INSECTA MUNDI

A Journal of World Insect Systematics

0111

Observations on the biology of the South African checkered beetle *Aphelochroa sanguinalis* (Westwood) (Coleoptera: Cleridae)

Jonathan R. Mawdsley
Research Associate
Department of Entomology, MRC 187
National Museum of Natural History
Smithsonian Institution
P. O. Box 37012
Washington, DC 20013-7012 USA

Hendrik Sithole
Research Manager: Invertebrates
Kruger National Park
Private Bag X402
Skukuza 1350 SOUTH AFRICA

Date of Issue: January 22, 2010

CENTER FOR SYSTEMATIC ENTOMOLOGY, INC., Gainesville, FL

Jonathan R. Mawdsley and Hendrik Sithole
Observations on the biology of the South African checkered beetle *Aphelochroa sanguinalis* (Westwood) (Coleoptera: Cleridae)
Insecta Mundi 0111: 1-6

Published in 2010 by
Center for Systematic Entomology, Inc.
P. O. Box 141874
Gainesville, FL 32614-1874 U. S. A.
http://www.centerforsystematicentomology.org/

Insecta Mundi is a journal primarily devoted to insect systematics, but articles can be published on any non-marine arthropod taxon. Manuscripts considered for publication include, but are not limited to, systematic or taxonomic studies, revisions, nomenclatural changes, faunal studies, book reviews, phylogenetic analyses, biological or behavioral studies, etc. **Insecta Mundi** is widely distributed, and referenced or abstracted by several sources including the Zoological Record, CAB Abstracts, etc.

As of 2007, **Insecta Mundi** is published irregularly throughout the year, not as quarterly issues. As manuscripts are completed they are published and given an individual number. Manuscripts must be peer reviewed prior to submission, after which they are again reviewed by the editorial board to insure quality. One author of each submitted manuscript must be a current member of the Center for Systematic Entomology.

Printed copies deposited in libraries of:
CSIRO, Canberra, ACT, Australia
Museu de Zoologia, São Paulo, Brazil
Agriculture and Agrifood Canada, Ottawa, Ontario, Canada
The Natural History Museum, London, England
Muzeum i Instytut Zoologii Pan, Warsaw, Poland
National Taiwan University, Taipei, Taiwan
California Academy of Sciences, San Francisco, CA, USA
Florida Department of Agriculture and Consumer Services, Gainesville, FL, USA
Field Museum of Natural History, Chicago, IL, USA
National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

Electronic copies in PDF format:
Printed CD mailed to all members at end of year.
Florida Center for Library Automation: http://purl.fcla.edu/fcla/insectamundi
University of Nebraska-Lincoln, Digital Commons: http://digitalcommons.unl.edu/insectamundi/

Author instructions available on the Insecta Mundi page at:
http://www.centerforsystematicentomology.org/insectamundi/

Printed Copy ISSN 0749-6737
On-Line ISSN 1942-1354
CD-ROM ISSN 1942-1362

INSECTA MUNDI 0111: 1-6 2010

Observations on the biology of the South African checkered beetle *Aphelochroa sanguinalis* (Westwood) (Coleoptera: Cleridae)

Jonathan R. Mawdsley
Research Associate
Department of Entomology, MRC 187
National Museum of Natural History
Smithsonian Institution
P. O. Box 37012
Washington, DC 20013-7012 USA
mawdsley@heinzctr.org

Hendrik Sithole
Research Manager: Invertebrates
Kruger National Park
Private Bag X402
Skukuza 1350 SOUTH AFRICA
HendrikS@sanparks.org

Abstract. The checkered beetle *Aphelochroa sanguinalis* (Westwood) (Coleoptera: Cleridae) is found in savanna and woodland ecosystems of southern and eastern Africa. During surveys for insect floral visitors in the Skukuza Ranger District of Kruger National Park, South Africa, we encountered adults of *Aphelochroa sanguinalis* on flowers of two tree species, *Acacia grandicornuta* Gerstner and *Acacia tortilis* (Forsskal) Hayne (Fabaceae). These two tree species flower in the early rainy season (November-December) and have small white flowers in small round ball-shaped clusters. Adults of *Aphelochroa sanguinalis* were not found on flowers of 14 other tree species with different floral structures which were flowering at the same time as *Acacia grandicornuta* and *Acacia tortilis*. Predatory, reproductive, and defensive behaviors (including the presence of a chemical defense) are described for *Aphelochroa sanguinalis* based on field and laboratory observations.

Introduction

The checkered beetle genus *Aphelochroa* Quedenfeldt (Coleoptera: Cleridae) contains seven species which are widely distributed throughout sub-Saharan Africa (Mawdsley 1994). This genus was revised by Mawdsley (1994) based on specimens from major museum collections in Europe and USA. In that study, a single species of *Aphelochroa*, *Aphelochroa sanguinalis* (Westwood 1852), was recorded from South Africa, based on museum specimens that had been collected in present-day KwaZulu-Natal and in Kruger National Park (Mawdsley 1994).

In 2007 and 2008, we encountered adults of *Aphelochroa sanguinalis* (Figure 1, 2) while conducting studies of the diversity and abundance of insect floral visitors in the Skukuza Ranger District of Kruger National Park (Figure 3; see Mawdsley and Sithole 2009 for further information about this study). The original intent of this project was to study the behavior and pollination ecology of species of the beetle family Melyridae associated with flowers (Mawdsley 2007). However, melyrid beetles proved to be less abundant on flowers in this area than beetles of other families, particularly Scarabaeidae, Buprestidae, and Cleridae (Mawdsley and Sithole 2009). The ecological interactions of floricolous Scarabaeidae and Buprestidae in southern Africa have been discussed by Holm and Marais (1992), Goldblatt et al. (1998; 2000; 2009), Gussmann (2002), and Gussmann and Holm (2004). In contrast, very little is known about the biology of southern African species of Cleridae (Bellamy 1985; Löyttyniemi and Löyttyniemi 1993). Species of Cleridae elsewhere in the world are important predators of forest insect pests (Balduf 1935; Corporaal 1950; Baker 1972; Coulson and Witter 1984) and floricolous clerids may also be important pollinators of flowering plant species (Stout et al. 2002; Mawdsley 2004; Smith-Ramirez et al. 2005; African Pollinator Initiative 2007). Given the lack of knowledge of the biology of African beetles in the family Cleridae, we decided to conduct field and laboratory observations on adults of *Aphelochroa sanguinalis*.

Materials and Methods

Our observations of *Aphelochroa sanguinalis* formed part of a larger study examining the diversity and abundance of insect floral visitors in the Skukuza Ranger District, Kruger National Park, South Africa (for more details about sampling, see Mawdsley and Sithole 2009). During this study, field teams sampled 4,280 insects from flowers of 196 trees and shrubs representing 16 flowering plant species from the families Combretaceae (*Combretum hereroense* Schinz*, Combretum zeyheri* Sonder), Ebenaceae (*Euclea divonorum* Hiern), Euphorbiaceae (*Flueggea virosa* (Roxburgh) Baillon), Fabaceae (*Acacia exuvialis* Verdcourt, *Acacia grandicornuta* Gerstner, *Acacia nigrescens* Oliver*, Acacia nilotica* (L.) Willdenow*, Acacia tortilis* (Forsskal) Hayne*, Cassia abbreviata* Oliver*, Dichrostachys cinerea* Miquel*, Peltophorum africanum* Sonder), and Tiliaceae (*Grewia bicolor* Jussieu*, Grewia flava* De Candolle*, Grewia flavescens* Jussieu, and *Grewia monticola* Sonder).

Results

Twenty-one adults of *Aphelochroa sanguinalis* were observed in the field. Five adults were captured alive and kept in the research facilities at Skukuza and Shingwedzi in Kruger National Park. Voucher specimens from this study are deposited in the Kruger National Park Research Collection at Skukuza, South Africa, and in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

Seasonality. Adults of *Aphelochroa sanguinalis* were collected from mid-November to early December, an activity period which corresponds with the start of the rainy season in the Skukuza Ranger District (Gertenbach 1980) and also corresponds with the flowering period of the associated tree species *Acacia grandicornuta* and *Acacia tortilis* (Schmidt et al. 2003). A single individual of *Acacia grandicornuta* was observed flowering in late dry season conditions in September, 2006; no adults of *Aphelochroa sanguinalis* were found on this tree.

Associated Tree Species. Adults of *Aphelochroa sanguinalis* were collected on flowers of *Acacia grandicornuta* (1 individual tree) and *Acacia tortilis* (5 individual trees) along the main H11 highway in the Skukuza Ranger District, Kruger National Park (Figure 3). Adults were not observed on flowers of 14 other tree or shrub species (listed above) which were flowering in this district at the same time as *Acacia grandicornuta* and *Acacia tortilis*. Of the 16 plant species included in this study, *Acacia grandicornuta* and *Acacia tortilis* are the only species with white flowers in small round ball-shaped clusters (Figure 2; Schmidt et al. 2003). Other species of *Acacia* flowering at the same time as *Acacia grandicornuta* and *Acacia tortilis* have different floral structures: elongate terminal clusters of small white flowers (*Acacia nigrescens*), and small round ball-shaped clusters of small yellow flowers (*Acacia exuvialis*, *Acacia nilotica*). The floral structures of the eleven other tree and shrub taxa flowering in the study area differ even more significantly from that of the *Acacia* species, with larger floral parts and/or different coloration (Schmidt et al. 2003).

Activity. Adults of *Aphelochroa sanguinalis* were observed walking on flowers, stems, leaves, and branches of *Acacia grandicornuta* and *Acacia tortilis* (Figure 1, 2). Although occasionally encountered on other parts of the plant such as stems and leaves, adults of *Aphelochroa sanguinalis* were found mainly on flowers and flower clusters.

Prey Detection. As in other Cleridae (Zhou et al. 2001), olfactory cues appear to be used by *Aphelochroa sanguinalis* to detect prey. In captivity, the adult beetles were observed vibrating their antennae rapidly in the presence of small Coleoptera, prior to the commencement of feeding behavior.

Prey. Adults of *Aphelochroa sanguinalis* appear to be generalist predators. Our captive adults fed on a wide range of small Coleoptera, including adults of species of Bruchidae, Cerambycidae, Dermestidae, Elateridae, Scarabaeidae, and Tenebrionidae. Adults of Tenthredinidae (Hymenoptera) were also consumed. All of the taxa consumed were collected on flowers of *Acacia* spp. and are representative of the insect fauna that the beetles would encounter while foraging on flowers. In addition to live insects, adults of *Aphelochroa sanguinalis* also drank water, sugar water, and honey while in captivity, suggesting that they may feed on nectar as well as other insects.

Feeding Behavior. The feeding behavior in *Aphelochroa sanguinalis* is similar to that described by Ekis (1977) for other Cleridae. The prey item is seized by the clerid using the first two pairs of legs and

Figure 1-2. Adults of *Aphelochroa sanguinalis* (Westwood) (Coleoptera: Cleridae) on *Acacia tortilis* (Forsskal) Hayne (Fabaceae) in Kruger National Park, South Africa. **1)** Male on foliage. **2)** Female on flowers.

manipulated so that the clerid's mandibles can be applied to the prothoracic-mesothoracic suture. This suture is opened by mandibular pressure and the contents of the prothorax are then consumed. The elytra and metathoracic wings are removed by the clerid's mandibles, and the meso- and meta-thoracic and abdominal contents are consumed by biting through the meso- and meta-thoracic and abdominal tergites. As the clerid finishes feeding on each body section, the hard portions of the exoskeleton are discarded.

Nocturnal Activity. Adults of *Aphelochroa sanguinalis* were attracted to fluorescent and incandescent light bulbs at night in the Skukuza Research Camp, Kruger National Park. The adult beetles were observed flying around exposed light bulbs and walking on the walls of buildings adjacent to the lights.

Reproductive Behavior. Amplexus (sensu Knisley and Schultz 1997) and copulation of *Aphelochroa sanguinalis* were observed on flowers of *Acacia grandicornuta* and *Acacia tortilis*. Males remained in the amplexus position following copulation, a behavior which has been interpreted as a possible example of "mate guarding" in other beetle taxa (Knisley and Schultz 1997). Gravid females of *Aphelochroa sanguinalis* were also observed on and near flowers, suggesting that oviposition by female *Aphelochroa sanguinalis* may occur on or near the tree species where the adults are found.

Defensive Behavior. Adults of *Aphelochroa sanguinalis* exhibited two defensive behaviors. The first behavior is to pull in all of the appendages close to the body and drop to the ground. This behavior occurs when the beetles are approached closely by a human observer or when the part of the plant on which the beetles are located is disturbed. The adult beetles remain motionless on the ground for some time and can be very hard to locate, especially if they fall into tall grass or leaf litter. The second behavior is to emit a foul-smelling chemical compound (see next section). This behavior occurs when the beetle is physically captured and handled.

Chemical Defense. The presence of a chemical defense in species of *Aphelochroa* was first noted by Marshall and Poulton (1902), who reported that adults of the Zimbabwean species *Aphelochroa fulva* Kraatz emitted a strong "verbena-like" odor. A similar pungent odor was emitted by adults of *Aphelochroa sanguinalis* when they were first captured and handled. Further investigations are needed to identify the specific chemical compounds that are involved in this chemical defense.

Predation. We found elytra of *Aphelochroa sanguinalis* in the web of an unidentified spider on *Acacia tortilis*, indicating that some predators are undeterred by the chemical defense of the beetles. We did not observe vertebrate predation on *Aphelochroa sanguinalis*.

Pollen Transport. We observed small amounts of pollen adhering to the bodies of adults of *Aphelochroa sanguinalis* collected on *Acacia tortilis* and *Acacia grandicornuta*. These two species of *Acacia* appear to

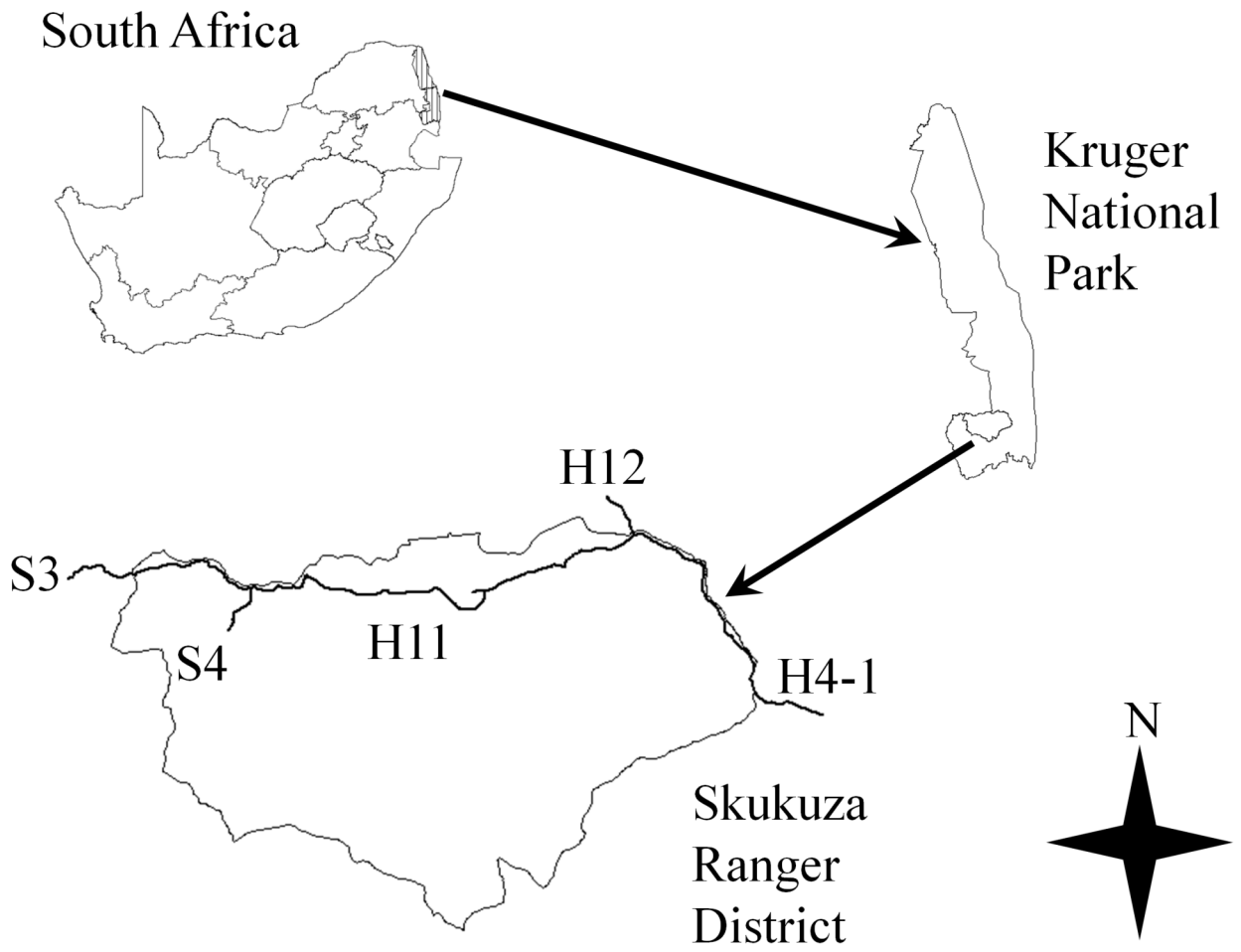

Figure 3. Location of the Skukuza Ranger District within Kruger National Park and South Africa, showing roads where sampling was conducted.

have generalist pollination systems (Mawdsley and Sithole 2009) and thus it is possible that *Aphelochroa sanguinalis* may serve as a pollinator of these tree species. However, this beetle is likely to be less significant as a pollinator than other insect visitors which are more abundant, carry larger pollen loads, and move more frequently between flowers. For *Acacia grandicornuta* and *Acacia tortilis*, these other pollinators include social and solitary bees (Hymenoptera: Apidae and Halictidae) as well as scarab beetles (Coleoptera: Scarabaeidae) (Mawdsley and Sithole 2009).

Acknowledgments

We thank Dr. F. Venter of South African National Parks for formal approval of our studies of beetle pollinators in Kruger National Park, South Africa. For field assistance, we thank V. Ndlovu, J. Baloyi, and O. Sithole of Kruger National Park, as well as A. S. and R. D. Mawdsley of Cleveland State University. For assistance with the identification of trees and shrubs in the field, we thank V. Ndlovu and J. Baloyi. We are especially grateful to A. S. Mawdsley for her assistance with the photography for this project. For comments on the manuscript, we thank Dr. D. G. Furth and Dr. C. L. Staines from the National Museum of Natural History, Smithsonian Institution, for their helpful suggestions and careful review.

Literature Cited

African Pollinator Initiative. 2007. Crops, browse and pollinators in Africa: an initial stock-taking. Food and Agriculture Organization of the United Nations (FAO); Rome. 55 p.

Baker, W. L. 1972. Eastern forest insects. U.S. Department of Agriculture Forest Service, Washington, D.C., Miscellaneous Publication 1175: 1-642.

Balduf, W. V. 1935. The bionomics of entomophagous Coleoptera. J. S. Swift Co.; St. Louis, Missouri. 220 p.

Bellamy, C. L. 1985. Cleroidea. p. 237-241. *In*: C. H. Scholtz and Holm, E. (eds.). Insects of Southern Africa. Butterworths; Durban, South Africa. 502 p.

Corporaal, J. B. 1950. Coleopterorum catalogus supplementa, pars 23 editio secunda, Cleridae. W. Junk; The Hague, Netherlands. 373 p.

Coulson, R. N., and J. A. Witter. 1984. Forest entomology: Ecology and management. John Wiley and Sons; New York. 684 p.

Ekis, G. 1977. Classification, phylogeny, and zoogeography of the genus *Perilypus* (Coleoptera: Cleridae). Smithsonian Contributions to Zoology 227: i-iv + 1-138.

Gertenbach, W. P. D. 1980. Rainfall patterns in the Kruger National Park. Koedoe 25:35-43.

Goldblatt, P., P. Bernhardt, and J. Manning. 1998. Pollination of petaloid geophytes by monkey beetles (Scarabaeidae; Rutelinae: Hoplini) in southern Africa. Annals of the Missouri Botanical Garden 85: 214-230.

Goldblatt, P., P. Bernhardt, and J. Manning. 2009. Adaptive radiation of the putrid perianth: *Ferraria* (Iridaceae: Irideae) and its unusual pollinators. Plant Systematics and Evolution 278: 53-65.

Goldblatt, P., J. Manning, and P. Bernhardt. 2000. Adaptive radiation of pollination mechanisms in *Sparaxis* (Iridaceae: Ixioideae). Adansonia, series 3, 22(1): 57-70.

Gussmann, S. V. M. 2002. Revision of the genus *Agelia* Laporte & Gory (Coleoptera: Buprestidae). Annals of the Transvaal Museum 39: 23-55.

Gussmann, S., and E. Holm. 2004. The African jewel beetles (Buprestidae: Julodinae). Taita Publishers; Hradec Králové, Czech Republic. 397 p.

Holm, E., and E. Marais. 1992. Fruit chafers of southern Africa (Scarabaeidae: Cetoniini). Ekogilde; Hartebeespoort, South Africa. 326 p. + 32 pl.

Knisley, C. B., and T. D. Schultz. 1997. The biology of tiger beetles and a guide to the species of the south Atlantic States. Virginia Museum of Natural History; Martinsville, Virginia. 210 p.

Löyttyniemi, K., and R. Löyttyniemi. 1993. Cleridae (Coleoptera) from Miombo woodland in Zambia. Entomologica Fennica 4(4): 223-224.

Marshall, G. A. K., and E. B. Poulton. 1902. Five years' observations and experiments (1896-1901) on the bionomics of South African insects, chiefly directed to the investigation of mimicry and warning colors. Transactions of the Entomological Society of London 1902: 287-584 + pl. 9-23.

Mawdsley, J. R. 1994. A revision of the genus *Aphelochroa* Quedenfeldt (Coleoptera: Cleridae: Clerinae). African Journal of Zoology 108: 121-132.

Mawdsley, J. R. 2004. Pollen transport by North American *Trichodes* Herbst (Coleoptera: Cleridae). Proceedings of the Entomological Society of Washington 106(1): 199-201.

Mawdsley, J. R. 2007. New records and notes on the ecology of African species of *Melyris* Fabricius (Coleoptera: Melyridae), with discussion of pollination biology. Proceedings of the Entomological Society of Washington 109(4): 960-962.

Mawdsley, J. R., and H. Sithole. 2009. Diversity and abundance of insect visitors to flowers of trees and shrubs in a South African savannah. African Journal of Ecology. Published online September 29, 2009. World Wide Web document at: http://www3.interscience.wiley.com/journal/122612161/abstract (accessed October 7, 2009).

Schmidt, E., M. Lotter, W. McCleland, S. Burrows, and J. E. Burrows. 2003. Trees and shrubs of Mpumalanga and the Kruger National Park: Names, common names, literature. Jacana Media; Johannesburg. 702 p.

Smith-Ramirez, C., P. Martinez, M. Nunez, C. Gonzalez, and J. J. Armesto. 2005. Diversity, flower visitation frequency and generalism of pollinators in temperate rain forests of Chiloé Island, Chile. Botanical Journal of the Linnaean Society 147(4): 399-416.

Stout, J. C., A. R. Kells, and D. Goulson. 2002. Pollination of the invasive exotic shrub *Lupinus arboreus* (Fabaceae) by introduced bees in Tasmania. Biological Conservation 106(3): 325-434.

Westwood, J. O. 1852. Descriptions of new species of Cleridae from Asia, Africa, and Australia. Proceedings of the Zoological Society of London 20: 34-55 + pl. 24-27.

Zhou, J., D. W. Ross, and C. G. Niwa. 2001. Kairomonal response of *Thanasimus undatulus*, *Enoclerus sphegeus* (Coleoptera: Cleridae), and *Temnochila chlorodia* (Coleoptera: Trogositidae) to bark beetle semiochemicals in eastern Oregon. Environmental Entomology 30(6): 993-998.

Received November 6, 2009; Accepted December 29, 2009.