

**Detlef Mader**

**Moon-Related Population Dynamics and Ecology  
of the Stag Beetle *Lucanus cervus*, Other Beetles,  
Butterflies, Dragonflies and Other Insects**

**Mondbezogene Populationsdynamik und Ökologie  
des Hirschkäfers *Lucanus cervus*, anderer Käfer,  
Schmetterlinge, Libellen und anderer Insekten**

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## **Abstracts of Articles**

After the timely publication of my book on population dynamics, ecology and conservation of the Stag Beetle *Lucanus cervus* LINNAEUS 1758 (Coleoptera: Lucanidae) in the region around Heidelberg and Mannheim in the southwestern part of Germany (MADER 2009) still before the beginning of the flight season of the most spectacular and best known beetle in the entomofauna of Middle Europe in spring 2009, a suite of additional data has been obtained by own observations, reports from friends of nature and review of the literature which have allowed the further elaboration and the enhanced assessment of various aspects of the biology of the Stag Beetle *Lucanus cervus*. The incorporation of the new results on ethology, ecology and phaenology of the Stag Beetle *Lucanus cervus* into revised and enlarged outlines of three chapters of my monograph has stimulated the edition of this volume as supplement and extension of my book. The new material has been integrated into extended and actualized evaluations of three sections of my compilation of the life history of the Stag Beetle *Lucanus cervus* which are presented in three articles in this volume. The three papers in this volume comprise summaries of long-term population dynamics, short-term population dynamics and swarming behaviour, and conservation measures of the Stag Beetle *Lucanus cervus*. This volume is published after the end of the flight season 2009 of the most spectacular and best known beetle in the entomofauna of Middle Europe, and is therefore available before the beginning of the flight season in spring 2010. The second article on the selenocyclical population dynamics of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects represents a considerable broadening of the spectrum of investigated species beyond the aspects which have been discussed in my book, and this significant widening of the suite of more than 500 evaluated species has resulted in the establishment of this issue as an additional volume to my book on the Stag Beetle *Lucanus cervus*.

### First Article

#### **Long-term population dynamics of the Stag Beetle *Lucanus cervus* (Coleoptera: Lucanidae) over up to 50 – 75 years**

#### **in the region around Heidelberg and Mannheim (Germany) : pp. 21 – 60**

The first article on the long-term population dynamics of the Stag Beetle *Lucanus cervus* over up to 50 – 75 years contains the evaluation of the reports of the observations of the Stag Beetle *Lucanus cervus* by more than 600 people at more than 225 localities in the region around Heidelberg and Mannheim in the southwestern part of Germany. The study area around Heidelberg and Mannheim extends for more than 100 km both from north to south and from west to east. Abt. 150 contributors have continuously observed the regular annual appearance of the Stag Beetle *Lucanus cervus* for periods of up to 50 – 75 years at their places of residence where they have been able to monitor its yearly occurrence in more or less constant quantity every year or in changing frequency with often a trend of diminution of the numbers of the individuals during the course of the years at abt. 75

localities, with the longest documentation reaching back to 1935. These long-term records of the regular annual appearance of the Stag Beetle *Lucanus cervus* for periods of up to three quarters of a century are unique data in the entomological literature. The long-term population dynamics of the Stag Beetle *Lucanus cervus* for periods of several decades or even more than half a century reflects the almost permanent stability of numerous established populations in the framework of various climatical and environmental changes. The analysis of the long-term population dynamics of the Stag Beetle *Lucanus cervus* for periods of up to 50 – 75 years has revealed that two different scenarios are developed. The first scenario comprises a more or less constant or randomly fluctuating quantity of observed individuals of the Stag Beetle *Lucanus cervus* per year where no trend of diminution of the number of registered individuals with time can be delineated. The second scenario includes the establishment of a pronounced trend of diminution of the quantity of observed individuals of the Stag Beetle *Lucanus cervus* with time. Although the numbers of individuals of the Stag Beetle *Lucanus cervus* appearing in the successive years are subjected to changes depending on various climatical and environmental influences, the fact that the populations continue to show up annually irrespectively of variations in frequency of individuals underlines the resistivity of the populations against external stress and the successful survival of the populations independently of the changing conditions of the surrounding framework. The long-term records of the regular yearly appearance of the Stag Beetle *Lucanus cervus* for periods of up to 50 – 75 years in the region around Heidelberg and Mannheim in the southwestern part of Germany by abt. 150 observers at abt. 75 localities in an areal extension of more than 100 km both from north to south and from west to east document the stability of the populations for several decades or even more than half a century and confirm the annual success of reproduction over the whole time span, thereby suggesting that under favourable conditions, the populations of the Stag Beetle *Lucanus cervus* have the chance to exist nearly permanently and to continue almost for ever like a perpetuum mobile.

## Second Article

### **Correlation of swarm phases of the Stag Beetle *Lucanus cervus*, other beetles, butterflies, dragonflies and other insects with the new moon and full moon phases of the lunar cycle : pp. 61 – 592**

The second article on the correlation of swarm phases of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects with the new moon and full moon phases of the lunar cycle includes the analysis of the short-term population dynamics of the Stag Beetle *Lucanus cervus* by the evaluation of the distribution of its peak activity during the period of appearance in the current year. The phaenological study has revealed that the culmination of the occurrence of the Stag Beetle *Lucanus cervus* takes place mainly on abt. 1 – 7 days when a pronounced swarming is established in the crepuscular period in the evening when predominantly abt. 10 – 20 or even abt. 20 – 30 individuals and subordinately abt. 5 – 10 individuals per day are flying and walking around, whereas before and after these swarm evenings, predominantly only abt. 1 – 2 or abt. 3 – 5 individuals and subordinately only abt. 5 – 10 individuals per day are walking and flying around during the period of appearance in the current year. The peak activity of the Stag Beetle *Lucanus cervus* with spectacular swarm evenings on abt. 1 – 7 days occurs often around the new moon or the full moon, thus suggesting that the breakout of the culmination of its activity and the development of extraordinary swarm evenings are frequently triggered by the turning points of the lunar cycle. The correlation of the peak activity of the Stag Beetle *Lucanus cervus* with the new moon at the end of the preceding lunar cycle or at the beginning of the following lunar cycle as well as with the full moon at the middle or central point of the lunar cycle has been documented at numerous localities based on own observations, personal communications and literature evaluation. Similarly as the peak activity of the Stag Beetle *Lucanus cervus* with spectacular swarm evenings occurs often around the new moon or the full moon, also the culmination of the appearance of individuals of other beetles, diurnal butterflies, nocturnal butterflies, dragonflies,

damselies and other insects is frequently related with the new moon or the full moon which is presented in a suite of examples of a broad spectrum of in total more than 500 species based on own observations and literature evaluation. The selenocyclical assessment of the short-term population dynamics of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects includes also the interpretation of the mechanisms triggering the correlation of swarm phases, mass flights and peak abundances with the new moon or the full moon. The turning points of the lunar cycle are often also significant breaks in weather character with frequently rapid changes from dry and warm periods to wet and cool periods or vice versa, and therefore particularly the changes from wet and cool periods to dry and warm periods around the new moon or the full moon could be the reasons for the triggering of the culmination of the activity with establishment of the peak numbers of individuals and development of pronounced swarm events or mass flights of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects. The significance of the correlation of swarm events or mass flights of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects with the new moon and full moon phases of the lunar cycle is also documented in the title of this volume on moon-related population dynamics and ecology of various insects. The selenocyclical assessment of the distribution of the frequency of occurrence of the Stag Beetle *Lucanus cervus*, other beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects and their connection with the new moon or the full moon has turned out to represent a fundamental advance in the understanding of the triggering of swarm phases, mass flights and peak abundances of insects, and it has been confirmed by several examples that the selenocyclical interpretation enhances also the understanding of mass growth of mushrooms and mass wandering of toads. The selenocyclical evaluation of the dates of observations of significant quantities of insects based on the review of the literature includes abt. 15 species of beetles, more than 100 species of diurnal butterflies, more than 300 species of nocturnal butterflies, abt. 30 species of dragonflies and abt. 20 species of damselflies.

### Third Article

#### **Schutzmaßnahmen für den Hirschkäfer *Lucanus cervus* in Garten, Streuobstwiese, Wald, Waldrand, Haus und Straße für alle Naturfreunde (Coleoptera: Lucanidae) : pp. 593 – 636**

The third article on conservation measures for the Stag Beetle *Lucanus cervus* in garden, orchard, forest, forest margin, house and street for all friends of nature focusses on various simple possibilities of support and assistance in the successful performance of its life cycle. The Stag Beetle *Lucanus cervus* is since long time in Germany and in other countries of Europe under rigorous nature protection which has been further restricted in the European Union in the last years. During the course of my study of population dynamics and ecology of the Stag Beetle *Lucanus cervus* in the region around Heidelberg and Mannheim in the southwestern part of Germany, I have developed a suite of simple conservation measures which could be executed by every friend of nature without problems in garden, orchard, forest, forest margin, house and street. These simple conservation measures could lead to a significant improvement of the conditions of life and reproduction of the Stag Beetle *Lucanus cervus*, and therefore as many friends of nature as possible should participate consequently in their application. The proposed conservation measures for the Stag Beetle *Lucanus cervus* include the transit service at streets and roads at the forest margin, the temporary closure of streets and roads at the forest margin for the traffic, the turnaround of males and females which are found lying on their back, the accumulation of compost heaps and dead wood piles with sufficient deposit time in gardens and orchards; the maintenance of natural tree stumps and the installation of artificial tree stumps in gardens, orchards and forests; the construction of stag beetle pyramids, piles and cradles; the installation of stag beetle pavements, the delineation of forest regions with restricted or prohibited cultivation, the supply of sap runs on trees in gardens and orchards, the planting

and cultivation of cherry trees in gardens and orchards, the cover and control of water containers in gardens, the inspection of lawns before mowing, the multiplication by sensitization of other friends of nature, the regular reporting of observations for central evaluation, and the engagement against actions of chemical destruction of populations of the Cockchafer *Melolontha*. The significance of the consequent execution of the proposed conservation measures for the Stag Beetle *Lucanus cervus* is particularly underlined by the fact that every single female which can be protected from premature non-natural mortality and which can find suitable substrates for the deposition of its eggs without problems is able for itself alone to found and to secure the persistence of the corresponding population in the next generation. Every single friend of nature who participates in the application of the suggested conservation measures for the Stag Beetle *Lucanus cervus* contributes with his help to achieve the aims of the fauna-flora-habitat-directive of the European Union in an extent as wide as possible and to secure the pronounced position of the Stag Beetle *Lucanus cervus* in the entomofauna of Middle Europe permanently.

## **Alphabetical index of Latin names of investigated insects**

The various beetles, diurnal butterflies, nocturnal butterflies, dragonflies, damselflies and other insects which are incorporated into the interpretation of the relationships of swarm phases, mass flights and peak occurrences with the new moon and full moon phases of the lunar cycle are listed in an alphabetical index of Latin names. The selenocyclical evaluation of the dates of observations of significant quantities of insects based on the review of the literature includes abt. 15 species of beetles, more than 100 species of diurnal butterflies, more than 300 species of nocturnal butterflies, abt. 30 species of dragonflies and abt. 20 species of damselflies. The different mushrooms which are analyzed concerning the relationships of mass growth with the new moon and full moon phases of the lunar cycle in comparison with the various insects are also compiled.

### **Reference**

MADER, D. (2009a): Populationsdynamik, Ökologie und Schutz des Hirschkäfers (*Lucanus cervus*) im Raum um Heidelberg und Mannheim. 418 pp.; Regionalkultur, Ubstadt-Weiher. ISBN 978-3-89735-594-1. Hardcover, 49 €. Order Address: dr.detlef.mader@web.de.