

**ROMANIAN ACADEMY
INSTITUTE OF BIOLOGY BUCHAREST**

**ABSTRACT
PHD THESIS**

**TAXONOMICAL, BIOLOGICAL AND ECOLOGICAL
RESEARCH STUDIES UPON THE LEAF BEETLES
(CHRYSOMELIDAE, COLEOPTERA) FROM BIHOR
COUNTY**

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Key words: coleopterans , biology , Bihor county

INTRODUCTION

The *Chrysomelidae* coleopterans, because the phytophagous alimentary diet, forms an important links in most of trophic chains from ecosystems .

Located in the north – western part of Romania, Bihor county is a very interesting region, from the scientific point of view .

The fauna of *Chrysomelidae* species from this region is the object of my PhD thesis .

The reasons of choosing for this subject are the followings: in Bihor county faunal data about the *Chrysomelidae* species are relatively little, also, aspects concerning the biology and the ecology of *Chrysomelidae* species in Bihor county are unknown .

The thesis contents a rich and unpublished scientific material, being structured on ten chapters, including 84 figures (62 are original), 25 tables (20 totality original) .

To my scientific coordinator, Ms. scientific researcher I PhD Doina Codreanu – Bălcescu, profound remark and remarkable gratitude, for the professionalism, scientific exigence along the entirely research period and elaboration of my PhD thesis .

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Chapter I

Physical – geographical characterization of Bihor county

Bihor County is located in the north-western part of Romania and it is part of Crișana historical province. In the south, it has a common boundary with Arad county, in the west with Hungary, in the north with Satu-Mare county, while in the east with Sălaj, Cluj and Alba counties.

It presents a varied landscape, including Crișurilor Plain in the west, Crișurilor hills in the central part and, in the southern and eastern parts, it is located a mountainous area, which culminates with the highest elevation of the county (Cucurbăta Mare peak-1,848 m).

The climate is temperate-continental. The hydrographical network is varied being represented by the following rivers – the Crișul Negru, the Crișul Repede, the Barcău, the Ier and their tributaries, some lakes and reservoirs built for fishery (sport fishing).

The soils also display a great variety – from the levigated chernozems characteristic to the forest steppe areas to the brown acid soils characteristic to the mountainous area. The climatic influence and the landscape variety determined the presence of numerous vegetal and animal species, some of these considered endemic and others representing rarities at national level.

Chapter II

Historical considerations regarding the research of *Chrysomelidae* family

II.1 Historical considerations regarding the research of *Chrysomelidae* family at European level

At European level, there has been undertaken research on the development of guides (monographs), publication of data from museum collections, genetic and morphological research or data about their economic importance (some species are defoliators of cultivated plants and trees).

In the 19th century, with the evolution of optical investigation devices, C. G. Calwer, E. Reitter made significant contributions to the knowledge of *Chrysomelidae*.

The 20th century is characterized by the diversification of the studies upon *Chrysomelidae*, especially starting with the fourth decade, and, here we mention the

contributions of certain researchers, such as A. Winkler, K. H. Mohr , H.Freude, Z. Kaszab, B.Gruev, A. Warchalowski, G. Bei-Bienko, M. Hansen, E. Petitpierre, S. Doguet, etc.

The action of different species of *Chrysomelidae* upon crops or forest plantations was studied by different researchers such as A. Balachowsky, L. Mesnil, L. Nef, Beffa Della, K. Gunther.

II. 2 Historical references of researches concerning *Chrysomelidae* family from Romania

The first faunistic research regarding the *Chrysomelidae* species from Romania were achieved by foreign entomologists or Romanian entomologists of German origin from Transylvania who published fauna lists mainly for Transylvania and Banat: J. Roth, Ed. Bielz, C. Fuss, G. Seidlitz, K. Petri. Afterwards, fauna lists of *Chrysomelidae* from Transylvania were published by the following researchers : O. Marcu, Al. Crişan, S .Maican, Şt. Balint, I. Rozner, Lorena Cosma Ilie .

Data regarding the distribution of *Chrysomelidae* in Moldova can be found in the works of certain authors such as C. Hormuzachi, M. Jaquet,L. Cosmovici, Al. Montandon, O. Marcu, M. Varvara, C. Tărăbuţă.

The *Chrysomelidae* species from Muntenia, as well as from other regions of the country can be found in the works of M. Jaquet, Al. Montandon, G. Ochs, S. Panin, A. Roşca, A. Konnerth-Ionescu, C. Hoinic, B. Gruev, E. Niţu, Al. Crişan, S. Maican.

Fauna lists including the *Chrysomelidae* from Dobrogea were achieved by the following authors: Şt. Negru, A. Roşca, M. Ieniştea, Al. Crişan, S. Maican, while *Chrysomelidae* species from Banat can be found in the works of the following authors : V. Szmolay, M. Ieniştea, M. Teodoreanu, Z. Kaszab, Al. Crişan.

Data regarding the distribution of *Chrysomelidae* in Oltenia are found in the works of different researchers, such as C. Hormuzachi, Al. Montandon, G. Ochs, O., Marcu, B. Bobîrnac, A.L. Ilie, C. Chimişliu, S.Maican.

Chapter III

Morpho – anatomical characteristics of *Chrysomelidae* family

According to the number of species (more than 35.000 worldwide), *Chrysomelidae* family is, after *Curculionidae* family, one of the great families of beetles. Mostly terrestrial

but also aquatic, *Chrysomelidae* are present in all ecosystems, from sea level to the alpine area, from desert areas to the Arctic region.

Their dimensions are variable, as well as the shape of the body: shield, round, oval, oblong, cylindrical. The European species present antennae made up of 10-11 segments of different forms, while larvae present only 2-3 segments.

The position of the head may be prognathous or orthognathous. The mouth parts are of broken and chewing type. Eyes are compound in case of adults and simple at larvae. The prothorax is free. The anterior wings called elytrons, are chitinous, while the posterior ones are membranous. The elytrons often have a metallic lustre, various colours and can present spots, stripes, dots. The elytrons can be hairless or have bristles (hair), sometimes spikes.

The legs present variable dimensions, some species having thickened posterior femurs, adapted for jumping. The tarsus is tetramer and has 1-2 claws. The abdomen of adult specimens does not have any type of appendix.

Chapter IV

Aspects regarding the biology of Chrysomelidae family

The reproduction is bisexual in case of most species, but, rarely, it appears irregular parthenogenesis.

Chrysomelidae are mostly oviparous, but the species living in extreme conditions (high altitude, arctic areas, etc.) can be ovoviviparous and even viviparous. The larvae are generally free, but there are species whose larvae present special protective covers. The pupa is form free pupa.

Being phytophagous *Coleoptera*, *Chrysomelidae* presents major economic importance and can cause serious damage to crops and forests.

Chapter V

Ecological considerations upon the *Chrysomelidae* species

The *Chrysomelidae* could live in land or aquatic ecosystems, from sea level to high altitudes (over 4000 m).

According to the humidity of the biotope they live, the *Chrysomelidae* species could be xerophilous, mesophilous, hydrophilous and hygrophilous.

In terms of trophic spectre, the *Chrysomelidae* species could be monophagous, oligophagous and polyphagous species.

The interspecific and intraspecific relationships observed at *Chrysomelidae* species are: cannibalism, mutualism, colony, supervision of descendants.

The *Chrysomelidae* species present active and passive defence means.

Passive defence means: protecting covers, protecting colours, mimicry, reflex bleeding.

Active defence means : jump, cycloaexy, flight, thanatosis.

Some *Chrysomelidae* species could cause serious damage to crops and forests.

Chapter VI

Methods of research, collection and preparation of the entomological material

(*Coleoptera*, *Chrysomelidae*)

The collection of *Chrysomelidae* (*Coleoptera*) was achieved by means of entomological net, clap net (Japanese umbrella) and different types of tweezers. After collection, *Chrysomelidae* specimens were killed in containers with poisonous vapours (chloroform, sulphuric ether).

The preparation of large species was achieved by entomological needle puncture in the right elytra, near the suture and scutellum. In case of small species, they were first determined, then stuck on small pieces of cardboard.

Experimentally, for the research of *Chrysomelidae* biology, there were used growing cages or gauze and raffia bags provided with small holes for the penetration of air, mounted at the end of the branches of the host plant.

The growing cages were provided with the host plants of the investigated species and a thermometer that indicated the temperature values corresponding to different stages in the life of *Chrysomelidae*.

The analytical ecological parameters such as absolute abundance, constancy, dominance, ecological significance index Dziuba were used to investigate the interspecific relationships among *Chrysomelidae*, as well as the relationships between *Chrysomelidae* and environmental factors (biotic and abiotic).

Chapter VII

Summary of *Chrysomelidae* species from Bihor county

According to the international taxonomy, *Chrysomelidae* family belongs to *Coleoptera* order, *Polyphaga* suborder.

Lobl I., Smetana A. (2010) propose a classification according to which *Chrysomelidae* family belongs to *Chrysomeloidea* superfamily together with *Cerambycidae* family.

The same authors divide the family in 12 subfamilies: *Sagrinae*, *Synetinae*, *Bruchinae*, *Cryptocephalinae*, *Donaciinae*, *Criocerinae*, *Cassidinae*, *Chrysomelinae*, *Galerucinae*, *Alticinae*, *Lamprosominae* and *Eumolpinae*.

The subfamily *Sagrinae* includes exotic species and the subfamily *Synetinae* does not have any representatives in Romania. The research regarding the *Chrysomelidae* fauna from Bihor County was achieved in the period 2010-2016 in 35 collection sites located in the plain, hilly-Subcarpathian and mountainous areas.

The identification of the species was achieved according to the following bibliographical sources: Z. Kaszab (1962) and A. Warchalowski (2003). There were identified 216 species belonging to 60 genera and 8 subfamilies. Of the total number of the identified species, 2 species are mentioned in Romania for the first time: *Phyllotreta scheuchi* Hktr. and *Dibolia russica* Wse.; 121 species represent new mentions for the analysed area; 49 species being considered rare or relatively rare in Romania : *Oulema erichsoni* Suffr. , *Labidostomis tridentata* L., *Smaragdina affinis* Ill., *Cryptocephalus vittula* Suffr., *Cryptocephalus querceti* Suffr., *Cryptocephalus signatifrons* Mull., *Cryptocephalus schaefferi* Schr., *Timarcha gibba* Hag., *Chrysolina aurichalcea* Mann., *Chrysolina eurina* Friv., *Chrysolina umbratilis* Wse., *Chrysolina oricalcia* Mull., *Chrysomela lapponica* L., *Chrysolina purpurascens* Germ.,

Oreina bifrons Fabr., *Galeruca melanocephala* Pon., *Luperus xanthopoda* Schr., *Euluperus major* Wse., *Phyllotreta punctulata* All., *Phyllotreta procera* Redtb., *Aphthona flaviceps* All., *Aphthona flava* Guill., *Aphthona semicyanea* All., *Longitarsus pinguis* Wse., *Longitarsus fuscoaeneus* Redtb., *Longitarsus rubiginosus* Foudr., *Longitarsus ballotae* Marsh., *Longitarsus symphyti* Hktr., *Longitarsus curtus* All., *Longitarsus pallidicornis* Kutsch., *Longitarsus ochroleucus* Marsh., *Longitarsus minusculus* Foudr., *Longitarsus atricillus* L., *Longitarsus linnaei* Duft., *Longitarsus longipennis* Kutsch., *Longitarsus holsaticus* L., *Argopus bicolor* Fisc., *Minota halmae* Apf., *Neocrepidodera nigritula* Gyll., *Dibolia cynoglossi* Koch., *Dibolia femoralis* Redt., *Chaetocnema compressa* Latz., *Chaetocnema schefferi* Kutsch., *Chaetocnema orientalis* Baud., *Crepidodera lamina* Bed., *Podagrica fuscipes* Fabr., *Psylliodes glaber* Duft., *Cassida seladonia* Gyll., *Cassida margaritacea* Schall.

In terms of abundance of species, the subfamilies *Alticinae* (102 species, 19 genera) and *Chrysomelinae* (48 species, 15 genera) are dominant followed by the subfamilies *Cryptocephalinae* (32 species, 7 genera), *Galerucinae* (14 species, 9 genera) *Criocerinae* (8 species, 4 genera), *Cassidinae* (8 species, 3 genera), *Donaciinae* (2 species, 2 genera), *Eumolpinae* (1 species, 1 genus). These ratios are consistent with the number of the species of the respective subfamilies at national and European level.

With regard to the distribution of the identified *Chrysomelidae* within the analysed geographical unit, there were identified 162 species (47 genera) in the plain area, 136 species (48 genera) in the hilly area and 62 species (30 genera) in the mountainous area. There were identified 19 species that are widespread in altitude, while 11 species are characteristic to a single geographical unit, namely the mountainous area.

The analysis of the trophic spectre of *Chrysomelidae* species from Bihor county emphasizes the predominance of oligophagous species (129), followed by polyphagous species (54), monophagous species (31) and 2 species with unknown host plants.

The host plants of the *Chrysomelidae* species from Bihor county belongs to 27 botanical families : *Cyperaceae* , *Poaceae* , *Sparganiaceae* , *Ranunculaceae* , *Liliaceae* , *Asteraceae* , *Brassicaceae* , *Fabaceae* , *Salicaceae* , *Fagaceae* , *Apiaceae* , *Rosaceae* , *Betulaceae* , *Tamaricaceae* , *Hypericaceae* , *Lamiaceae* , *Oleaceae* , *Primulaceae* , *Asclepiadaceae* , *Solanaceae* , *Rubiaceae* , *Plantaginaceae* , *Caryophyllaceae* , *Polygonaceae* , *Caprifoliaceae* , *Convolvulaceae* , *Chenopodiaceae*.

From the zoogeographical view point, there predominate European (39) and central-European species (39), followed by Euro-Asian species(30), Euro-Siberian species (28),

Palaearctic species (25), Euro-Asian and north-African species (22), European and Asia Minor species (22), Holarctic species (5), Carpathian endemic species (3), zonal endemic species (1), Pontic (1) and south-European species (1).

There were identified three ecological categories *Chrysomelidae* belong to in Bihor county – land (140 species), eurytopic (63 species) and forest (13 species).

According to the humidity of the biotope they live in, the *Chrysomelidae* species from Bihor county can be characterized as: mesophilous (162 species), mesohygrophilous (42 species), mesoxerophilous (8 species), xerophilous (2 species) and hygrophilous (2 species).

Some species present a large altitudinal distribution, approximately 1000 -1700 m. Example: *Oulema melanopus* L., *Cryptocephalus flavipes* Fabr., *Chrysolina fastuosa* Scop., *Chrysomela populi* L., *Crepidodera aurea* Geoffr., *Cassida vibex* L., *Cassida viridis* L.

Other species are characteristic of one single geographical unit: *Oreina* sp., *Sclerophaedon carpathicus* Wse., *Mniophila muscorum* Koch. etc.

Chapter VIII

***Chrysolina fastuosa* Scopoli, 1763 – ecological and biological observations and researches performed in Bihor county (2012-2016)**

The biology and ecology of this species was studied in the plain, hilly and mountainous areas of Bihor County, during 2012-2016. Attacking medicinal and aromatic plants that belong to the families *Lamiaceae* and *Urticaceae*, this species has economic importance. To these, there are added *Symphytum officinale* L. (*Boraginaceae* family), *Rumex conglomeratus* Murr. (*Polygonaceae* family) and *Erigeron annuus* Pers. (*Asteraceae* family), not previously mentioned in the scientific literature.

Mono- and bivoltine species, under favourable climatic conditions, it can be observed even the third generation (partial, up to the larval stage). The full stage of development of a generation under natural conditions lasts seven weeks, while under laboratory conditions, it lasts five weeks and a half.

The intensity of the adult flight presents two maximums: mid-May and the first half of June, when $t = 24-27^{\circ}\text{C}$. At temperatures below and above these values, the flight is reduced or even absent. Wind has generally an inhibitory effect on larvae and adults of the species. Wintering is achieved mostly by adults, but, sometimes, it can occur in the larval stage (in the case of the third generation).

Chapter IX

Observations concerning some ethological, ecological and biological characteristics of Chrysomelidae family from Bihor county

1. I achieved personal observations regarding the appearance in nature, host plants, number of generations per year, particularities of eggs, presence of larvae during the cold season for the following species: *Galeruca rufa* Germ., *Hypocassida subferuginea* Schr., *Clytra laeviuscula* Ratz and *Chrysolina herbacea* Duft.
2. At the species *Chrysomela vigintipunctata* Scop., *Luperus xanthopoda* Schr. and *Cassida viridis* L. I observed chromatic anomalies unmentioned in the specialized literature.
3. I achieved observations regarding the sexual contact at 9 species of *Chrysomelidae* at very late dates, not mentioned in the scientific literature, because of global warming.
4. I identified 18 species of *Chrysomelidae* that continued their activity during winter due to the increased temperatures registered in the last years (2012-2016), the disposing of respective territory, the temperature of microclimate offered by host – plants, weather conditions of environment, vigour of plants: *Phyllotreta diademata* Foudr., *Psylliodes chrysocephalus* L., *Longitarsus minusculus* Foudr., *Galeruca tanacetii* L., *Altica oleracea* L., *Longitarsus longipennis* Kutsch., *Longitarsus brisouti* Hktr., *Longitarsus holsaticus* L., *Longitarsus pratensis* Panz., *Longitarsus brunnaeus* Duft., *Phaedon laevigatus* Duft., *Longitarsus ballotae* Marsh., *Longitarsus aeneicollis* Fald., *Longitarsus fuscoaeneus* Redtb., *Hispa atra* L., *Podagrica menetriesii* Fald., *Chaetocnema tibialis* Ill., *Chaetocnema chlorophana* Duft.
5. At the level of Bihor county, the drought and the dog days has negative effect upon the *Chrysomelidae* species only in territories with reduced or absent vegetation, because the anthropogenic impact and secondary to weather conditions.

Chapter X

The anthropogenic impact upon the Chrysomelidae species from Bihor county

The human activities with baneful influence upon the populations or even the existence of *Chrysomelidae* species from Bihor county are : agricultural work, the establishment of agricultural or forest monocultures, extreme grazing, deforestations , drainings, burnings, physical pollution (radioactive), mowing .

Conclusions

This PhD thesis is a complex study regarding the biological, ecological and ethological aspects of *Chrysomelidae* from Bihor county. The study was conducted during 2010-2016 in 35 collection / research sites located in the plain, hilly-subcarpathian and mountainous areas of Bihor county.

The collected faunal material, completed with data from the scientific literature, led to the identification of 216 species belonging to 8 subfamilies and 60 genera.

Of these, 179 species were collected by the author, 2 species were identified for the first time in Romania and 121 species are newly mentioned for the analysed area.

From the trophic point of view, there predominate oligophagous species, followed by polyphagous, monophagous species and those with unknown host plants. I identified new host plants for certain *Chrysomelidae* species.

From the zoogeographical point of view, there predominate the European and central-European species.

There were identified three ecological categories for the *Chrysomelidae* species from Bihor county – land, eurytopic and forest. According to the humidity of the specific biotope, there were identified mesophilous, mesohygrophilous, mesoxerophilous, xerophilous and hygrophilous species.

I identified species that are very rare at national level and brought new contributions on the altitudinal distribution of *Chrysomelidae* in the conditions specific to Bihor county. I conducted research on the biology and ecology of the species *Chrysolina fastuosa* Scop., the respective data being not known up to present at national level.

I conducted observations regarding the biology and ecology of certain species of *Chrysomelidae* from Bihor county – colour, presence during the cold season and drought periods, certain ecological indexes in different research sites.

The last chapter aims to identify the main factors of anthropogenic impact on nature and proposes the establishment of parks and protected areas.

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