,19	0,37	1,76
Paraphloeostiba gayndahensis		0,15	0,17			0,32
Omalium rugatum			0,13	0,07	0,05	0,25
Lordithon exoletus			0,10		0,10	0,20
Quedius fumatus				0,20		0,20
Mycetoporus mulsanti		0,14				0,14
Tachyporus pusillus	0,06	0,07				0,13
Tachyporus nitidulus		0,13				0,13
Othius laeviusculus	0,10					0,10
Proteinus brachypterus					0,07	0,07
Mycetoporus angularis				0,06		0,06
Tot_CS	1,62	3,76	3,27	1,00	1,25	**10,90**
Nb_Species	5	7	6	5	5	**13**

Tab. 6.3.3 - Trend of the Staphylinidae species captures frequency (CS) in the **BOS** station traps.



Graph. 6.3.3 Captures frequency (CS) of the more abundantly Staphylinidae species sampled in the **BOS** station.

Among sampled species, only 2 (*Ocypus olens* and *Quedius latinus*) are present in all traps, although sometimes with different CS values. *Ocypus mus* is absent in the traps **BOS-04** and **BOS-05**; *Omalium rugatum* is absent in the traps **BOS-01** and **BOS-02,** while the other species are present in only one or two traps.
In the table below (tab. 6.3.4) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.06 (7 in **BOS-02**; 6 in **BOS-03**; and 5 in **BOS-01**, **BOS-04** and **BOS-05**). *Ocypus olens* ranks first in all traps; *Ocypus mus* ranks second in traps **BOS-01** and **BOS-02**, third in trap **BIO-03** and it is absent in other two traps; *Quedius latinus* ranks second in traps **BOS-03, BOS-04, BOS-05,** third in **BOS-02** and fourth in **BOS-01.**

BOS-1
Ocypus olens
Ocypus mus
Othius laeviusculus
Quedius latinus
Tachyporus pusillus

BOS-2
Ocypus olens
Ocypus mus
Quedius latinus
Paraphloeostiba gayndahensis
Mycetoporus mulsanti
Tachyporus nitidulus
Tachyporus pusillus

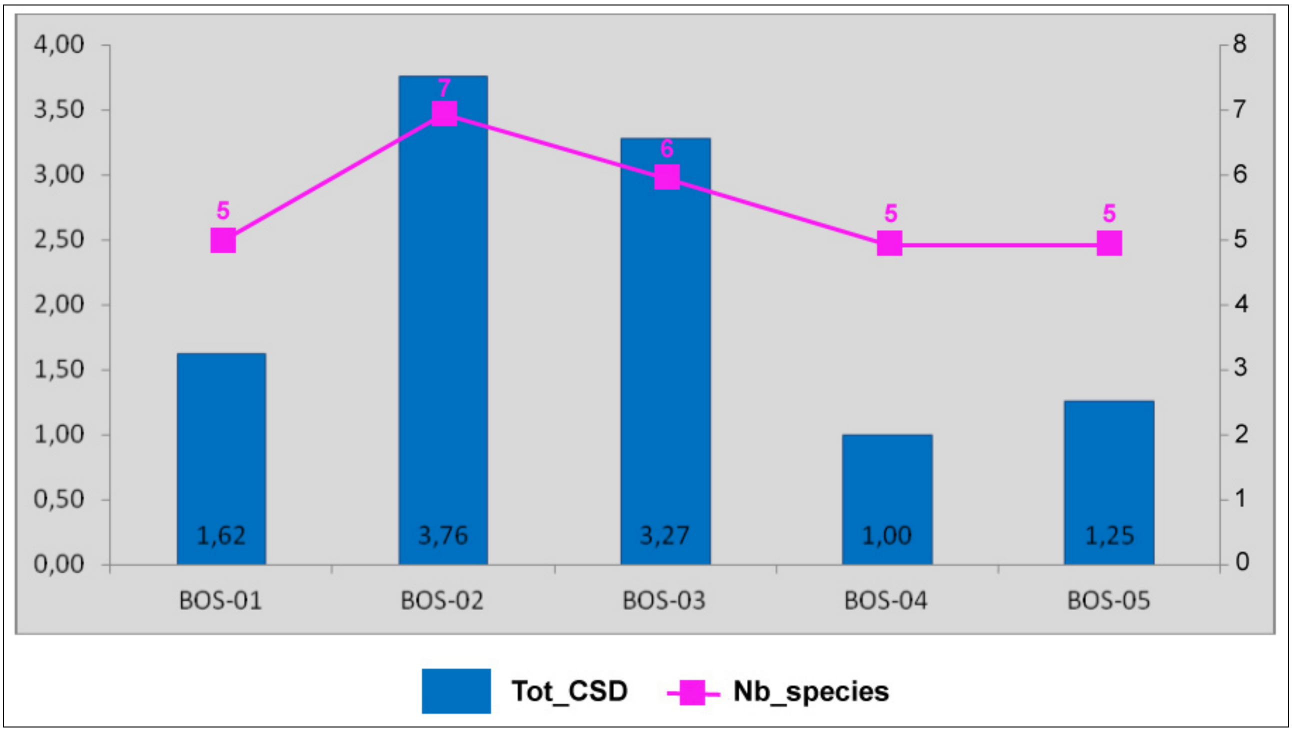
BOS-3
Ocypus olens
Quedius latinus
Ocypus mus
Paraphloeostiba gayndahensis
Omalium rugatum
Lordithon exoletus

BOS-4
Ocypus olens
Quedius fumatus
Quedius latinus
Omalium rugatum
Mycetoporus angularis

BOS-5
Ocypus olens
Quedius latinus
Lordithon exoletus
Proteinus brachypterus
Omalium rugatum

Tab. 6.3.4 – Rank/abundance of the Staphylinidae species in the **BOS** station traps.

The graph. 6.3.4 represents Staphylinidae capture frequencies and number of species sampled in each trap of the **BOS** station.
The CS values found in the individual traps, present the highest value in the trap **BOS-02** and the lowest value in the trap **BOS-04**.
No trap has collected all **13** species sampled in the station. The greatest number of species (**7**) was recorded in the trap **BOS-02** and the minimum (**5**) in the traps **BOS-01, BOS-04** and **BOS-05**.



Graph. 6.3.4 - Captures frequency (CS) and Staphylinidae species number in the **BOS** station traps.

Station CON (Orchard)

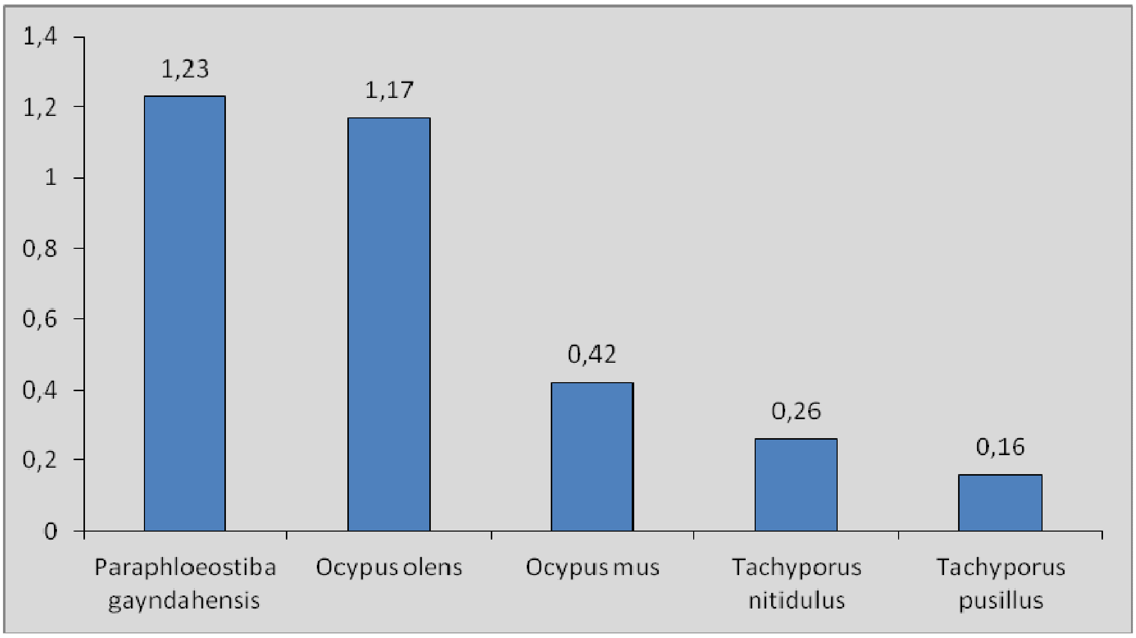
In the **CON** station a total of **22** Staphylinidae species was sampled with a CS value of **4,17**. ***Paraphloeostiba gayndahensis*** (CS: 1,23) and ***Ocypus olens*** (CS: 1,17) characterize this station regarding the captures frequency (57,55%); other species that show significant CS values (see also graph. 6.3.5) as follows:

Ocypus mus: CS 29,03
Tachyporus nitidulus: CS 0,42
Tachyporus pusillus: CS 0,26
Omalium rugatum: CS 0,16

These seven species represent the 77,69% of the total CS of the station.
The trend of the Staphylinidae species captures frequency in the 8 **CON** station traps is shown in table 6.3.5.

Species	CON-01	CON-02	CON-03	CON-04	CON-05	CON-06	CON-07	CON-08	Tot_CS
Paraphloeostiba gayndahensis	0,10		0,07	0,05			0,05	0,97	1,23
Ocypus olens	0,27	0,16		0,14	0,04	0,40	0,08	0,09	1,17
Ocypus mus	0,09	0,04			0,12		0,12	0,04	0,42
Tachyporus nitidulus	0,08			0,05		0,05	0,03	0,05	0,26
Tachyporus pusillus	0,13						0,04		0,16
Omalium rugatum		0,06	0,06						0,11
Mycetoporus mulsanti	0,09								0,09
Sepedophilus nigripennis					0,04	0,05			0,09
Proteinus atomarius								0,06	0,06
Astenus sp.				0,06					0,06
Proteinus brachypterus			0,06						0,06
Bisnius fimetarius							0,05		0,05
Mycetoporus angularis						0,05			0,05
Quedius levicollis							0,04		0,04
Quedius boops	0,04								0,04
Anotylus intricatus								0,04	0,04
Anotylus inustus								0,04	0,04
Omalium poggii								0,04	0,04
Omalium rivulare								0,04	0,04
Philonthus debilis					0,04				0,04
Quedius cruentus					0,04				0,04
Acidota cruentata							0,03		0,03
Tot_CS	0,80	0,25	0,18	0,28	0,29	0,54	0,45	1,38	**4,17**
Nb_Species	7	3	3	4	5	4	8	9	**22**

Tab. 6.3.5 - Trend of the Staphylinidae species captures frequency (CS) in the **CON** station traps.



Graph. 6.3.5 - Captures frequency (CS) of the more abundantly Staphylinidae species sampled in the **CON** station.

Among sampled species, *Ocypus olens* is present in all traps, except in trap **CON-03**, although sometimes with different CS values. *Paraphloeostiba gayndahensis* is absent in the traps **CON-02**, **CON-05** and **CON-06**; *Ocypus mus* is absent in the traps **CON-03, CON-04** and **CON-06**; *Tachyporus nitidulus* is absent in the traps **CON-02, CON-03** and **CON-05**, while the other species are present in only one or two traps.

In the table below (tab. 6.3.6) are indicated the species rank/abundance in the individual traps considering the species with CS values ≥ 0.06 (7 in **CON-01** and **CON-06**; 6 in **CON-03**, **CON-04**, and **CON-05**; 5 in **CON-02** and **CON-08** and 3 in **CON-07**). *Ocypus olens* ranks first in the traps **CON-01, CON-02, CON-04, CON-06,** second in the traps **CON-05, CON-07, CON-08** and it's absent in the trap **CON-03**; *Paraphloeostiba gayndahensis* ranks first in the traps **CON-03** and **CON-08** third in the traps **CON-01, CON-04, CON-07** and it's absent in other traps**.** *Ocypus mus* ranks first in the traps **CON-05** and **CON-07,** third in the trap **CON-02** and the fourth in the trap **CON-01**.

CON-1
Ocypus olens
Tachyporus pusillus
Paraphloeostiba gayndahensis
Ocypus mus
Mycetoporus mulsanti
Tachyporus nitidulus

CON-2
Ocypus olens
Omalium rugatum

CON-3
Paraphloeostiba gayndahensis
Proteinus brachypterus
Omalium rugatum

CON-4
Ocypus olens
Astenus sp.

CON-5
Ocypus mus

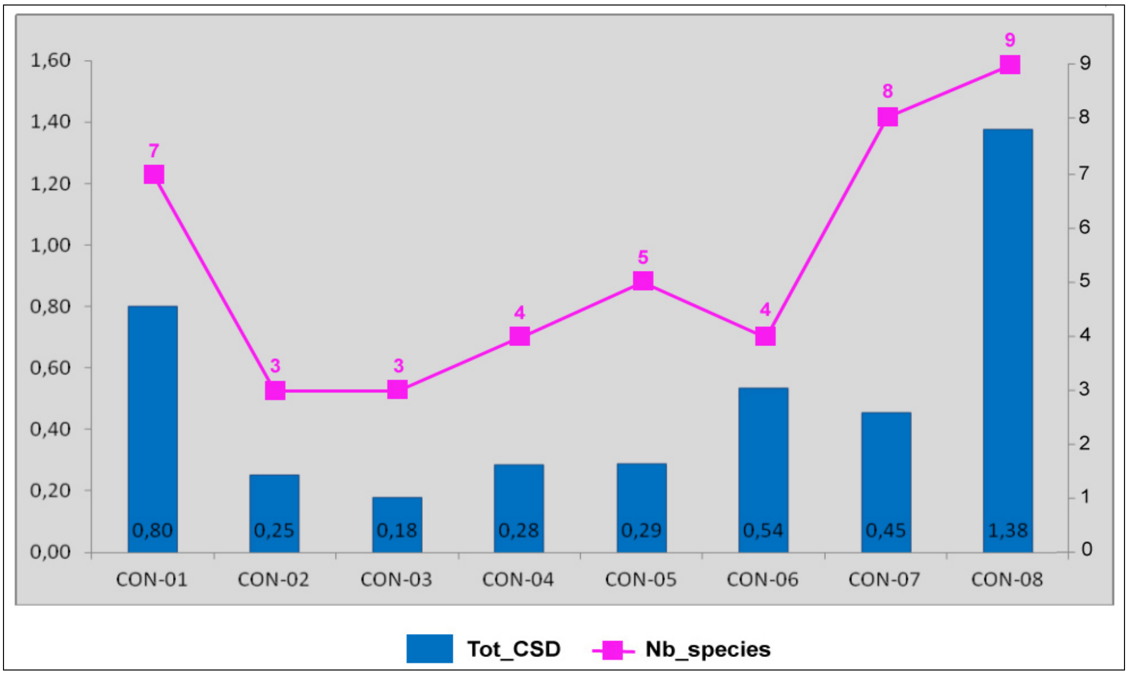
CON-6
Ocypus olens

CON-7
Ocypus mus
Ocypus olens

CON-8
Paraphloeostiba gayndahensis
Ocypus olens
Proteinus atomarius

Tab. 6.3.6 – Rank/abundance of the Staphylinidae species in the **CON** station traps.

The graph. 6.3.6 represents Staphylinidae capture frequencies and species number sampled in each trap of the **CON** station.
The CS values found in the individual traps, present the highest value in the trap **CON-08** and the lowest value in the trap **CON-03**.
No trap has collected all the **22** species sampled in the station. The greatest number of species (**9**) was recorded in the trap **CON-08** and the minimum (**3**) in the traps **CON-02** and **CON-03**.



Graph. 6.3.6 - Captures frequency (CS) and Staphylinidae species number in the **CON** station traps.

7 MULTIVARIATE ANALYSIS OF THE COMMUNITIES

7.1 Non metric multidimensional scaling based on the Bray-Curtis matrix

FAMILIES OF THE COLEOPTERA

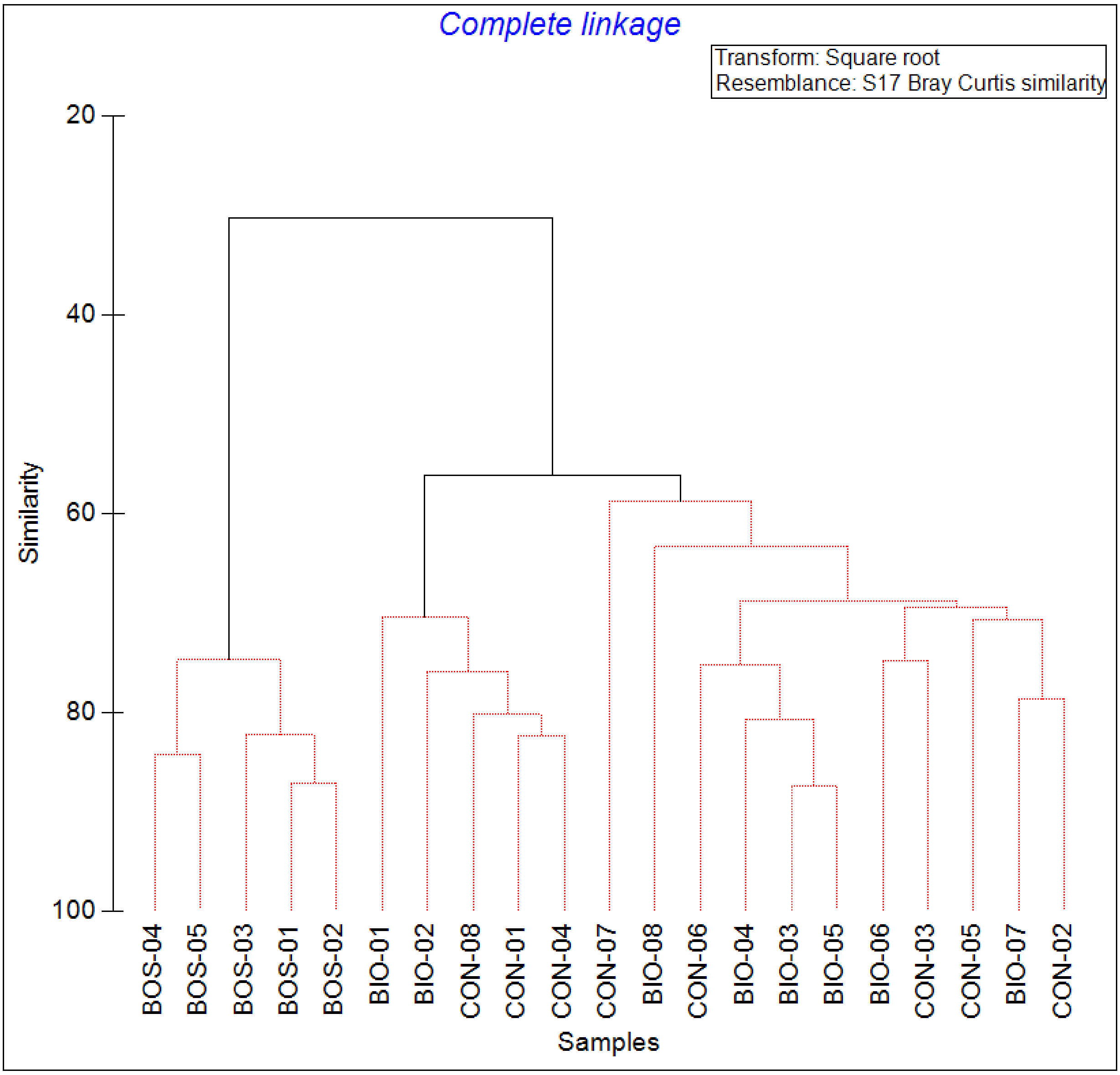
Looking at the dendrogram of similarity among the traps based on the Bray-Curtis index regards to the Families of Coleoptera (graph. 7.1.1), it is evident that the results of some of the clusters identified differ with each other in a statistical significance (p <0.5 at least %) according to the SIMPROF test.

3 clusters are individuated, at a level of similarity at least 60%, significantly different from each, grouping:

1. all traps of station **BOS**;

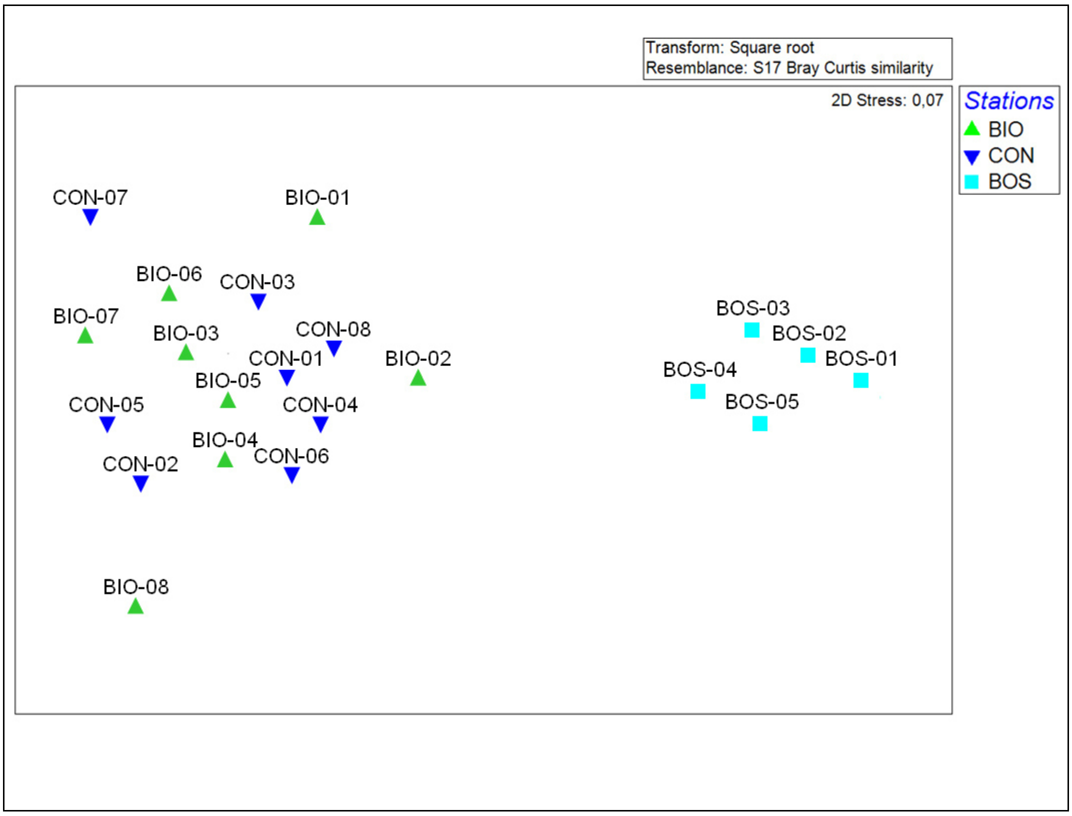
2. traps BIO-01, **BIO-02**, **CON-01**, **CON-04 and CON-08**;

3. traps BIO-03, **BIO-04**, **BIO-05**, **BIO-06**, **BIO-07**, **BIO-08**, **CON-02**, **CON-03**, **CON-05**, **CON-06 and CON-07**.

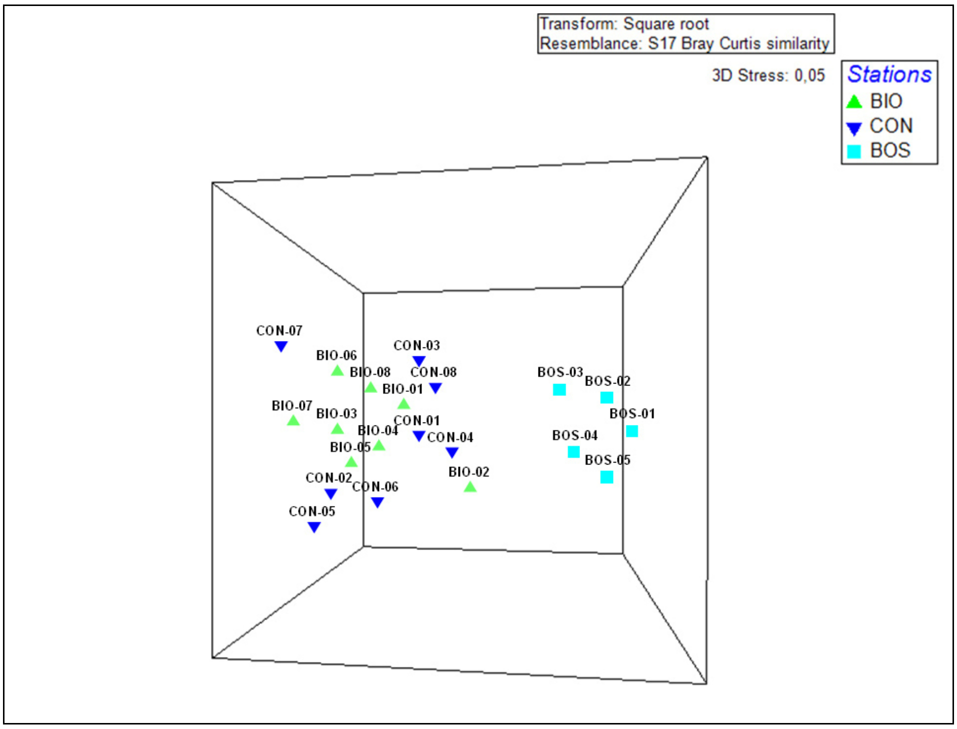


Graph. 7.1.1 – The dendrogram values based on the Bray-Curtis similarity index between the traps of stations investigated in regards to the Families of Coleoptera. The black lines show the clusters that are significantly different (at least p <0,5%) according to the SIMPROF test.

In regards to the Families of the Coleoptera, the Nonmetric Multi Dimensional Scaling (NMDS), elaborated on the Bray-Curtis similarity matrix between the traps, both in 2D (graph 7.1.2) and 3D (graph 7.1.3), shows a cluster for the traps of the **BOS** station, while the traps of the **BIO** and **CON** stations are not very well distinguished.

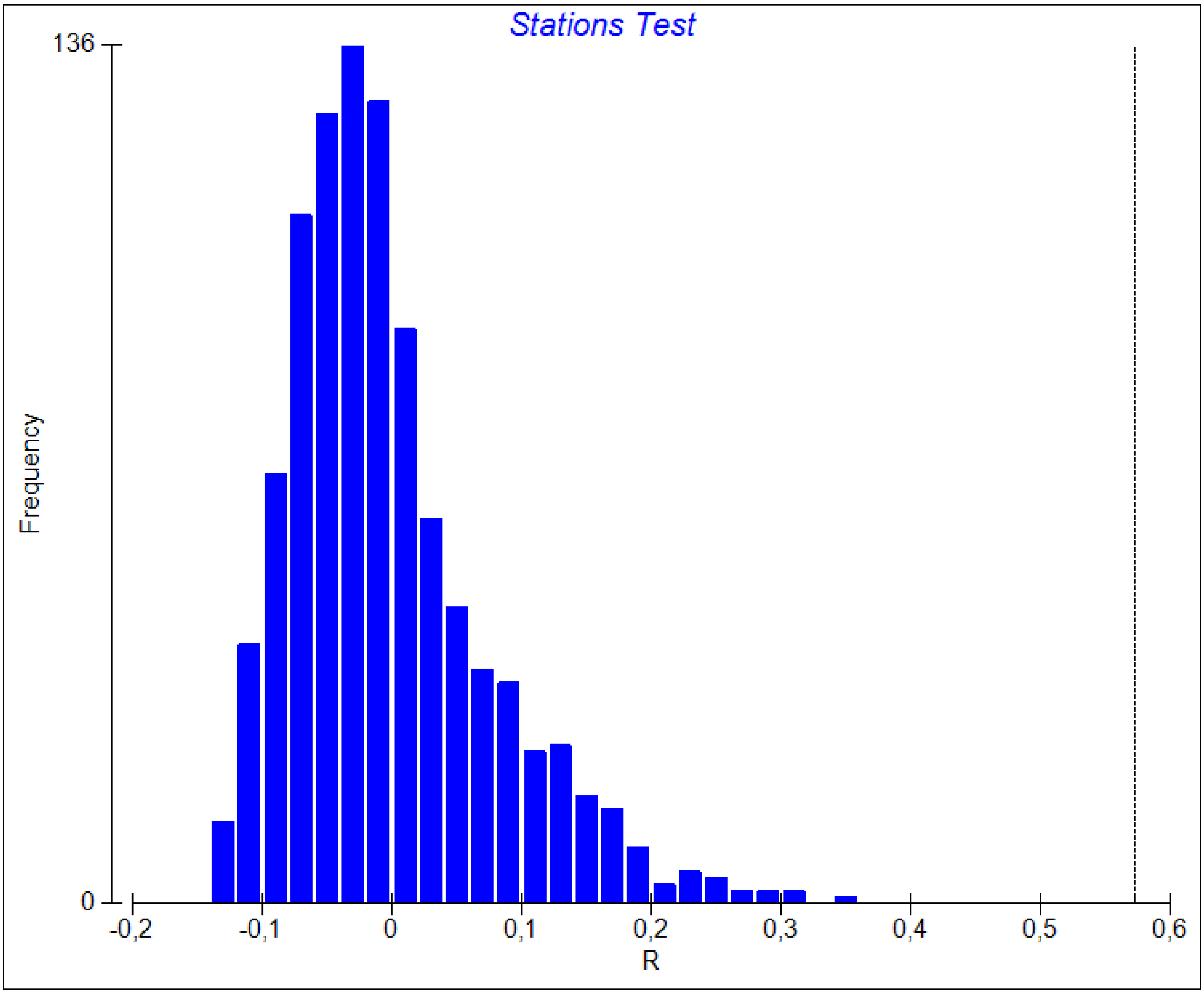


Graph. 7.1.2 - The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations in regards to Families of the Coleoptera (2 D vision).



Graph. 7.1.3 – The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations in regards to Families of the Coleoptera (3 D vision).

The analysis shows that the traps of a station are, in most cases, more similar to each other than with the traps of other stations. The ANOSIM test (graph. 7.1.4) confirms this hypothesis with a statistical significance.



Graph. 7.1.4 – ANOSIM tests: distribution of expected frequencies of R (histogram) compared with the observed value of R (**0,57**) (continuous line) between the traps of the stations investigated in regards to Families of the Coleoptera.

In tables 7.1.1-7.1.3, the Families of the Coleoptera that determine the similarities between the traps of each station are shown. For each family, the mean abundance in the traps (Av. Abund) and the mean similarity (Av. Sim) between them in regards to each single Family are given. In the third column, the value of the ratios between the similarity and standard deviation are shown (Sim/SD), which provides an indication of the uniformity of distribution of the taxon in the samples; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns, the percentage contribution of each Coleoptera Family are shown in order to determine the overall average similarity between the traps (Contrib%) and the cumulative percentage of families in question (Cum%) up to the threshold of 90%.
From the analysis, the results for the **BIO** and **CON** stations consist of 11-12 Families with similar weight in regards to the individual stations, which contribute mostly to determining the similarity between the traps in order of abundance: **Staphylinidae**, **Carabidae**, **Anthicidae**, **Tenebrionidae**, and **Melyridae**, while the **BOS** station only has 6 Families, which contribute mostly to determining the similarity between the traps in order of abundance: **Carabidae**, **Staphylinidae**, **Cryptophagidae**, **Ptinidae**, **Zopheridae** and **Tenebrionidae**.

Station BIO

Average similarity: 71,04

Family	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Staphylinidae	2,38	17,92	9,47	25,22	25,22
Carabidae	1,72	12,08	4,52	17,00	42,22
Anthicidae	1,45	10,06	3,47	14,16	56,38
Tenebrionidae	0,98	6,93	3,30	9,75	66,13
Melyridae	1,02	4,98	1,83	7,01	73,14
Nitidulidae	0,53	3,41	4,71	4,81	77,94
Curculionoidea	0,43	2,95	4,53	4,15	82,09
Zopheridae	0,48	2,50	1,55	3,51	85,60
Elateridae	0,23	1,53	1,55	2,15	87,76
Leiodidae	0,28	1,30	1,02	1,83	89,59
Oedemeridae	0,22	1,17	1,02	1,64	**91,23**

Tab. 7.1.1 – The average similarity between the traps and percentage contribution to the similarity of the Coleoptera Families in the **BIO** station; further explanations in the text.

Station CON

Average similarity: 72,00

Family	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Staphylinidae	2,41	17,10	4,53	23,74	23,74
Carabidae	1,69	11,68	4,39	16,23	39,97
Anthicidae	1,43	10,44	12,69	14,51	54,48
Tenebrionidae	1,12	7,74	4,57	10,75	65,23
Melyridae	0,66	3,74	2,04	5,19	70,42
Curculionoidea	0,57	3,41	1,59	4,73	75,15
Nitidulidae	0,52	3,12	3,04	4,34	79,48
Cryptophagidae	0,52	2,20	1,40	3,05	82,53
Oedemeridae	0,36	2,01	1,43	2,79	85,32
Zopheridae	0,32	1,84	1,49	2,56	87,88
Ptinidae	0,26	1,19	0,94	1,65	89,53
Mordellidae	0,21	1,11	1,02	1,55	**91,07**

Tab. 7.1.2 – The average similarity between the traps and percentage contribution to the similarity of the Coleoptera Families of in the **CON** station; further explanations in the text.

Station BOS

Average similarity: 80,41

Family	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Carabidae	5,77	27,76	4,81	34,52	34,52
Staphylinidae	4,41	24,62	15,50	30,62	65,14
Cryptophagidae	1,51	7,42	8,88	9,23	74,37
Ptinidae	1,16	5,72	3,90	7,12	81,48
Zopheridae	1,17	5,19	2,67	6,45	87,94
Tenebrionidae	0,55	2,57	2,73	3,19	**91,13**

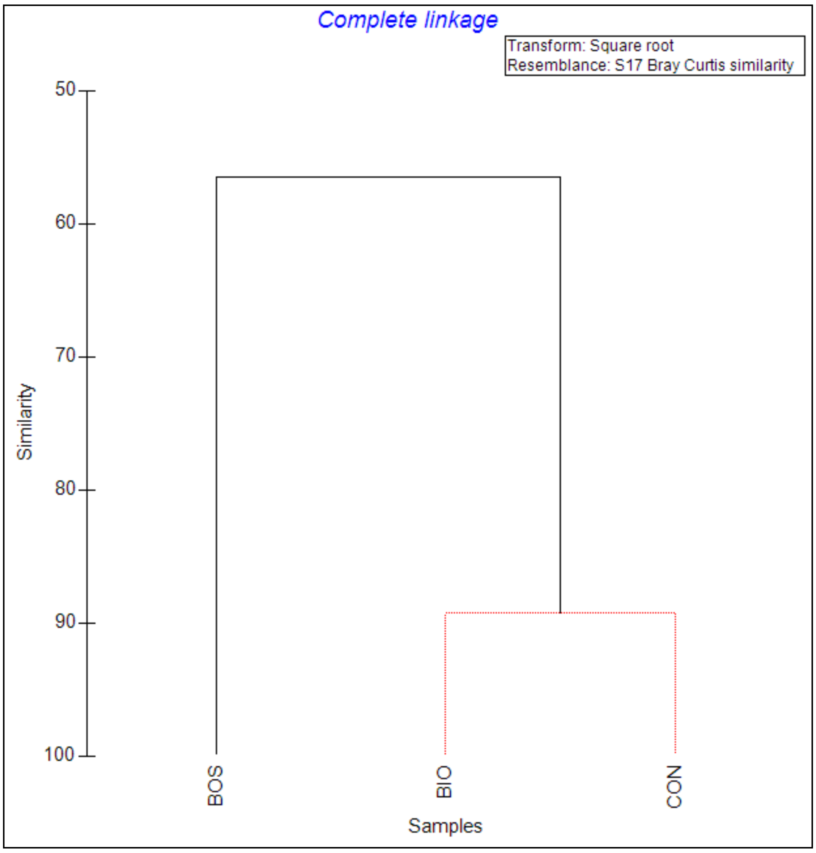
Tab. 7.1.3 – The average similarity between the traps and percentage contribution to the similarity of the Coleoptera Families of in the **BOS** station; further explanations in the text.

The statistical significance of differences between the stations were calculated using the Parwise test, based on the comparison of observed and expected values of R between pairs of stations (tab. 7.1.4). The analysis shows that the **BOS** station is significantly higher and differs from each other, while the traps of the **CON** and **BIO** stations do not differ significantly from each other; these are grouped together into two clusters according to the Bray-Curtis index (graph 7.1.5); the first with about 90% similarity includes the **CON** and **BIO** stations, the second separates the **BOS** station.

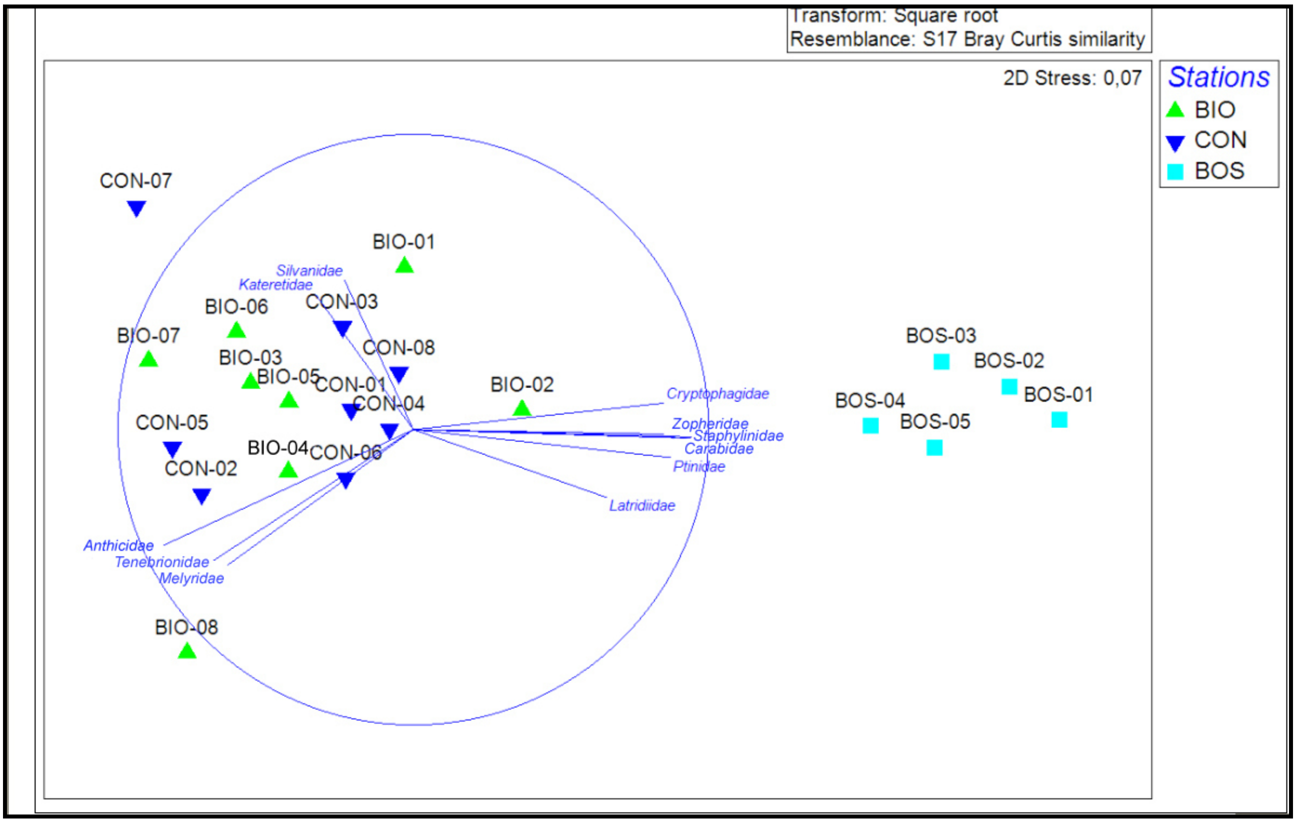
Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
BIO/CON	-0,075	86,9	6435	999	868
BIO/BOS	0,984	0,3	1287	999	2
CON/BOS	1	0,2	1287	999	1

Tab. 7.1.4 - Pairwise tests, based on the values of R observed for pairs of stations in regards to the Coleoptera Families. The significance % refers to the number of values of R that fall within the range of the expected frequencies compared to the total number of possible permutations.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2D (graph 7.1.6), elaborated on the Bray-Curtis similarity matrix between traps, in regards to the Coleoptera Families shows a clear dissimilarity between the traps of the **BOS** station to the **BIO** and **CON** pair.
The **Carabidae**, **Staphylinidae**, **Cryptophagidae**, **Zopheridae**, **Ptnidae**, **Endomichidae**, and **Lathridiidae** Families are centered on the traps of the **BOS** station, characterizing it and clearly differentiating the traps of this station rather from the other stations. The **Leiodidae**, **Lucanidae**, **Scirtidae**, **Cebrionidae**, **Elateridae**, **Mycetophagidae** and **Nitidulidae** Families occupy an intermediate position between the traps of the **BOS** station and the traps of the **BIO** and **CON** stations, while the other Families are centered on the pair of stations, **BIO/CON**, that contribute to determining their similarities and to differentiate them from the **BOS** station.



Graph. 7.1.5 – The dendrogram of the Bray-Curtis similarity index values between the investigated stations in regards to the Coleoptera Families.



Graph. 7.1.6 - The correlation between Nonmetric Multi Dimensional Scaling (NMDS) developed on the Bray-Curtis similarity matrix between the stations and the Coleoptera Families; in the figure, only those most abundantly sampled determine the differences or similarities among the traps of three stations are indicated.

In tables 7.1.5-7.1.7, the Families of the Coleoptera that determine the dissimilarity between the traps of each station are shown. For each family, the mean abundance in the traps (Av. Abund) and the mean dissimilarity (Av. Diss) between them in regards to each single Family are given. In the fourth column, the value of the ratios between dissimilarity and standard deviation (Dis/SD), which provides an indication of the uniformity of distribution of the taxon in the samples is shown; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns, the percentage contribution of each family of the Coleoptera are shown to determine the overall average dissimilarity between the traps (Contrib%) and the cumulative percentage of families in question (Cum%), up to the threshold of 90%.

In general, the mean overall value of dissimilarity between stations varies from 27,78% of the pair **BIO/CON** and 53,09% of the pair **BIO/BOS**. By examination of the tables is also clear that for each comparison between pairs of stations the first 6 Families in order of abundance give a dissimilarity between stations with a contribution that varies from about 43,47% to 69,12%.

Among the families that occur most frequently in the first six positions are: **Carabidae**, **Staphylinidae**, **Anthicidae**, and **Cryptophagidae**.

Groups BIO/CON

Average dissimilarity = 27,78

Family	Group BIO Av.Abund	Group CON Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Melyridae	1,02	0,66	2,64	0,98	9,52	9,52
Staphylinidae	2,38	2,41	2,43	1,45	8,74	18,26
Carabidae	1,72	1,69	2,21	1,37	7,95	26,22
Anthicidae	1,45	1,43	1,74	1,18	6,26	32,48
Cryptophagidae	0,22	0,52	1,57	0,99	5,65	38,13
Tenebrionidae	0,98	1,12	1,48	1,33	5,34	43,47
Curculionoidea	0,43	0,57	1,19	1,46	4,27	47,74
Zopheridae	0,48	0,32	1,13	1,28	4,07	51,81
Kateretidae	0,21	0,20	1,04	1,20	3,76	55,57
Nitidulidae	0,53	0,52	1,00	1,21	3,59	59,15
Ptinidae	0,23	0,26	0,95	1,44	3,44	62,59
Oedemeridae	0,22	0,36	0,94	1,19	3,38	65,97
Leiodidae	0,28	0,15	0,87	1,30	3,14	69,11
Mordellidae	0,17	0,21	0,77	1,31	2,76	71,87
Endomychidae	0,04	0,20	0,74	1,13	2,68	74,55
Chrysomelidae	0,24	0,20	0,74	1,41	2,66	77,20
Scarabeidae	0,13	0,16	0,74	1,15	2,65	79,86
Coccinellidae	0,16	0,18	0,61	1,30	2,21	82,07
Latridiidae	0,09	0,11	0,59	1,06	2,11	84,18
Cerambycidae	0,12	0,06	0,52	1,01	1,88	86,06
Corylophidae	0,09	0,07	0,52	0,93	1,86	87,92
Elateridae	0,23	0,17	0,51	1,17	1,84	89,76
Mycetophagidae	0,11	0,08	0,49	1,07	1,76	**91,52**

Tab. 7.1.5 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **CON** stations for the Coleoptera Families more abundantly sampled; additional explanations in the text.

Groups BIO/BOS
Average dissimilarity = 53,09

Family	Group BIO Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Carabidae	1,72	5,77	13,86	2,93	26,12	26,12
Staphylinidae	2,38	4,41	7,13	3,37	13,44	39,55
Anthicidae	1,45	0,10	4,69	2,88	8,84	48,39
Cryptophagidae	0,22	1,51	4,40	4,07	8,29	56,69
Melyridae	1,02	0,04	3,37	1,27	6,34	63,03
Ptinidae	0,23	1,16	3,23	2,63	6,09	69,12
Zopheridae	0,48	1,17	2,54	1,61	4,79	73,91
Tenebrionidae	0,98	0,55	1,61	1,69	3,03	76,95
Latridiidae	0,09	0,38	1,20	1,58	2,26	79,21
Endomychidae	0,04	0,33	1,03	1,73	1,93	81,14
Curculionoidea	0,43	0,20	0,90	1,40	1,70	82,84
Oedemeridae	0,22	0,00	0,77	1,59	1,46	84,30
Chrysomelidae	0,24	0,04	0,76	1,35	1,44	85,73
Nitidulidae	0,53	0,42	0,76	1,14	1,44	87,17
Kateretidae	0,21	0,00	0,72	0,81	1,36	88,53
Leiodidae	0,28	0,19	0,71	1,19	1,34	89,87
Elateridae	0,23	0,28	0,61	1,14	1,15	**91,03**

Tab. 7.1.6 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **BOS** stations for the Coleoptera Families more abundantly sampled; additional explanations in the text.

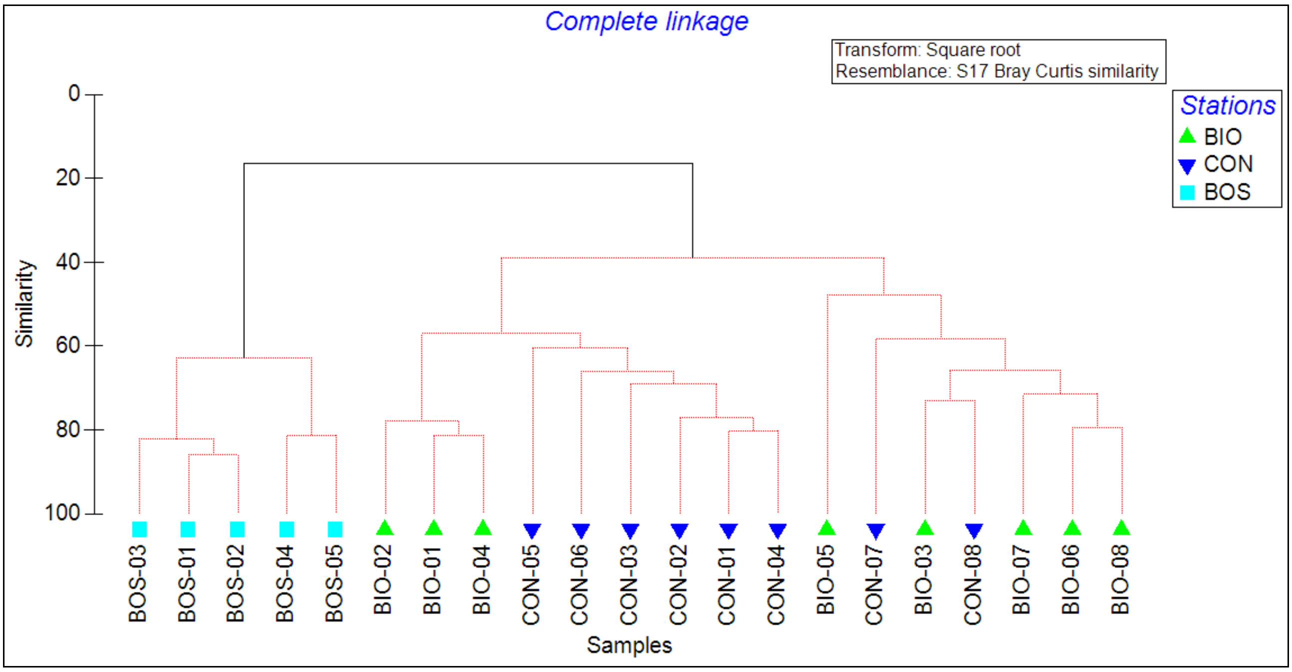
Groups CON/BOS
Average dissimilarity = 52,38

Family	Group CON Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Carabidae	1,69	5,77	13,92	2,88	26,83	26,83
Staphylinidae	2,41	4,41	6,93	2,87	13,36	40,19
Anthicidae	1,43	0,10	4,58	4,47	8,82	49,02
Cryptophagidae	0,52	1,51	3,53	2,23	6,81	55,83
Ptinidae	0,26	1,16	3,09	2,62	5,96	61,79
Zopheridae	0,32	1,17	2,93	1,94	5,64	67,43
Melyridae	0,66	0,04	2,12	1,70	4,09	71,52
Tenebrionidae	1,12	0,55	2,00	1,77	3,85	75,37
Curculionoidea	0,57	0,20	1,47	1,64	2,83	78,20
Oedemeridae	0,36	0,00	1,27	1,72	2,44	80,64
Latridiidae	0,11	0,38	1,09	1,66	2,09	82,74
Nitidulidae	0,52	0,42	0,79	1,30	1,52	84,25
Kateretidae	0,20	0,00	0,70	1,00	1,34	85,60
Endomychidae	0,20	0,33	0,68	1,20	1,31	86,90
Elateridae	0,17	0,28	0,67	1,10	1,29	88,20
Mordellidae	0,21	0,06	0,67	1,42	1,29	89,48
Chrysomelidae	0,20	0,04	0,63	1,40	1,21	**90,70**

Tab. 7.1.7 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **CON** and **BOS** stations for the Coleoptera Families more abundantly sampled; additional explanations in the text.

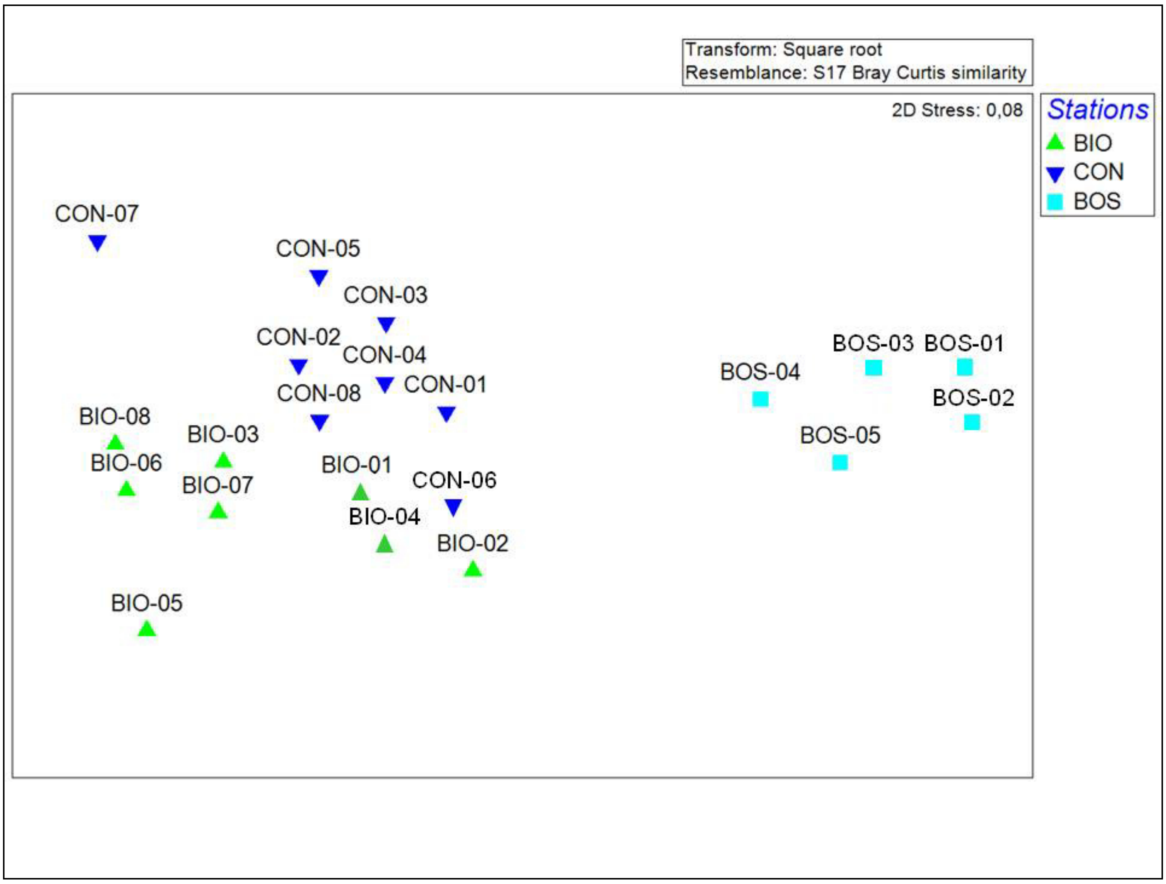
SPECIES OF CARABIDAE

Looking at the dendrogram of similarities among traps based on the Bray-Curtis index, in regards to Carabidae species (graph. 7.1.7) it is evident that one cluster groups the traps of the **BOS** station which differs with each other in a statistical significance (p <0.5 at least %) according to the SIMPROF test, while those cluster grouping the traps of the **BIO** and **CON** stations have not statisticalsignificance.

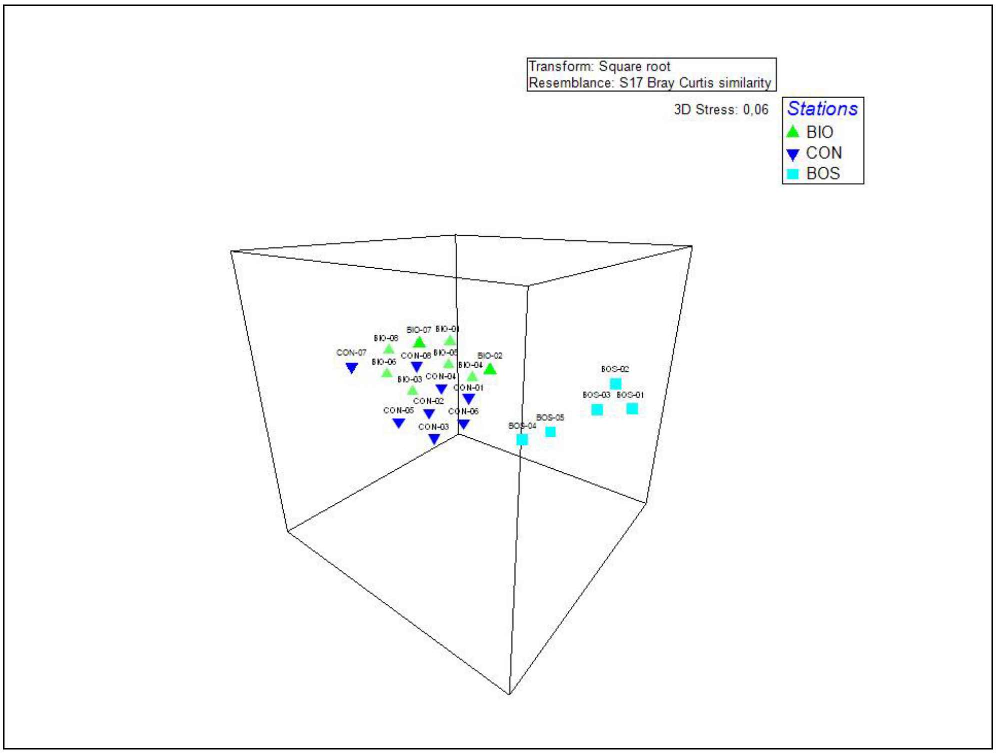


Graph. 7.1.7 – The Dendrogram values based on the Bray-Curtis similarity index between the traps of stations investigated in regards to the Carabidae species. The black lines show the clusters that are significantly different (at least p <0,5%) according to the SIMPROF test.

In regards to the Carabidae species, the Nonmetric Multi Dimensional Scaling (NMDS), elaborated on the Bray-Curtis similarity matrix between the traps, both in 2 D (graph. 7.1.8) and 3 D (graph. 7.1.9) vision, shows a cluster for the traps of the **BOS** station, the vicinity of traps of the **BIO** station and trap **CON-04**, the vicinity of all remaining traps of **CON** station with **CON-07** slightly spaced from the other of this station.

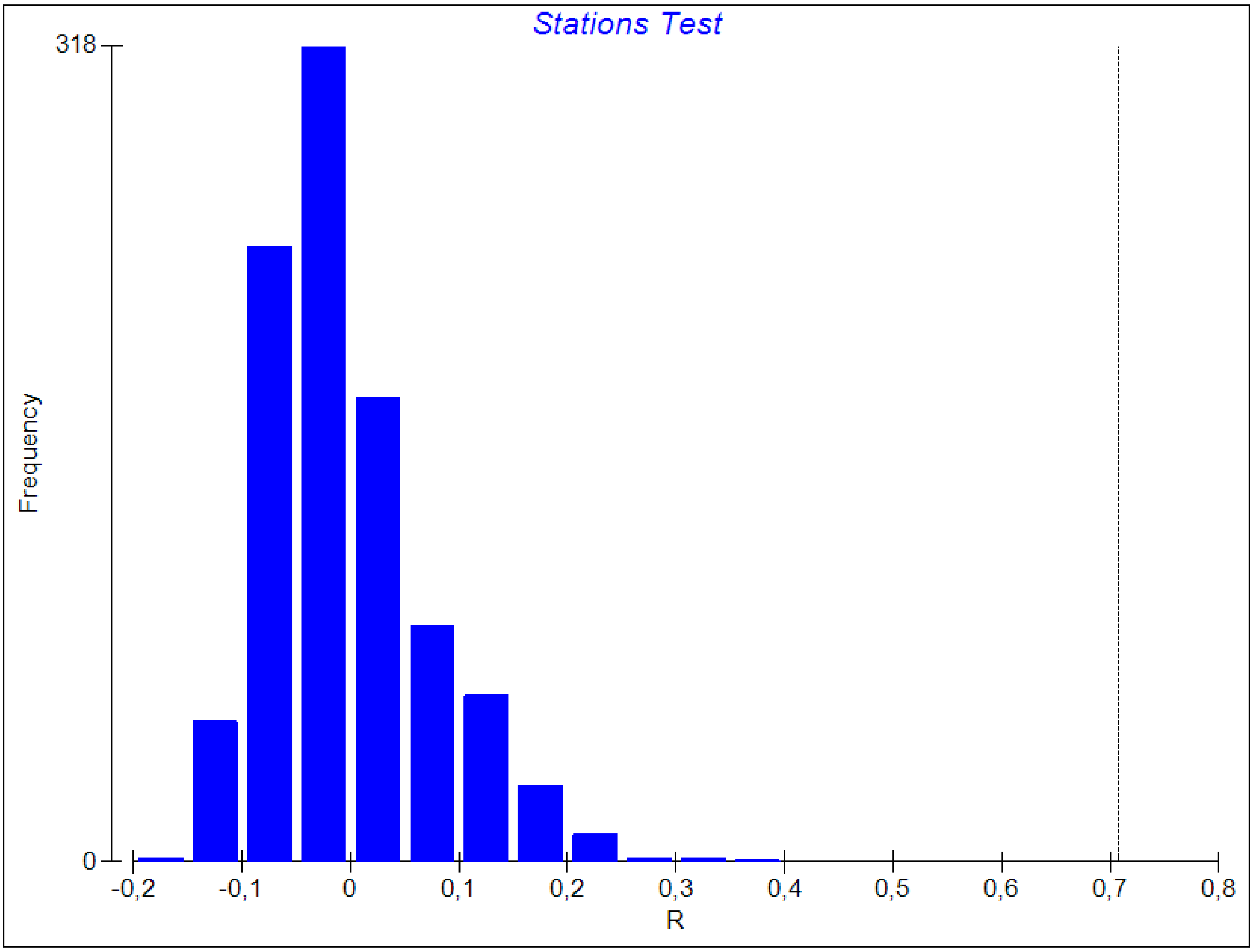


Graph. 7.1.8 – The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations in regards to Carabidae species (2 D vision).



Graph. 7.1.9 – The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations in regards to Carabidae species (3 D vision).

The analysis shows that the traps of a station are, in most cases, more similar to each other than with the traps of other stations. The ANOSIM test (graph. 7.1.10) confirms this hypothesis with an high statistical significance.



Graph. 7.1.10 – ANOSIM tests: distribution of expected frequencies of R (histogram) compared with the observed value of R (**0,71**) (continuous line) between the traps of the stations investigated in relation to Carabidae species.

In tables 7.1.8-7.1.10, the species of Carabidae that determine the similarity between the traps of each station are shown. For each species, the mean abundance in the traps (Av. Abund) and the mean similarity (Av. Sim) between them in regards to each single species are given. In the third column, the value of the ratios between the similarity and standard deviation (Sim/SD) are shown, which provides an indication of the uniformity of distribution of the taxon in the samples; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns, the percentage contribution of each species of Carabidae are shown in order to determine the overall average similarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.
From the analysis, the results for the **BIO** and **CON** stations consist of 5-6 species, although with different weight in relation to individual stations, which contribute most to the determining the similarity between the traps in oder of abundance: ***Syntomus obscuroguttatus***, ***Calathus fuscipes graecus***, ***Laemostenus algerinus algerinus***, ***Calathus montivagus***, and ***Calathus ambiguus***, while only three species (***Calathus montivagus***, ***Calathus fuscipes graecus***, and ***Laemostenus algerinus algerinus***) contribute at more than 90% to determine the similarity between the traps of the **BOS** station.

Group BIO

Average similarity: 65,86

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Syntomus obscuroguttatus	1,11	24,95	6,90	37,89	37,89
Calathus fuscipes graecus	0,95	19,57	4,22	29,71	67,60
Laemostenus algerinus algerinus	0,42	10,19	2,76	15,47	83,07
Calathus montivagus	0,43	4,30	0,83	6,53	89,60
Calathus ambiguus	0,25	2,65	0,68	4,03	**93,63**

Tab. 7.1.8 – The average similarity between the traps and percentage contribution to the similarity of the Carabidae species in the **BIO** station; further explanations in the text.

Group CON

Average similarity: 47,28

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Calathus fuscipes graecus	1,16	21,63	3,84	32,57	32,57
Laemostenus algerinus algerinus	0,58	11,81	4,92	17,79	50,36
Syntomus obscuroguttatus	0,57	10,80	3,66	16,26	66,62
Harpalus decipiens	0,41	7,77	2,93	11,69	78,31
Calathus ambiguus	0,36	6,11	4,17	9,20	87,51
Calathus montivagus	0,46	6,04	1,22	9,10	**96,61**

Tab. 7.1.9 – The average similarity between the traps and percentage contribution to the similarity of the Carabidae species in the **CON** station; further explanations in the text.

Group BOS

Average similarity: 76,03

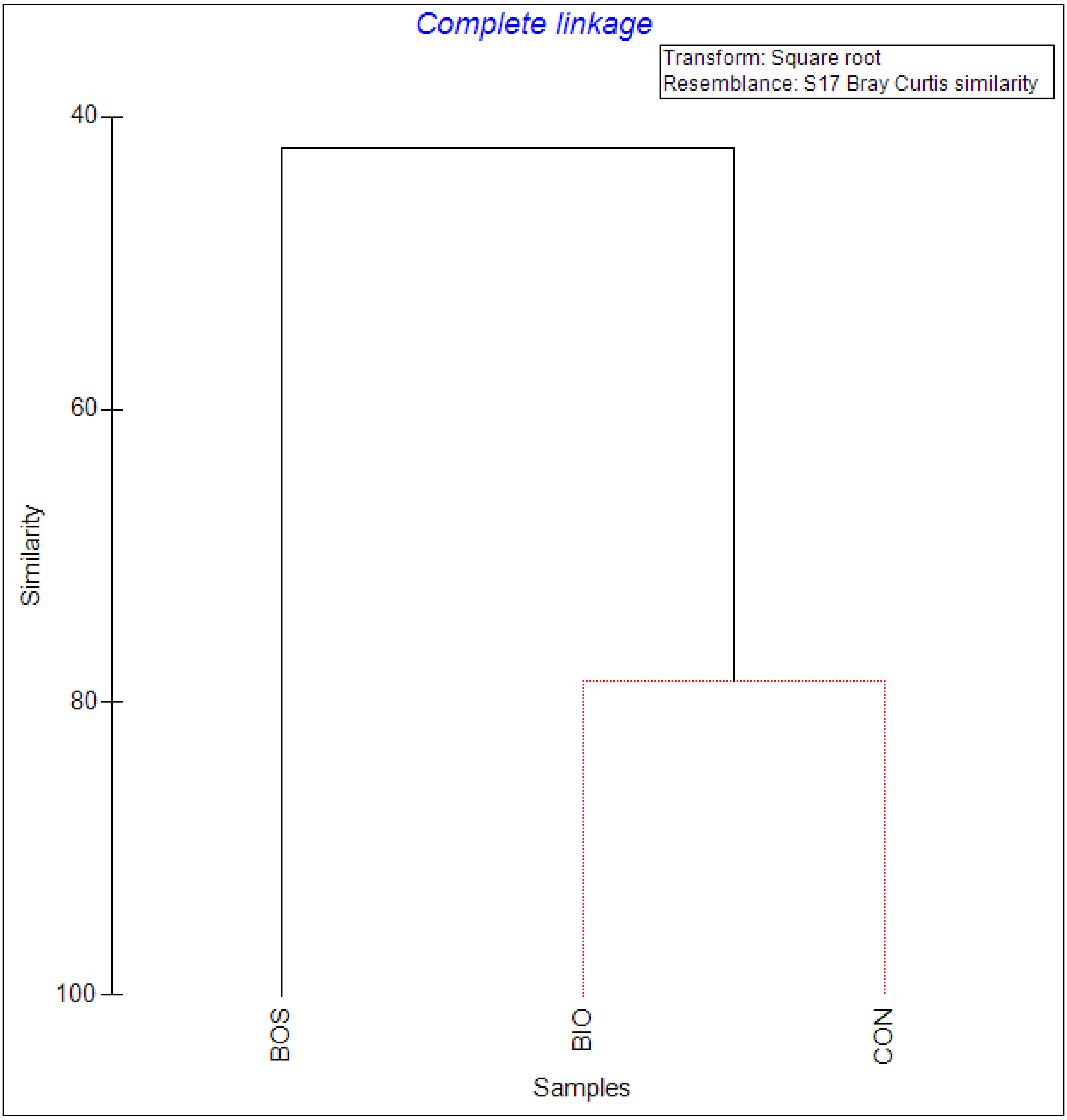
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Calathus montivagus	4,95	39,29	5,80	51,68	51,68
Calathus fuscipes graecus	2,41	18,51	5,50	24,35	76,03
Laemostenus algerinus algerinus	1,36	11,33	8,35	14,91	**90,94**

Tab. 7.1.10 – The average similarity between the traps and percentage contribution to the similarity of the Carabidae species in the **BOS** station; further explanations in the text.

The statistical significance of differences between the stations were calculated using the Parwise test, based on the comparison of observed and expected values of R between pairs of stations (tab. 7.1.11). The analysis shows that only the **BOS** station significant differs from each other, while the **CON** and **BIO** stations do not differ significantly from each other; these are grouped together according to the Bray-Curtis index (graph. 7.1.11) into two clusters: the first with about 80% similarity includes the **CON** and **BIO** stations, the second separates the **BOS** station.

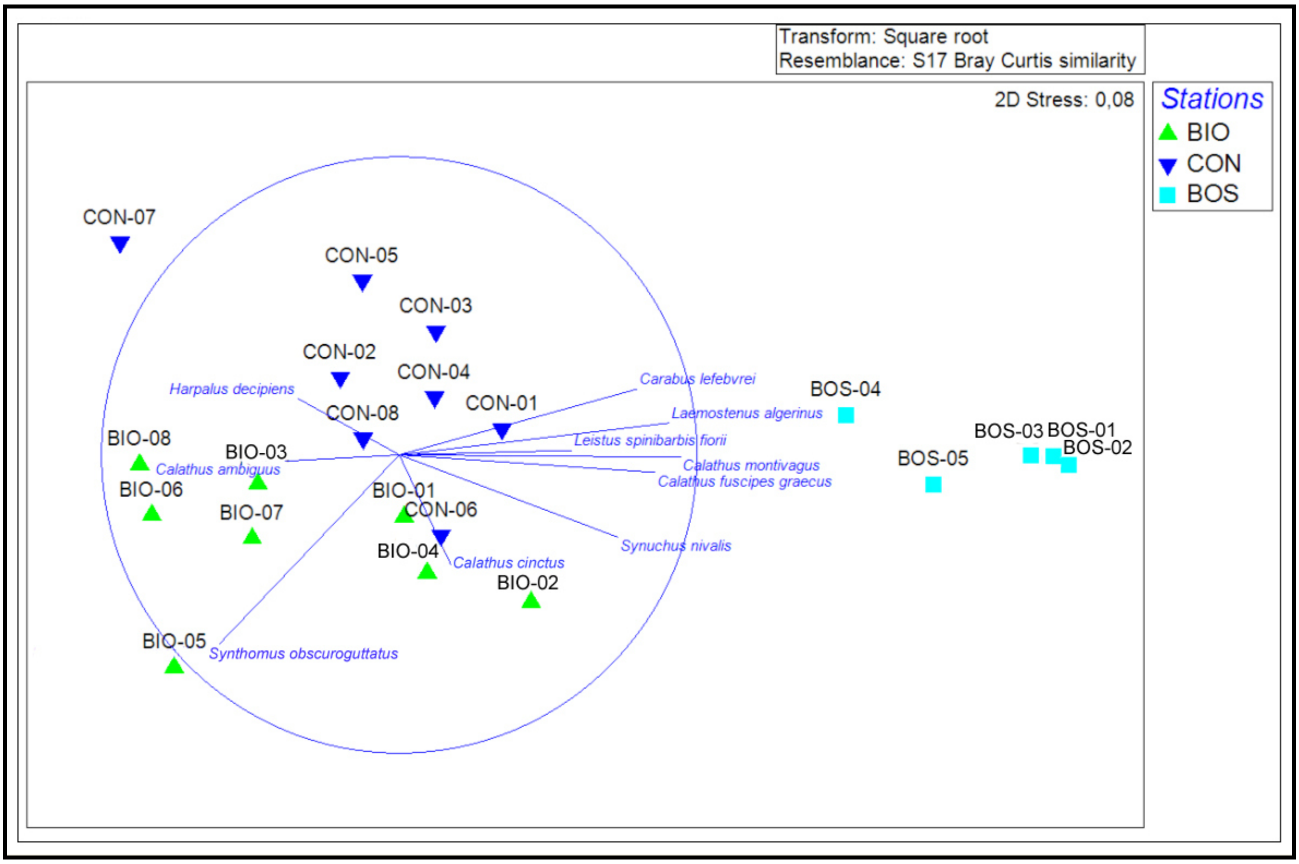
Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
BIO/CON	0,287	1,1	6435	999	10
BIO/BOS	0,989	0,4	1287	999	3
CON/BOS	0,972	0,2	1287	999	1

Tab. 7.1.11 – The Pairwise tests, based on the values of R observed for pairs of stations in regards to Carabidae species. The significance % refers to the number of values of R that fall within the range of expected frequencies compared to the total number of possible permutations.



Graph. 7.1.11 – The dendrogram of Bray-Curtis similarity index values between the investigated stations in regards to the Carabidae species.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2 D (graph. 7.1.12), elaborated on the Bray-Curtis similarity matrix between traps, in regards to Carabidae species shows a dissimilarity between the traps of the **BOS** station to the **BIO/CON** pair. ***Calathus montivagus***, ***Calathus fuscipes graecus***, ***Carabus lefebvrei***, ***Laemostenus algerinus algerinus***, ***Synchus nivalis***, ***Leistus spinibarbis fiorii***, and ***Notiophilus rufipes*** (the last two species exclusives) are centered on the traps of the **BOS** station characterizing it and differentiating the traps of this station rather from the other stations. ***Calathus cinctus*** occupies an intermediate position between traps of **BOS**, **BIO**, and **CON** stations. The remaining of the species are centered on the **BIO/CON** pair of the station contributing to determininig their similarities and to differentiate them from the **BOS** station, with ***Harpalus decipiens*** lacking in traps of the **BOS** station.



Graph. 7.1.12 – The correlation between Nonmetric Multi Dimensional Scaling (NMDS) developed on the Bray-Curtis similarity matrix between the stations and the Carabidae species; in the figure only those most abundantly sampled determine the differences or similarities among the traps of three stations are indicated.

In tables 7.1.12-7.1.14 the Carabidae species that determine the dissimilarity between the traps of each station are shown. For each species, the mean abundance in the traps (Av. Abund) and the mean dissimilarity (Av. Diss) between them in regards to each single species are given. In the fourth column, the value of the ratios between dissimilarity and standard deviation (Diss/SD), which provides an indication of the uniformity of distribution of the taxon in the samples is shown; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns, the percentage contribution of each Carabidae species are shown to determine the overall average dissimilarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.

In general, the mean overall value of dissimilarity between stations varies from 38,42% of the pair **BIO/CON,** and 69,78% of the pair **BIO/BOS**. By examination of the tables is also clear that the comparisons between traps of pairs **BIO/BOS** and **CON/BOS** stations, the first 3 species in order of abundance give a dissimilarity between stations with a contribution of more than 70%, while the comparison between traps of pair of stations **BIO/CON** the first 3 species in order of abundance give a dissimilarity between stations with a contribution of about 48%.

Species that occur most frequently are: ***Calathus montivagus***, ***Calathus fuscipes graecus***, ***Laemostenus algerinus algerinus***, and ***Syntomus obscuroguttatus***.

Groups BIO/CON
Average dissimilarity = 38,42

	Group BIO	Group CON				
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Syntomus obscuroguttatus	1,11	0,57	7,02	1,64	18,28	18,28
Calathus fuscipes graecus	0,95	1,16	6,28	1,43	16,34	34,62
Calathus montivagus	0,43	0,46	5,29	1,42	13,77	48,39
Harpalus decipiens	0,18	0,41	3,63	1,38	9,45	57,84
Calathus ambiguus	0,25	0,36	3,54	1,32	9,22	67,06
Laemostenus algerinus algerinus	0,42	0,58	2,59	1,45	6,75	73,82
Calathus cinctus	0,16	0,06	1,90	1,18	4,94	78,75
Carabus lefebvrei lefebvrei	0,02	0,15	1,83	1,19	4,76	83,51
Synchus nivalis	0,10	0,02	1,28	0,80	3,34	86,85
Platyderus sp.	0,06	0,03	0,86	0,66	2,23	89,08
Harpalus sulphuripes	0,02	0,04	0,83	0,52	2,15	**91,23**

Tab. 7.1.12 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **CON** stations for the Carabidae species more abundantly sampled; additional explanations in the text.

Groups BIO/BOS
Average dissimilarity = 69,78

	Group BIO	Group BOS				
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Calathus montivagus	0,43	4,95	32,01	4,62	45,88	45,88
Calathus fuscipes graecus	0,95	2,41	10,13	2,00	14,52	60,40
Syntomus obscuroguttatus	1,11	0,08	7,61	2,88	10,91	71,31
Laemostenus algerinus algerinus	0,42	1,36	6,58	4,63	9,43	80,74
Carabus lefebvrei lefebvrei	0,02	0,53	3,60	2,42	5,16	85,90
Synchus nivalis	0,10	0,45	2,68	1,61	3,84	89,75
Calathus ambiguus	0,25	0,10	1,73	1,00	2,48	**92,23**

Tab. 7.1.13 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **BOS** stations for the Carabidae species more abundantly sampled; additional explanations in the text.

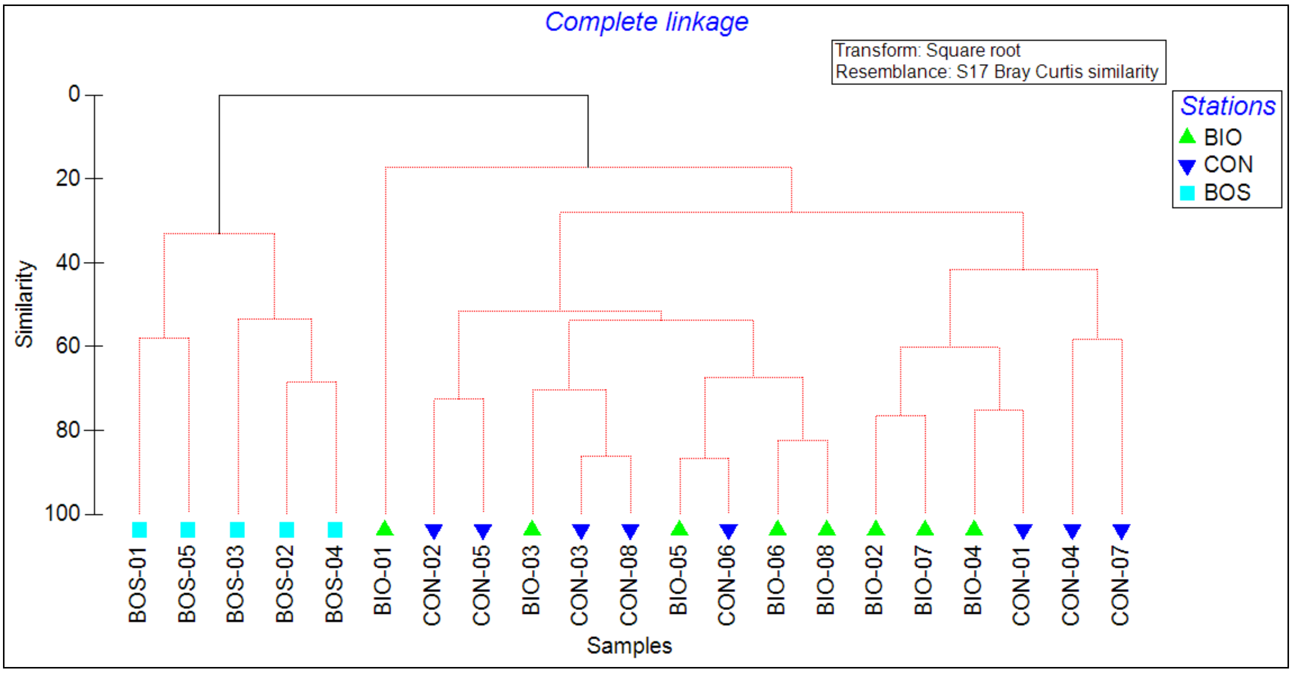
Groups CON/BOS
Average dissimilarity = 63,65

	Group CON	Group BOS				
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Calathus montivagus	0,46	4,95	31,05	5,09	48,78	48,78
Calathus fuscipes graecus	1,16	2,41	8,53	1,61	13,41	62,18
Laemostenus algerinus algerinus	0,58	1,36	5,34	2,68	8,39	70,58
Syntomus obscuroguttatus	0,57	0,08	3,64	1,86	5,72	76,30
Harpalus decipiens	0,41	0,00	2,97	2,47	4,66	80,97
Synchus nivalis	0,02	0,45	2,87	1,70	4,51	85,48
Carabus lefebvrei lefebvrei	0,15	0,53	2,71	1,73	4,26	89,74
Calathus ambiguus	0,36	0,10	1,96	1,30	3,07	**92,82**

Tab. 7.1.14 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **CON** and **BOS** stations for the Carabidae species more abundantly sampled; additional explanations in the text.

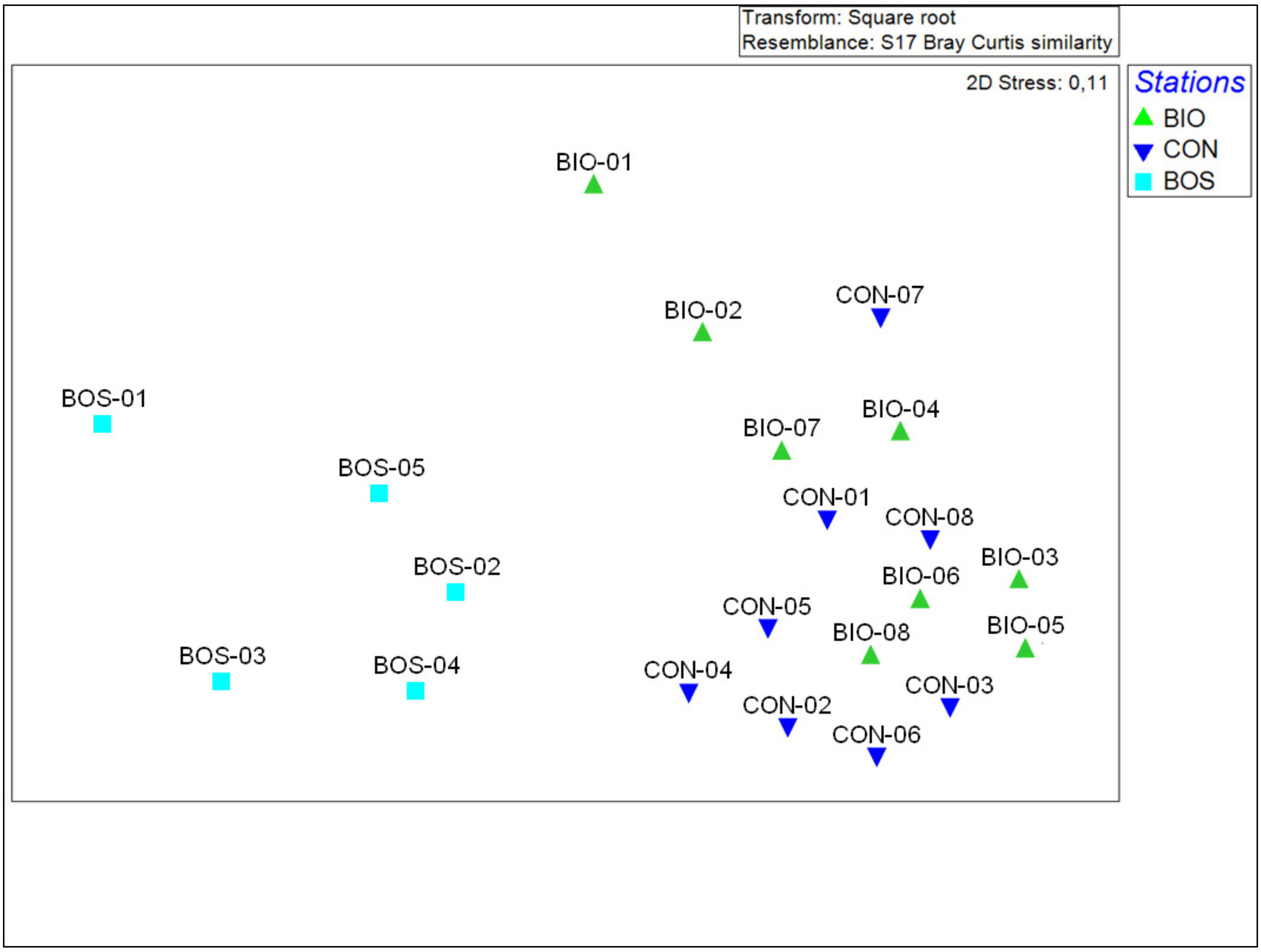
SPECIES OF TENEBRIONIDAE

Looking at the dendrogram of similarities among traps based on the Bray-Curtis index in regards to Tenebrionidae species (graph. 7.1.13) it is evident that the cluster which grouped the traps of **BOS** station results different with each other in a statistical significance (p <0.5 at least %) according to the SIMPROF test. The second cluster groups all other traps of **BIO** and **CON** stations.

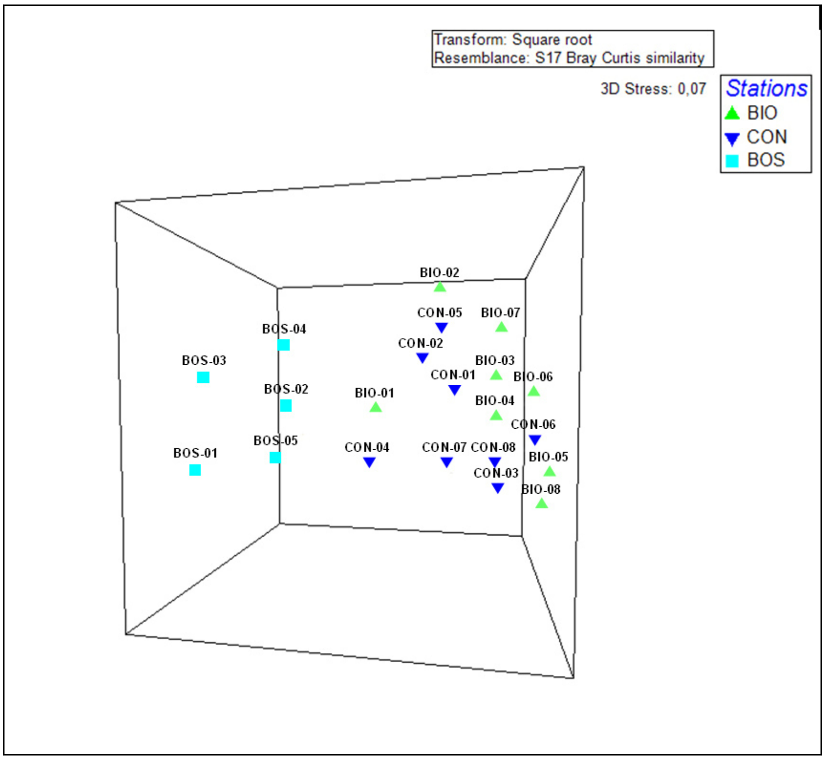


Graph. 7.1.13 – The Dendrogram values based on Bray-Curtis similarity index between the traps of stations investigated in regards to the Tenebrionidae species. The black lines show the clusters that are significantly different (at least p<0,5%) according to the SIMPROF test.

In regards to the Tenebrionidae species, the Nonmetric Multi Dimensional Scaling (NMDS), elaborated on the Bray-Curtis similarity matrix between the traps, in relation to species of Tenebrionidae, both in 2 D (graph. 7.1.14) and 3 D (graph. 7.1.15), shows a cluster for the traps of the **BOS** station, while the traps of **BIO** station are not clearly separated from those of the **CON** station.

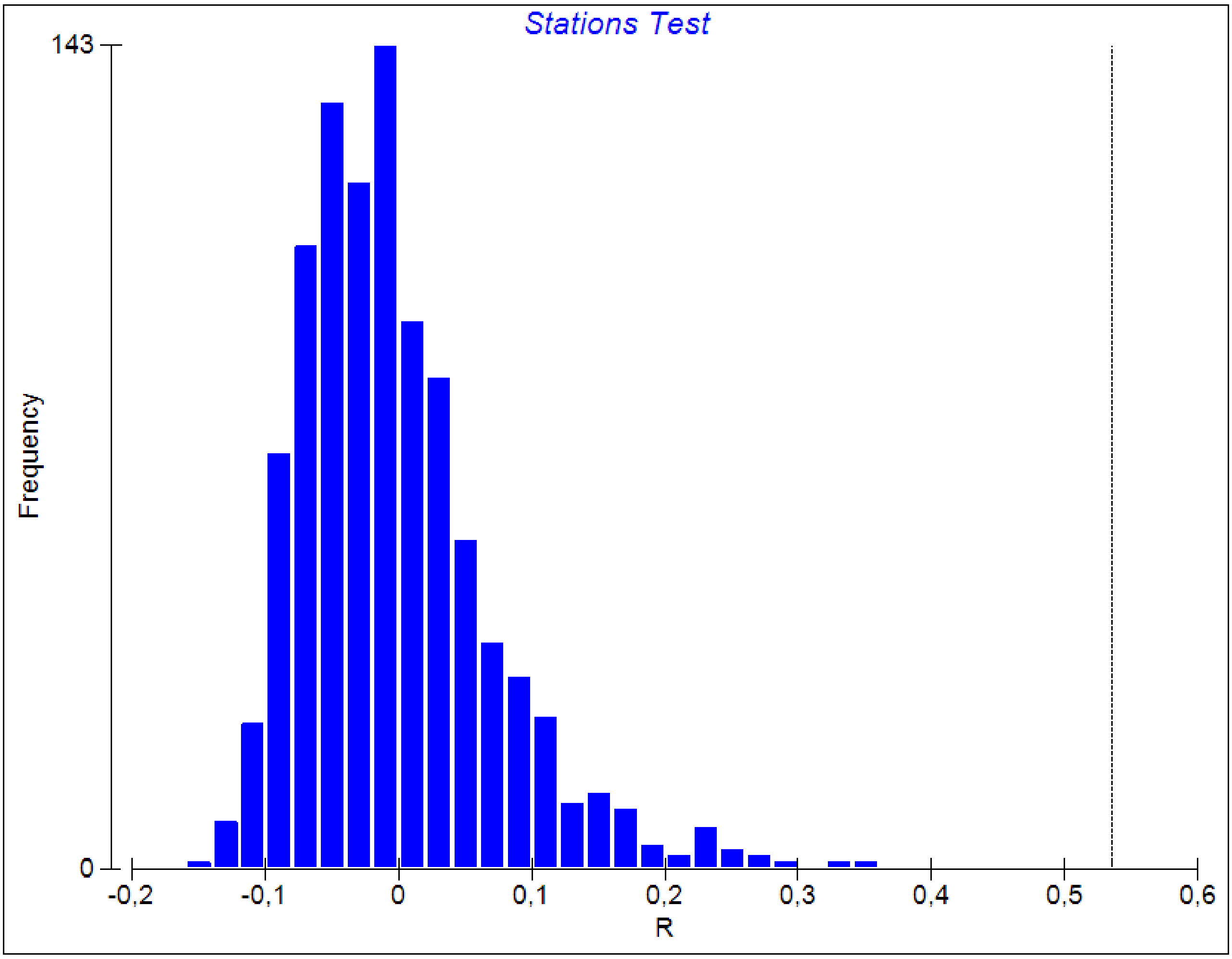


Graph. 7.1.14 – The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations, in relation to the Tenebrionidae species (2 D vision).



Graph. 7.1.15 – The Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations, in relation to the Tenebrionidae species (3 D vision).

The analysis shows that the traps of a station are, in most cases, more similar to each other than with the traps of other stations. The ANOSIM test (graph. 7.1.16) confirms this hypothesis with a statistical significance.



Graph. 7.1.16 – ANOSIM tests: distribution of expected frequencies of R (histogram), compared with the observed value of R (**0,53**) (continuous line) between the traps of the stations investigated in regards to Tenebrionidae species.

In tables 7.1.15-7.1.17, the species of Tenebrionidae that determine the similarities between the traps of each station are shown. For each species, the mean abundance in the traps (Av. Abund) and the mean similarity (Av. Sim) between them in regards to each single species are given. In the third column the value of the ratios between the similarity and standard deviation (Sim/SD) are shown, which provides an indication of the uniformity of distribution of the taxon in the samples; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns, the percentage contribution of each species of Tenebrionidae are shown in order to determine the overall average similarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.

From analysis, the results for the **BIO** station consist of 4 species which contribute mostly to determining the similarity between the traps: ***Opatrum verrucosum***, ***Stenosis sardoa ardoini***, ***Blaps gibba***, and ***Pimelia rugulosa rugulosa***, the latter two species determine more than 90% of the similarity between the traps of the **CON** station. Only two species, ***Accanthopus velikensis***, and ***Helops rossii***, contribute more than 90% to determine the similarity between the traps of **BOS** station.

Group BIO
Average similarity: 53,85

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Pimelia rugulosa	0,81	33,84	2,63	62,85	62,85
Opatrum verrucosum	0,24	9,10	1,56	16,90	79,75
Blaps gibba	0,21	3,55	0,47	6,58	86,33
Stenosis sardoa ardoini	0,13	2,84	0,49	5,27	**91,60**

Tab. 7.1.15 – The average similarity between the traps and percentage contribution to the similarity of the Tenebrionidae species in the **BIO** station; further explanations in the text.

Group CON
Average similarity: 59,73

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Pimelia rugulosa	1,04	50,31	5,65	84,23	84,23
Blaps gibba	0,18	3,50	0,72	5,86	**90,09**

Tab. 7.1.16 – The average similarity between the traps and percentage contribution to the similarity of the Tenebrionidae species in the **CON** station; further explanations in the text.

Group BOS
Average similarity: 50,95

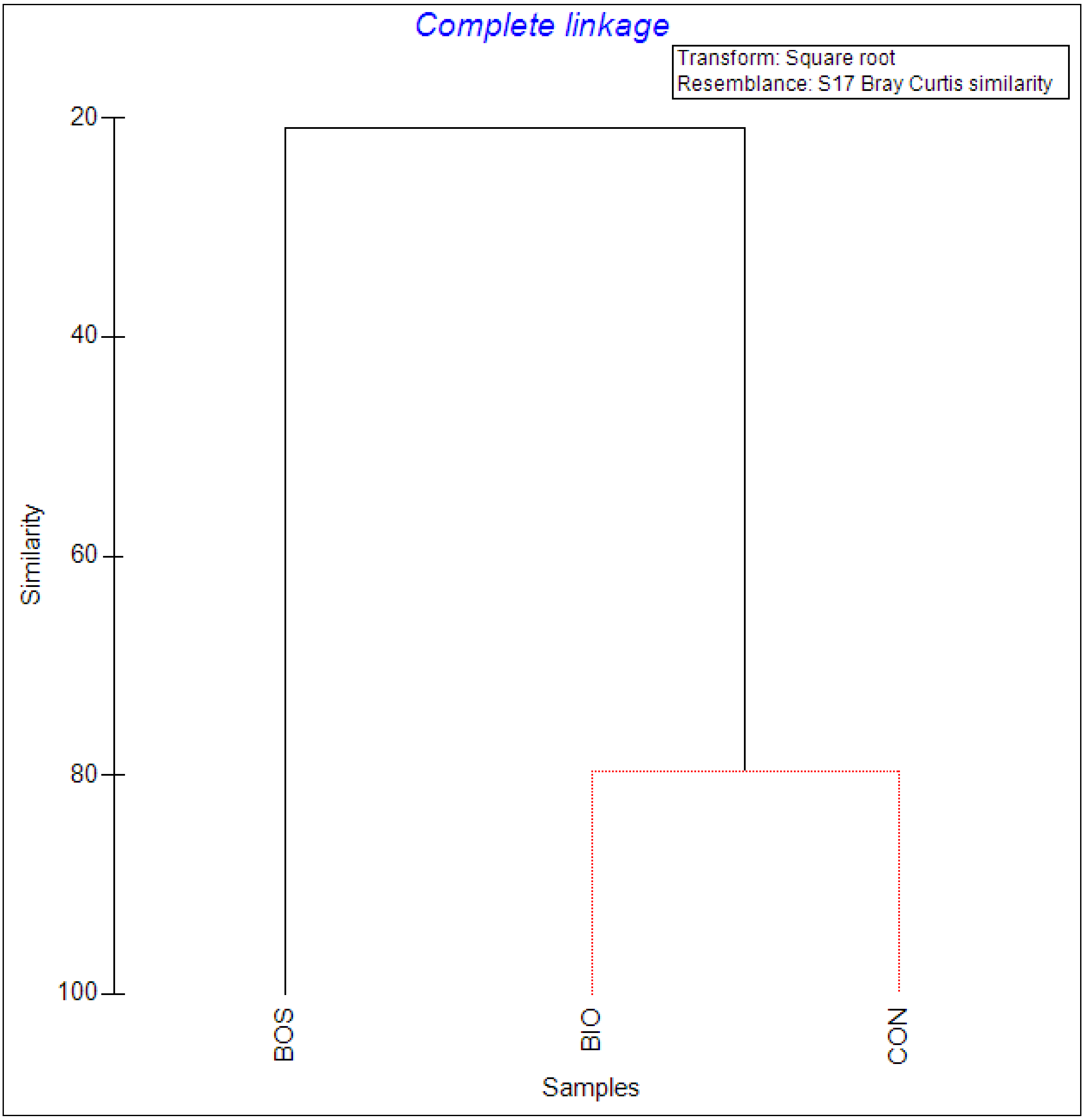
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Accanthopus velikensis	0,43	40,48	4,77	79,45	79,45
Helops rossii	0,18	5,96	0,62	11,70	**91,15**

Tab. 7.1.17 – The average similarity between the traps and percentage contribution to the similarity of the Tenebrionidae species in the **BOS** station; further explanations in the text.

The statistical significance of differences between the stations were calculated using the Parwise test, based on comparison of observed and expected values of R between pairs of stations (tab. 7.1.18). The analysis shows that only the traps of the **BOS** station highly significant differ from each other; these are grouped together, according to the Bray-Curtis index (graph. 7.1.17), into two clusters: the first includes the traps of the **BOS** station, the second with about 80% of similarity includes pair of **BIO** and **CON** stations.

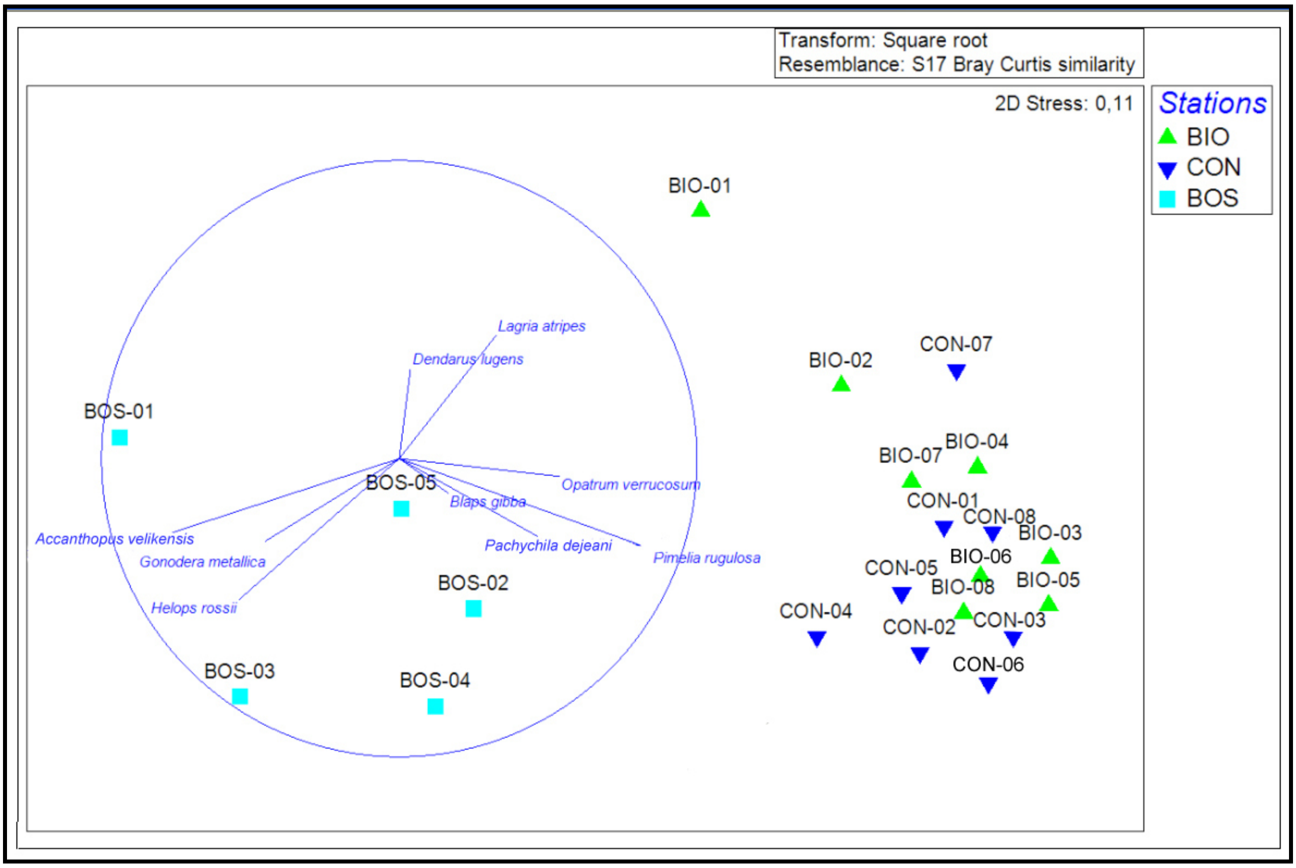
Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
BIO/CON	0,061	20,6	6435	999	205
BIO/BOS	0,936	0,2	1287	999	1
CON/BOS	0,976	0,2	1287	999	1

Tab. 7.1.18 – The Pairwise tests, based on the values of R observed for pairs of stations in regards to the Tenebrionidae species. The significance % refers to the number of values of R that fall within the range of expected frequencies compared to the total number of possible permutations.



Graph. 7.1.17 – The Dendrogram of Bray-Curtis similarity index values between the investigated stations in regards to the Tenebrionidae species.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2 D (graph. 7.1.18), elaborated on the Bray-Curtis similarity matrix between stations, in regards to Tenebrionidae species indicates a clear dissimilarity between the traps of the **BOS** station to the **BIO/CON** pair. ***Accanthopus velikensis***, ***Gonodera metallica*** (exclusives of station **BOS**), and ***Helops rossii*** are centered on the traps of the **BOS** station. The remaining of the species are centered on the pair of the **BIO/CON** stations contribute to determining their similarities and to differentiate them from the **BOS** station. ***Opatrum verrucosum***, ***Pachychila dejeani***, ***Lagria atripes***, ***Lagria hirta***, ***Isomira ferruginea***, ***Isomira murina***, and ***Dendarus lugens*** are lacking in the traps of the **BOS** station.



Graph. 7.1.18 – The correlation between Nonmetric Multi Dimensional Scaling (NMDS) developed on the Bray-Curtis similarity matrix between the stations and the Tenebrionidae species; in the figure only those most abundantly sampled determine the differences or similarities among the traps of three stations are indicated.

In tables 7.1.19-7.1.21, the species of Tenebrionidae that determine the dissimilarity between the traps of each station are shown. For each species the mean abundance in the traps (Av. Abund) and the mean dissimilarity (Av. Diss) between them in relation to each single species are given. In the fourth column, the value of the ratios between dissimilarity and standard deviation (Diss/SD), which provides an indication of the uniformity of distribution of the taxon in the samples is shown, higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns the percentage contribution of each species of Tenebrionidae are shown to determine the overall average dissimilarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.

The mean overall value of dissimilarity between the traps of the stations varies from 43,94% of the pair **BIO/CON** and 87,88% of the pair **BIO/BOS**. By examination of the tables, is also clear that for each comparison between the traps of pairs of stations already the first 3 species in order of abundance give a dissimilarity between stations with a contribution of more than 50%.

Among the species that occur most frequently are: ***Pimelia rugulosa rugulosa***, ***Blaps gibba***, ***Opatrum verrucosum***, ***Accanthopus velikensis***, ***Pachychila dejeani***, and ***Stenosis sardoa ardoini***.

Groups BIO/CON
Average dissimilarity = 43,94

Species	Group BIO Av.Abund	Group CON Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Pimelia rugulosa	0,81	1,04	12,39	1,21	28,20	28,20
Blaps gibba	0,21	0,18	6,77	1,16	15,40	43,60
Opatrum verrucosum	0,24	0,07	6,11	1,56	13,90	57,50
Stenosis sardoa ardoini	0,13	0,13	4,74	0,88	10,79	68,29
Pachychila dejeani	0,13	0,13	4,41	1,13	10,03	78,32
Lagria atripes	0,11	0,05	3,34	0,95	7,60	85,92
Isomira ferruginea	0,00	0,07	1,71	0,56	3,90	89,82
Lagria hirta	0,02	0,02	1,15	0,51	2,62	**92,45**

Tab. 7.1.19 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **CON** stations for the Tenebrionidae species more abundantly sampled; additional explanations in the text.

Groups BIO/BOS
Average dissimilarity = 87,88

Species	Group BIO Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Pimelia rugulosa	0,81	0,09	27,32	2,11	31,09	31,09
Accanthopus velikensis	0,00	0,43	17,51	2,89	19,92	51,01
Opatrum verrucosum	0,24	0,00	8,91	2,01	10,14	61,15
Blaps gibba	0,21	0,10	8,10	1,02	9,22	70,37
Stenosis sardoa ardoini	0,13	0,05	6,41	0,70	7,30	77,66
Helops rossii	0,00	0,18	6,29	1,10	7,16	84,82
Pachychila dejeani	0,13	0,00	4,55	0,93	5,17	89,99
Lagria atripes	0,11	0,00	4,22	0,91	4,80	**94,80**

Tab. 7.1.20 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **BOS** stations for the Tenebrionidae species more abundantly sampled; additional explanations in the text.

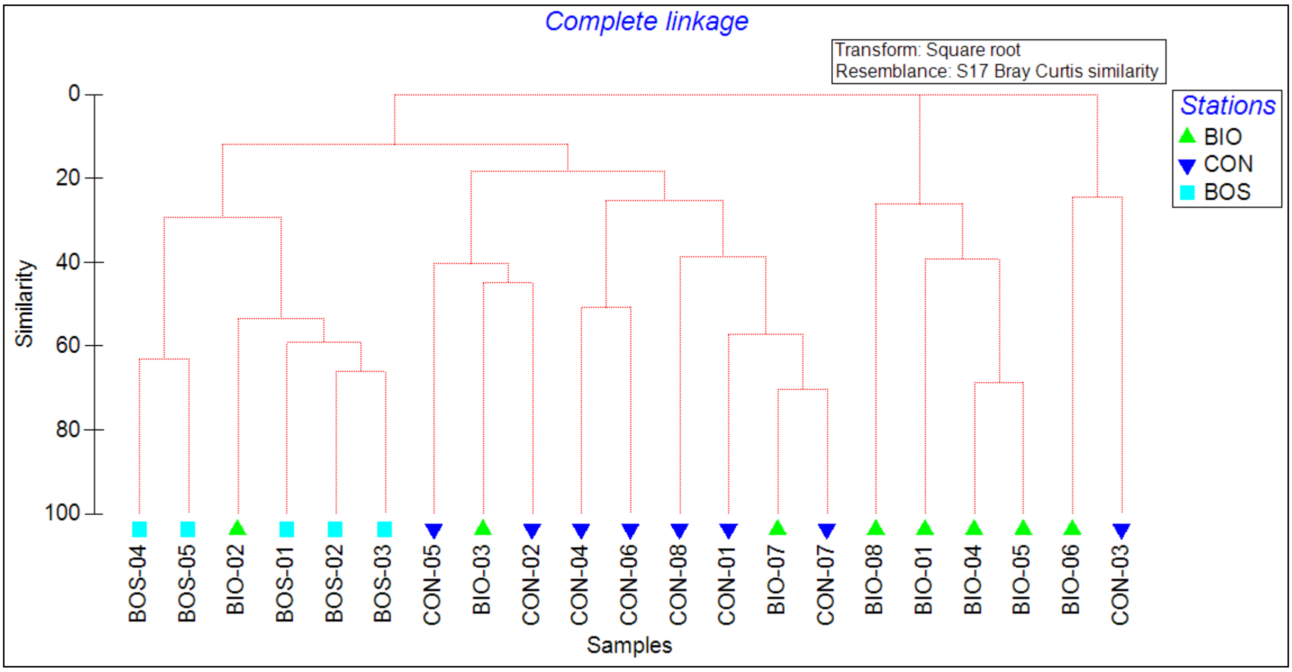
Groups CON/BOS
Average dissimilarity = 86,66

Species	Group CON Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Pimelia rugulosa	1,04	0,09	36,92	3,32	42,60	42,60
Accanthopus velikensis	0,00	0,43	17,39	2,91	20,07	62,67
Blaps gibba	0,18	0,10	6,43	1,16	7,42	70,09
Helops rossii	0,03	0,18	6,24	1,10	7,20	77,29
Pachychila dejeani	0,13	0,00	4,82	0,91	5,56	82,86
Stenosis sardoa ardoini	0,13	0,05	4,58	1,00	5,29	88,15
Opatrum verrucosum	0,07	0,00	2,37	0,56	2,73	**90,88**

Tab. 7.1.21 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **CON** and **BOS** stations for the Tenebrionidae species more abundantly sampled; additional explanations in the text.

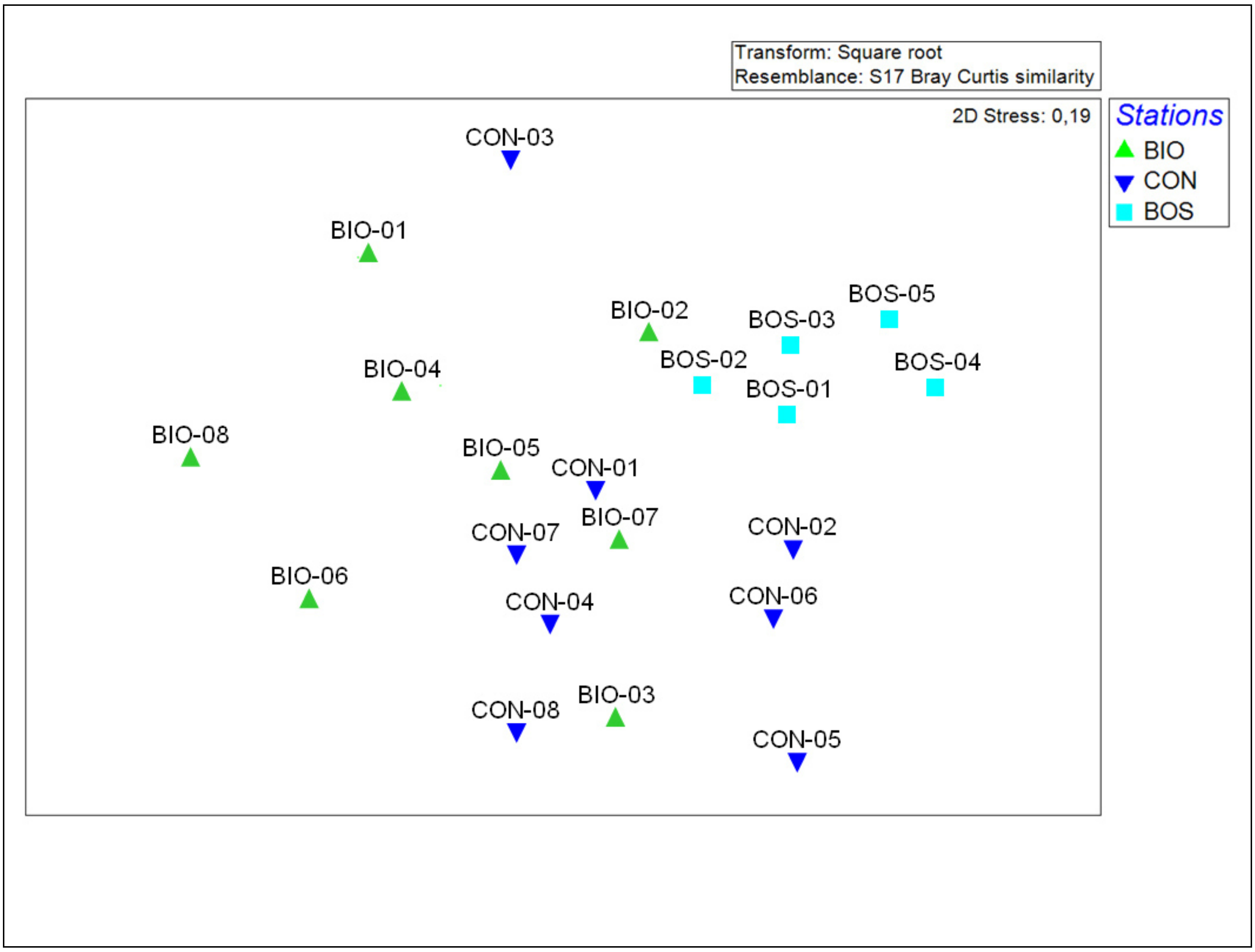
SPECIES OF STAPHYLINIDAE

The dendrogram of similarities among the traps, based on the Bray-Curtis index in regards to the Staphylinidae species (graph. 7.1.19), shows clusters which not differ with each other in a statistical significance (p <0.5 at least %) according to the SIMPROF test.

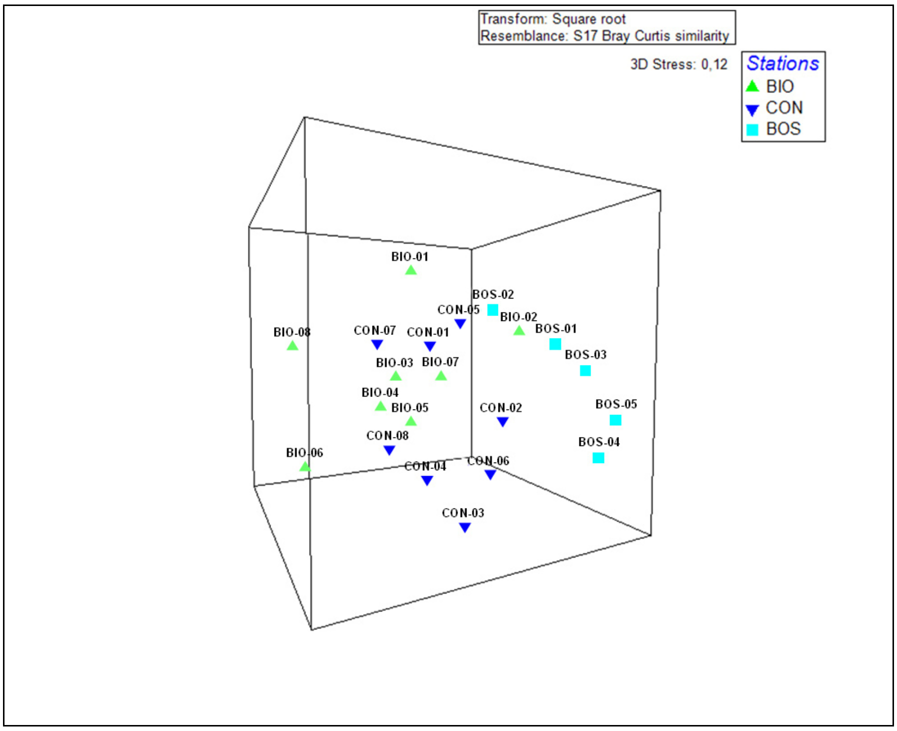


Graph. 7.1.19 – The Dendrogram values based on the Bray-Curtis similarity index between the traps of stations investigated in relation to species of Staphylinidae. The black lines show the clusters that are statistically significantly different (at least p <0,5%) according to the SIMPROF test.

In regards to the Staphylinidae species, the Nonmetric Multi Dimensional Scaling (NMDS) elaborated on the Bray-Curtis similarity matrix between the traps, both in 2D (graph. 7.1.20) and 3D (graph. 7.1.21), shows a cluster for the traps of the **BOS** station, while the traps of the **BIO** station are not separate from those of the **CON** station with the trap **BIO-02** very close to those of the **BOS** station.

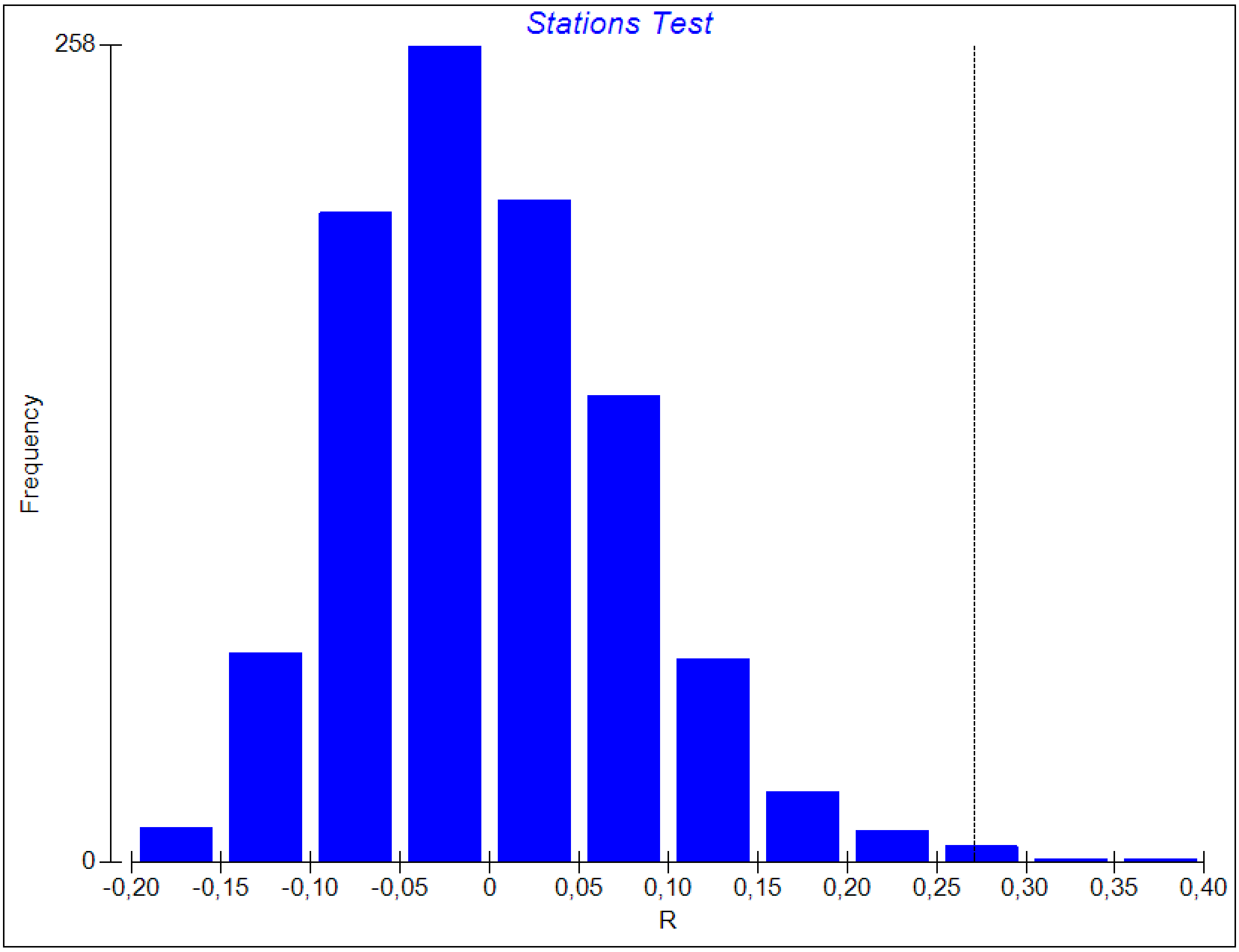


Graph. 7.1.20 – The Nonmetric Multi Dimensional Scaling (NMDS), elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations, in regards to the Staphylinidae species (2 D vision).



Graph. 7.1.21 – The Nonmetric Multi Dimensional Scaling (NMDS), elaborated on the Bray-Curtis similarity matrix between the traps of investigated stations, in regards to the Staphylinidae species (3 D vision).

The analysis shows that, generally, the traps of a station are no more similar to each other compared to those of the other stations. The ANOSIM test (graph. 7.1.22) confirms this hypothesis.



Graph. 7.1.22 – ANOSIM tests: distribution of expected frequencies of R (histogram) compared with the observed value of R (**0,27**) (continuous line) between the traps of the stations investigated in regards to the Staphylinidae species.

In tables 7.1.22-7.1.24, the Staphylinidae species that determine the similarities between the traps of each station are shown. For each species, the mean abundance in the traps (Av. Abund) and the mean similarity (Av. Sim) between them in regards to each single species are given. In the third column, the value of the ratios between similarity and standard deviation (Sim/SD) are shown, which provides an indication of the uniformity of distribution of the taxon in the samples; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns the percentage contribution of each species of Staphylinidae are shown in order to determine the overall average similarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.

From the analysis, the results for the stations consist of 4-5 species, although with different weight in relation to individual stations, which contribute mostly to the determining the similarity between the traps in order of abundace: ***Ocypus olens***, ***Paraphloeostiba gayndahensis***, ***Tachyporus nitidulus***, ***Omalium rugatum***, and ***Ocypus mus***.

Group BIO

Average similarity: 29,82

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Tachyporus nitidulus	0,16	8,00	1,01	26,84	26,84
Paraphloeostiba gayndahensis	0,20	7,48	0,94	25,07	51,91
Tachyporus pusillus	0,19	7,19	0,96	24,10	76,01
Ocypus olens	0,22	3,00	0,48	10,06	86,08
Omalium rugatum	0,12	2,21	0,49	7,41	**93,49**

Tab. 7.1.22 – The average similarity between the traps and percentage contribution to the similarity of the Staphylinidae species in the **BIO** station; further explanations in the text.

Group CON

Average similarity: 31,56

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ocypus olens	0,30	15,12	1,33	47,91	47,91
Paraphloeostiba gayndahensis	0,22	5,19	0,69	16,45	64,37
Ocypus mus	0,15	5,07	0,68	16,07	80,44
Tachyporus nitidulus	0,12	4,15	0,70	13,15	**93,59**

Tab. 7.1.23 – The average similarity between the traps and percentage contribution to the similarity of the Staphylinidae species in the **CON** station; further explanations in the text.

Group BOS

Average similarity: 52,63

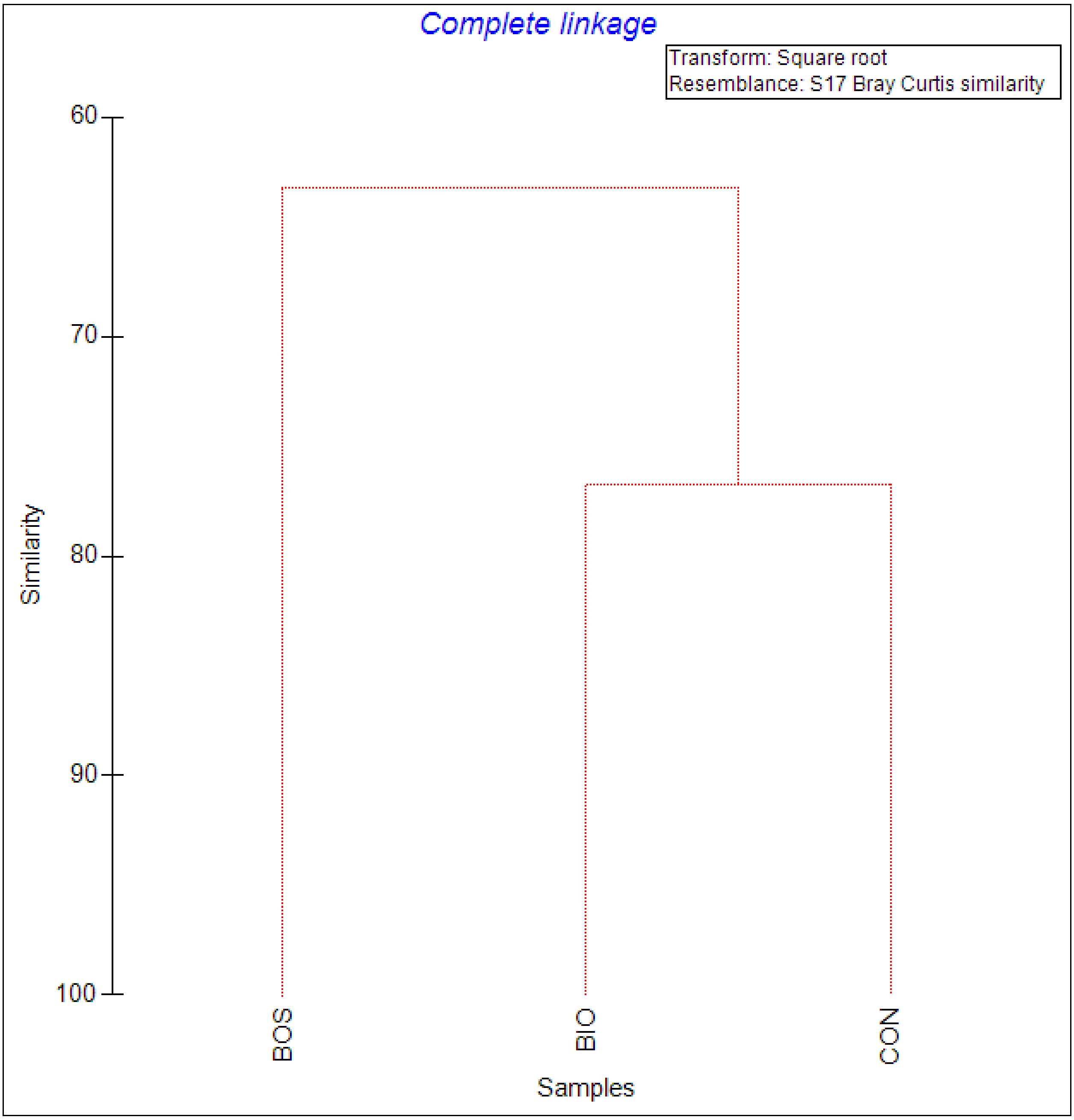
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ocypus olens	0,90	27,66	7,10	52,57	52,57
Quedius latinus	0,48	13,49	3,22	25,63	78,19
Ocypus mus	0,41	6,06	0,61	11,52	89,72
Omalium rugatum	0,15	2,67	0,61	5,08	**94,79**

Tab. 7.1.24 – The average similarity between the traps and percentage contribution to the similarity of the Staphylinidae species in the **BOS** station; further explanations in the text.

The statistical significance of differences between the stations were calculated using the Parwise test, based on the comparison of observed and expected values of R between pairs of stations (tab. 7.1.25). The analysis shows that only a pair of stations **BIO/BOS** significant differ from each other. The stations are grouped together according to the Bray-Curtis index (graph. 7.1.23) into two clusters: the first includes the station **BOS** the second the **BIO/CON** pair.

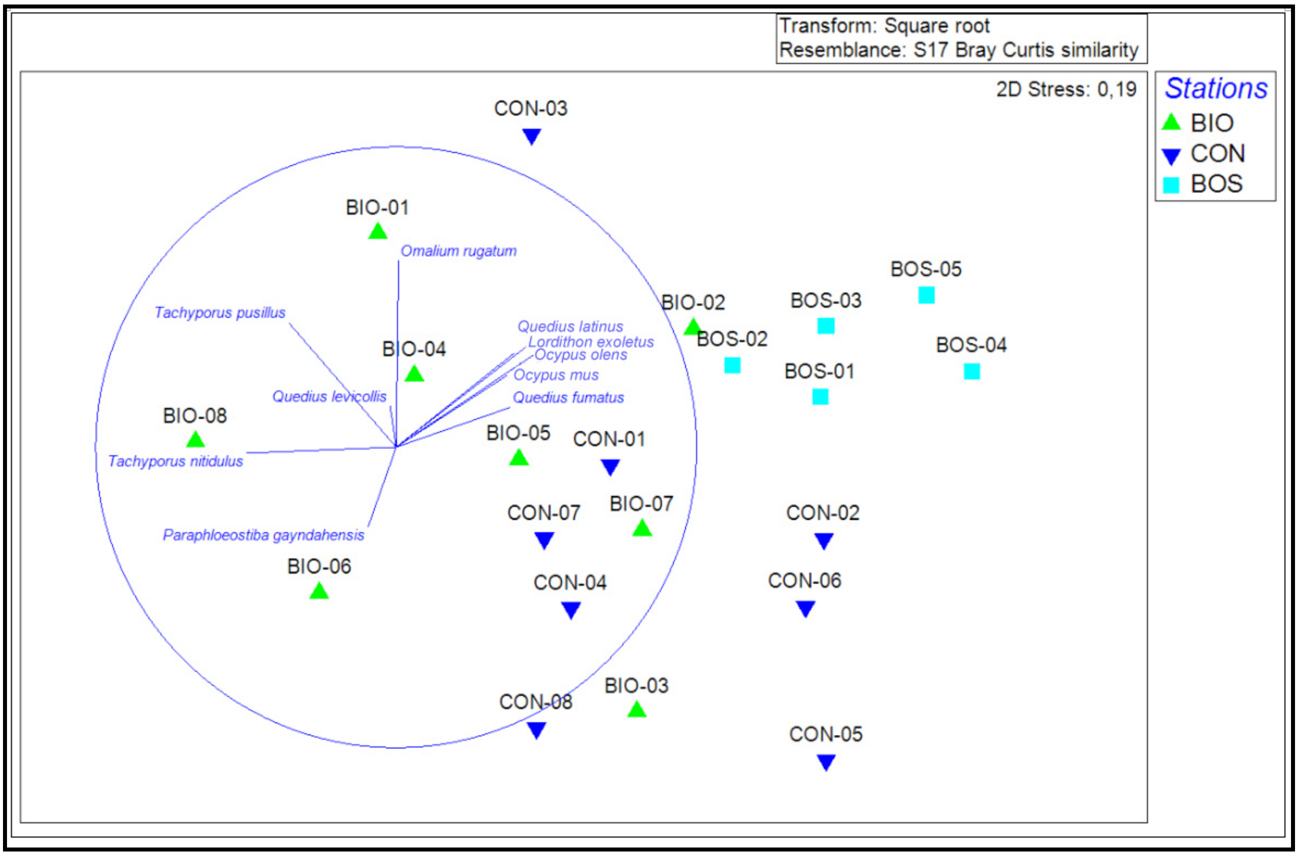
Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
BIO/CON	0,046	24,6	126	999	245
BIO/BOS	0,508	0,4	126	999	3
CON/BOS	0,404	0,6	126	999	5

Tab. 7.1.25 – The Pairwise tests, based on the values of R observed for pairs of stations in regards to the Staphylinidae species. The significance % refers to the number of values of R that fall within the range of expected frequencies compared to the total number of possible permutations.



Graph. 7.1.23 – The Dendrogram of Bray-Curtis similarity index values between the investigated stations and the Staphylinidae species.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2 D (graph. 7.1.24), elaborated on the Bray-Curtis similarity matrix between stations, in regards to species of Staphylinidae shows a poor dissimilarity between the traps of the three stations, with those of the **BOS** station slightly distinguished from the other two. ***Quedius latinus***, ***Lordithon exoletus***, and ***Quedius fumatus*** are exclusive of the **BOS** station, while ***Ocypus olens***, and ***Ocypus mus*** are centered on this station. The remaining of the species are centered on the pair of the **BIO/CON** stations.



Graph. 7.1.24 – The correlation between Nonmetric Multi Dimensional Scaling (NMDS), developed on the Bray-Curtis similarity matrix between the stations and the Staphylinidae species; in the figure only those most abundantly sampled and determine the differences or similarities among the three stations are indicated.

In tables 7.1.25-7.1.27, the species of Staphylinidae that determine the dissimilarity between the traps of each station are shown. For each species, the mean abundance in the traps (Av. Abund) and the mean dissimilarity (Av. Diss) between them in relation to each single species are given. In the fourth column, the value of the ratios between dissimilarity and standard deviation (Diss/SD), which provides an indication of the uniformity of distribution of the taxon in the samples is shown; higher values indicate greater uniformity, lower values indicate little homogeneous distributions of catches. In the last two columns the percentage contribution of each species of Staphylinidae are shown to determine the overall average dissimilarity between the traps (Contrib%) and the cumulative percentage of species in question (Cum%) up to the threshold of 90%.

The mean overall value of dissimilarity between stations varies from 70,28% of the pair **BIO/CON** and 78,12% of the pair **CON/BOS**. By examination of the tables is also clear that for each comparison between pairs of stations already the first 5 species in order of abundance give a dissimilarity between stations with a contribution that varies from about 50% to more than 60%.

Among the species that occur most frequently are: ***Ocypus olens***, ***Ocypus mus***, ***Paraphloeostiba gayndahensis***, ***Quedius latinus***, ***Tachyporus pusillus***, ***Tachyporus nitidulus***, and ***Omalium rugatum***.

Groups BIO/CON
Average dissimilarity = 70,28

	Group BIO	Group CON				
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Ocypus olens	0,22	0,30	10,50	1,50	14,93	14,93
Paraphloeostiba gayndahensis	0,20	0,22	7,30	1,12	10,38	25,32
Tachyporus pusillus	0,19	0,06	6,56	1,30	9,34	34,65
Ocypus mus	0,13	0,15	6,19	1,22	8,80	43,46
Omalium rugatum	0,12	0,05	4,67	0,92	6,64	50,10
Tachyporus nitidulus	0,16	0,12	4,58	1,00	6,51	56,62
Quedius levicollis	0,07	0,02	2,50	0,67	3,56	60,18
Sepedophilus nigripennis	0,02	0,05	2,42	0,64	3,45	63,63
Tachyporus sp.	0,03	0,00	1,95	0,36	2,77	66,40
Mycetoporus mulsanti	0,02	0,03	1,54	0,52	2,20	68,60
Philonthus debilis	0,02	0,02	1,48	0,51	2,11	70,71
Xantholinus sp.	0,05	0,00	1,43	0,52	2,03	72,74
Proteinus brachypterus	0,00	0,03	1,35	0,35	1,91	74,66
Tachyporus abner	0,04	0,00	1,27	0,54	1,81	76,47
Acidota cruentata	0,02	0,02	1,25	0,51	1,78	78,25
Astenus sp.	0,00	0,03	1,17	0,36	1,66	79,91
Phyllodrepa floralis	0,02	0,00	1,12	0,36	1,60	81,51
Stenus aceris	0,02	0,00	1,12	0,36	1,59	83,10
Gyrohypnus fracticornis	0,02	0,00	1,07	0,36	1,52	84,62
Mycetoporus angularis	0,00	0,02	0,95	0,36	1,36	85,98
Quedius cruentus	0,00	0,02	0,92	0,36	1,30	87,28
Bisnius fimetarius	0,00	0,02	0,81	0,36	1,15	88,43
Sepedophilus sicilianus	0,02	0,00	0,77	0,37	1,10	89,54
Philonthus jurgans	0,02	0,00	0,75	0,37	1,06	**90,60**

Tab. 7.1.25 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **CON** stations for the Staphylinidae species more abundantly sampled; additional explanations in the text.

Groups BIO/BOS
Average dissimilarity = 77,80

Species	Group BIO Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ocypus olens	0,22	0,90	17,70	2,05	22,75	22,75
Quedius latinus	0,00	0,48	11,99	2,58	15,41	38,15
Ocypus mus	0,13	0,41	8,99	1,26	11,56	49,71
Paraphloeostiba gayndahensis	0,20	0,14	4,79	1,49	6,16	55,87
Tachyporus nitidulus	0,16	0,06	4,19	1,48	5,38	61,25
Tachyporus pusillus	0,19	0,09	3,98	1,25	5,12	66,37
Omalium rugatum	0,12	0,15	3,78	1,17	4,86	71,23
Lordithon exoletus	0,00	0,11	2,81	0,76	3,61	74,84
Quedius fumatus	0,00	0,08	2,48	0,48	3,18	78,02
Othius laeviusculus	0,02	0,05	1,81	0,58	2,33	80,35
Mycetoporus mulsanti	0,02	0,07	1,63	0,61	2,10	82,44
Quedius levicollis	0,07	0,00	1,46	0,55	1,87	84,32
Proteinus brachypterus	0,00	0,05	1,36	0,48	1,75	86,07
Mycetoporus angularis	0,00	0,04	1,34	0,48	1,73	87,80
Tachyporus sp.	0,03	0,00	1,12	0,36	1,44	89,24
Xantholinus sp.	0,05	0,00	1,02	0,53	1,31	**90,54**

Tab. 7.1.26 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **BIO** and **BOS** stations for the Staphylinidae species more abundantly sampled; additional explanations in the text.

Groups CON/BOS
Average dissimilarity = 78,12

Species	Group CON Av.Abund	Group BOS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ocypus olens	0,30	0,90	15,22	2,16	20,86	20,86
Quedius latinus	0,00	0,48	12,51	2,72	17,15	38,01
Ocypus mus	0,15	0,41	9,35	1,55	12,81	50,82
Paraphloeostiba gayndahensis	0,22	0,14	5,66	1,10	7,76	58,57
Omalium rugatum	0,05	0,15	3,69	1,16	5,06	63,63
Tachyporus nitidulus	0,12	0,06	3,38	1,27	4,64	68,27
Lordithon exoletus	0,00	0,11	2,93	0,77	4,02	72,29
Tachyporus pusillus	0,06	0,09	2,76	0,92	3,79	76,07
Quedius fumatus	0,00	0,08	2,60	0,48	3,57	79,64
Proteinus brachypterus	0,03	0,05	1,87	0,60	2,56	82,20
Mycetoporus mulsanti	0,03	0,07	1,83	0,61	2,51	84,71
Mycetoporus angularis	0,02	0,04	1,74	0,59	2,39	87,10
Othius laeviusculus	0,00	0,05	1,59	0,49	2,18	89,29
Sepedophilus nigripennis	0,05	0,00	1,31	0,56	1,79	**91,08**

Tab. 7.1.27 – The average dissimilarity between the stations and percentage contribution to the dissimilarity between the **CON** and **BOS** stations for the Staphylinidae species more abundantly sampled; additional explanations in the text.

8. COMPARISON AMONG INVESTIGATED STATIONS DURING THE PRESENT RESEARCH AND STATIONS OF A PREVIOUS RESEARCH (BOEMI, 2010)

8.1 METHODS

The results obtained in the present field research have been compared with those of a previous research conducted, from April to September 2008, using the same method of pit fall-traps, in B zone of the southern slope of the Etna Regional Park at the same altitude (1,300-1,400 m), in three similar habitat typologies: organic and conventional orchards (apple and pear trees) and wooded remnants (BOEMI 2010). Figure 8.1.1 shows the location of the two areas.

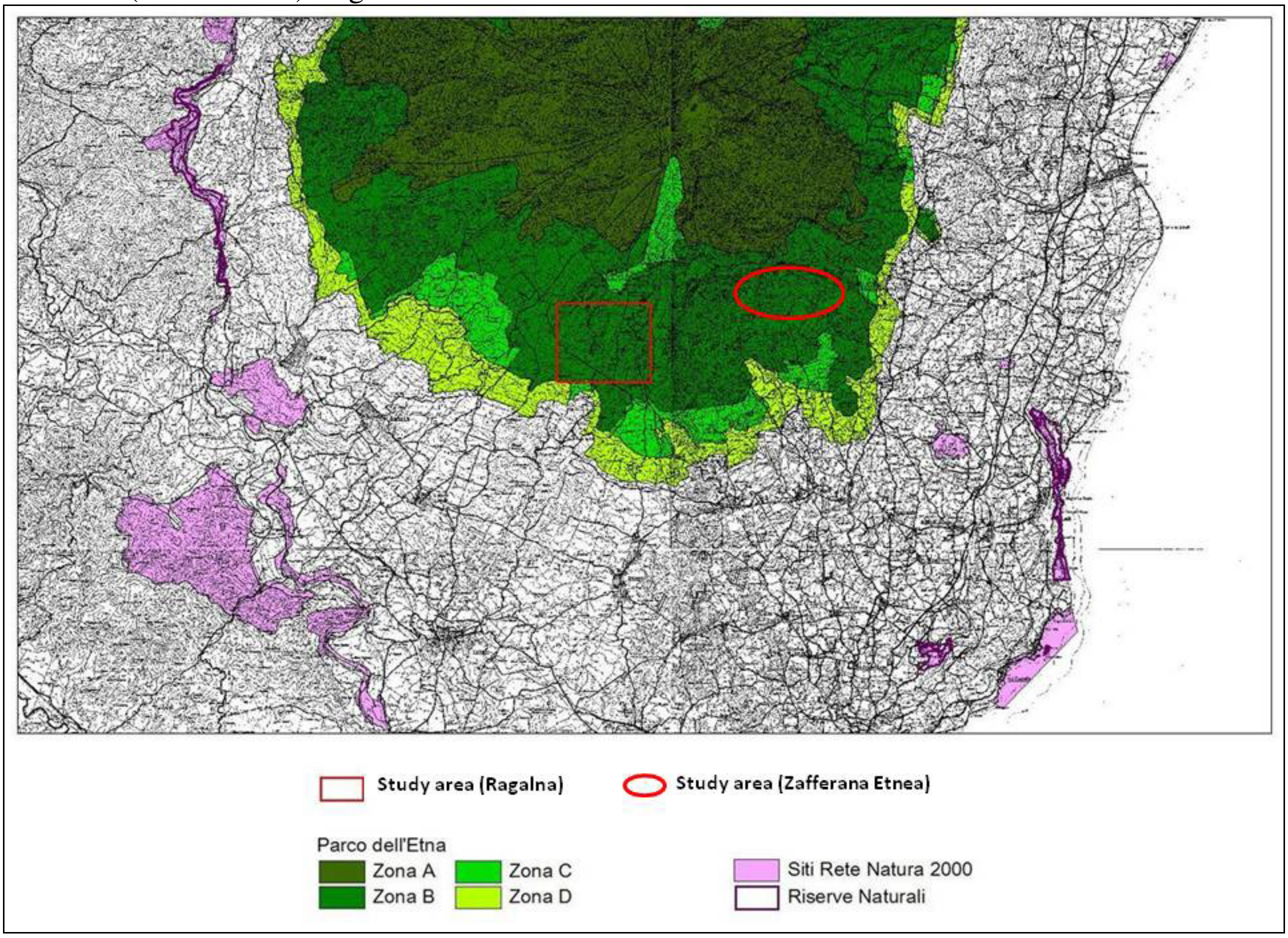


Fig. 8.1.1 – Location of the two study areas.

The comparison has been conducted in regards to Coleoptera Families and Carabidae, Tenebrionidae and Staphylinidae (excluding Aleocharinae) species captures frequencies during 6 periods identified with the months of April, May, June, July, August, and September.

8.2 BRIEF DESCRIPTION OF STUDY-2008 STATIONS

Station R-BIO

Organic orchards (apple and pear trees) located in Ragalna at 1,377 m a. s. l., with exposure S/SO, placed in residual plots among lava outcroppings on a ground almost flat (slope less than 1%). The conduction of the soil involves two annual plowing and the maintaining of grassed margins. The annual provided treatments were: 3 phytoiatric treatments with use of pheromone traps (Exosex CM ® IntrachemBio Italia), 3 anticryptogamics treatments using Bordoflow® Manica Italia, 3 microbiological treatments using granulosis virus and *Bacillus thuringiensis* and 2 treatments with *Bacillus subtilis* following by 2 interventions using copper hydroxide (Heliocuivre® IntrachemBio Italia).

Station R-CON

Conventional orchards (apple and pear trees) located in Ragalna at 1.394 m a. s. l., with exposure S/SO, placed in residual plots among lava outcroppings on a ground slightly sloping (slope about than 2%). The conduction of the soil involves two annual plowing and the eradication of the grassed margins and wild plants. No data about treatments.

Station R-BOS

Wooded remnants are located on the southern slope of Mount Etna at 1,210 a.s.l., interspersed with more or less recent lava outcrops, characterized by a moderate inclination (about 3%), a good trees cover and a well-developed undergrowth.

In the prosecution of this study, the **BIO**, **CON** and **BOS** stations are designated as **Z-BIO**, **Z-CON** and **Z-BOS** stations to distinguish them from those relating to the Ragalna area.

8.3 GENERAL RESULTS ANALYSIS

FAMILIES

During the compared period in the 6 considered stations were surveyed a total, expressed in CS, of **702,35** captures, which are representative of **35** Families (tab. 8.3.1).

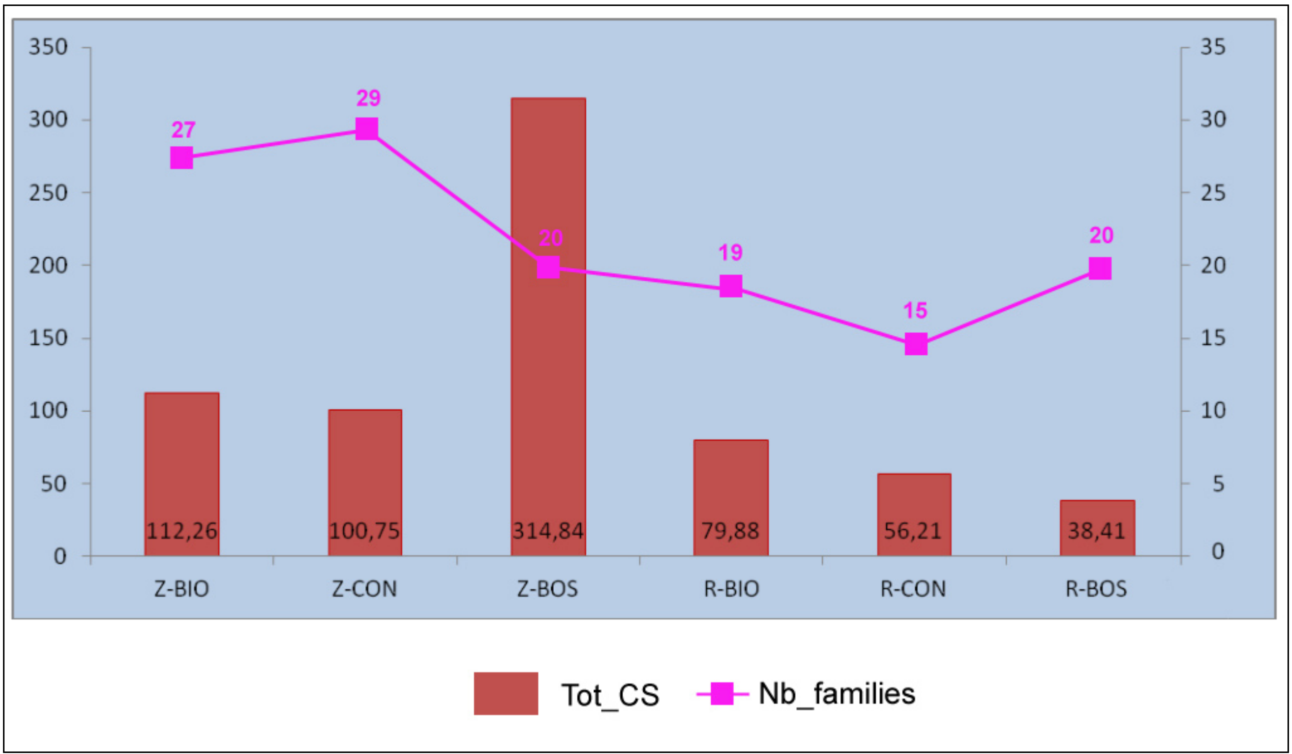
FAMILIES	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS	Total	%
Carabidae	23,95	23,94	204,68	6,12	1,76	7,73	268,18	38,2
Staphylinidae	35,52	37,47	83,95	8,13	22,39	11,69	199,16	28,3
Anthicidae	17,66	13,38	0,16	53,09	3,23	0,19	87,71	12,5
Tenebrionidae	7,93	10,27	1,47	6,57	16,96	0,97	44,17	6,3
Melyridae	15,49	3,84	0,06	0,23	0,06	0,09	19,77	2,8
Cryptophagidae	0,54	1,59	8,42	0,05	0,32	6,28	17,20	2,4
Ptinidae	0,59	0,72	4,00		0,09	7,46	12,87	1,8
Zopheridae	2,54	0,62	7,56				10,73	1,5
Chrysomelidae	0,47	0,20	0,06	1,06	7,46	0,38	9,64	1,4
Curculionidea	1,26	1,91	0,42	2,33	1,99	0,96	8,87	1,3
Nitidulidae	2,13	2,13	1,34	0,53	1,21	1,12	8,46	1,2
Elateridae	0,50	0,33	0,45	0,39	0,07	0,21	1,95	0,3
Latridiidae	0,34	0,19	1,16				1,69	0,24
Oedemeridae	0,40	1,12		0,08	0,07		1,68	0,24
Leiodidae	1,02	0,19	0,30			0,09	1,61	0,23
Coccinellidae	0,27	0,34		0,46	0,45		1,51	0,21
Scarabaeidae	0,25	0,45		0,31		0,17	1,18	0,17
Endomychidae	0,04	0,54	0,28	0,07		0,09	1,02	0,14
Mordellidae	0,10	0,43	0,07	0,04		0,15	0,79	0,11
Cerambycidae	0,23	0,15	0,09	0,06	0,07	0,18	0,77	0,10
Silvanidae		0,10				0,43	0,53	0,075
Corylophidae	0,36	0,14					0,50	0,071
Ptiliidae		0,15		0,22		0,09	0,46	0,065
Cantharidae	0,18	0,14	0,08				0,40	0,057
Lucanidae	0,09	0,05	0,22				0,36	0,051
Mycetophagidae	0,10	0,16	0,07				0,32	0,045
Buprestidae	0,10	0,05		0,08			0,23	0,033
Kateretidae	0,05	0,10					0,14	0,020
Phalacridae	0,05	0,05					0,09	0,013
Aderidae					0,09		0,09	0,013
Clambidae						0,09	0,09	0,013
Histeridae				0,06			0,06	0,008
Cleridae						0,05	0,05	0,007
Cebrionidae	0,05						0,05	0,007
Throscidae	0,05						0,05	0,007
Total CS	112,26	100,75	314,84	79,88	56,21	38,41	702,35	100
%	16	14,3	44,8	11,4	8	5,5	100	
N. Families	27	29	20	19	15	20	35	

Tab. 8.3.1 - Trends in catches of the considered Families contingent in each station expressed as CS value.

Regarding the table 8.3.1, the Families that show a captures frequency at least of 2% of the total CS value are 6: **Carabidae** (38,2%), **Staphylinidae** (28,3%), **Anthicidae** (12,5%), **Tenebrionidae** (6,3%), **Melyridae** (2,8%), and **Cryptophagidae** (2,4%), representing more than **90%** of the entire considered sampling. They are present in all investigated stations.

In total 11 Families result present in all 6 stations; while 6 are exclusive of 1 station, but always with CS value very low.

Considering the general trend of the captures frequency within the 6 stations (graph. 8.3.1), the **Z-BOS** station shows the highest CS value (44,8%), while the **R-BOS** station has the minimum CS value (5,5%); regarding the sampled species number is observed that the greatest species number (**29**) has been surveyed in the **Z-CON** station and the minimum (**15**) in the **R-CON** station.

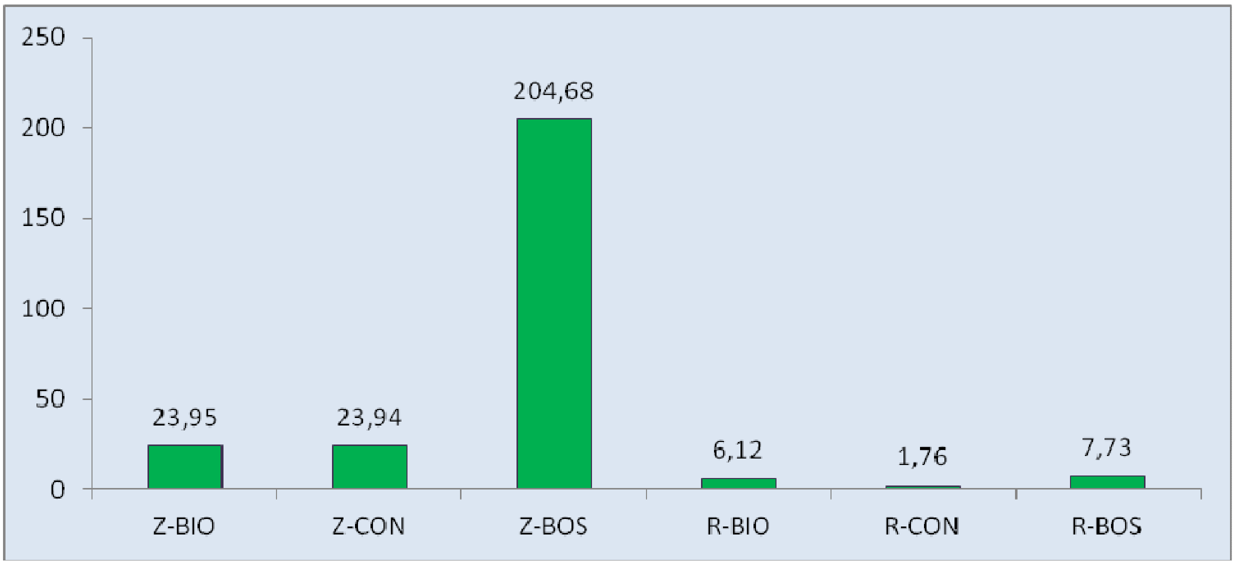


Graph. 8.3.1 - Overall trend of catches of the specimens (Tot_CS) and Families number (Nb_Families) sampled in each station.

Below are considered the most abundant sampled Families to their distribution in the stations.

Carabidae

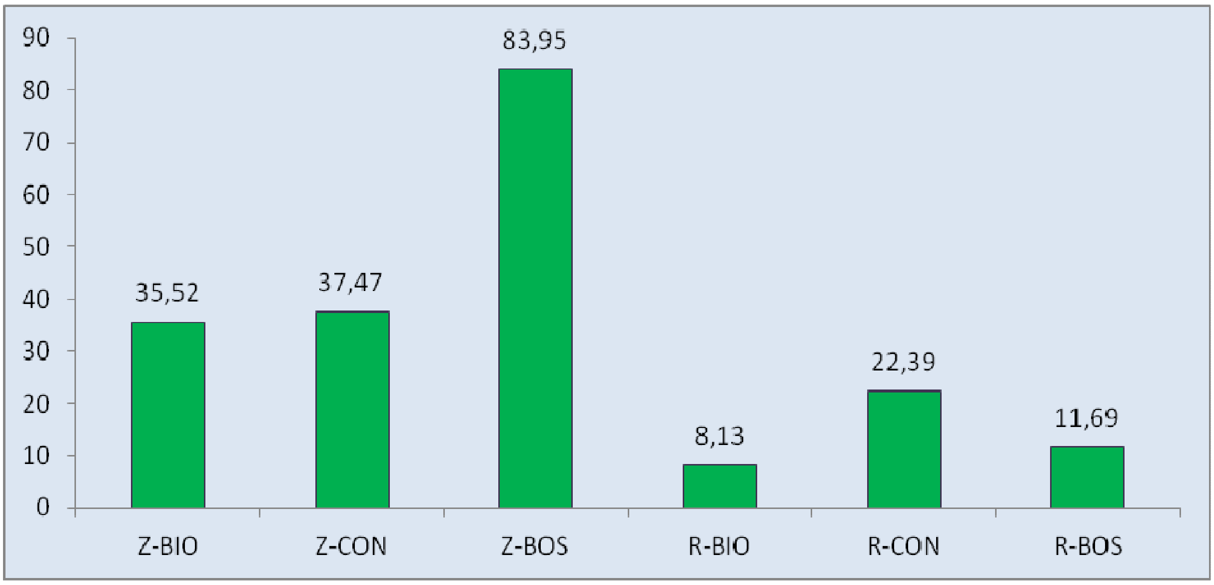
This is the Family with the highest CS value, which represents the 38,02% of the entire sampling period. The maximum (76,3%) of the catches was recorded in the **Z-BOS** station, while the minimum (0,6%) is found in the **R-CON** station (graph. 8.3.2).



Graph. 8.3.2 - Trend of the Carabidae captures frequency (CS) within the single station.

Staphylinidae

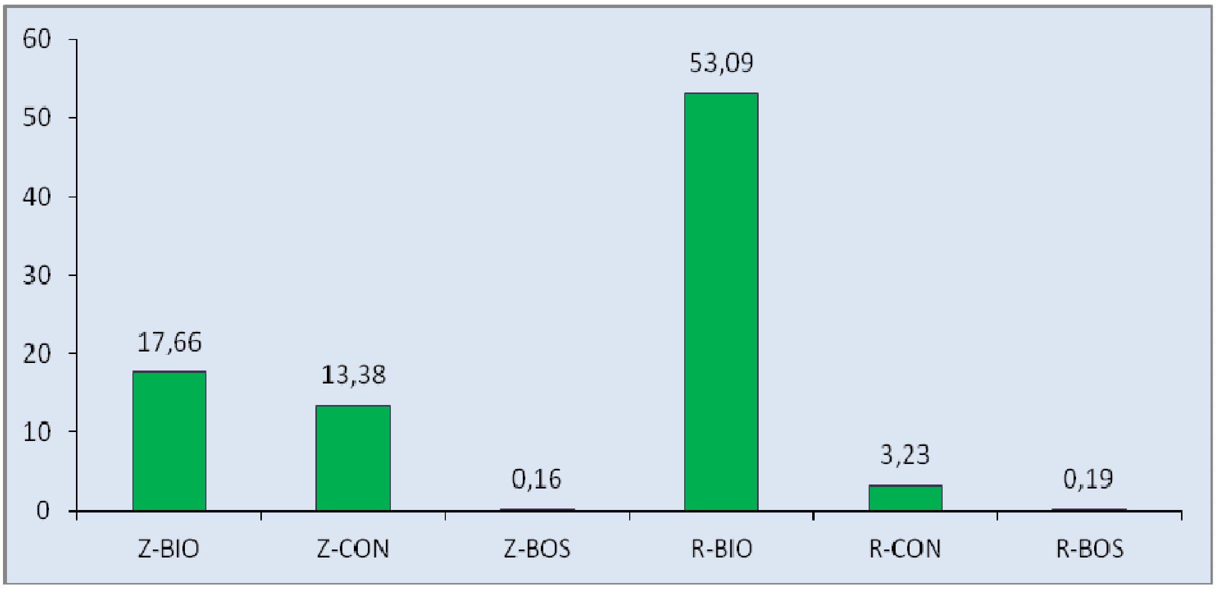
This is the Family with the second CS value, which represents the 28,3% of the entire sampling period. The maximum (42,1%) of the catches was recorded in the **Z-BOS** station, while the minimum (4,1%) is found in the **R-BIO** station (graph. 8.3.3).



Graph. 8.3.3 - Trend of the Staphylinidae captures frequency (CS) within the single station.

Anthicidae

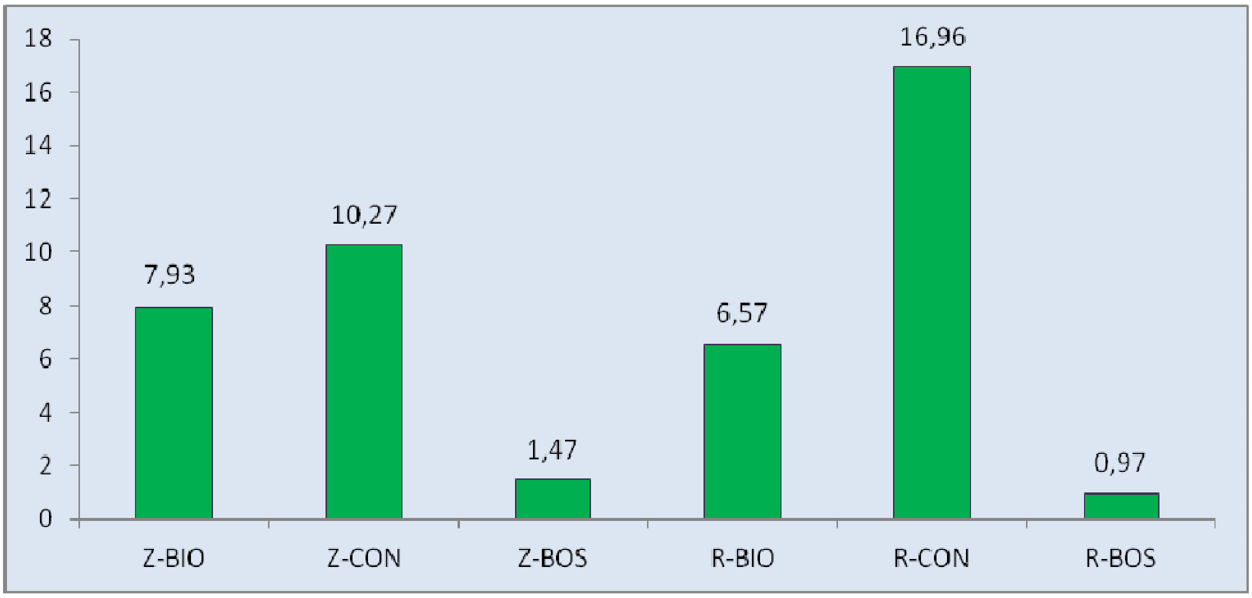
This is the Family with the third CS value, which represents the 12,5% of the entire sampling period. The maximum (60,5%) of the catches was recorded in the **R-BIO** station, while the minimum (0,2%) is found in the **Z-BOS** station (graph. 8.3.4).



Graph. 8.3.4 - Trend of the Anthicidae captures frequency (CS) within the single station.

Tenebrionidae

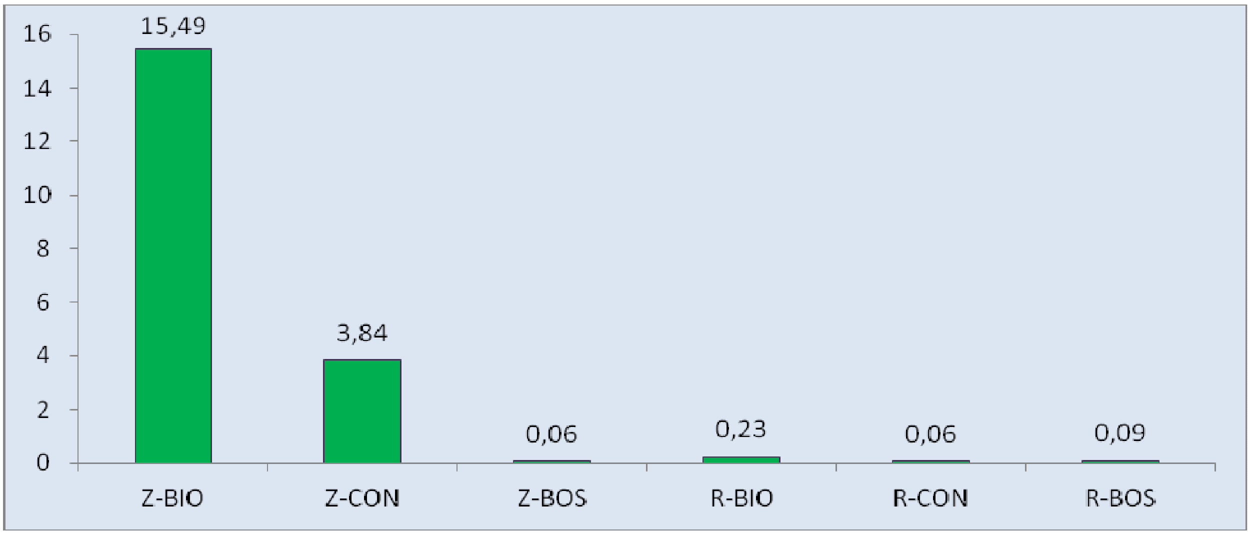
This is the Family with the fourth CS value, which represents the 6,3% of the entire sampling period. The maximum (38,4%) of the catches was recorded in the **R-CON** station, while the minimum (2,2%) is found in the **R-BOS** station (graph. 8.3.5).



Graph. 8.3.5 - Trend of the Tenebrionidae captures frequency (CS) within the single station.

Melyridae

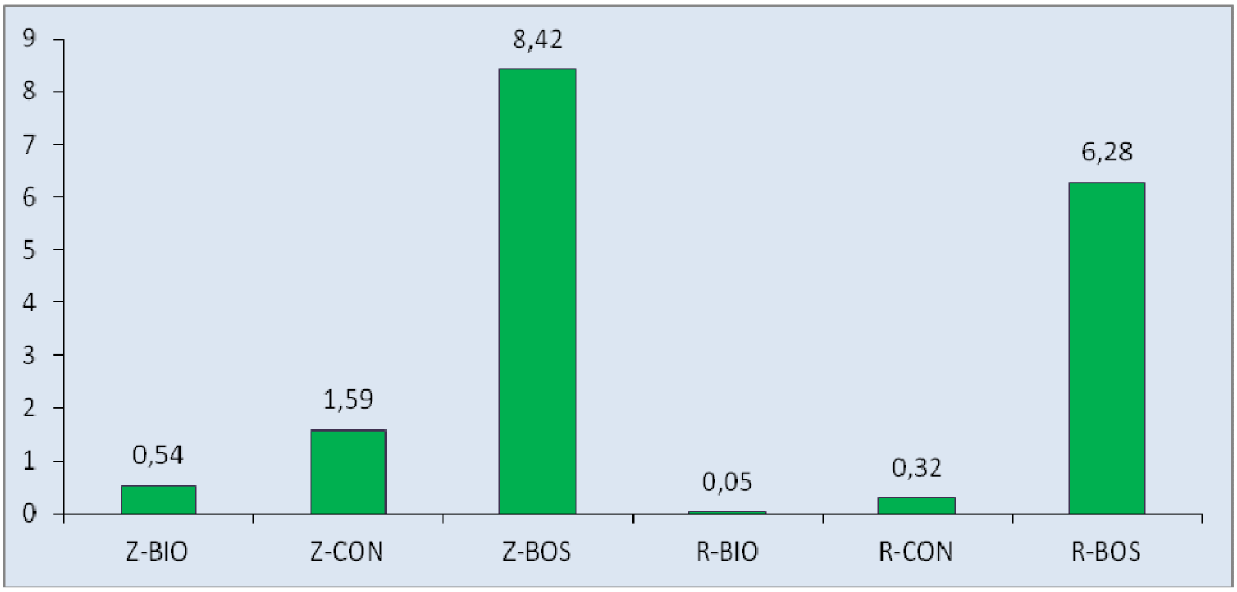
This is the Family with the fifth CS value, which represents the 2,8% of the entire sampling period. The maximum (78,3%) of the catches was recorded in the **Z-BIO** station, while the minimum (0,3%) is found in the **Z-BOS** and **R-CON** stations (graph. 8.3.6).



Graph. 8.3.6 - Trend of the Melyridae captures frequency (CS) within the single station.

Cryptophagidae

This is the Family with the sixth CS value, which represents the 2,4% of the entire sampling period. The maximum (48,9%) of the catches was recorded in the **Z-BOS** station, while the minimum (0,3%) is found in the **R-BIO** station (graph. 8.3.7).



Graph. 8.3.7 - Trend of the Cryptophagidae captures frequency (CS) within the single station.

SPECIES OF CARABIDAE, STAPHYLINIDAE AND TENEBRIONIDAE

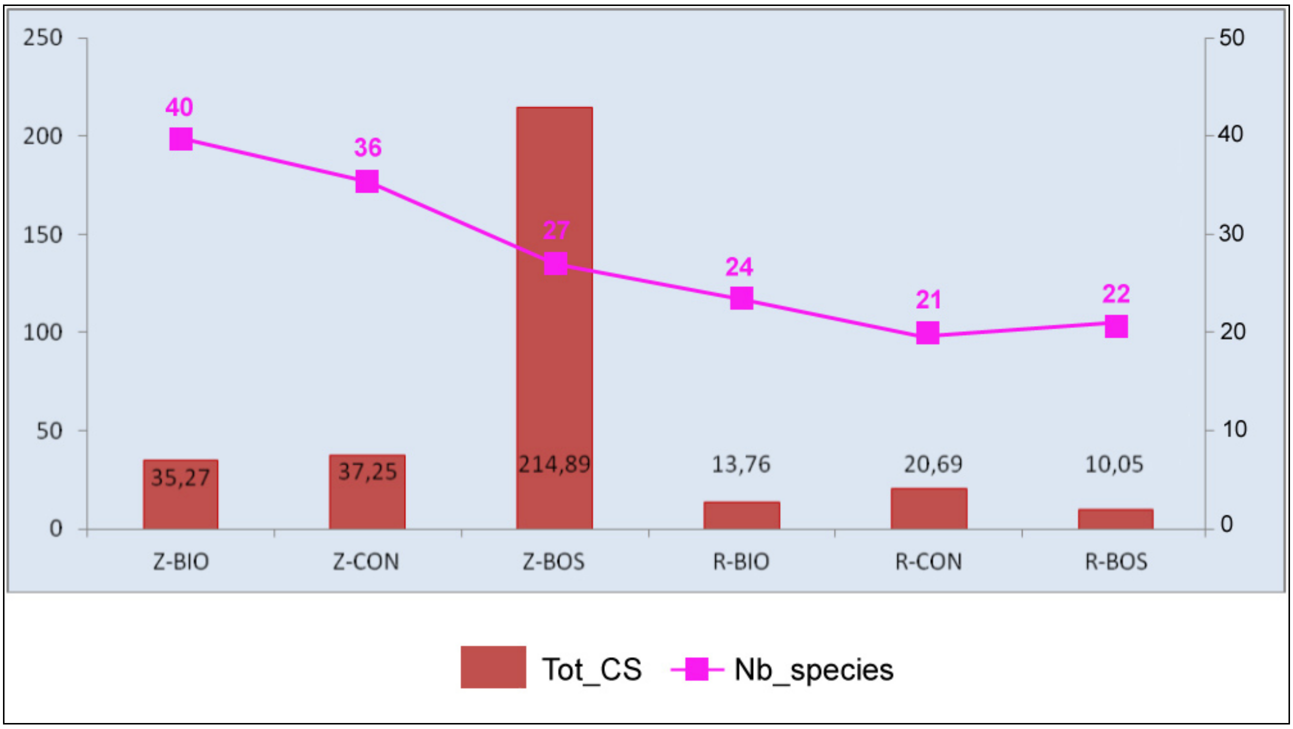
During the compared period, in the 6 considered stations were surveyed a total, expressed in CS, of **331,92** captures, which are representative of **85** species and subspecies of Carabidae, Staphylinidae and Tenebrionidae (tab. 8.3.2).

TAXA	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS	Total	%
Calathus montivagus	3,16	2,91	154,17	1,53	1,27	6,55	169,58	51,10
Calathus fuscipes graecus	9,35	12,77	37,60				59,73	18
Cnemeplatia atrops				3,91	16,43		20,34	6,12
Pimelia rugolosa rugulosa	5,72	8,52	0,07		0,09	0,49	14,89	4,49
Laemostenus algerinus algerinus	1,28	2,60	9,19			0,35	13,42	4,04
Synthomus obscuroguttatus	7,61	1,54	0,20				9,35	2,82
Ocypus olens	1,02	0,93	5,42	0,23		0,56	8,16	2,46
Calathus ambiguus	1,30	1,57	0,17				3,04	0,91
Paraphloeostiba gayndahensis	0,56	1,19	0,22	0,18	0,69	0,20	3,03	0,91
Pachychilia dejeani	0,37	0,30		1,98			2,65	0,79
Ocypus mus	0,28	0,22	1,81				2,30	0,69
Microlestes luctuosus				1,86	0,33	0,05	2,23	0,67
Harpalus decipiens	0,54	1,64					2,19	0,65
Synuchus nivalis	0,32	0,05	1,66				2,03	0,61
Carabus lefebvrei lefebvrei		0,29	1,26			0,28	1,83	0,55
Pterostichus melas italicus				1,66			1,66	0,50
Blaps gibba	0,69	0,64	0,08				1,42	0,42
Accanthopus velikensis			0,82				0,82	0,24
Blaps lethifera				0,51	0,21	0,09	0,82	0,24
Quedius latinus			0,65			0,14	0,79	0,23
Stenosis sardoa ardoini	0,34	0,34	0,08				0,76	0,22
Tachyporus nitidulus	0,27	0,19	0,07		0,22		0,74	0,22
Microlestes sp. 2				0,62			0,62	0,18
Omalium rugatum	0,29	0,11	0,20				0,60	0,18
Tachyporus pusillus	0,18	0,05	0,13	0,14	0,07		0,57	0,17
Calathus cinctus	0,24	0,14	0,13				0,52	0,15
Opatrum verrucosum	0,43						0,43	0,12
Helops rossii		0,07	0,36				0,43	0,12
Stenosis melitana				0,07	0,07	0,22	0,36	0,10
Leistus spinibarbis fiorii			0,08			0,26	0,34	0,10
Lagria atripes	0,24	0,10					0,33	0,099
Quedius cruentus				0,06	0,14	0,09	0,29	0,087
Sepedophilus nigripennis	0,05	0,05		0,05	0,14		0,29	0,087
Philonthus debilis	0,04			0,13	0,11		0,28	0,084
Othius laeviusculus	0,04		0,10	0,05		0,09	0,28	0,084
Lagria hirta	0,04				0,16	0,05	0,25	0,075
Quedius levicollis	0,20	0,04					0,25	0,075
Notiophilus rufipes			0,16		0,09		0,24	0,072
Phyllodrepa floralis	0,05				0,17		0,22	0,066
Isomira ferruginea		0,19					0,19	0,057
Harpalus sulphuripes	0,05	0,14					0,18	0,054
Lionychus sp. 1				0,18			0,18	0,054
Pseudomasoreus canigouensis				0,07		0,10	0,17	0,051
Leistus sp. 1						0,15	0,15	0,045
Oodes sp. 1				0,06	0,09		0,15	0,045
Oodes sp. 2				0,14			0,14	0,042
Alphasida grossa						0,13	0,13	0,039
Proteinus brachypterus		0,06	0,07				0,12	0,036
Platyderus sp.		0,06	0,06				0,12	0,036
Mycetoporus mulsanti	0,04		0,08				0,12	0,036

Tachyporus abner	0,04			0,07			0,11	0,033
Stenus sp. 1					0,11		0,11	0,033
Tachyporus hypnorum					0,11		0,11	0,033
Cymindis miliaris	0,06	0,05					0,11	0,033
Tentyria grossa				0,10			0,10	0,03
Isomira murina		0,10					0,10	0,03
Harpalus atratus		0,10					0,10	0,03
Anotylus speculifrons						0,10	0,10	0,03
Xantholinus sp.	0,09						0,09	0,027
Cymindis axillaris	0,04	0,04					0,08	0,024
Gabrius nigritulus					0,07		0,07	0,021
Gabronthus sp. 1					0,07		0,07	0,021
Micropeplus calabricus				0,07			0,07	0,021
Gonodera metallica			0,07				0,07	0,021
Quedius masoni				0,06			0,06	0,018
Astenus sp.		0,06					0,06	0,018
Proteinus atomarius		0,06					0,06	0,018
Mycetoporus baudueri				0,05			0,05	0,015
Anotylus sculpturatus					0,05		0,05	0,015
Bisnius fimetarius		0,05					0,05	0,015
Omalium excavatum	0,05						0,05	0,015
Quedius picipes						0,05	0,05	0,015
Quedius tristis						0,05	0,05	0,015
Dendarus lugens	0,05						0,05	0,015
Isomira sp.	0,05						0,05	0,015
Ocys harpaloides		0,04					0,04	0,012
Quedius boops boops		0,04					0,04	0,012
Gabrius doderoi						0,04	0,04	0,012
Quedius humeralis						0,04	0,04	0,012
Mycetoporus rufescens	0,04						0,04	0,012
Philonthus jurgans	0,04						0,04	0,012
Philonthus tenuicornis	0,04						0,04	0,012
Sepedophilus sicilianus	0,04						0,04	0,012
Stenus aceris	0,04						0,04	0,012
Total CS	**35,27**	**37,25**	**214,89**	**13,76**	**20,69**	**10,05**	**331,92**	**100**
%	**10,62**	**11,22**	**64,74**	**4,14**	**6,23**	**3,03**	**100**	
N Taxa	**40**	**36**	**27**	**24**	**21**	**22**	**85**	

Tab. 8.3.2 - Trends of catches of the considered species contingent in each station expressed as CS value.

Regarding the table 8.3.2, the species showing a captures frequency at least of 2% of the total CS value are 7: 4 **Carabidae** (*Calathus montivagus* (51,1%) *Calathus fuscipes graecus* (18%), *Laemostenus algerinus* (4,04%) and *Synthomus obscuroguttatus* (2,82%)), 1 **Staphylinidae** (*Ocypus olens* (2,46%)), and 2 **Tenebrionidae** (*Cnemeplatia atrops* (6,12%) and *Pimelia rugolosa rugulosa* (4,49)), representing about **89%** of the entire sampling. Among the 85 considered species, only *Calathus montivagus* and *Paraphloeostiba gayndahensis* are present in all investigated stations, while *Pimelia rugolosa rugulosa* lacks in the **R-BIO** station and *Ocypus olens* in the **R-CON** station. All other species are present at most in 4 stations.
Considering the general trend of the capture frequency within the 6 stations (graph. 8.3.8), the **Z-BOS** station shows the highest value of CS (64,74%), while the **R-BOS** station has the minimum CS value (3,03%); regarding the number of species sampled is observed that the greatest number of species (**40**) has been surveyed in the **Z-BIO** station and the minimum (**21**) in the **R-CON** station.

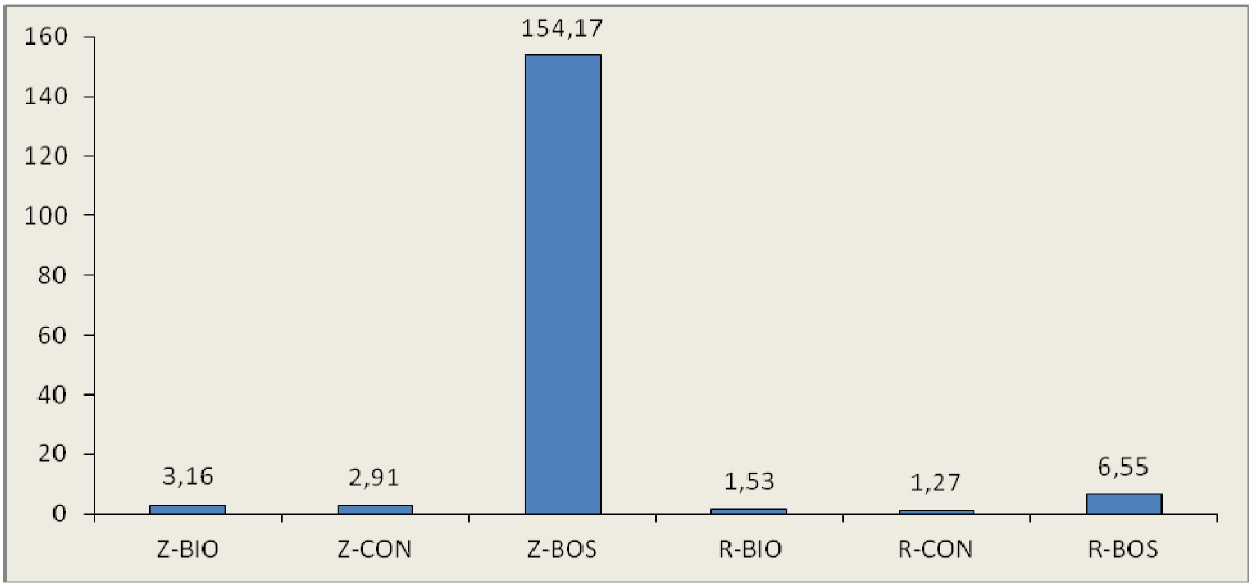


Graph. 8.3.8 - Overall trend of the specimens catches (Tot_CS) and species number (Nb_Species) sampled in each station.

Below are considered the most abundant sampled species to their distribution in the stations.

Calathus montivagus

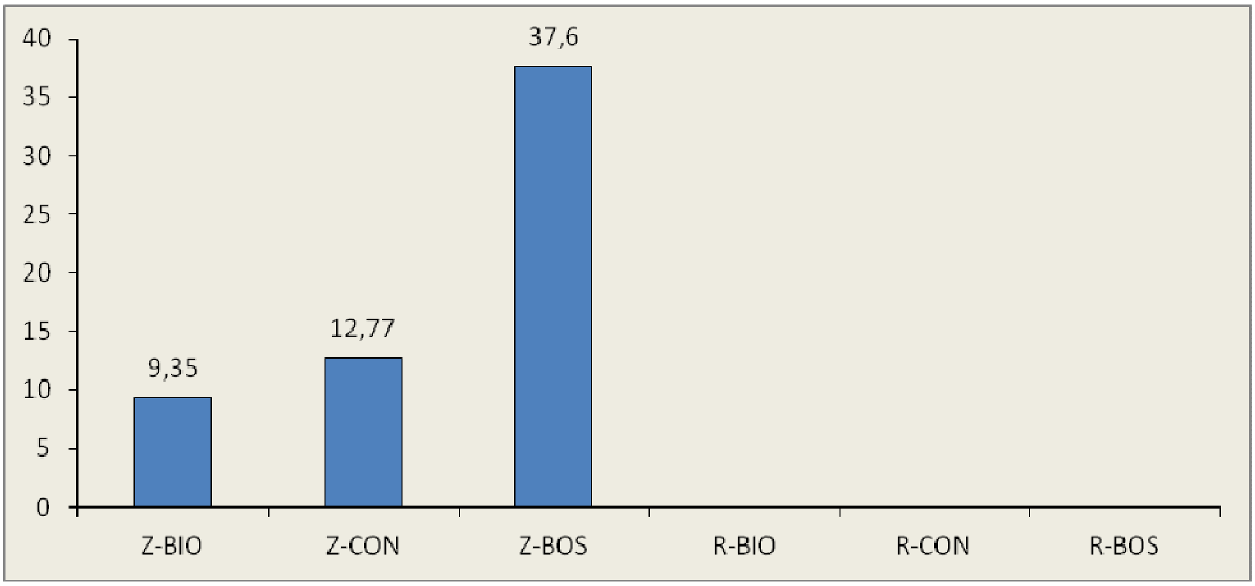
This is the species with the highest CS value, which represents the 51,10% of the entire sampling period. The maximum (90,9%) of the catches was recorded in the **Z-BOS** station, while the minimum (0,75%) is found in the **R-CON** station (graph. 8.3.9).



Graph. 8.3.9 - Trend of *Calathus montivagus* captures frequency (CS) within the single station.

Calathus fuscipes graecus

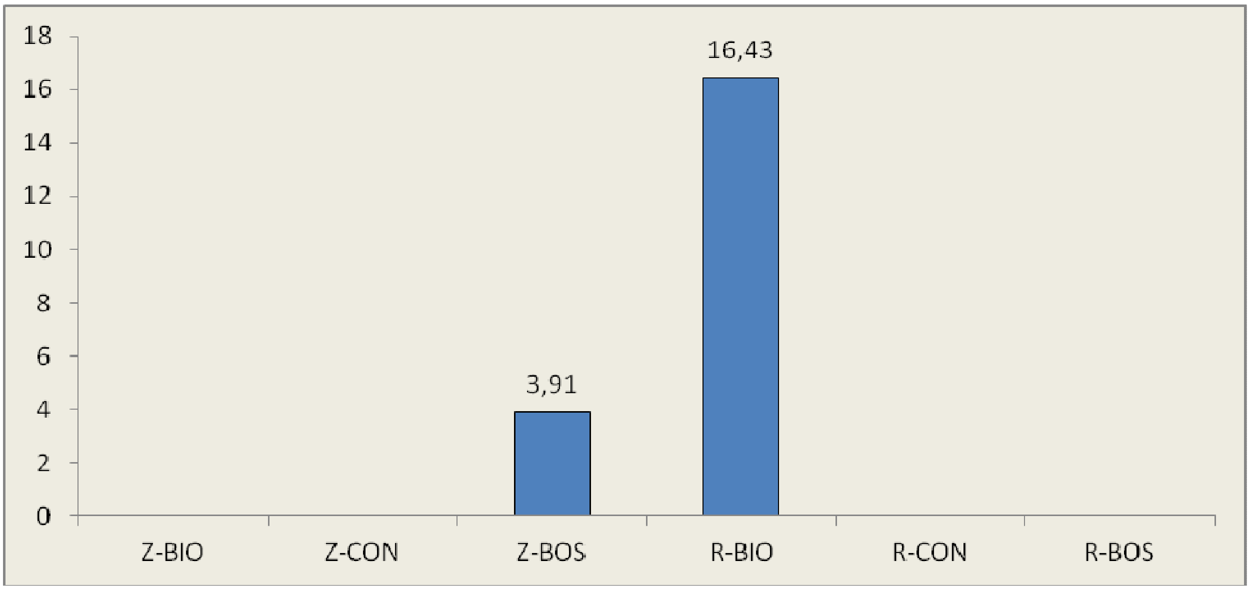
This is the species with the second CS value, which represents the 18% of the entire sampling period. It is present only in Zafferana stations with the maximum (62,9 %) of the catches recorded in the **Z-BOS** station, and the minimum (15,6%) found in the **Z-BIO** station (graph. 8.3.10).



Graph. 8.3.10 - Trend of *Calathus fuscipes graecus* captures frequency (CS) within the single station.

Cnemeplatia atrops

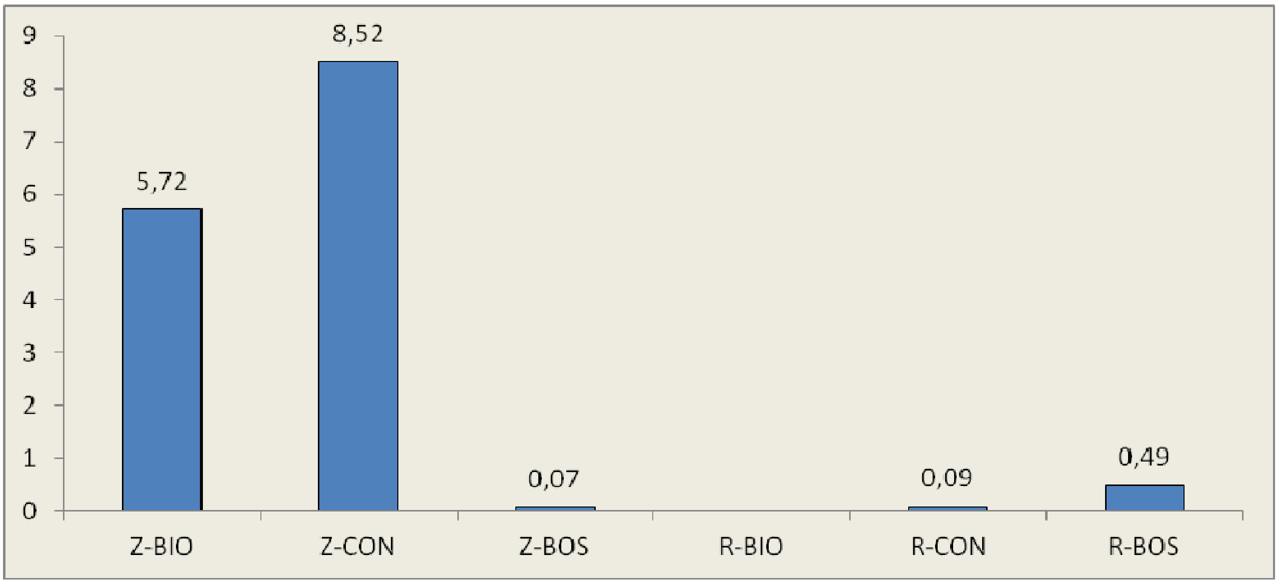
This is the species with the third CS value, which represents the 6,12% of the entire sampling period. It is present only in the **R-CON** (80,8% of the catches) and the **R-BIO** (19,2% of the catch) stations (graph. 8.3.11).



Graph. 8.3.11 - Trend of *Cnemeplatia atrops* captures frequency (CS) within the single station.

Pimelia rugolosa rugulosa

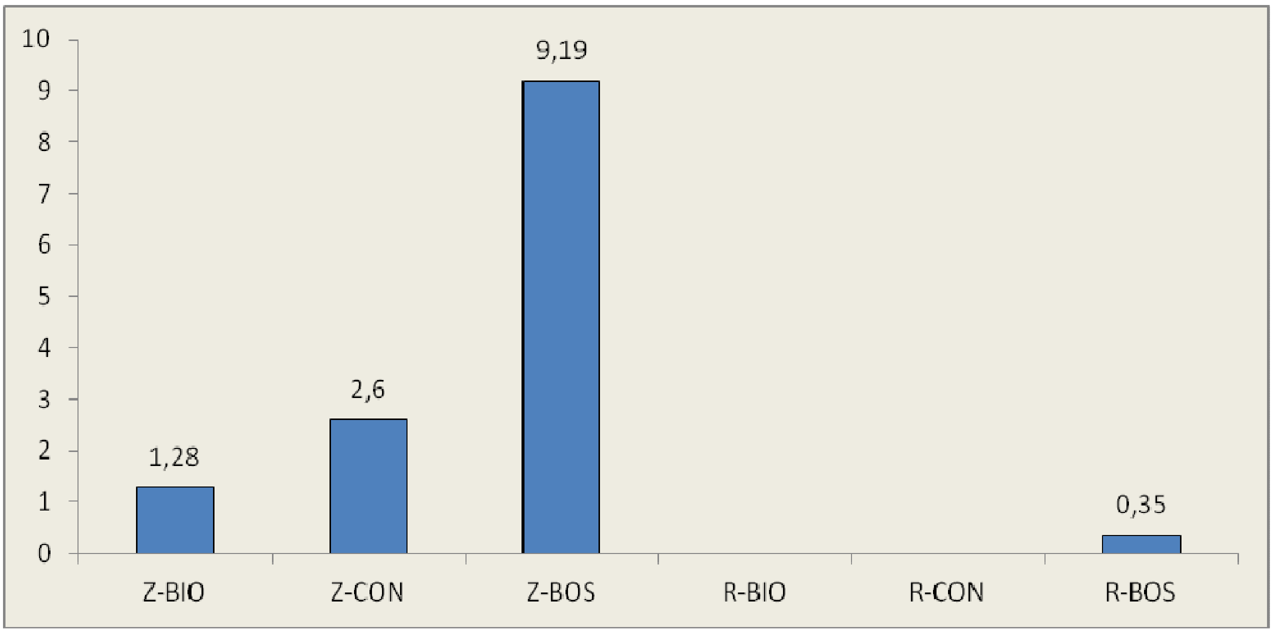
This is the species with the fourth CS value, which represents the 4,49% of the entire sampling period. This species lacks only in the **R-BIO** station and shows the maximum (57,2%) of the catches in the **Z-CON** station, while the minimum (0,47%) is found in the **Z-BOS** station (graph. 8.3.12).



Graph. 8.3.12 - Trend of *Pimelia rugolosa rugulosa* captures frequency (CS) within the single station.

Laemostenus algerinus algerinus

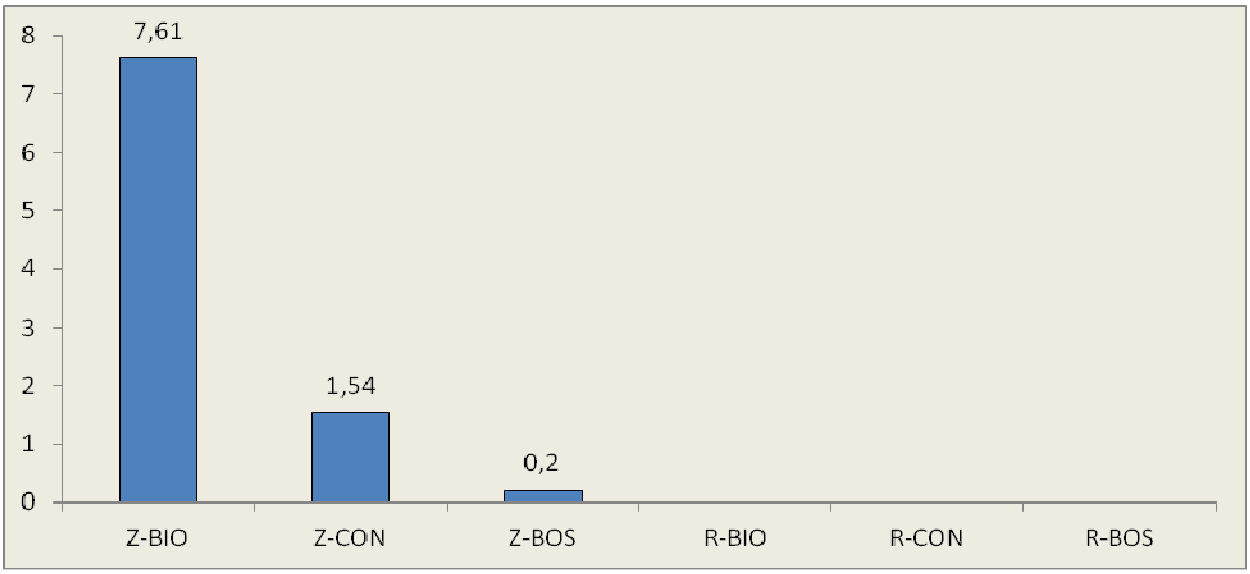
This is the species with the fifth CS value, which represents the 4,04% of the entire sampling period. It lacks in the **R-BIO** and **R-CON** stations and shows the maximum (68,48%) of the catches in the **Z-BOS** station, while the minimum (2,6%) is found in the **R-BOS** station (graph. 8.3.13).



Graph. 8.3.13 - Trend of *Laemostenus algerinus* captures frequency (CS) within the single station.

Synthomus obscuroguttatus

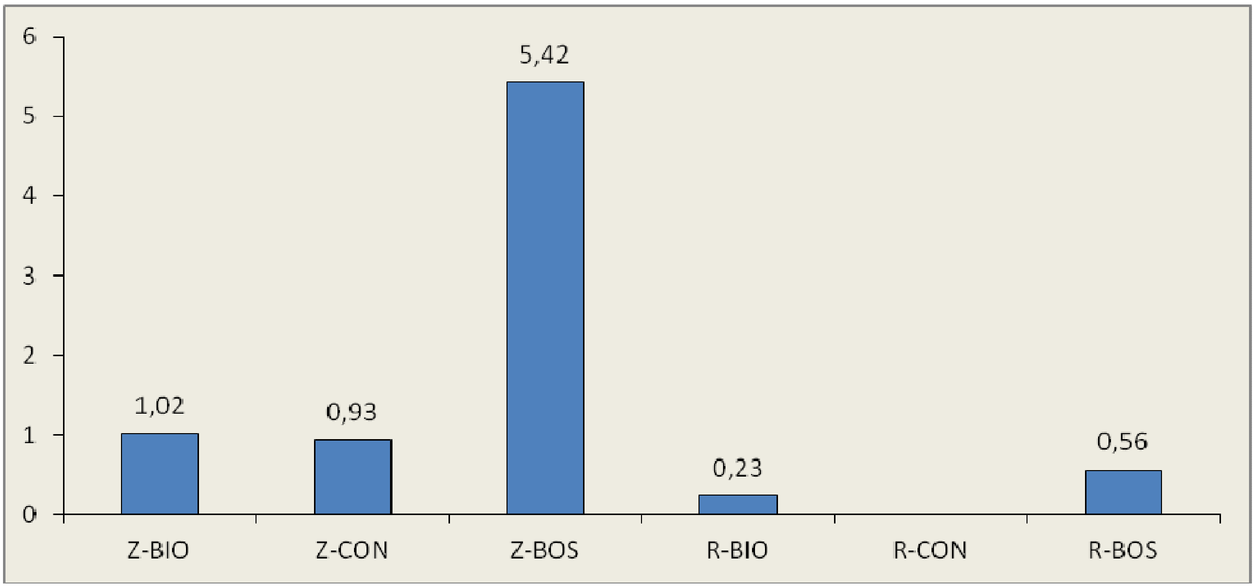
This is the species with the sixth CS value, which represents the 2,82% of the entire sampling period. It lacks in all Ragalna stations and shows the maximum (81,4%) of the catches in the **Z-BIO** station, and the minimum (2,14%) in the **Z-BOS** station (graph. 8.3.14).



Graph. 8.3.14 - Trend of *Synthomus obscuroguttatus* captures frequency (CS) within the single station.

Ocypus olens

This is the species with the seventh CS value, which represents the 2,46% of the entire sampling period. It lacks in the **R-CON** station and shows the maximum (66,4%) of the catches in the **Z-BOS** station, and the minimum (2,82%) in the **R-BIO** station (graph. 8.3.15).



Graph. 8.3.15 - Trend of *Ocypus olens* captures frequency (CS) within the single station.

8.4 MULTIVARIATE ANALYSIS OF THE COMMUNITIES

FAMILIES

Looking at the dendrogram of similarities among the traps based on the Bray-Curtis index regards to the Coleoptera Families (graph. 8.4.1) it is evident that the results of some of the clusters identified result differ with each other in a statistical significance (p <0.5 at least %) according to the SIMPROF test.

Those with statistical significance (although at different level of similarity) are 7:

1. **all traps** of **Z-BOS** station;

2. traps **Z-CON-01**, **Z-CON-04**, **Z-CON-06**, **Z-CON-08**, **Z-BIO-01**, and **Z-BIO-02**;

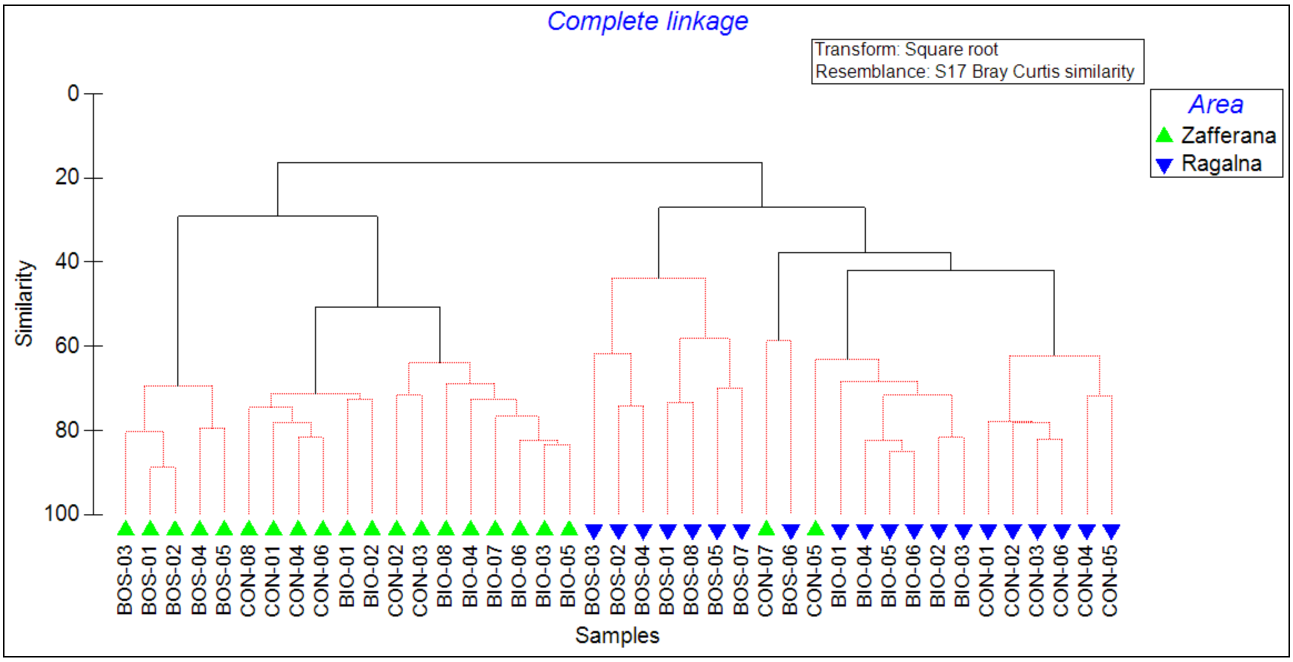
3. traps **Z-CON-02**, **Z-CON-03**, **Z-BIO-03**; **Z-BIO-04**, **Z-BIO-05**, **Z-BIO-06**, **Z-BIO-07**, and **Z-BIO-08**;

4. all traps of **R-BOS** station excluding **R-BOS-06**;

5. traps **Z-CON-07** and **R-BOS-06**;

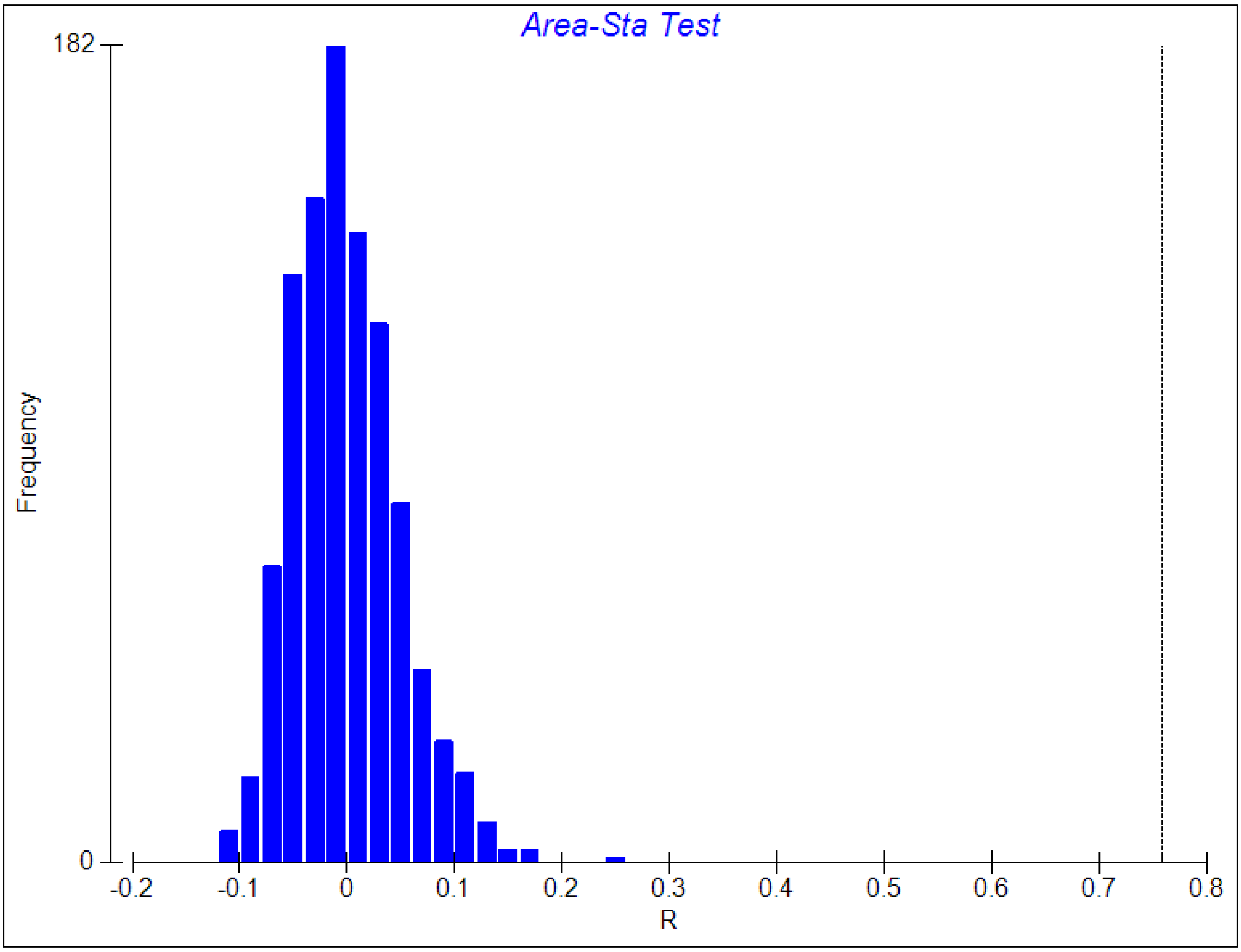
6 all traps of **R-BIO** station and trap **Z-CON-05**;

7 all traps of **R-CON** station.



Graph. 8.4.1 – The Dendrogram values based on the Bray Curtis similarity index between the traps of stations investigated in regards to the Coleoptera Families. The black lines show the clusters that are significantly different (at least p <0,5%) according to the SIMPROF test.

The analysis shows that the traps of a station are, in most cases, more similar to each other than with the traps of other stations. The ANOSIM test (graph. 8.4.2) confirms this hypothesis with high statistical significance.



Graph. 8.4.2 – ANOSIM tests: distribution of expected frequencies of R (histogram) compared with the observed value of R (**0,76**) (continuous line) between the traps of the stations investigated in regards to the Coleoptera Families.

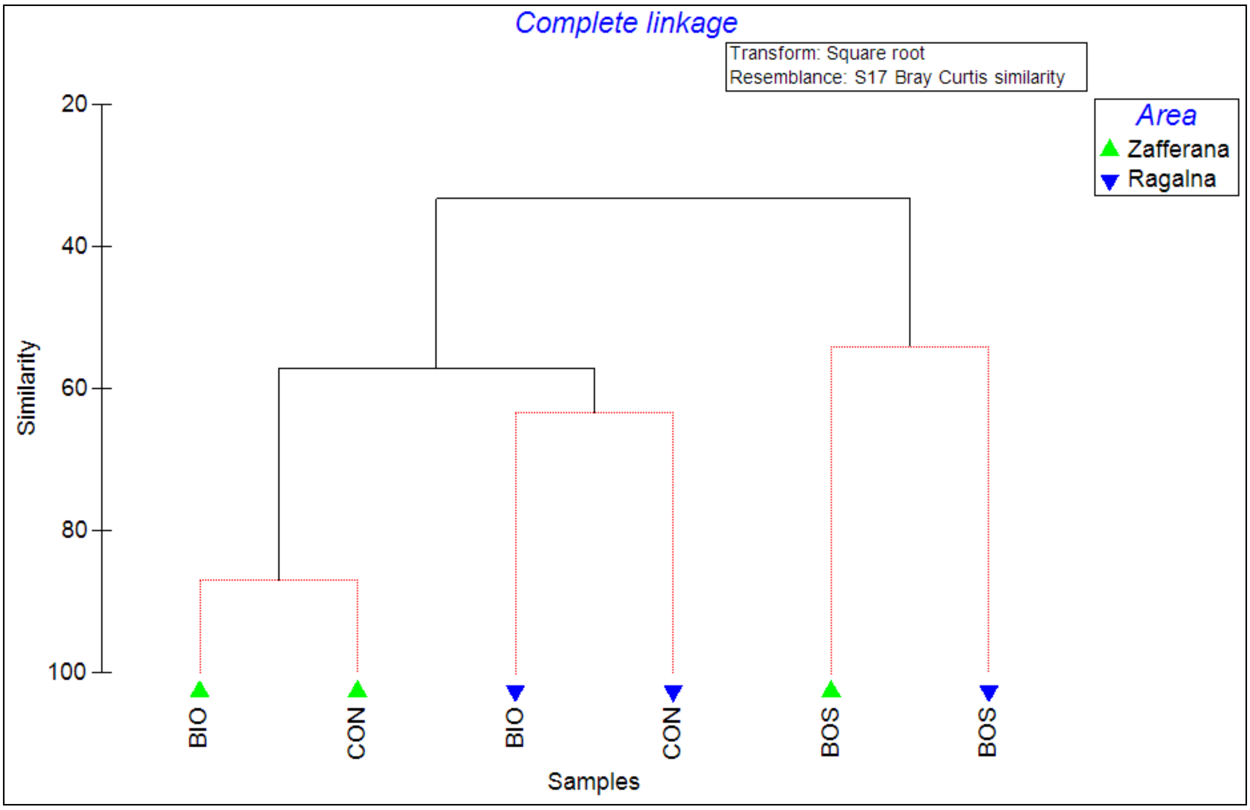
The examination of the Bray-Curtis similarity index in regards to all Coleoptera Families (tab. 8.4.1), shows a medium-high similarity (values under 50% of similarity) between almost all stations. Only two comparisons between stations recorded values lower than 50% of similarity, in decreasing order as follows: **R-CON/Z-BOS** and **R-BIO/Z-BOS** pairs.

Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-BIO						
Z-CON	86,88					
Z-BOS	56,50	57,23				
R-BIO	61,72	63,11	33,20			
R-CON	57,12	60,51	37,99	63,23		
R-BOS	51,15	56,92	53,98	53,83	52,78	

Tab. 8.4.1 – Bray-Curtis similarity index between the studied stations in regards to the Coleoptera Families. In green are marked the values equal to or greater than 50; in light blue those under 50.

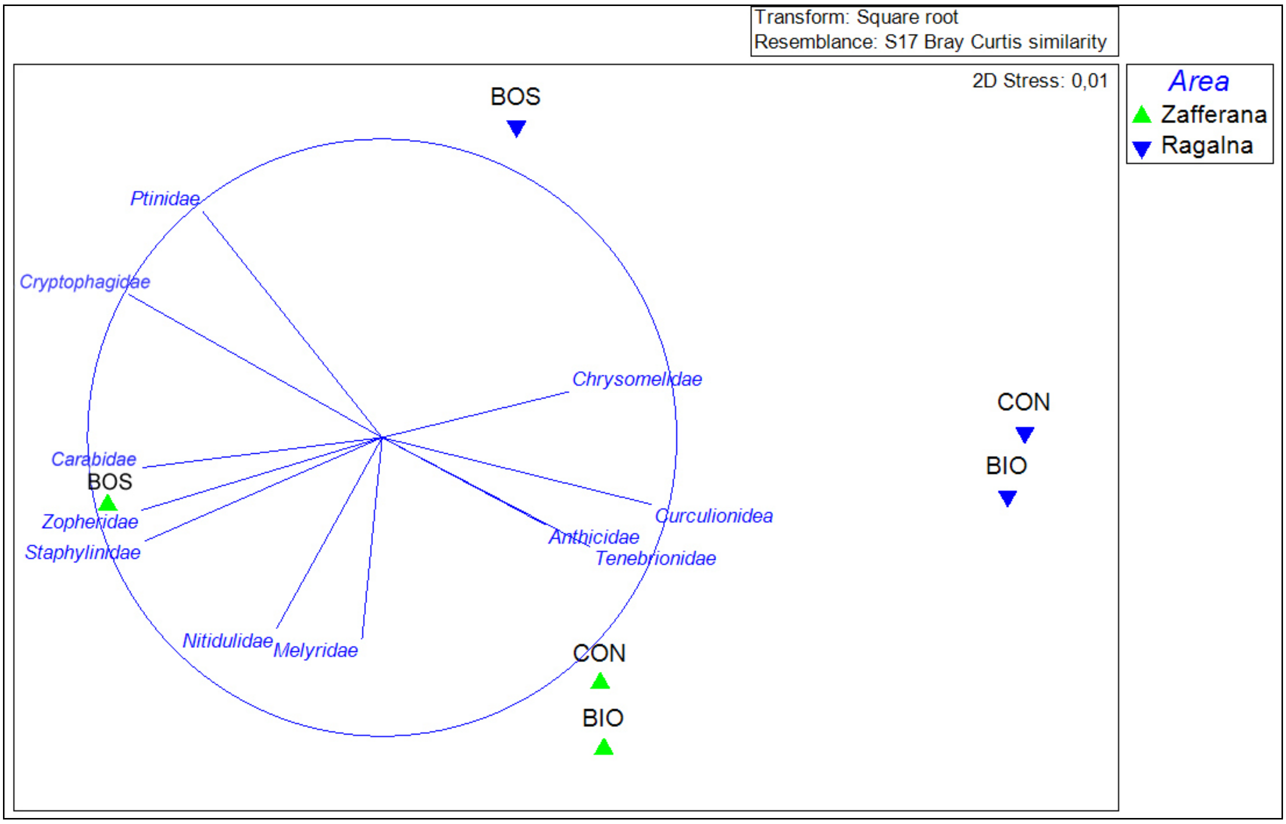
Looking at the dendrogram of similarities among stations based on the Bray-Curtis index in regards to the Coleoptera Families (graph. 8.4.3) it is evident that some of the identified clusters result different with each other in a statistical significance (p <0.5% at least) according to the SIMPROF test. At different similarity level, between 30% and 60%, are individuated 3 clusters significantly different from each and grouping:

1. **Z-BIO** and **Z-CON stations**;
2. **R-BIO** and **R-CON stations**;
3. **Z-BOS** and **R-BOS stations**.



Graph. 8.4.3 – The Dendrogram of Bray Curtis similarity index values between the investigated stations in regards to the Coleoptera Families.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2 D vision (graph. 8.4.4), elaborated on the Bray Curtis similarity matrix between stations, in regards to Families indicates again the level of clustering between stations.



Graph. 8.4.4 - The correlation between Nonmetric Multi Dimensional Scaling (NMDS) developed on the Bray-Curtis similarity matrix between the stations and the Coleoptera Families; in the figure, only those most abundantly sampled determine the differences or similarities among the traps of six stations are indicated.

The **Carabidae**, **Staphylinidae**, and **Zopheridae** Families are centered on the traps of the **Z-BOS** station, characterizing it and clearly differentiating the traps of this station rather from the other stations. The **Cryptophagidae** and **Ptnidae** Families occupy an intermediate position between the traps of the **Z-BOS** and **R-BOS** stations, while the **Nitidulidae** and **Melyridae** occupy an intermediate position between the traps of the **Z-BOS** and the pair **Z-BIO/Z-CON** stations. The Families **Anthicidae**, **Tenebrionidae**, **Chrysomelidae** and the **Curculionidea Superfamily** are centered on the pairs of the orchads stations (**Z-BIO/Z-CON** and **R-BIO/R-CON)** determining their similarities and differentiating them from the woodland stations (**Z-BOS** and **R-BOS**).
Regarding the Families number in common for pairs of stations and its percentage on the cumulative Families number for the two stations (tab. 8.4.2) **Z-BIO/Z-CON** is the pair with the maximum value of Families number and percentage, while **Z-BOS/R-BIO** and **R-BIO/R-CON** are the pairs with the minimum value of Families number and **Z-CON/R-CON** with the minimum value of percentage. It is to emphasize how, only for 1 pair of stations the percentage value is <50%, all other show values for percentage ≥ 50%.

Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-CON	**27** (*93,1*)					
Z-BOS	**20** (*74,0*)	**20** (*69,0*)				
R-BIO	**17** (*58,6*)	**18** (*60,0*)	**13** (*50,0*)			
R-CON	**14** (*50,0*)	**14** (*46,7*)	**14** (*60,9*)	**13** (*61,9*)		
R-BOS	**16** (*51,6*)	**18** (*58,1*)	**15** (*60,0*)	**15** (*60,0*)	**12** (*52,2*)	

Tab. 8.4.2 – Number of Families in common for pairs of stations (in **bold**) and its percentage on the cumulative number of Families (in *italic*). In green are marked the highest values, in light blue the lowest values, in fuchsia the percentage value≥ 50%.

The statistical significance of differences between the stations (R average = **0,76**) was calculated using the Parwise test, based on comparison of observed and expected values of R between pairs of stations. The differences about R (and the relative significance level) for stations pair are shown in table 8.4.3 and is clear how different is the situation depending of station pair itself (values from 0,008 to 1); only the pair **ZBIO/ZCON** shows no statistic significance level, all other pair of stations are significantly different from each others.

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
Z-BIO/Z-CON	0,008	41,1	6435	999	410
Z-BIO/Z-BOS	0,938	0,1	1287	999	0
Z-BIO/R-BIO	0,864	0,1	3003	999	0
Z-BIO/R-CON	0,876	0,1	3003	999	0
Z-BIO/R-BOS	0,883	0,1	6435	999	0
Z-CON/Z-BOS	0,883	0,2	1287	999	1
Z-CON/R-BIO	0,759	0,2	3003	999	1
Z-CON/R-CON	0,743	0,1	3003	999	0
Z-CON/R-BOS	0,842	0,1	6435	999	0
Z-BOS/R-BIO	1	0,2	462	462	1
Z-BOS/R-CON	1	0,2	462	462	1
Z-BOS/R-BOS	0,907	0,1	1287	999	0
R-BIO/R-CON	0,956	0,2	462	462	1
R-BIO/R-BOS	0,916	0,1	3003	999	0
R-CON/R-BOS	0,826	0,1	3003	999	0

Tab. 8.4.3 - Pairwise tests based on the values of R observed for pair of stations in relation to Families considered. The significance % refers to the number of values of R that fall within the range of expected frequencies compared to the total number of possible permutations.

From analysis with the SIMPER test is assessed the dissimilarity between station; the values are synthesized in table 8.4.4, and it is evident that the level of dissimilarity between stations is very low (with the maximum for pair **Z-BOS/R-BIO** (66,80) and the minimum for pair **Z-BIO/Z-CON** (13,12).

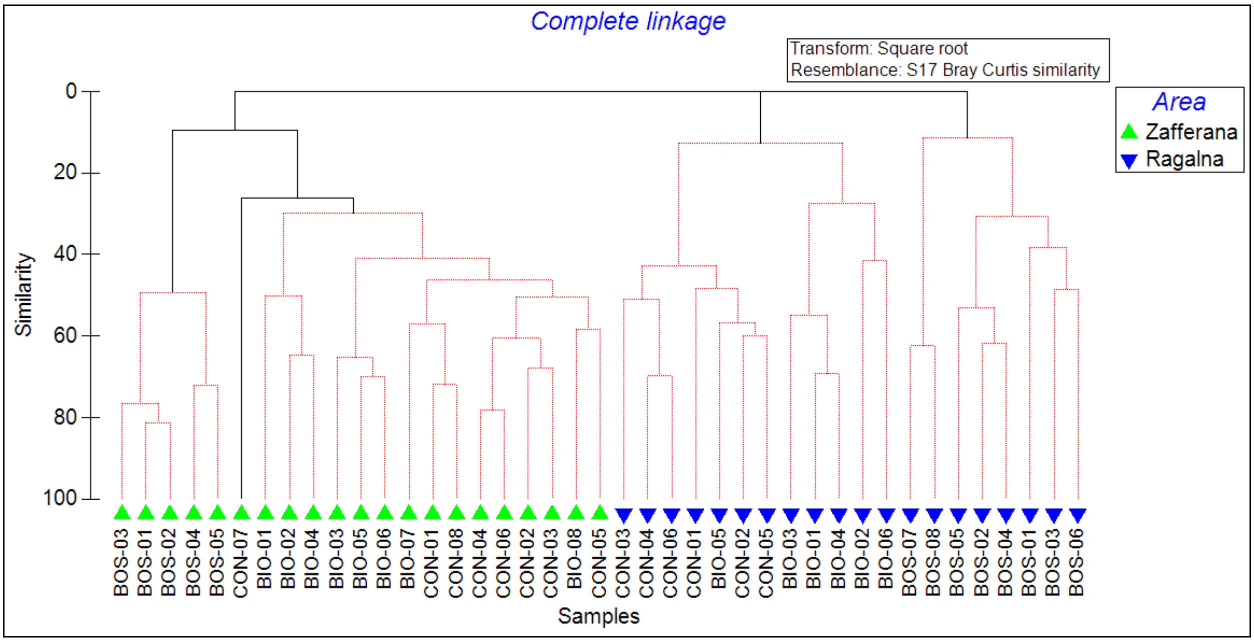
Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-BIO						
Z-CON	13,12					
Z-BOS	43,50	42,77				
R-BIO	38,28	36,89	66,80			
R-CON	42,88	39,49	62,01	36,77		
R-BOS	48,85	43,08	46,02	46,17	47,22	

Tab. 8.4.4 – Dissimilarity values between stations pair assessed by SIMPER test. In fuchsia is marked the maximum value, in yellow the minimum value.

SPECIES OF CARABIDAE, STAPHYLINIDAE AND TENEBRIONIDAE

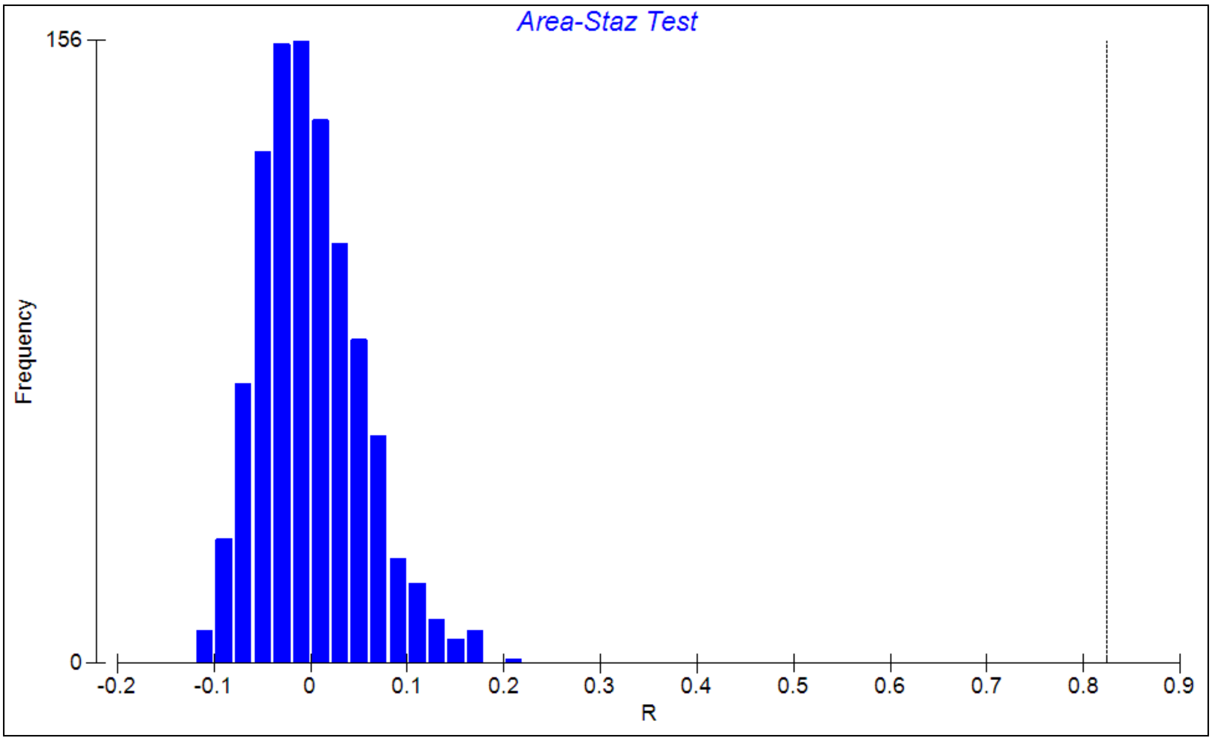
Looking at the dendrogram of similarity among traps based on the index of Bray-Curtis in relation to considered species (graph. 8.4.5) it is evident that some of the clusters identified result different with each other in a statistically significance (p <0.5 at least %) according to the SIMPROF test. Those with statistically significance (although at different level of similarity) are 5:

1. **all traps** of **Z-BOS** station;
2. trap **Z-CON-07**;
3. all traps of **Z-BIO** and **Z-CON** stations excluding **Z-CON-07**;
4. all traps of **R-BIO** and **R-CON** stations;
5. all traps of **R-BOS** station.



Graph. 8.4.5 - Dendrogram of values based on similarity index of Bray Curtis between the traps of stations investigated in relation to species considered. The black lines show the clusters that are statistically significantly different (at least p <0,5%) according to the SIMPROF test.

Then, analysis shows that the traps of a station are, in most cases, more similar to each other than with the traps of other stations. The ANOSIM test (graph. 8.4.6) confirms this hypothesis with high statistical significance.



Graph. 8.4.6 – ANOSIM tests: distribution of expected frequencies of R (histogram) compared with the observed value of R (**0,82**) (continuous line) between the traps of the stations investigated in relation to species considered.

The examination of the Bray-Curtis index of similarity in relation to all the considered species (tab. 8.4.5), shows a very low similarity (values under 50% similarity) between almost all stations: Only the comparisons between **Z-BIO/Z-CON** stations recorded values over 50% of similarity.

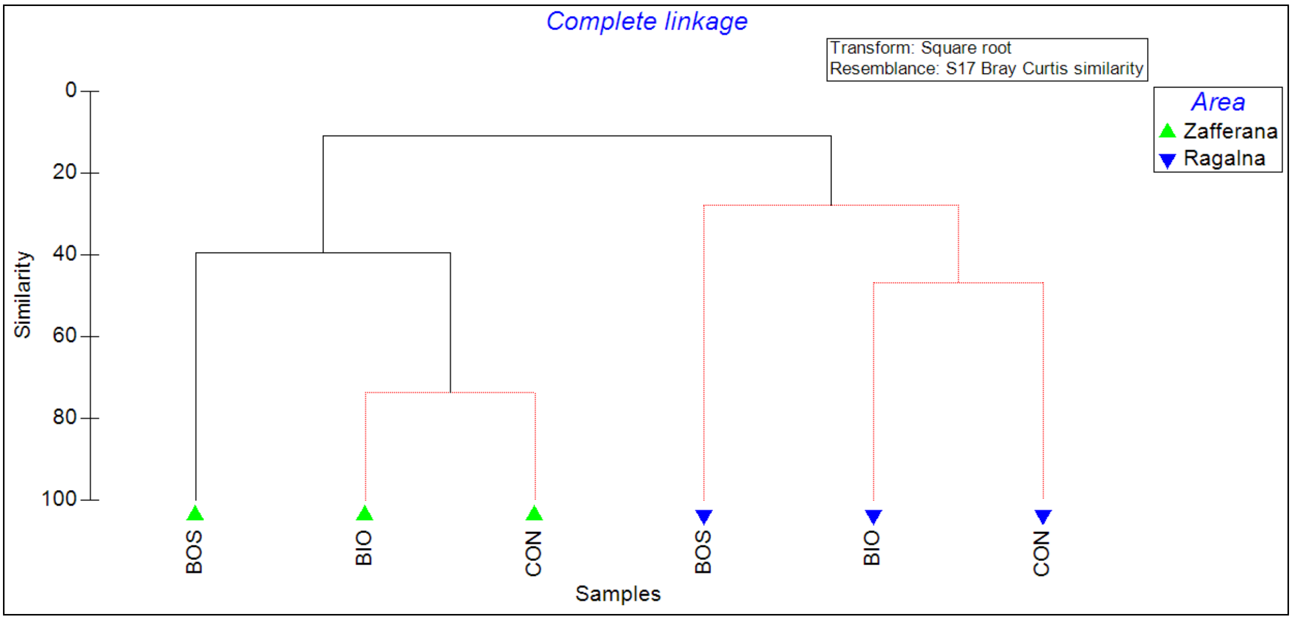
Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-BIO						
Z-CON	73,76					
Z-BOS	39,39	43,62				
R-BIO	20,02	16,22	11,00			
R-CON	19,90	16,93	11,18	46,78		
R-BOS	25,92	26,86	26,43	29,85	27,85	

Tab. 8.4.5 – Bray-Curtis index of similarity between the stations studied in relation to considered species. In green are marked the values equal to or greater than 50; in light blue those under 50.

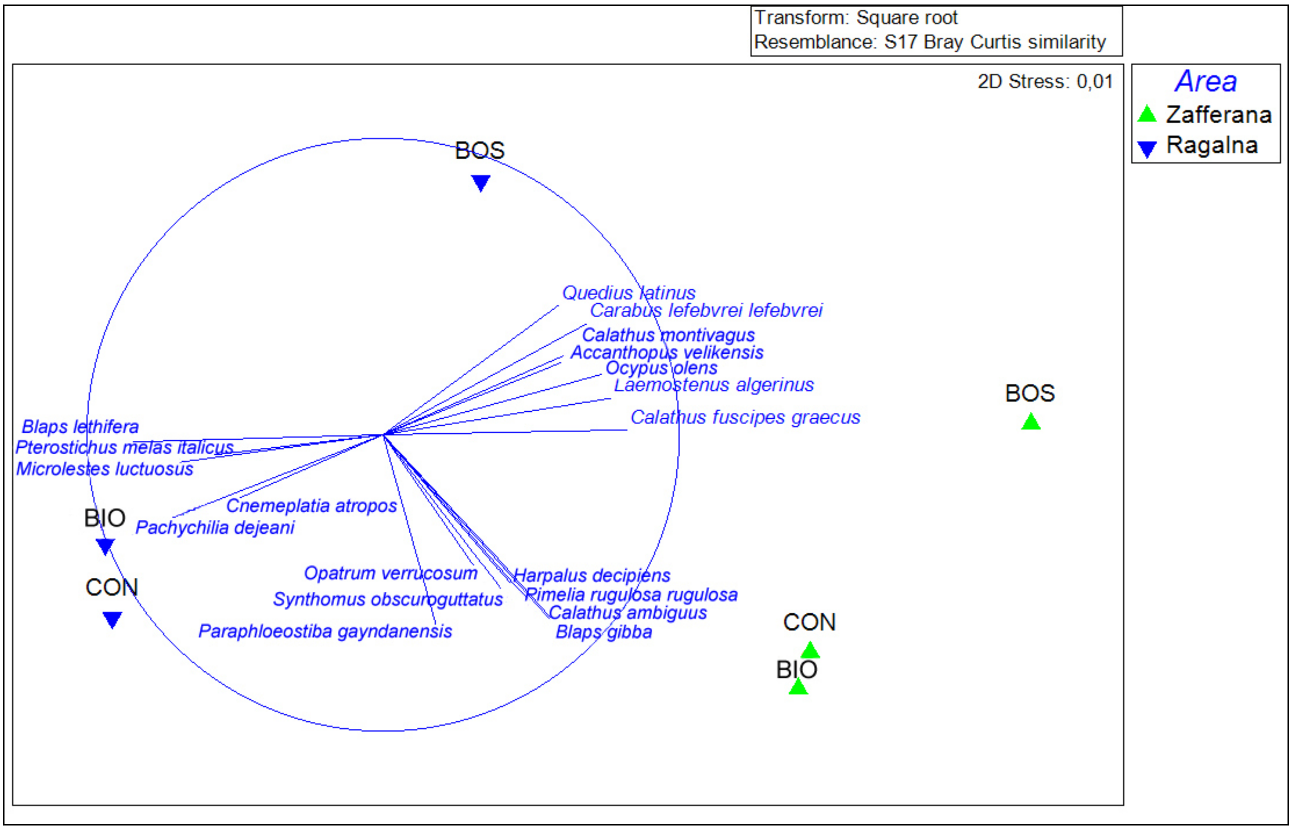
Looking at the dendrogram of similarity among stations based on the index of Bray-Curtis in relation to considered species (graph. 8.4.7) it is evident that some of the clusters identified result different with each other in a statistically significance (p <0.5% at least) according to the SIMPROF test. At different similarity level are individuated 3 clusters significantly different from each and grouping:

1. stations Z-BOS
1. stations Z-BIO and **Z-CON**;
3. stations R-BIO, **R-CON** and **R-BOS**.

The Nonmetric Multi Dimensional Scaling (NMDS) in 2 D vision (graph. 8.4.8), elaborated on the Bray Curtis similarity matrix between stations, in relation to species indicates again the level of clustering between stations.



Graph. 8.4.7 - Dendrogram of Bray Curtis similarity index values between the investigated stations with regard to considered species.



Graph. 8.4.8 - The correlation between Nonmetric Multi Dimensional Scaling (NMDS) developed on the Bray-Curtis similarity matrix between the stations and the Carabidae, Tenebrionidae and Staphylinidae species; in the figure only those most abundantly sampled determine the differences or similarities among the traps of three stations are indicated.

Laemostenus algerinus, *Ocypus olens*, *Calathus montivagus*, and *Quedius latinus* are centered on the traps of the woodland stations (**Z-BOS** and **R-BOS**) while *Calathus fuscipes graecus*, *Carabus lefebvrei lefebvrei*, and *Accanthopus velikensis* are exclusives to Zafferana area and show the highest CS value in the **Z-BOS** station, where they are centered. *Pimelia rugulosa rugulosa*, with *Calathus ambiguus*, *Harpalus decipiens, Synthomus obscuroguttatus* and *Blaps gibba* (these last four species exclusives to Zafferana area) are centered and characterize the Zafferana orchards

stations (**Z-BIO** and **Z-CON**) together *Opatrum verrucosum*, exclusive to the **Z-BIO** station. *Paraphloeostiba gayndanensis* occupies an intermediate position between between the orchards stations traps (**Z-BIO/Z-CON** and **R-BIO/R-CON**). *Pachychilia dejeani* with *Cnemeplatia atrops*, *Microlestes luctuosus* and *Blaps lethifera* (these last three species exclusives to Ragalna area) are centered and characterize the Ragalna orchards stations traps (**R-BIO** and **R-CON**) together *Pterostichus melas italicus,* exclusive to the **R-BIO** station.
Regarding the number of species in common for pairs of stations and its percentage on the cumulative number of species for the two stations (tab. 8.4.6) **Z-BIO/Z-CON** is the pair with the maximum value for number of species and the pair **Z-CON/Z-B**OS show the higher value of percentage, while **Z-BOS/R-BIO** is the pair with the minimum values for number of species and of percentage. It is to emphasize how all pair of station the percentage value is lower than 50%.

Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-CON	**24** (*46,1*)					
Z-BOS	**18** (*36,7*)	**20** (*46,5*)				
R-BIO	**9** (*16,4*)	**6** (*11,8*)	**5** (*10,9*)			
R-CON	**9** (*17,3*)	**6** (*14,3*)	**6** (*60,9*)	**11** (*32,3*)		
R-BOS	**7** (*12,7*)	**6** (*11,5*)	**9** (*22,5*)	**9** (*24,3*)	**8** (*22,8*)	

Tab. 8.4.6 – Number of species in common for pairs of stations (in **bold**) and its percentage on the cumulative number of species (in *italic*). In green are marked the highest values, in light blue the lowest values.

The statistical significance of differences between the stations (R average = **0.82**) was calculated using the Parwise test, based on comparison of observed and expected values of R between pairs of stations. The differences about R (and the relative significance level) for stations pair are shown in table 8.4.7 and is clear how different is the situation depending of station pair itself (values from 0,008 to 1); only the pair **ZBIO/ZCON** shows no statistic significance level, all other pair of stations are significantly different from each others.

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
Z-BIO/Z-CON	0,119	8,2	6435	999	81
Z-BIO/Z-BOS	0,911	0,2	1287	999	1
Z-BIO/R-BIO	0,999	0,1	3003	999	0
Z-BIO/R-CON	1	0,1	3003	999	0
Z-BIO/R-BOS	0,92	0,1	6435	999	0
Z-CON/Z-BOS	0,846	0,3	1287	999	2
Z-CON/R-BIO	0,998	0,1	3003	999	0
Z-CON/R-CON	1	0,2	3003	999	1
Z-CON/R-BOS	0,866	0,1	6435	999	0
Z-BOS/R-BIO	1	0,2	462	462	1
Z-BOS/R-CON	1	0,2	462	462	1
Z-BOS/R-BOS	0,857	0,2	1287	999	1
R-BIO/R-CON	0,617	0,4	462	462	2
R-BIO/R-BOS	0,762	0,1	3003	999	0
R-CON/R-BOS	0,881	0,1	3003	999	0

Tab. 8.4.7 - Pairwise tests based on the values of R observed for pair of stations in relation to considered species. The significance % refers to the number of values of R that fall within the range of expected frequencies compared to the total number of possible permutations.

From analysis with the SIMPER test is assessed the dissimilarity between station; the values are synthesized in table 8.4.8, and it is evident that the level of dissimilarity between stations is very high (with the maximum for pair **Z-BOS/R-CON** (93,90) and the minimum for pair **Z-BIO/Z-CON** (48,34), which is the only pair of stations that shows average dissimilarity value lower than 50%.

Station	Z-BIO	Z-CON	Z-BOS	R-BIO	R-CON	R-BOS
Z-BIO						
Z-CON	48,34					
Z-BOS	73,87	69,31				
R-BIO	90,38	89,92	91,54			
R-CON	90,99	91,37	93,90	63,98		
R-BOS	83,66	80,72	81,67	78,64	82,37	

Tab. 8.4.8 – Dissimilarity values between stations pair assessed by SIMPER test. In fuchsia is marked the maximum value, in yellow the minimum value.

9 RESULTS AND CONCLUSION

The research performed in the C.da Cassone (Zafferana) area of the Etna Regional Park, has allowed for the collection of **11,765** Coleoptera specimens that belong to **32** Families and a Superfamily, Curculionoidea, which includes the Staphylinidae and Carabidae, which account for more than 70% of the all captures. The higher CS value of the Coleoptera specimens are recorded in the **BOS** station and the lowest in the **CON** station, while the higher number of Families are recorded in the **CON** station and the lowest in the **BOS** station. Therefore, there seems to be a positive correlation between the specimen captures frequency and the number of the sampled Families. The same result was also recorded for the Carabidae, Tenebrionidae and Staphylinidae Families.
In total, **4,002** Carabidae specimens belong to **21** species and subspecies, **538** Tenebrionidae specimens belong to **14** species and subspecies, and **325** Staphylinidae specimens, (excluding Aleocharinae and Scydmeninae), belong to **38** species and subspecies were collected.

In regards to the Contrada Cassone area, some simple considerations arise on the structure and composition of the Coleoptera soil communities:

a) The ANOSIM test shows that the traps of one station are more similar to each other than with the traps of other stations, with a statistical significance in regards to the Coleoptera Families (R value **0,57**), Carabidae species (R value **0,71**), and Tenebrionidae species (R value **0,53**), while no statistical significance is recorded for the Staphylinidae species (R value **0,27**).

b) The dendrograms, based on the Bray-Curtis similarity index, clearly distinguishes the traps of the **BOS** station from those of the orchards traps, both the organic station (**BIO**) and the conventional station (**CON**). The **BOS** station traps clusters that are separated with a statistical significance (according to the SIMPROF test) in regards to the Coleoptera Families, Carabidae species, and Tenebrionidae species, while no statistical significance is recorded in regards to the Staphylinidae species.

c) The stations are characterized by relatively high average similarity values in regards to the Coleoptera Families (**BIO**: 71,04; **CON**: 72,00; **BOS**: 80,41), Carabidae species (**BIO**: 65,86; **CON**: 47,28; **BOS**:76,03) and Tenebrionidae species (**BIO**: 53,85; **CON**: 59,73; **BOS**: 50,95), while the average similarity values, in regards to the Staphylinidae species, are significantly lower (**BIO**: 29,82; **CON**: 31,56; **BOS**: 52,63). Also, the analysis of the Carabidae, Staphylinidae and Tenebronidae species rank/abundance highlights a different structure of the individual stations.

d) The Parwise test, based on the comparison of observed and expected values of R, between pairs of stations, shows different results in regards to the considered taxa:

- Considering the Coleoptera Families, the traps of the **BOS** station differ from each other, while the traps of the **CON** and **BIO** stations do not differ significantly from each other; these are grouped together into two clusters, according to the Bray-Curtis index and with statistical significance; the first with about 90% similarity includes the **CON** and **BIO** stations, the second separates the **BOS** station.
- In regards to the Carabidae and Tenebrionidae species, only the traps of the **BOS** station significantly differs from each other, while the **CON** and **BIO** stations do not differ significantly from each other; these are grouped together, according to the Bray-Curtis index, into two clusters and with statistical significance; the first with about 80% similarity includes the **CON** and **BIO** stations, the second separates the **BOS** station.
- In regards to the Staphylinidae species, only the traps of the paired stations, **BIO/BOS**, significantly differ from each other. The stations are grouped together, but without statistical significance, according to the Bray-Curtis index, into two clusters: the first includes the **BOS**

station, the second, the **BIO/CON** paired stations.

e) The Nonmetric Multi Dimensional Scaling (NMDS) shows the Coleoptera Families and the Carabidae, Tenebrionidae and Staphylinidae species, which determine the similarities and the differences between the stations.

- In regards to the the Coleoptera Families, **Carabidae**, **Staphylinidae**, **Cryptophagidae**, **Zopheridae**, **Ptnidae**, **Endomichidae**, and **Lathridiidae**, are centered on the **BOS** station traps, characterizing them and clearly differentiating the traps of this station rather from the other stations. The **Leiodidae**, **Lucanidae**, **Scirtidae**, **Cebrionidae**, **Elateridae**, **Mycetophagidae** and **Nitidulidae** occupy an intermediate position between the traps of the **BOS** station and the traps of the **BIO** and **CON** stations, while the other Families are centered on the pair of the **BIO/CON** stations, and determine their similarities.

- In regards to the Carabidae species, ***Calathus montivagus**, **Calathus fuscipes graecus**, **Carabus lefebvrei**, **Laemostenus algerinus algerinus**, **Synuchus vivalis***, ***Leistus spinibarbis fiorii***, and ***Notiophilus rufipes*** (the last two species exclusive to the **BOS** station), are centered on the traps of the **BOS** station, characterizing it and differentiating the traps of this station rather from the other stations. ***Calathus cinctus*** occupies an intermediate position between traps of the **BOS**, **BIO** and **CON** stations. The remaining species are centered on the paired stations, **BIO/CON,** which determine their similarities.

- In regards to the Tenebrionidae species, ***Accanthopus velikensis**, **Gonodera metallica*** (exclusive to the **BOS** station), and ***Helops rossii,*** are centered on the traps of the **BOS** station. The remaining species are centered on the paired stations, **BIO/CON,** which determine their similarities and differentiate them from the **BOS** station. ***Opatrum verrucosum**, **Pachychila dejeani**, **Lagria atripes**, **Lagria hirta**, **Isomira ferruginea**, **Isomira murina*** and ***Dendarus lugens*** are lacking in the traps of the **BOS** station.

- In regards to the Staphylinidae species, ***Quedius latinus***, ***Lordithon exoletus*** and ***Quedius fumatus*** are exclusive to the **BOS** station, while ***Ocypus olens***, and ***Ocypus mus*** are centered on this station. The remaining species are centered on the paired stations, **BIO/CON.**

f) The examination of the capture frequency trend in the single months of the sampling period, provides useful information on the dynamics of soil coenosis.

- In regards to the Coleoptera Families, the higher CS value is in **September** (128,02), while between **November and February**, low CS values (3,33-8,37) are recorded. The higher number of Families (**26**), are recorded in **July** and the lowest, (7), in **November** and **February**. Therefore, there seems to be a positive correlation between the specimen captures frequency and the number of the sampled Families.
A more careful analysis of the most abundantly censed Coleoptera Families, confirm the general scarcity of the catches between November and March, but shows the different CS peak values. The Carabidae observe a peak in September, with the high value also in August, for the Staphylinidae, the catches are more evenly distributed than the Carabidae and show a CS value peak in May, for the Anthicidae, Tenebrionidae and Zopheridae, the catches are concentrated between April and June, and the Melyridae show about 90% of the captures in June.
The general scarcity of catches between November and February is explained by taking into consideration the environment in which the collection stations were placed, which are characterized by very cold winters with frequent snowmaking soil.

- In regards to the Carabidae species, ***Calathus montivagus***, ***Calathus fuscipes graecus***, ***Calathus ambiguus***, and ***Synuchus vivalis*** show a captures concentration in August and September, with a peak in this last month, while in ***Laemostenus algerinus algerinus,*** the catches are more evenly distributed than the previous species, with a CS value peak in May. ***Syntomus obscuroguttatus*** show a sharp CS value peak in April, while the catches of ***Harpalus decipiens*** and ***Carabus lefebvrei lefebvrei*** are concentrated between May and August, with a captures peak in June.

- In regards to the Tenebrionidae species, generally, they are lacking consistently between November and March with the ecological characteristics of the Family. ***Pimelia rugulosa rugulosa*** have an irrregular trend of catches, with a CS value peak in June, ***Blaps gibba*** shows similar CS values between May and November, with a captures peak in June, ***Accanthopus velikensis*** are present between June and October, with the highest CS value in June, 90% of ***Lagria hirta*** catches are recorded in May, while ***Opatrum verrucosum*** shows more than 47% of the captures in April.

- In regards to the Staphylinidae species, the captures of ***Ocypus olens*** are concentrated between August and November, with a sharp CS value peak in September, ***Ocypus mus*** shows a similar trend, with a sharp CS value peak in October, while 0% of the ***Paraphloeostiba gayndahensis*** catches are recorded between June and September, with a sharp CS value peak in July. ***Quedius latinus*** shows a very irregular captures trend with the captures concentration between April and June, with the peak in this last month; it is lacking in other periods, except in October and January.

In conclusion, the analysis showed a homogeneity between the traps of individual stations, in terms of biotic communities of soil fauna, confirmed by the ANOSIM test. This homogeneity is matched by a lack of similarity between the orchards (**BIO** and **CON**) and woods (**BOS**) stations, highlighted by the dendrograms of similarity and the Parwise test. Given that the stations are adjacent and do not present substantial differences of exposure, steepness and altitude, the differences can be attributed largely to the different methods of operation of the sites investigated, which also determine different soil characteristics. Particularly, in relation to the **CON** and **BIO** stations, their similarity shows that regarding the soil fauna, it is not so much the cultivation method (organic or conventional) that influence its structure and composition, but the type and amount of annual plowing.

As demonstrated by the presence of many woodland species, although with low CS values within orchards, the study shows that the presence of the natural vegetation edges, more or less extensive within or neighboring to the agro-ecosystems, increases environmental heterogeneity. This results in greater wealth and dynamism of the communities, allowing them to maintain, even in small areas, a significant fraction of the fauna of the natural and seminatural environments.

The asynchrony of the most sampled taxa represents another aspect of biodiversity. The phenology of these taxa allows identifying in the winter season, characterized by cold winters with frequent snowmaking soil. Outside of this period, the fraction of soil fauna examined in this study, shows an articulation and a structural complexity that allows it to occupy most of the temporal domains with different species that follow one another in time. This diversity, as demonstrated by the results of recent studies (e. g. DUELLI, 1999, PURTAUF et alii, 2005, BENNET et alii 2006, ZAMORA et alii 2007) is favored by the landscape mosaic structure.

The more abundantly sampled Coleoptera taxa generally show a clear preference for a station, where they make record high CS values, while they are absent or present with low CS values in the other stations. Their presence is thus linked to some patches, as opposed to the other, and therefore, is made possible precisely by the environmental mosaic that characterizes the study area.

Turning to the results of the comparison between the two areas of Ragalna and Zafferana, there are some considerations:

In the comparison period between April and September, in regards to the Coleoptera Families, the Zafferana area recorded a total CS value of 528,19 (75,2% of the total CS value) and 31 Families, while the Ragalna area recorded a total CS value of 174,5 (24,8% of the total CS value) and 25 Families. The **Z-BOS** station shows the highest CS value (44,8%), while the **R-BOS** station has the minimum CS value (5,5%); regarding the sampled Families, the greatest number of Familes observed, (**29**), has been surveyed in the **Z-CON** station and the minimum, (**15**), in the **R-CON**

station. In this case, there also seems to be a positive correlation between the specimen captures frequency and the number of the sampled Families.
A similar result was also recorded considering the total of 85 species of the Carabidae, Tenebrionidae and Staphylinidae. The Zafferana area recorded a total CS value of 287,41 (86,6% of the total CS value) and 53 species, while the Ragalna area recorded a total CS value of 44,5 (13,4% of the total CS value) and 47 species. The **Z-BOS** station shows the highest value of CS (64,74%), while the **R-BOS** station has the minimum CS value (3,03%); regarding the sampled species, the greatest number observed, **40**), has been surveyed in the **Z-BIO** station and the minimum, (**21**), in the **R-CON** station.

a) Also in this case, the ANOSIM test shows that the traps of one station are more similar to each other than with the traps of other stations, with a statistical significance, in regards to the Coleoptera Families (R value **0,76**) and the Carabidae, Tenebrionidae and Staphylinidae species (R value **0,82**).

b) In regards to the Coleoptera Families:
The examination of the Bray-Curtis similarity index shows a medium-high similarity (values over 50% of similarity) between almost all stations. Only two comparisons between stations recorded similarity values lower than 50% and are in decreasing order as follows: **R-CON/Z-BOS** and **R-BIO/Z-BOS** pairs.
The dendrogram, based on the Bray-Curtis similarity index, clearly distinguishes three clusters, with a statistical significance (according to the SIMPROF test), which separate the wooded stations (**Z-BOS** and **R-BOS**) from the orchards station, and this latter in the Ragalna orchards (**R-BIO** and **R-CON**) and in the Zafferana orchards (**Z-BIO** and **Z-CON**).
The **Carabidae**, **Staphylinidae**, and **Zopheridae** Families are centered on the traps of the **Z-BOS** station, characterizing it and clearly differentiating the traps of this station from the other stations. The **Cryptophagidae** and **Ptnidae** Families occupy an intermediate position between the traps of the **Z-BOS** and **R-BOS** stations, while the **Nitidulidae** and **Melyridae** occupy an intermediate position between the traps of the **Z-BOS** and the paired **Z-BIO/Z-CON** stations. The **Anthicidae**, **Tenebrionidae**, **Chrysomelidae** Families and the **Curculionidea Superfamily** are centered on the pairs of the orchard stations (**Z-BIO/Z-CON** and **R-BIO/R-CON),** determining their similarities and differentiating them from the wooded stations (**Z-BOS** and **R-BOS**).
The Parwise test shows that only the pair **Z-BIO/Z-CON** results are very similar, all other pair of stations are significantly different from each others.

c) In regards to the Carabidae, Tenebrionidae and Staphylinidae species:
The examination of the Bray-Curtis index of similarity, in relation to all the considered species, shows a very low similarity (values under 50% similarity) between almost all of the stations. Only the comparisons between **Z-BIO/Z-CON** stations recorded values of over 50% similarity.
The dendrogram, based on the Bray-Curtis similarity index, clearly distinguishes three clusters, with a statistical significance (according to the SIMPROF test), which separates the **Z-BOS** station from the Zafferana orchard stations (**Z-BIO** and **Z-CON**) and the Ragalna stations (**R-BIO**, **R-CON** and **R-BOS**).
Laemostenus algerinus, ***Ocypus olens***, ***Calathus montivagus*** and ***Quedius latinus*** are centered on the traps of the wooded stations (**Z-BOS** and **R-BOS**), while ***Calathus fuscipes graecus***, ***Carabus lefebvrei lefebvrei*** and ***Accanthopus velikensis*** are exclusives to the Zafferana area and show the highest CS value in the **Z-BOS** station, where they are centered. ***Pimelia rugulosa rugulosa***, with ***Calathus ambiguus***, ***Harpalus decipiens***, ***Synthomus obscuroguttatus*** and ***Blaps gibba*** (these last four species are exclusives to the Zafferana area), are centered and characterize the Zafferana orchard stations, (**Z-BIO** and **Z-CON**), together ***Opatrum verrucosum***, exclusive to the **Z-BIO** station. ***Paraphloeostiba gayndanensis*** occupies an intermediate position between between the orchards stations traps (**Z-BIO/Z-CON** and **R-BIO/R-CON**). ***Pachychilia dejeani*** with ***Cnemeplatia atrops***, ***Microlestes luctuosus*** and ***Blaps lethifera*** (these last three species exclusives

to the Ragalna area) are centered and characterize the Ragalna orchards stations traps (**R-BIO** and **R-CON**) together ***Pterostichus melas italicus***, exclusive to the **R-BIO** station.
The Parwise test shows that only the **Z-BIO/Z-CON** pair are very similar, all other pairs of stations are significantly different from each other.

The comparison between the two sampled areas, shows that at both the Families and species level, the geographic factor, (in our case the location on two different volcano slopes), play an important role along with the ecological one, (the investigated habitat type and the climatic characteristics), in determining the structure of the soil of the Coleoptera communities.
The detected biodiversity, in some cases, seems to be a function of the intrinsic stations structure, while in others, it seems that in relation to the investigated animal groups, which can provide a significantly different framework, even within a single station (BÜCHS et alii 2003, BERENDSE et alii 2009).
The interpretation of the biocoenotic data must be characterized with prudence and the component investigated must be taken into account, which generally represents a fraction, more or less extensive, of the overall animal diversity, which reflects the bio-ecological characteristics of the taxa and their ecological plasticity (DIEKÖTTER et alii, 2008, BALOG et alii 2009). So, it is very complex to draw general considerations examining one, or a few animal groups, although some areas may present the structural features that confer a strong and homogeneous connotation to the structure of the soil fauna.
All of this represents a biocoenotic analysis limitation that can be partially overcome by a multi-taxa approach (KOTZE & SAMWAYS, 1999, DE ARANZABAL et alii 2008), that should be used to carry out the studies preparatory to the elaboration of the concrete management measures for the natural and semi-natural environments and agro-ecosystems, aimed at biodiversity protection.
On one hand, the study shows a certain specificity of the soil zoocoenosis within the individual investigated stations and their contribution to the biodiversity conservation in the area. On the other hand, it remains in defining the effects of this biodiversity on the stability of the agro-ecosystems.
It is a much debated topic, and not all authors agree to positively evaluate the fallout of the biodiversity found in natural and semi-natural areas of the agro-ecosystems. A concern, for example, is the possibility that these areas might facilitate the diffusion of the generalist predator species, which may play the role of the regulators of the harmful species population inside the agro-ecosystems, limiting, therefore, the necessity of the use of pesticides. Also the subject of debate, is the role played by natural and semi-natural areas as ecological corridors within an environmental mosaic (WITH & CRIST 1995, KAREIVA & WENNERGREN 1995, DUELLI 1997, DUELLI & OBRIST 1998, HADDAD 1999, ALTIERI 1999, TSCHARNTKE et alii 2005, ROSCHEWITZ et alii 2005, DIEKÖTTER et alii 2008, ĆURČIĆ & DURDIĆ, 2013). Many authors agree, however, on the importance of structure in the patches of the landscape in determining the stability of a single agro-ecosystem (ATAURI & DE LUCIO 2001, ÖSTMAN et alii 2001, RENJIFO 2001, WITH et alii 2002, DAILY et alii 2003, EILU et alii 2003, WEIBULL & ÖSTMAN 2003, BENNETT et alii 2006, ERNOULT et alii 2006, ZAMORA et alii 2007, DE ARANZABAL et alii 2008).
The study highlights how the different methods of cultivation, conventional or organic, do not cause any significant differences in the soil fauna; the investigated orchards, in fact, do not differ significantly from each other (more obvious are those in the Zafferana area in respect to those in the Ragalna area). The relative poverty and homogeneity of the orchard soil fauna may be put in relation to the plowing, both in regards to their annual number, and above all, the manner with which they are made. From this point of view, it would be appropriate that the Etna Park Authority, at least for the orchards falling in the B zone, develop guidelines that provide for the maintenance of adequate grassed stripes at the crop margins. This measure, which is easy to implement, would certainly have a very positive effect on the increase and/or maintenance of the soil fauna biodiversity.

The study also shows the strategic role of the patches of the environmental mosaic for preservation of the adequate biodiversity levels of soil fauna in the areas of study. To set a correct policy of the biodiversity protection and management of a protected area, based on scientific criteria, and not aesthetic criteria, the maintenance of high levels of the landscape heterogeneity should therefore be an important principle and strategy to be pursued.
The properties of the environmental mosaic on a landscape scale, and its significance for the biodiversity conservation, have been recently investigated (DUELLI 1997, BÜCHS et alii, 2003, BENNET et alii 2006) in order to have a valid scientific basis for the study and the predisposition of measures for the protection and management of the land. The studies highlight three main properties that have effects on the biocoenosis: the extension of the habitat, the composition of the mosaic and the spatial configuration of the elements. In particular, the extension of the habitat has influence on the presence of the individual species. The composition of the mosaic, understood as a proportion of habitats, has significant effects on the composition of the animal as a whole. Finally, in general, the habitat heterogeneity is positively correlated with the taxonomic richness of biotic communities. We must also consider the specificity of the community in relation to the geographic location.
Considering that some studies have shown different properties of the environmental mosaics, characterized by good or poor ecological connectivity, have different responses according to the groups investigated (DIEKÖTTER et alii 2008) and conservation strategies should still be consistent with the flexible principles based on precise preliminary studies.

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