Research on Chrysomelidae

Vol. 1 Edited by Pierre Jolivet, Jorge Santiago-Blay & Michael Schmitt

Brill Publishers, Leiden, The Netherlands, 2008, 430pp.

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This collective/edited book is the first volume in a proposed series intended to present a composite picture of progress in the study of the Chrysomelidae, a large family of beetles with more than 40,000 recorded species to which more are continually being added as new species are discovered and described.

The book contains 8 sections: Phylogeny and Molecular Biology, Morphology and Anatomy, Palaeontology, Relations to Plants, Biological and Ecological Studies, Taxonomy and Faunistics, Population Biology, and Parasitology. In the first chapter, Jesus Gomez-Zurita discusses the process of speciation in the enigmatic genus *Timarcha* on the basis of genetic and phylogenetic studies during the past 30 years. It has been inferred that while most species of the genus have evolved in allopatry, sympatric speciation has also occurred due to chromosomal changes, host plant shifts, or both. This significant contribution is of interest both to those who are studying *Timarcha* and Chrysomelinae, and also to those who are dealing with problems of speciation in general.

Also in Section 1, host plant shift is discussed by Eben and Monteros in their contribution: "Specialization is not dead end: further evidence from Diabroticina beetles". They have worked out phylogenies of beetles of the Subtribe Diabroticina (Subfamily Galerucinae) on the basis of molecular data of "six gene fragments (including both mitochondrial and nuclear genes)". From the phylogenies they have inferred that the ancestral stage for the subtribe was monophagous and specialized for feeding on plants of Fabaceae, but in radiation beyond the ancestral stage some lineages became oligophagous and even polyphagous. Along two lineages there actually evolved a secondary specialization for Cucurbitaceae. "The plant family Cucurbitaceae has been a crucial host during the history of Diabroticina. Early during the evolution of these beetles Cucurbitaceae were introduced within their host range, and have been maintained throughout the lineage. The herbivore-plant relationship has evolved toward the situation where some species of these beetles have incorporated the secondary compounds produced by the cucurbits as a defence mechanism against predators". This study shows that specialization is not a dead-end in evolutionary process, and further evolution may lead to oligophagy/polyphagy.

Kergoat, Delobel, Ru and Silvain in their chapter in Section 1 discuss the systematics of bruchids (bruchines for these authors) in view of available molecular data for this group. The authors have decided to stick to the cladistic principle that sister groups be assigned the same taxonomic status. As the seed beetles group appears as a sister group to the chrysomelid subfamily Sagrinae in phylogenetic trees, they too have been taken as a subfamily (Subfamily Bruchinae) under Chrysomelidae. While discussing the host-plant relationship among bruchines, they have referred to host-plant shifts. They say: "these shifts toward chemically dissimilar host-plants have also likely involved the development of several 'key innovations' (e.g. new detoxification abilities) to circumvent extant plant defences ….". They point out "that considerable work is required in the future to better understand the evolution of host-plant associations in bruchines". The authors have emphasized the use of male genitalic features "when defining or revising taxonomic groups".

In Section 2 Scholler in his paper: "Comparative morphology of sclerites used by Camptosomatan leaf beetles for formation of extrachorion….", describes variations in the sclerotised plates in the rectal lining of females with their microsculpture in a number of different species, and hopes that "the pattern of sclerites (will) provide, most likely a valuable character set for phylogenetic studies on Camptosomata". Also in this section Nesterova describes larval morphology and developmental history of two sibling species of *Galerucella*, *G. nymphaeae* and *G. aquatica*, and Mikhailov presents a meticulous study of body colour variation in *Oreina* and *Crosita*, inferring a correlation between body colouration and altitude/season. Verma, in his contribution in Section 2, discusses taxonomic significance, variability and evolution of male genitalia in insects, with particular reference to Chrysomelidae. Use of genitalic features in species-level taxonomy as well as in macrotaxonomy is described with examples. Those parts of the genitalia which are directly involved in intromission present low variability or show hypoallometry or undergo canalized development, but the accessory parts show considerable variation. It has been inferred that evolution of the genitalia has been guided by a mosaic of factors, including sperm competition, cryptic female choice, sexual conflict, coadaptation of male and female genitalia, and in some cases even resistance to mite infection of the genitalic parts. Beenen and Jolivet in this section point out the taxonomic position of the leaf beetles with abbreviated or shortened elytra, that is showing brachelytrous condition, and also their habitat. Chrysomelids with such reduced elytra are only in the subfamilies Chrysomelinae, Galerucinae and Alticinae, and such forms occur in Alpine habitats, desert areas, and in oceanic islands. The advantage of the shortened elytra in such stressing conditions has been discussed.

In Section 3 Elias and Kuzmina discuss "Response of Chrysomelidae to Quaternary environmental changes". They find the chrysomelids dominating among the abundant insect fossils from the Quaternary period. Further they note that the leaf beetles of this period "match modern species exactly". Mostly fossil chrysomelids have been studied in Eurasia, and it has been inferred that "composition of ancient chrysomelid faunas was shaped by the waxing and waning of continental

Date of online publication 26 February 2009
ISSN 0974-7907 (online) | 0974-7893 (print)

* Dobler, S., D. Daloze & J.M. Pasteels (1998). Sequestration of plant compounds in a leaf beetle's defensive secretion: cardenolides in *Chrysochus*. *Chemoecology* 8: 111-118.

** Labeyrie, E. & S. Dobler (2004). Molecular adaptation of *Chrysochus* leaf beetles to toxic compounds in their food plants. *Molecular Biology and Evolution* 21(2): 218-221.

ice sheets" with alternating glacial and interglacial periods.

In Section 4 Flinte, de Macedo, and Monteiro record food plants for 35 out of 51 species under 21 genera of Cassidinae in the tropical rain forests of Brazil. In addition, oviposition pattern and larval behaviour for some of the species have also been observed. In this section Medeiros and Moreira concentrate on food plant choice of one cassidine species in Brazil, *Gratiana spadicea*. This tortoise beetle is generally regarded as monophagous, feeding exclusively on *Solanum sisymbriifolium*. But the authors have found that in the lab. the beetle could feed, live, and reproduce on three other native species of *Solanum*. On the other hand, larvae of the beetle rejected these other *Solanum* species, or showed low survival on them, or could not attain sexual maturity on them. Females of this cassidine, though earlier fed on those other *Solanum* species, chose to lay eggs on *Solanum sisymbriifolium*.

In the next section, "Biological and Ecological Studies" Heron gives a detailed account of life-history of the cassidine *Aspidimorpha submutata*, including adult and larval feeding patterns and possible defensive value of body colouration, which is variable between bright metallic gold to dull coppery red, with transparent and colourless explanate margins. In this section Vencl and Nishida describe a new species of *Oulema* (Criocerinae) from Thailand. The larva of this criocerine produces rounded to spindle shaped galls on various parts of the monocotyledonous *Commelina* plant. As has been pointed out by the authors, beetles, producing galls on monocotyledons, are extremely rare. Though in phylogenetic trees Criocerinae appear as a sister group to Sagrinae, the authors believe that gall induction and leaf mining have evolved within Criocerinae. Also included in Section 5 is a contribution from Bontems and Lee recording a new case of viviparity in *Agrosteomela chinensis* (Chrysomelinae). The viviparity has been observed in vivo, and also in an anatomical study. Included in the contribution is a figure of an ovariole, showing the basal-most chamber occupied by a 2nd brood larva, after a 1st brood larva has been delivered.

Section 6 includes papers on "Taxonomy and Faunistics". Among these papers is one by Biondi and Alessandro, who revise the *Chaetocnema pulla* group of species along with description of a new species from Central Africa. The communication is supported by scanning electron micrographs of characteristic features of the species covered. LeSage, in his contribution, points out differences between two species of pale-legged flea beetles (Alticinae), *Altica knabii* and *A. pedipallida*, the latter a new species described by LeSage. These two species look very similar externally, but differ in the details of their male and female external genitalia. The genitalic differences, however are so small that the species seem to be members of the same species group. Section 6 also incorporates a contribution from Jolivet and Verma: "On the origin of the chrysomelid fauna of New Caledonia". The authors find the fauna of the archipelago disharmonious and enigmatic. It includes both vicariant forms, which represent lineages of the Gondwanan origin, and forms, which have reached the islands by dispersal from Indonesia and other neighbouring land masses in recent times. The vicariant forms are the Tribe Spilopyrini (Eumolpinae) and the primitive chrysomeline *Zira*, which seems to have a South American connection. Sagrinae, which have a Gondwanan distribution, occurring in Australia and even Madagascar, are surprisingly lacking in New Caledonia. Migrants, arriving through dispersal, belong to ten chrysomelid subfamilies, but cassidines are represented by only 1 or 2 species, and Chrysomelinae only by *Zira*. Higher Eumolpinae (i.e. more advanced than Spilopyrini) are the most diversified group of leaf beetles in New Caledonia.

In Section 7 Grenha, de Macedo, and Monteiro study population fluctuation in the cassidine *Mecistomela marginata* on the palm *Allagoptera arenaria*. They note that the bigger the palm, the larger the number of the adult beetles on it. They have also observed that females of the beetle search for palms with more leaf buds, which are the food source for the larvae. Irrespective of climatic changes during year the beetle population size on a palm remains almost unchanged, which may be due to "low annual variation in the quantity of resources" and/or to "other regulatory factors, such as adult predation or egg parasitism".

In Section 7 Lam, Krell, Bradshaw, Rice and Pedigo verify the validity of the mathematical models prepared by Lam et al. (2000, 2001) to predict mortality in winter and population size during summer precipitation in the bean leaf beetle *Cerotoma trifurcata*. They collected data of mortality in winter and population size in summer, also air mean subfreezing winter temperature and mid-summer precipitation during 1999 to 2002. Using the models and taking into account the data for the current year, they predicted mortality in winter and population size in summer in the following year. The predictions turned out to be quite correct. The authors suggest use of the models in planning pest control strategy.

Section 8 includes only one paper on the diversity and specificity of parasitoids attacking Neotropical Cassidinae. The authors of this paper, Cuignet, Windsor, Reardon and Hance, point out that in spite of several remarkable defence devices among cassidines, they could collect 41 species of parasitoids from 47 Panamanian cassidine species. More than half the parasitoids belong to Eulophidae. Majority of the eulophids could be collected from a single host species, but a few were not so host specific.

Those who are interested in study of Chrysomelidae have reason to feel obliged to Prof. P. Jolivet of Paris, who along with equally-zealous colleagues has edited a series of collective books on biology of leaf beetles, providing a ready reference and guidance on current trends of research. The books are: *Biology of Chrysomelidae* (1988) (Editors: P. Jolivet, E. Petitpierre, & T.H. Hsiao), *Novel Aspects of the Biology of Chrysomelidae* (1994) (Editors: P. Jolivet, M.L. Cox, & E. Petitpierre), *Chrysomelidae Biology*, in 3 volumes (1996) (Editors: P. Jolivet, & M.L. Cox), *New Developments in the Biology of Chrysomelidae* (2004) (Editors: P. Jolivet, J.A. Santiago-Blay, & M. Schmitt), and now *Research on Chrysomelidae*, vol. 1 (2008), which is being reviewed here. *Research on Chrysomelidae*, vol. 2 is soon going to be in print.