



Documenting museum records of West African Coccinellidae (Coleoptera) in Benin and Senegal

Kwevitoukoui Hounkpati^{‡,§}, Joseph V. McHugh[‡], Abdoul Aziz Niang[‡], Georg Goergen[¶]

[‡] Department of Entomology, University of Georgia, Athens, United States of America

[§] Grain de Sel Togo, Inc., Athens, United States of America

[‡] Laboratoire de Zoologie des Invertébrés Terrestres, Institut Fondamental d'Afrique Noire Cheikh Anta Diop, Dakar, Senegal

[¶] International Institute of Tropical Agriculture, Cotonou, Benin

Corresponding author: Kwevitoukoui Hounkpati (bhounkpati@graindeseltogo.org)

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Abstract

Background

This work provides a preliminary inventory of West African Coccinellidae.

This was based on the West African Coccinellidae (WAC) specimens in the holdings of insect collections at the Laboratoire de Zoologie des Invertébrés Terrestres at the Institut Fondamental d'Afrique Noire Cheikh Anta Diop (IFAN), Senegal and the Biodiversity Center at the International Institute of Tropical Agriculture (IITAB), Benin.

New information

A total of 129 species representing 11 tribes and 40 genera is reported, including one species of the subfamily Microweiseinae and 128 species of the subfamily Coccinellinae. The geographic distribution of collection localities is presented for these species. *Cheilomenes lunata* (Fabricius, 1775), *Cheilomenes propinqua* (Mulsant, 1850), *Cheilomenes sulphurea* (Olivier, 1791), *Chnootriba elaterii* (Rossi, 1794), *Chnootriba similis* (Thunberg, 1781), *Exochomus laeviusculus* Weise, 1909, *Hyperaspis delicatula*

(Mulsant, 1850) and *Hyperaspis pumila* Mulsant, 1850 are the best represented species in these collections.

Keywords

Africa, Coccinelloidea, Coccinellinae, distribution, diversity, insect collection, inventory, Microweiseinae, taxonomy, museum, systematics, lady beetles, ladybugs.

Introduction

Natural history museums play a critical role in science and education (Gropp 2018, Holmes et al. 2016). They contribute fundamental data, necessary for understanding the biodiversity of Earth across temporal and geographic ranges. Biological information derived from specimen data provides essential information supporting a wide range of basic and applied biological endeavours. Museum specimens often play an important role in the recognition of threatened taxa, allowing the scientific community to propose appropriate action (e.g. Thomson et al. 2018, Mikula et al. 2018). Other activities that benefit from specimen-based biological information include the monitoring of environmental change, protecting public health and safety and enhancing agriculture, to name a few (Suarez and Tsutsui 2004).

In agriculture, biological collections can provide vitally important information about pest species, including phenology, food preferences, behaviour, ecological associations etc. (Escalona et al. 2017). For invasive species, museum data can help to identify the point of entry, the date of introduction, the rate of expansion and the native distributional range, which is where natural enemies (potential biocontrol agents) might be found.

The full benefits of natural history museums can only be realised if these collections are known and accessible to the public and scientific communities worldwide, thereby enabling cooperation between local and distant scientists to explore and advance our knowledge of global biodiversity. Unfortunately, access to biological collections is limited for researchers in some regions, like Africa. Much of the available museum material of African origin is housed in natural history museums or private collections in Europe (Klopper et al. 2002, Miller and Rogo 2001). There are some major African national or regional natural history museums. The majority of their holdings comprise subsets of material that was collected by missionaries, explorers and scientists from European institutions (Medler 1980, Scholtz and Mansell 2017). There are some natural history museums in West Africa, but these have remained overlooked by the research community.

Coccinellidae Latreille, 1807, commonly known as ladybugs, are small beetles ranging from 0.8 to 18 mm (Seago et al. 2011). Although some coccinellids are phytophagous or fungivorous (Ipert 1999), nearly 70% of species are considered predaceous, preying on aphids, mealybugs, scale insects, thrips, leaf hoppers, mites and other soft bodied insects (Giorgi et al. 2009, Riddick 2017, Shah and Khan 2014, Ślipiński and Tomaszewska 2010,

Szawaryn et al. 2015). One of the earliest and most successful examples of biocontrol was the management of cottony-cushion scale, *Icerya purchasi* Maskell, 1879, on citrus crops using the vedalia lady beetle, *Rodolia cardinalis* (Mulsant, 1850), in California during the 1890s.

Due to their economic importance, major regional taxonomic works have been published for the coccinellid faunas of North America, Europe, Palearctic Region, Russian Far East, other parts of the former USSR, Oriental region, Central Asia, Japan, Vietnam, China and Australia (e.g. Giorgi et al. 2009, Tomaszewska and Szawaryn 2013, Tomaszewska and Ślipiński 2013, Ślipiński et al. 2012). Unfortunately, nothing comparable exists for Africa. The identification of African lady beetles has been done almost exclusively by European entomologists and explorers (Medler 1980). As a result, valuable reference specimens and their associated collection data are often inaccessible to researchers and agencies in Africa (Scholtz and Mansell 2017).

Coccinellidae has been the focus of several recent phylogenetic studies as researchers attempt to understand the evolution of the group and to improve its classification (e.g. Escalona and Ślipiński 2012, Kobayashi et al. 2011, Nedved and Kovář 2012, Robertson et al. 2015, Seago et al. 2011, Tomaszewska and Szawaryn 2013, Tomaszewska and Ślipiński 2013, Ślipiński et al. 2012). Unfortunately, endemic African taxa are very poorly represented in these studies, probably because appropriate material was unavailable and because the state of taxonomy for those groups was not mature.

Although Africa is well known for its rich and charismatic vertebrate diversity, there is far less appreciation for the great diversity of other taxa there. It is estimated that 100,000 species of insects are currently known from the continent and conservative estimates put the total number of insect species there at about 600,000, yet few research collections of insects exist on the continent (Miller and Rogo 2001). While entomological research collections in some African countries (e.g. Algeria, Egypt, Ghana, Kenya, Libya, Malawi, Morocco, Mozambique, South Africa, Tanzania, Uganda and Zambia) have appeared for some time in registries of museums (e.g. Arnett et al. 1993, Evenhuis 2019), others remain virtually unknown to the outside world, especially those in French West African countries (*Afrique Occidentale Française*). This is true for the two largest reference collections of arthropods in West Africa, the Biodiversity Center at the International Institute of Tropical Agriculture (IITAB) in Benin and the Laboratoire de Zoologie des Invertébrés Terrestres at the Institut Fondamental d'Afrique Noire Cheikh Anta Diop (IFAN) in Senegal. These two important resources were absent from compilations of insect and spider collections of the world until just recently when they were added to a web-based listing of biological collections by Evenhuis (2019) following an enquiry by the senior author.

The Laboratoire de Zoologie des Invertébrés Terrestres (formerly Section Entomologie) was created in 1945 by André Villiers. It is housed in the Institut Fondamental d'Afrique Noire Cheikh Anta Diop (IFAN), Université Cheikh Anta Diop, Dakar in Senegal (Fig. 1a–b). The IFAN insect collection was established to serve as a centre for entomological collection-based research in West Africa. With over 400,000 specimens, the IFAN insect museum is the largest insect collection in West Africa. Dr. Abdoul Aziz Niang, a specialist of

Phlebotomine sandflies (Diptera: Psychodidae), is the current Curator and Director of the IFAN insect collection.



Figure 1. [doi](#)

Photos of the two largest West African insect museums: **a.** IFAN, outside view of the museum; **b.** IFAN, inside view of the museum showing insect boxes; **c.** IITAB, outside view of the museum; **d.** IITAB, inside view of the museum showing insect cabinets and drawers.

The International Institute of Tropical Agriculture (IITA) is a non-profit international research organisation founded in 1967. Headquartered in Ibadan, Nigeria, IITA is a member of the Consultative Group for International Agricultural Research. IITA has stations and hubs in Central, Eastern, Southern and West Africa (www.iita.org). The IITAB, IITA Biodiversity Center (formerly IITA insect centre or museum) is housed at the Benin Station of IITA in Calavi, Cotonou, Benin (Fig. 1c–d). With over 365,000 specimens, the IITAB collection is the second largest insect collection in West Africa. Dr. Georg Goergen, Entomologist and Biosystematist, is the current Curator and Director of the IITAB.

The taxonomic impediment, which affects biologists around the world, impacts West African researchers especially hard. Most African scientists must rely on distant experts for the identification of insect specimens. Africa produces far fewer trained insect taxonomists than any other continent in the world (de Carvalho et al. 2005). This gap in taxonomic knowledge has also limited the assessment of biodiversity in Africa (Coleman 2015). Currently, the Biodiversity Center of IITA, Benin (IITAB) is one of the major insect identification hubs in Africa.

The IFAN and IITA insect collections are the two largest in West Africa, a region situated between the Tropic of Cancer and Equator, covering 6,140,000 km², approximately one

fifth of Africa. More than 75% of the land consists of plains lying below an elevation of 300 m. The region includes 16 countries: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. Additionally, the United Nations recognises Saint Helena (a United Kingdom Overseas Territory), Ascension and Tristan da Cunha as part of West Africa (Comité Inter-états de Lutte contre la Sécheresse dans le Sahel 2016, Kabo-bah and Diji 2018) (Fig. 2).

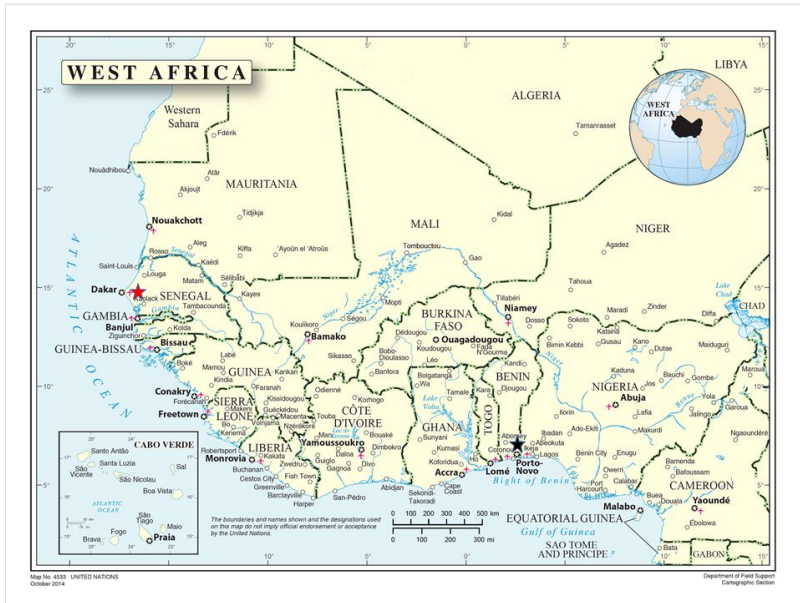


Figure 2. [doi](#)

Map of West Africa (United Nations 2014).

Given the importance of coccinellids and the patchy knowledge of their diversity in West Africa, we summarised data about the taxonomic holdings of this family in IFAN and IITAB insect collections with the goals of raising the visibility of those institutions and providing a preliminary inventory of West African Coccinellidae (WAC). This work represents part of ongoing research on the WAC by the senior author, who is currently developing a formal taxonomic catalogue of West African Coccinellidae.

Materials and methods

Museum specimens were studied at the IFAN and IITAB insect collections in West Africa. We photographed specimens and recorded label data (e.g. taxonomic determination, collection locality, collection date, associated plants, collector, determiner etc.).

The taxonomic names that were recorded on museum specimens were put in a database and updated to currently valid names using the systematics literature. Aberrations,

variations and subspecies were not included in the database except when museum specimens were identified as such. References are provided, when appropriate, to clarify the current classification for species. In some cases, specimen determinations were made (by KH) using the literature along with examination of reference collections of authoritatively identified material at the Musée Royal de l'Afrique Centrale (MRAC), Museum für Naturkunde der Humboldt-Universität (ZMHB), Museum of Comparative Zoology (MCZ), National Museum of Natural History (NMNH) and University of Georgia Collection of Arthropods (UGCA). Annotations are given when an invalid determination on a specimen label has been updated to the currently valid taxonomic name.

Many museums and institutions kindly assisted this study by hosting visits, providing data or initiating loans of specimens for this and related studies. These collections and institutions include the following:

CERAAS, Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse, Université Cheikh Anta Diop de Dakar, Senegal.

IFAN, Institut Fondamental d'Afrique Noire Cheikh Anta Diop, Dakar, Senegal.

IITAB, International Institute of Tropical Agriculture, Benin Station, Cotonou, Benin.

MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.

MRAC, Musée Royal de l'Afrique Centrale, Tervuren, Belgium.

NMNH, National Museum of Natural History (formerly USNM: United States National Museum), Washington D.C., U.S.A.

UCAD, Université Cheikh Anta Diop de Dakar, Dakar, Senegal.

UEM/IPD, Unité d'Entomologie Médicale, Institut Pasteur de Dakar, Dakar, Senegal.

UGA, University of Georgia, Athens GA, U.S.A.

UGCA, University of Georgia Collection of Arthropods, Georgia Museum of Natural History, Athens, GA, U.S.A.

ZMHB, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

Other abbreviations used in the text:

DRC, Democratic Republic of the Congo.

The updated specimen database was used to produce the first list of West African coccinellid diversity (Table 1) and to explore general characteristics about the museum holdings. Valid taxonomic names and tribal placement follow Seago et al. (2011). Generic and species names are arranged alphabetically. The lists of synonyms provided below valid names are not exhaustive, but instead include only junior synonyms that have been

used in literature regarding West African taxa or ones that appear on specimen determination labels in the focal collections.

Table 1.

Updated list of coccinellid holdings of the IFAN and IITAB collections, where: **a***: present at IFAN, but not from West African locality, **b***: present at IITAB, but not from West Africa locality, **a**: present at IFAN, West African source, **b**: present at IITAB, West African source and **ab**: in both museums. The current list is limited to specific rank only. Subspecies and aberrations are mentioned only if they were found on specimen determination labels.

Taxon	Collection localities	References
Family Coccinellidae Latreille, 1807		
Subfamily Microweiseinae Leng, 1920		
Tribe Serangiini Pope, 1962		
<i>Serangium kunowi</i> Weise, 1892*1	Zambia ^{b*}	Escalona and Ślipiński 2012
Subfamily Coccinellinae Latreille, 1807		
Tribe Chilocorini Mulsant, 1846		
<i>Brumoides foudrasii</i> (Mulsant, 1850) = <i>Exochomus foudrasii</i> Mulsant, 1850	Benin ^b , Gambia ^b , Guinea ^b , Nigeria ^b , Senegal ^a	Mader 1954
<i>Chilocorus distigma</i> (Klug, 1835)	Mozambique ^{b*} , Nigeria ^b , Senegal ^a	
<i>Chilocorus dorhni</i> Mulsant, 1850	Senegal ^a	
<i>Chilocorus schioedtei</i> Mulsant, 1850 = <i>Chilocorus discoideus</i> Crotch, 1874	Benin ^{ab} , Cameroon ^{a*} , Ghana ^{b*} , Guinea ^a , Nigeria ^b , Senegal ^a	Chazeau and Couturier 1985, Samways et al. 1999
<i>Chilocorus simoni</i> Sicard, 1907	South Africa ^{ab*}	
<i>Exochomus flavipes</i> (Thunberg, 1781)	Gabon ^b , Madagascar ^{b*} , Nigeria ^b , Senegal ^a	

Taxon	Collection localities	References
<i>Exochomus laeviusculus</i> Weise, 1909	Benin ^a , Côte d'Ivoire ^a , Guinea ^a , Mali ^a , Mauritania ^a , Senegal ^a , Togo ^a	
<i>Exochomus nigrifrons</i> Gerstäcker, 1871*2	Mali ^a , Senegal ^{ab}	Biranvand et al. 2017a, Łączyński and Tomaszewska 2012
= <i>Brumus nigrifrons</i> Gerstäcker, 1871		
= <i>Brumus fulviventris</i> Fairmaire, 1884		
= <i>Brumus trivittatus</i> Weise, 1891		
= <i>Brumus nigeriana</i> Korschefsky, 1938		
= <i>Brumus nigrifrons</i> <i>nigerianus</i> Korschefsky, 1938		
<i>Parexochomus nigripennis</i> (Erichson, 1843)	Mali ^a , Senegal ^a	Biranvand et al. 2017b, Li et al. 2016, Kovář 2007
= <i>Exochomus nigripennis</i> (Erichson, 1843)		
= <i>Exochomus</i> <i>nigromaculatus nigripennis</i> Crotch, 1874		
<i>Exochomus pulchellus</i> Gerstäcker, 1871	Gambia ^b , Niger ^a , Rwanda ^b , Senegal ^a	
<i>Exochomus troberti</i> Mulsant, 1850	Burkina Faso ^a , Nigeria ^b , Senegal ^a	Hodek et al. 2012, Mohamed et al. 2018, Kovář 2007
= <i>Exochomus flavipes</i> <i>troberti</i> Mulsant, 1850		
Tribe Coccidulini Mulsant, 1846		
= Scymnini Mulsant, 1846		
= Exoplectrini Crotch, 1874		
<i>Aulis annexa</i> Mulsant, 1850	Senegal ^a	
<i>Clitostethus flavotestaceus</i> Mader, 1955	Senegal ^a	

Taxon	Collection localities	References
<i>Nephus flavomaculatus</i> Fürsch, 1966	Benin ^b , Nigeria ^b	
<i>Nephus vetustus</i> Weise, 1915	Gabon ^b , Nigeria ^b	
<i>Nephus phenacoccophagus</i> Fürsch, 1987	Nigeria ^b	
<i>Nephus kamburovi</i> Fürsch, 1992	Malawi ^{b*}	
<i>Nephus oblongosignatus</i> Mulsant, 1850	Tanzania ^{b*}	
<i>Nephus ornatulus</i> Korschefsky, 1931	DRC ^{b*} , Ghana ^b , Nigeria ^b , Rwanda [*] , Senegal ^b , Sierra Leone ^b , Togo ^b	Fürsch 1966
= <i>Scymnus ornatulus</i> Korschefsky, 1931		
<i>Nephus sudanicus</i> Weise, 1925	Mauritania ^a	
<i>Scymnobioides bilucernarius</i> (Mulsant, 1850)	Mexico ^{b*}	Gordon and González 2002
= <i>Nephus bilucernarius</i> (Mulsant, 1850)		
<i>Scymnus canariensis</i> Wollaston, 1864	São Tome and Principe ^{a*} , Senegal ^a	
<i>Scymnus casstroemi</i> Mulsant, 1850	Guinea ^a , Senegal ^a	
<i>Scymnus gnavus</i> Weise, 1895	Guinea ^a	
<i>Scymnus kibonotensis</i> Weise, 1910	Côte d'Ivoire ^a , Guinea ^a , Nigeria ^b	
<i>Scymnus levailanti</i> Mulsant, 1850	Nigeria ^b , Malawi ^{b*}	
<i>Scymnus pruinosus</i> Weise, 1895	Zambia ^{b*}	
<i>Scymnus monroviae</i> Casey, 1899	Benin ^a , Côte d'Ivoire ^a , Guinea ^a , Niger ^a , Senegal ^a , Togo ^a	
<i>Scymnus nigrosellatus</i> Mader, 1950	Zambia ^{b*}	

Taxon	Collection localities	References
<i>Scymnus quadrivittatus</i> Mulsant, 1850	Nigeria ^b	
<i>Scymnus rubiginosus</i> Mader, 1950	Côte d'Ivoire ^a , Guinea ^a , Senegal ^a	
<i>Scymnus scapuliferus</i> Mulsant, 1850	Benin ^a , Côte d'Ivoire ^a , Guinea ^b , Nigeria ^b , Madagascar ^{b*} , Senegal ^a , Togo ^a	
<i>Scymnus schoutedeni</i> Mader, 1950	Senegal ^a	
<i>Scymnus senegalensis</i> Mader, 1955	Côte d'Ivoire ^a , Gambia ^a , Guinea ^a , Mali ^a , Mauritania ^a , São Tome and Principe ^a , Senegal ^a	
<i>Scymnus villiersi</i> Mader, 1955	Niger ^a , Senegal ^a	
<i>Stethorus aethiops</i> Weise, 1899	Benin ^b , Ghana ^b , Guinea-Bissau ^b , Mozambique ^{b*} , Nigeria ^b , Sierra Leone ^b , Tanzania ^{b*}	
<i>Stethorus endroedyi</i> Fürsch, 1970	Malawi ^{b*}	
<i>Stethorus jejunos</i> Casey, 1899	Ghana ^b , Nigeria ^b , Mozambique ^{b*} , Tanzania ^{b*}	
Tribe Coccinellini Latreille, 1807		
<i>Adalia bipunctata</i> (Linnaeus, 1758)	Cameroon ^{a*}	
<i>Anisolemnia decempustulata</i> Weise, 1888	Togo ^a	Chazeau and Couturier 1985, Mader 1954
= <i>Anisolemnia 10-pustulata</i> Weise, 1888		
<i>Bulaea anceps</i> (Mulsant, 1850)	Mozambique ^{b*}	Fürsch 2005
= <i>Isora circularis</i> Mader, 1941		
<i>Caria welwitschii</i> Crotch, 1874	Guinea ^a	
<i>Cheilomenes aurora</i> Gerstäcker 1871	Tanzania ^{a*}	Fürsch 1975
= <i>Cydonia aurora</i> Gerstäcker, 1871		

Taxon	Collection localities	References
<p><i>Cheilomenes lunata</i> (Fabricius, 1775)</p> <p>= <i>Cydonia lunata</i> (Fabricius, 1775)</p> <p>= <i>Cydonia lunata vulpina</i> (Fabricius, 1798)</p> <p>= <i>Cydonia lunata vulpiphursa</i> Olivier, 1791</p>	<p>Benin^a, Burkina Faso^a, Cameroon^{a†}, Côte d'Ivoire^a, Gabon^{a†}, Gambia^a, Guinea^a, Guinea-Bissau^a, Liberia^a, Mali^a, Senegal^a, West Africa^a, South Africa^{a†}, Tanzania^{a†}</p>	<p>Fürsch 1991a</p>
<p><i>Cheilomenes sulphurea</i> (Olivier, 1791)</p> <p>= <i>Cheilomenes orbicularis</i> Casey, 1899</p> <p>= <i>Cheilomenes sulphurea sulphurea</i> (Olivier, 1791)</p>	<p>Angola^{b†}, Cameroon^{a†}, Côte d'Ivoire^a, Democratic Republic of Congo (DRC)^{b†}, Gabon^{b†}, Ghana^b, Nigeria^b, Malawi^{b†}, Rwanda^{b†}, Senegal^a</p>	<p>Eizaguirre 2007</p>
<p><i>Cheilomenes propinqua</i> (Mulsant, 1850)</p> <p>= <i>Cheilomenes vicina</i> (Mulsant, 1850)</p> <p>= <i>Cydonia vicina</i> Mulsant, 1850</p> <p>= <i>Cheilomenes vicina vicina</i> Mulsant, 1850</p> <p>= <i>Cheilomenes propinqua vicina</i> Mulsant, 1850</p>	<p>Côte d'Ivoire, Gabon^{b†}, Guinea-Bissau^{ab}, Mali^a, Mauritania^a, Niger^a, Nigeria^b, Senegal^{ab}</p>	<p>Eizaguirre 2007, Fürsch 1979</p>
<p><i>Cheilomenes quadrilineata</i> (Mulsant, 1850)</p> <p>= <i>Cydonia 4-lineata</i> Mulsant, 1850</p>	<p>Senegal^a</p>	
<p><i>Coccinella intermedia</i> (Crotch, 1874)</p> <p>= <i>Lioadalia intermedia</i> Crotch, 1874*3</p> <p>= "<i>Cydonia intermedia</i>" Cramer</p>	<p>São Tome and Principe^{a†}</p>	<p>Gordon 1987a, Nematollahi 2016</p>
<p><i>Coccinella septempunctata</i> Linnaeus, 1758</p>	<p>Cape Verde^a</p>	

Taxon	Collection localities	References
<i>Declivitata hamata</i> (Thunberg, 1808)	Senegal ^a	Fürsch 1987
= <i>Alesia hamata</i> (Mulsant, 1850)		
= <i>Micraspis striata</i> (Crotch, 1874)		
= <i>Alesia striata</i> (Gemminger & Harold, 1876)		
= <i>Alesia striata hamata</i> (Weise, 1898)		
= <i>Declivitata hamata</i> Fürsch, 1964		
<i>Declivitata uncifera</i> Fürsch, 1967	Cameroon ^a , DRC ^b , Guinea-Bissau ^p	
<i>Harmonia vigintiduomaculata</i> (Fabricius, 1792)	Benin ^b , Liberia ^a , Nigeria ^p , Togo ^b	Coutanceau 2008
= <i>Stictoleis vigintiduomaculata</i> (Fabricius, 1792)		
= <i>Stictoleis 22-maculata</i> (Fabricius, 1792)		
<i>Hippodamia variegata</i> (Goeze, 1777)	Colombia ^b , Nigeria ^b , Senegal ^b , Tanzania ^a *	GBIF Secretariat 2019, Gordon 1987b
= <i>Adonia variegata</i> (Goeze, 1777)		
<i>Lemnia machadoi</i> Mader, 1952	Cameroon ^a	Fürsch 2002
= <i>Dysis sicardi</i> Mader, 1954		
<i>Megalocaria dilatata</i> (Fabricius, 1775)	Benin ^b	Hodek et al. 2012, Poorani 2002
= <i>Anisolemnia dilatata</i> (Fabricius, 1775)		
<i>Micraspis lineola</i> (Fabricius, 1775)	Togo ^b	Nattier et al. 2015, Ślipiński 2007
= <i>Alesia lineola</i> (Fabricius, 1775)		

Taxon	Collection localities	References
<i>Micraspis striata</i> (Fabricius, 1792)	Côte d'Ivoire ^a , Gabon ^b , Guinea ^a , São Tome and Principe ^a , Senegal ^{a*}	Kovář 2007, Ślipiński 2007
= <i>Alesia striata</i> (Fabricius, 1792)		
<i>Psyllobora bisoconotata</i> (Mulsant, 1850)	Senegal ^a	Ali et al. 2018
<i>Psyllobora lutescens</i> (Crotch, 1874)	Guatemala ^{b*}	
<i>Psyllobora variegata</i> (Fabricius, 1781)	South Africa ^{a*}	Nicolas 2013
= <i>Thea variegata</i> (Fabricius, 1781)		
<i>Xanthadalia effusa</i> (Erichson, 1843)	Benin ^b , DRC ^a	
<i>Xanthadalia rufescens</i> Mulsant, 1850	Benin ^b , Mali ^a , Mauritania ^a , Senegal ^a	Fürsch 1987
Tribe Diomini Gordon, 1999		
<i>Diomus hennesseyi</i> Fürsch, 1987	Nigeria ^b	
Tribe Epilachnini Mulsant, 1846		
<i>Chnootriba elaterii</i> (Rossi, 1794)	Benin ^a , Côte d'Ivoire ^a , Gambia ^a , Guinea ^a , Liberia ^a , Mali ^a , Mauritania ^a , Nigeria ^b , São Tome and Principe ^{a*} , Senegal ^a	Hodek et al. 2012, Jadwiszczak and Węgrzynowicz 2003, Tomaszewska and Szawaryn 2016
= <i>Henosepilachna elaterii</i> (Rossi, 1794)		
= <i>Epilachna chrysomelina</i> (Fabricius, 1775)		
= <i>Epilachna chrysomelina manca</i> Mader, 1929		
= <i>Henosepilachna elaterii voltaensis senegalensis</i> Fürsch, 1964		
<i>Chnootriba hirta</i> (Thunberg, 1781)	Guinea ^a , Tanzania ^{a*}	Tomaszewska and Szawaryn 2016
= <i>Henosepilachna hirta</i> (Thunberg, 1781)		

Taxon	Collection localities	References
= <i>Epilachna hirta</i> (Thunberg, 1781)		
<i>Chnootriba similis</i> (Thunberg, 1781)	Benin ^a , Burkina Faso ^a , Côte d'Ivoire ^a , DRC ^{a*} , Guinea ^a , Liberia ^a , Nigeria ^b , Senegal ^a	Chazeau and Couturier 1985, Jadwiszczak and Węgrzynowicz 2003, Tomaszewska and Szawaryn 2016
= <i>Chnootriba assimilis</i> Mulsant, 1850		
= <i>Chnootriba similis</i> ab. repanda Sicard, 1930		
<i>Cleta punctipennis</i> (Mulsant, 1850)	Togo ^{ab}	Tomaszewska and Szawaryn 2016
= <i>Epilachna punctipennis</i> Mulsant, 1850		
<i>Cleta sahlbergi</i> (Mulsant, 1850)	Côte d'Ivoire ^a , Kenya ^{a*}	Szawaryn et al. 2015, Tomaszewska and Szawaryn 2016
= <i>Solanophila sahlbergi</i> Mulsant, 1850		
<i>Epilachna bissexguttata</i> Weise, 1895	Côte d'Ivoire ^a , DRC ^{a*} , Mali ^a , Niger ^a , Senegal ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna monticola</i> Weise, 1899		
= <i>Solanophila monticola</i> Weise, 1898		
<i>Epilachna bomparti</i> Mulsant, 1850	Liberia ^a , Senegal ^a	
<i>Epilachna colorata</i> Mulsant, 1850	Cameroon ^{a*} , Liberia ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna subsignata</i> Mulsant, 1895		
= <i>Solanophila subsignata</i> Mulsant, 1895		
= <i>Solanophila elliptica</i> Weise, 1912		
<i>Epilachna iocosa</i> (Mader, 1941)	South Africa ^{a*}	Jadwiszczak and Węgrzynowicz 2003
= <i>Solanophila 20-punctata</i> Mader, 1941		

Taxon	Collection localities	References
<i>Epilachna nigratarsis</i> Mulsant, 1850	Cameroon ^a , Liberia ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna impatiens</i> Fürsch, 1960		
<i>Epilachna vigintipunctata</i> Mulsant, 1850	Liberia ^a , Tanzania ^a , Togo ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna punctipennis multinotata</i> Gerstäcker, 1873	Equatorial Guinea ^a , Senegal ^a	
<i>Henosepilachna atropos</i> (Sicard, 1912)	Equatorial Guinea ^a , Senegal ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna atropos</i> Sicard, 1912	Tanzania ^a	
<i>Henosepilachna bisseptemnotata</i> (Mulsant, 1853)	Tanzania ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna bisseptemnotata</i> Mulsant, 1853	Benin ^a	
<i>Henosepilachna clavareai</i> (Weise, 1901)	Benin ^a	Fürsch 1991b
= <i>Epilachna clavareai</i> Weise, 1901	Côte d'Ivoire ^a , Liberia ^a	
<i>Henosepilachna ertli</i> (Weise, 1906)	Côte d'Ivoire ^a , Liberia ^a	Jadwiszczak and Węgrzynowicz 2003
= <i>Epilachna ertli</i> Weise, 1906	Côte d'Ivoire ^a	
<i>Henosepilachna fulvosignata</i> (Reiche, 1847)	Equatorial Guinea ^a	Jadwiszczak and Węgrzynowicz 2003
<i>Henosepilachna moseri</i> (Weise, 1903)	Equatorial Guinea ^a	
= <i>Epilachna moseri</i> Weise, 1903	Benin ^b , Mali ^a , Niger ^b , Nigeria ^b , Senegal ^a	Jadwiszczak and Węgrzynowicz 2003, Heinrichs and Barrion 2004
<i>Henosepilachna reticulata</i> (Olivier 1791)	Benin ^b , Mali ^a , Niger ^b , Nigeria ^b , Senegal ^a	
= <i>Epilachna reticulata</i> (Olivier 1791)	Liberia ^a	Jadwiszczak and Węgrzynowicz 2003
<i>Henosepilachna simplex</i> (Weise, 1895)	Liberia ^a	

Taxon	Collection localities	References
= <i>Epilachna simplex</i> Weise, 1895		
<i>Solanophila canina</i> (Fabricius, 1781)	Guinea ^a	
<i>Solanophila dregei</i> (Mulsant, 1850)	Côte d'Ivoire ^a	Tomaszewska and Szawaryn 2016
= <i>Epilachna dregei</i> Mulsant, 1850		
<i>Solanophila scalaris</i> (Gerstäcker, 1871)	Tanzania ^{a*}	Mader 1941
= <i>Epilachna scalaris</i> (Gerstäcker, 1871)		
Tribe Hyperaspini Mulsant, 1846		
<i>Hyperaspis aestimabilis</i> Mader, 1955	Angola ^{b*} , DRC ^{b*} , Malawi ^{b*} , Zambia ^{b*}	
<i>Hyperaspis centralis</i> Mulsant, 1850	Mexico	
<i>Hyperaspis delicatula</i> (Mulsant, 1850)	Benin ^b , Gambia ^b , Ghana ^b , Guinea-Bissau ^b , Nigeria ^b , Malawi ^{b*} , Sénégal ^b , Sierra Leone ^b , Togo ^b	
<i>Hyperaspis lugubris</i> (Randall, 1838)	Ghana ^b , Nigeria ^b	Gordon 1985
= <i>Hyperaspis jucunda</i> LeConte, 1852		
<i>Hyperaspis maindroni</i> (Sicard, 1929)	Mauritania ^a , Niger ^a , Senegal ^a	Biranvand et al. 2017b, Ali et al. 2018
<i>Hyperaspis merckii</i> (Mulsant, 1850)	Mauritania ^a , Senegal ^a	
<i>Hyperaspis pumila</i> Mulsant, 1850	Gambia ^b , Guinea ^b , Guinea-Bissau ^b , Niger ^a , Nigeria ^b , Senegal ^b , Togo ^b	Biranvand et al. 2017b
<i>Hyperaspis senegalensis</i> (Mulsant, 1850)	Gambia ^b , Ghana ^b , Nigeria ^b , Senegal ^b , Sierra Leone ^b , Malawi ^{b*}	
<i>Hyperaspis sericea</i> Fürsch, 1972	Malawi ^{b*}	

Taxon	Collection localities	References
<i>Hyperaspis vinciguerra</i> Capra, 1929	Gambia ^b , Senegal ^b , Malawi ^{b*}	
<i>Tenuisvalvae notata</i> (Mulsant, 1850)	Benin ^b , Bolivia ^{b*} , Nigeria ^b	Gordon and Canepari 2008
= <i>Hyperaspis notata</i> Crotch, 1874)		
Tribe Ortaliini Mulsant, 1850		
<i>Ortalia ovulum</i> Weise, 1898	Liberia ^a , Mali ^a , Togo ^b	
Tribe Noviini Mulsant, 1846		
<i>Rodolia cardinalis</i> (Mulsant, 1850)	Kenya ^{b*}	
<i>Rodolia iceryae</i> Janson in Ormerod, 1887	Senegal ^a	Hounkpati et al. 2019
= <i>Rodolia iceryae</i> Janson, 1887		
= <i>Rodolia obscura</i> Weise, 1898		
<i>Rodolia occidentalis</i> Weise, 1898	Benin ^a , Ghana ^a , Nigeria ^a , Senegal ^{ab}	
<i>Rodolia senegalensis</i> Weise, 1913	Senegal ^a	
Tribe Platynaspini Mulsant, 1846		
<i>Platynaspis capicola</i> Crotch, 1874	DRC ^{b*} , Malawi ^{b*}	
<i>Platynaspis ferruginea</i> Weise, 1895	Benin ^b , Togo ^b	
<i>Platynaspis kollari</i> Mulsant, 1850	Liberia ^a	
<i>Platynaspis obscura</i> Gorham, 1901	Côte d'Ivoire ^a , Liberia ^a	
<i>Platynaspis pilosa</i> Sicard, 1930	South Africa ^{a*}	

Taxon	Collection localities	References
<i>Platynaspis rufipennis</i> Gerstäcker, 1871	Côte d'Ivoire ^a , Liberia ^a , Niger ^a	
<i>Platynaspis vittigera</i> Weise, 1895	DRC ^b	
Tribe Sticholotidini Weise, 1901		
<i>Pharoscymnus sexguttatus</i> (Gyllenhal, 1808)	Ghana ^b	
<i>Nomen nudum</i>		
" <i>Leis maculata</i> "*4	Côte d'Ivoire ^a	

Checklist of West African Coccinellidae in IFAN and IITAB museums (see Table 1 for more details)

Serangium kunowi Weise, 1892

Distribution: Zambia

Brumoides foudrasii (Mulsant, 1850)

Distribution: Benin, Gambia, Guinea, Nigeria, Senegal

Chilocorus distigma (Klug, 1835)

Distribution: Mozambique

Chilocorus dorrhni Mulsant, 1850

Distribution: Senegal

Chilocorus schioedtei Mulsant, 1850

Distribution: Benin, Cameroon

Chilocorus simoni Sicard, 1907

Distribution: South Africa

***Exochomus flavipes* (Thunberg, 1781)**

Distribution: Gabon

***Exochomus laeviusculus* Weise, 1909**

Distribution: Benin, Côte d'Ivoire, Guinea, Mali, Mauritania, Senegal, Togo

***Exochomus nigrifrons* Gerstäcker, 1871**

Distribution: Mali, Senegal

***Parexochomus nigripennis* (Erichson, 1843)**

Distribution: Mali, Senegal

***Exochomus pulchellus* Gerstäcker, 1871**

Distribution: Gambia, Niger, Rwanda, Senegal

***Exochomus troberti* Mulsant, 1850**

Distribution: Burkina Faso

***Aulis annexa* Mulsant, 1850**

Distribution: Senegal

***Clitostethus flavotestaceus* Mader, 1955**

Distribution: Senegal

***Nephus flavomaculatus* Fürsch, 1966**

Distribution: Benin, Nigeria

***Nephus vetustus* Weise, 1915**

Distribution: Gabon

***Nephus phenacoccophagus* Fürsch, 1987**

Distribution: Nigeria

***Nephus kamburovi* Fürsch, 1992**

Distribution: Malawi

***Nephus oblongosignatus* Mulsant, 1850**

Distribution: Tanzania

***Nephus ornatulus* Korschevsky, 1931**

Distribution: DRC

***Nephus sudanicus* Weise, 1925**

Distribution: Mauritania

***Scymnobius bilucernarius* (Mulsant, 1850)**

Distribution: Mexico

***Scymnus canariensis* Wollaston, 1864**

Distribution: São Tome and Principe, Senegal

***Scymnus castroemi* Mulsant, 1850**

Distribution: Guinea, Senegal

***Scymnus gnavus* Weise, 1895**

Distribution: Guinea

***Scymnus kibonotensis* Weise, 1910**

Distribution: Côte d'Ivoire, Guinea, Nigeria

***Scymnus levailanti* Mulsant, 1850**

Distribution: Nigeria, Malawi

***Scymnus pruinus* Weise, 1895**

Distribution: Zambia

***Scymnus monroviae* Casey, 1899**

Distribution: Benin, Côte d'Ivoire, Guinea, Niger, Senegal, Togo

***Scymnus nigrosellatus* Mader, 1950**

Distribution: Zambia

***Scymnus quadrivittatus* Mulsant, 1850**

Distribution: Nigeria

***Scymnus rubiginosus* Mader, 1950**

Distribution: Côte d'Ivoire, Guinea, Senegal

***Scymnus scapuliferus* Mulsant, 1850**

Distribution: Benin, Côte d'Ivoire, Guinea, Nigeria, Madagascar, Senegal, Togo

***Scymnus schoutedeni* Mader, 1950**

Distribution: Senegal

***Scymnus senegalensis* Mader, 1955**

Distribution: Côte d'Ivoire, Gambia, Guinea, Mali, Mauritania, São Tome and Principe, Senegal

***Scymnus villiersi* Mader, 1955**

Distribution: Niger, Senegal

***Stethorus aethiops* Weise, 1899**

Distribution: Benin, Ghana, Guinea-Bissau, Mozambique

***Stethorus endroedyi* Fürsch, 1970**

Distribution: Malawi

***Stethorus jejunos* Casey, 1899**

Distribution: Ghana, Nigeria, Mozambique

***Adalia bipunctata* (Linnaeus, 1758)**

Distribution: Cameroon

***Anisolemnia decempustulata* Weise, 1888**

Distribution: Togo

***Bulaea anceps* (Mulsant, 1850)**

Distribution: Mozambique

***Caria welwitschii* Crotch, 1874**

Distribution: Guinea

***Cheilomenes aurora* Gerstäcker, 1871**

Distribution: Tanzania

***Cheilomenes lunata* (Fabricius, 1775)**

Distribution: Benin, Burkina Faso

***Cheilomenes sulphurea* (Olivier, 1791)**

Distribution: Angola, Cameroon

***Cheilomenes propinqua* (Mulsant, 1850)**

Distribution: Côte d'Ivoire, Gabon

***Cheilomenes quadrilineata* (Mulsant, 1850)**

Distribution: Senegal

***Coccinella intermedia* (Crotch, 1874)**

Distribution: São Tome and Principe

***Coccinella septempunctata* Linnaeus, 1758**

Distribution: Cape Verde

***Declivitata hamata* (Thunberg, 1808)**

Distribution: Senegal

***Declivitata uncifera* Fürsch, 1967**

Distribution: Cameroon

***Harmonia vigintiduomaculata* (Fabricius, 1792)**

Distribution: Benin, Liberia, Nigeria, Togo

***Hippodamia variegata* (Goeze, 1777)**

Distribution: Colombia, Nigeria, Senegal, Tanzania

***Lemnia machadoi* Mader, 1952**

Distribution: Cameroon

***Megalocaria dilatata* (Fabricius, 1775)**

Distribution: Benin

***Micraspis lineola* (Fabricius, 1775)**

Distribution: Togo

***Micraspis striata* (Fabricius, 1792)**

Distribution: Côte d'Ivoire, Gabon

***Psyllobora bisoctonotata* (Mulsant, 1850)**

Distribution: Senegal

***Psyllobora lutescens* (Crotch, 1874)**

Distribution: Guatemala

***Psyllobora variegata* (Fabricius, 1781)**

Distribution: South Africa

***Xanthadalia effusa* (Erichson, 1843)**

Distribution: Benin, DRC

***Xanthadalia rufescens* Mulsant, 1850**

Distribution: Benin, Mali, Mauritania, Senegal

***Diomus hennesseyi* Fürsch, 1987**

Distribution: Nigeria

***Chnootriba elaterii* (Rossi, 1794)**

Distribution: Benin, Côte d'Ivoire, Gambia, Guinea, Liberia, Mali, Mauritania, Nigeria, São Tome and Principe, Senegal

***Chnootriba hirta* (Thunberg, 1781)**

Distribution: Guinea, Tanzania

***Chnootriba similis* (Thunberg, 1781)**

Distribution: Benin, Burkina Faso

***Cleta punctipennis* (Mulsant, 1850)**

Distribution: Togo

***Cleta sahlbergi* (Mulsant, 1850)**

Distribution: Côte d'Ivoire, Kenya

***Epilachna bissexguttata* Weise, 1895**

Distribution: Côte d'Ivoire, DRC

***Epilachna bomparti* Mulsant, 1850**

Distribution: Liberia, Senegal

***Epilachna colorata* Mulsant, 1850**

Distribution: Cameroon

***Epilachna iocosa* (Mader, 1941)**

Distribution: South Africa

***Epilachna nigratarsis* Mulsant, 1850**

Distribution: Cameroon

***Epilachna vigintipunctata* Mulsant, 1850**

Distribution: Liberia, Tanzania

***Henosepilachna atropos* (Sicard, 1912)**

Distribution: Equatorial Guinea

***Henosepilachna bisseptemnotata* (Mulsant, 1853)**

Distribution: Tanzania

***Henosepilachna clavareaui* (Weise, 1901)**

Distribution: Benin

***Henosepilachna ertli* (Weise, 1906)**

Distribution: Côte d'Ivoire, Liberia

***Henosepilachna fulvosignata* (Reiche, 1847)**

Distribution: Côte d'Ivoire

***Henosepilachna moseri* (Weise, 1903)**

Distribution: Equatorial Guinea

***Henosepilachna reticulata* (Olivier, 1791)**

Distribution: Benin, Mali, Niger, Nigeria, Senegal

***Henosepilachna simplex* (Weise, 1895)**

Distribution: Liberia

***Solanophila canina* (Fabricius, 1781)**

Distribution: Guinea

***Solanophila dregei* (Mulsant, 1850)**

Distribution: Côte d'Ivoire

***Solanophila scalaris* (Gerstäcker, 1871)**

Distribution: Tanzania

***Hyperaspis aestimabilis* Mader, 1955**

Distribution: Angola, DRC

***Hyperaspis centralis* Mulsant, 1850**

Distribution: Mexico

***Hyperaspis delicatula* (Mulsant, 1850)**

Distribution: Benin, Gambia, Ghana, Guinea-Bissau, Nigeria, Malawi

***Hyperaspis lugubris* (Randall, 1838)**

Distribution: Ghana, Nigeria

***Hyperaspis maindroni* (Sicard, 1929)**

Distribution: Mauritania, Niger, Senegal

***Hyperaspis merckii* (Mulsant, 1850)**

Distribution: Mauritania, Senegal

***Hyperaspis pumila* Mulsant, 1850**

Distribution: Gambia, Guinea, Guinea-Bissau, Niger, Nigeria, Senegal, Togo

***Hyperaspis senegalensis* (Mulsant, 1850)**

Distribution: Gambia, Ghana, Nigeria, Senegal, Sierra Leone, Malawi

***Hyperaspis sericea* Fürsch, 1972**

Distribution: Malawi

***Hyperaspis vinciguerra* Capra, 1929**

Distribution: Gambia, Senegal, Malawi

***Tenuisvalvae notata* (Mulsant, 1850)**

Distribution: Benin, Bolivia

***Ortalia ovulum* Weise, 1898**

Distribution: Liberia, Mali, Togo

***Rodolia cardinalis* (Mulsant, 1850)**

Distribution: Kenya

***Rodolia iceryae* Janson in Ormerod, 1887**

Distribution: Senegal

***Rodolia occidentalis* Weise, 1898**

Distribution: Benin, Ghana, Nigeria, Senegal

***Rodolia senegalensis* Weise, 1913**

Distribution: Senegal

***Platynaspis capicola* Crotch, 1874**

Distribution: DRC

***Platynaspis ferruginea* Weise, 1895**

Distribution: Benin, Togo

***Platynaspis kollari* Mulsant, 1850**

Distribution: Liberia

***Platynaspis obscura* Gorham, 1901**

Distribution: Côte d'Ivoire, Liberia

***Platynaspis pilosa* Sicard, 1930**

Distribution: South Africa

***Platynaspis rufipennis* Gerstäcker, 1871**

Distribution: Côte d'Ivoire, Liberia, Niger

***Platynaspis vittigera* Weise, 1895**

Distribution: DRC

***Pharoscygnus sexguttatus* (Gyllenhal, 1808)**

Distribution: Ghana

“*Leis*” “*maculata*”

Distribution: Côte d'Ivoire

Analysis

The taxonomically updated list of coccinellid species, present in the IFAN and IITAB collections, includes 129 species, representing 40 genera assigned to 11 tribes and two subfamilies following the classification of Seago et al. (2011). A total of 751 West African coccinellid specimens was recorded for the two collections. Of those, 385 specimens (68 spp., 30 genera) are deposited at IITA, while 366 specimens (84 spp., 31 genera) are at IFAN Table 1.

Most specimens (62%) were curated under currently valid names; however, 38% of specimens were labelled using junior synonyms. At IITA, 83% of the specimens were labelled using currently valid species names, while at IFAN, 39% of specimens were labelled using valid names.

Five genera comprise 57% of the specimens: *Exochomus* (6%), *Chnootriba* (9%), *Scymnus* (13%), *Cheilomenes* (14%) and *Hyperaspis* (15%) (Fig. 3). Twenty-five (of 40) genera each represent less than 1% of the total specimens. The remaining genera (*Chilocorus*, *Declivitata*, *Epilachna*, *Henosepilachna*, *Nephus*, *Platynaspis*, *Rodolia*, *Stethorus* and *Xanthadalia*) each account for between 2 and 5% of the overall specimen total.

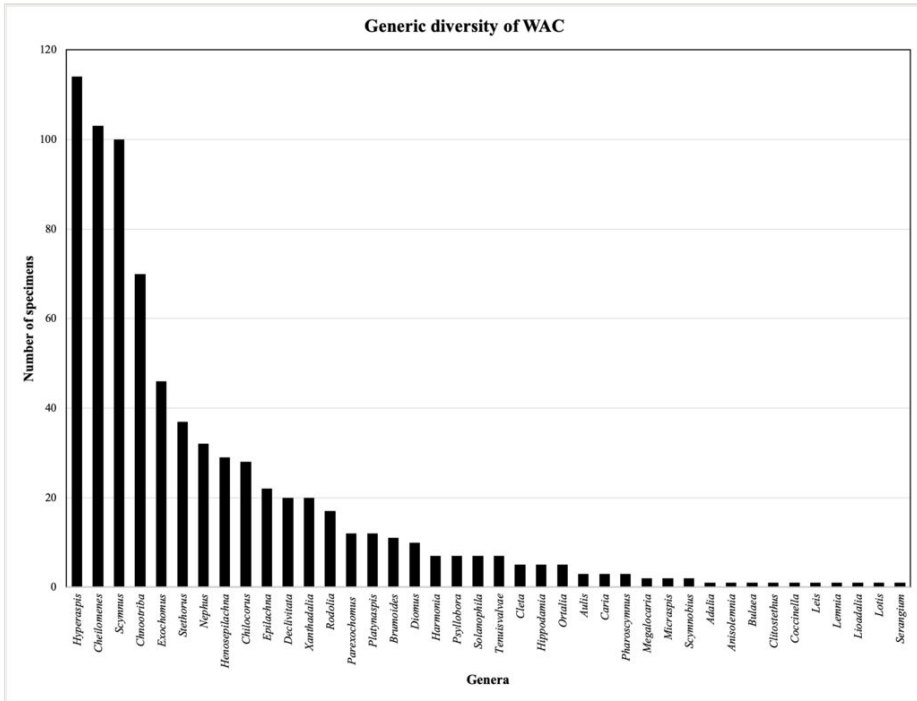


Figure 3. [doi](#)

Generic-level specimen representation in the IFAN and IITAB Collections.

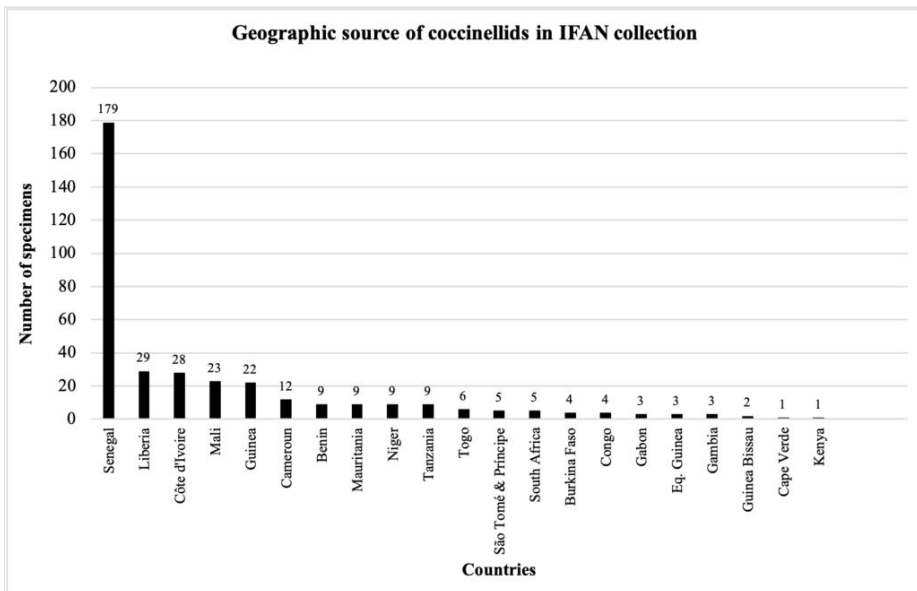


Figure 4. [doi](#)

Geographic source of coccinellid specimens in the IFAN Collection.

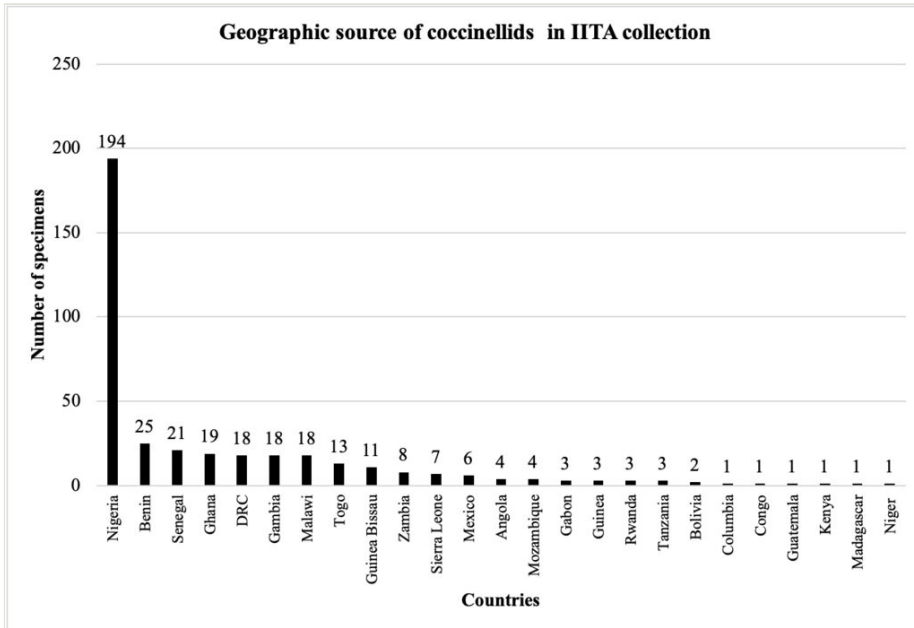


Figure 5. [doi](#)

Geographic source of coccinellid specimens in the IITAB Collection.

Cheilomenes lunata (Fabricius, 1775), *Cheilomenes propinqua* (Mulsant, 1850), *Cheilomenes sulphurea* (Olivier, 1791), *Chnootriba elaterii* (Rossi, 1794), *Chnootriba similis* (Thunberg, 1781), *Exochomus laeviusculus* Weise, 1909, *Hyperaspis delicatula* (Mulsant, 1850) and *Hyperaspis pumila* Mulsant, 1850, are the most abundant species in the collections (Fig. 6). Specimens identified as *Scymnus* sp. make up the third most numerous group appearing in these collections.

Geographic distribution

The coccinellid holdings in these two collections originated in 35 countries with 85% of specimens coming from West African countries, 14% coming from other African countries (DRC, Gabon, Madagascar, Malawi, Mozambique, Rwanda, Tanzania and Zambia) and 1% from non-African countries. More than half (66%) of West African material, housed in these two collections, came from just five countries: Senegal (27%), Nigeria (26%), Benin (5%), Liberia (4%) and Côte d'Ivoire (4%).

West African specimens housed in the IFAN museum were collected from 22 African countries. Most of these specimens (77%) were from five countries: Senegal (49%), Liberia (8%), Côte d'Ivoire (8%), Guinea (6%) and Mali (6%) (Fig. 4). The coccinellid specimens in the IITA originated in 25 countries, including 10 non-West African countries and four non-African countries (Bolivia, Columbia, Guatemala and Mexico). Most lady beetle specimens in the IITA museum (72%) were collected from five West African countries: Nigeria (50%),

Benin (6%), Gambia (5%), Ghana (5%) and Senegal (5%). Two non-West African countries were represented: DRC (5%) and Malawi (5%) (Fig. 5).

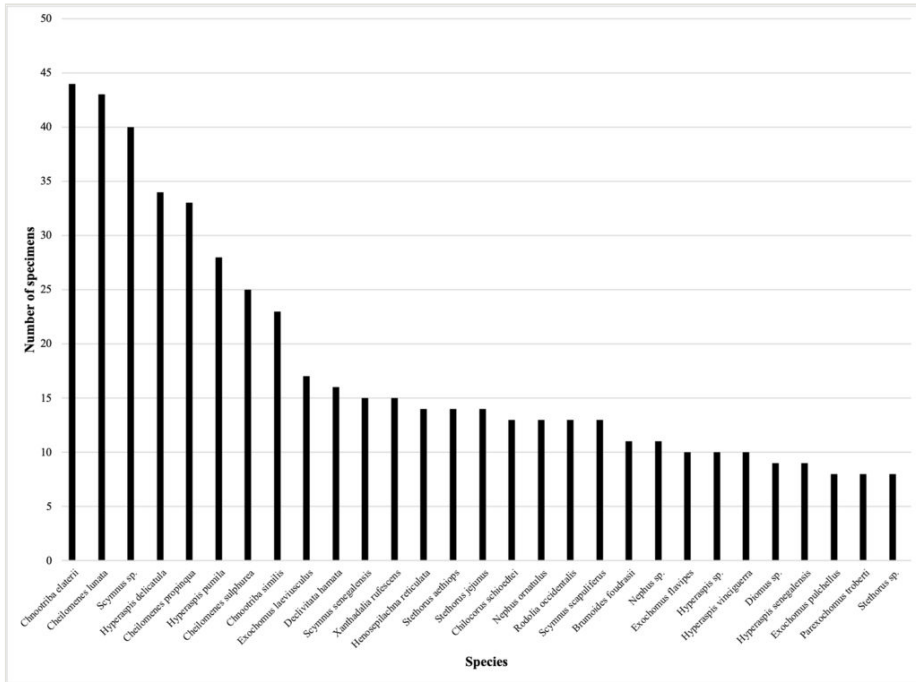


Figure 6. [doi](#)

Specific-level specimen representation of coccinellid holdings of the IFAN and IITAB Collections.

Temporal distribution

Coccinellid material in the IFAN and IITA insect collections differ in temporal coverage (IFAN: 1900–1994; IITAB: 1950–2009) (Fig. 7). In the IFAN collection, the oldest specimens were all collected in 1900 and represent the following species: *Adalia bipunctata* (Linnaeus, 1758), *Anisolemnia decempustulata* Weise, 1888, *Aulis annexa* Mulsant, 1850, *Brumoides foudrasii* (Mulsant, 1850), *Caria welwitschii* Crotch, 1874, *Cheilomenes aurora* Gerstäcker 1871, *Cheilomenes lunata* (Fabricius, 1775) and *Chnootriba elaterii* (Rossi, 1794). A single specimen of *Stethorus aethiops* Weise, 1899, collected in 1950, represents the oldest coccinellid record in the IITAB collection.

Both collections show a spike in growth of coccinellid holdings during one decade, but not the same one (Fig. 7). While 17% of the IFAN WAC specimens were collected between 1900 and 1944, the great majority (73%) were collected between 1945 and 1954. Only 5% of the specimens were added between 1955 and 1994. No new coccinellid material has been added since 1994.

The IITAB WAC records indicate that 6% of specimens were collected between 1950 and 1979, 80% from 1980 to 1989 and 14% between 1990 and 2009. No new coccinellid material was added after 2009.

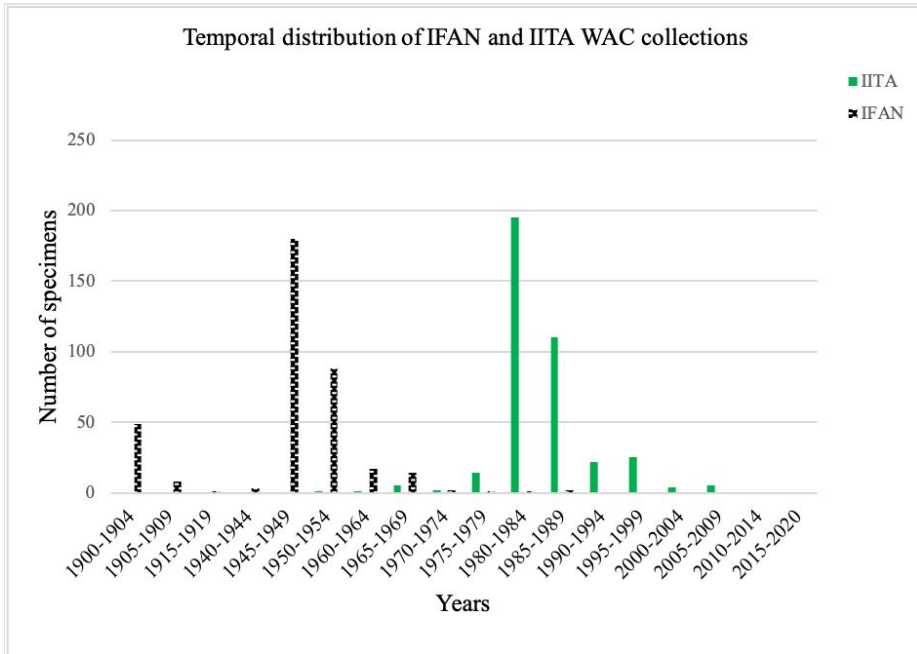


Figure 7. [doi](#)

Temporal distribution of IFAN and IITAB collection of coccinellids.

Discussion

Data records compiled from collection labels in the IFAN and IITAB insect collections show that both collections combined provide an historical record of West African coccinellid diversity spanning over a century. It is clear that much coccinellid diversity in this region remains unrecorded though.

Very little published information is available about African coccinellids. Fürsch (1992) reports 70 species from Western Uganda. In Algeria, 75 species were recorded (Lakhal et al. 2018). The West African region, with its surface area of 6,140,000 km², is nearly 26 times the size of Uganda (236,040 km²) and more than twice the size of Algeria.

West Africa, with its diverse ecosystems, landscapes, bioclimatic regions and vegetation (desert, rain forest, savannah), should support one of the highest diversities of coccinellids in all of Africa. The current total of 129 known coccinellid species from West Africa is surprisingly low for such a heterogeneous region.

The two focal collections of this study, the largest biodiversity centres in West Africa, differ in their taxonomic coverage. The IFAN holds more West African coccinellid diversity (31 gen., 84 spp.) than IITA (30 gen., 68 spp.). One possible explanation for the higher taxonomic diversity at IFAN is that their coccinellid records span nearly a century (1900–1994) while records at IITA only range from 1950 to 2009. In addition, the holdings at IFAN were enhanced by many expeditions to other West African countries, especially Côte d'Ivoire, Liberia, Mali, Mauritania, Senegal and Togo (Paulian et al. 1983).

A species name can become invalid due to the discovery of an older valid name or due to subsequent reclassification of the species in a different genus. Even though there was more taxonomic diversity represented at IFAN, 61% of species names used in the collection have not been updated to the valid names used in the current classification. At IITAB, however, most coccinellid species names (83%) were current and valid. It should also be noted that the various researchers, who have served as curators of IFAN insect collection, were taxonomists. Even though their expeditions and fieldwork focused on insect biodiversity in general, their efforts were concentrated on their respective specialities. These researchers each left Africa after some time and were no longer involved in the curation of these collections (e.g. André Villiers: 1945–1956, Michel Condamin: 1950–1973 and 1978–1988; Roger Roy: 1958–1992, Bernadette Soltani: 1988, Aïssatou Dramé: 1988–1991, Sun Heat Han: 1992–1996) (A. Niang pers. comm.). These are some of the potential reasons why the taxonomy of the coccinellid holdings at these museums was not current.

The IITA arthropod collection plays a crucial taxonomic role by providing essential, authoritative insect identifications amongst other services (e.g. biodiversity monitoring, pest management control etc.). IITA research has contributed to the description of more than 120 arthropod species (Ortiz 2017). This position of the IITA helps to explain why the identifications of its WAC specimens are more current: the IITAB WAC collection is newer than the one at IFAN.

Considering the numbers of specimens, *Exochomus* (6%), *Chnootriba* (9%), *Scymnus* (13%), *Cheilomenes* (14%) and *Hyperaspis* (15%) are the most strongly represented West African genera in the two collections. *Cheilomenes lunata*, *Cheilomenes propinqua*, *Cheilomenes sulphurea*, *Chnootriba elaterii* and *Chnootriba similis* are the most commonly collected species. Whereas *Cheilomenes lunata*, *C. propinqua* and *C. sulphurea* are widespread aphid predators, *Chnootriba elaterii* and *Ch. similis* are serious herbivorous pests of major staple crops. All these species may have been collected more often because they are relatively large, more colourful than many other coccinellids in the region and are regularly occurring on many cultivated and wild plants. In contrast, the collection, preparation and identification of tiny, brown coccinellids, like *Scymnus* species, are more difficult and time consuming. Drab, minute coccinellids could have been abundantly collected in field samples, but might never have been prepared, identified and curated. As a result, these less conspicuous coccinellids could be greatly under-represented in museum holdings even though they might be very common and important in various agroecosystems.

Many predaceous species are represented in the holdings, such as *Exochomus flavipes* (Thunberg, 1781), *Exochomus laeviusculus* Weise, 1909, *Stethorus jejunos* Casey, 1899, *Hyperaspis delicatula*, *H. pumila*, *Rodolia cardinalis* (Mulsant, 1850) and *Scymnus senegalensis* Weise, 1913. Some of these species are poorly represented in these collections, but this is likely due to collection and preparation biases, rather than actual rarity in the region. Although these relative abundance numbers of specimens in the collections are not the result of systematic and long-term sampling efforts, the simple spatial and temporal records of occurrence for these species in the region provide important information that could facilitate entomological research and pest management programmes in the sub-region.

Records of material in both IFAN and IITAB show that more than 60% of WAC specimens were collected from five countries (Senegal, Nigeria, Benin, Liberia and Côte d'Ivoire). These countries might have experienced more collecting effort because they either house the museums (Benin and Senegal) or because they are neighbouring countries where museum expeditions could be easily conducted (Côte d'Ivoire, Liberia, Nigeria). Benin, Côte d'Ivoire, Nigeria and Senegal have been agricultural research and trade centres in West Africa since the colonial period (Paulian et al. 1983). IFAN (Senegal), IITA (Benin, Nigeria) and ORSTOM (Côte d'Ivoire) were originally established to promote scientific research before the 1950s. Studies conducted through those organisations have continued to be published in more recent years (Chazeau and Couturier 1985, Fürsch 1991a, Sæthre et al. 2011), generating specimens for the museums.

The collecting efforts that built these museum holdings were haphazard, not the result of long-term, systematic monitoring efforts in the region. More than 23% of IITAB WAC specimens were collected from the IITA Station in Ibadan, Nigeria, while 17% of IFAN WAC were collected in Dakar, Senegal. Despite the high historical value of both collections, the geographic record is uneven. Some countries were far more heavily sampled over the years than others.

The coccinellid material housed in both collections is diverse, but there is a surprising lack of overlap in taxa between the two collections, even though they are in neighbouring countries that have similar ecological habitats. At IFAN, there are 56 WAC species that are not present in IITAB. There are 35 WAC species represented in the IITAB holdings that are not found in the IFAN collection. The lack of overlap could be due to collecting biases in the projects or expeditions that occurred at each institution. A large percentage of taxa represented in these museums was collected by only a few individuals (Fig. 3) which is consistent with that scenario. In fact, the combined WAC diversity at these two collections (40 genera, 129 species), represents only 75% of genera and 50% of the species already known to occur in the region as reported in the literature (KH). This lack of overlap between collections may be due in part from being at an early stage of discovery and collection development for WAC diversity. It is clear that there is a need for much more thorough study and sampling in order to accurately assess the diversity of this important group across West Africa.

It is noteworthy that both collections include African coccinellids from outside West Africa. The IITAB also has material from Central and South America (Bolivia, Columbia, Guatemala and Mexico). These non-West African specimens were probably received as exchanges between international collaborators who were conducting general systematics research or were collaborating with the various Insect Pest Management programmes carried out by IITA. These collaborations with researchers from around the world might help to explain why the identifications of material at IITAB were taxonomically more current than at IFAN. In fact, most of the IITAB coccinellids were identified by a German researcher, Helmut Fürsch, a taxonomic authority of Afrotropical Coccinellidae.

The IFAN and IITA WAC collections each show a history that is marked by three distinct periods of development. For IFAN, these significant periods occurred in 1900-1944, 1945-1954 and 1955-1994. IFAN holds some material that predates the establishment of the insect collection in the 1940s. This older material (collected 1900-1944) came from many European collections and collectors (e.g. P. Daget, E. Fleutiaux, M. Griaule, T. Jackson, Delattre, H. Junod, A. Vuillet etc.). In 1945, André Villiers established the IFAN entomology section and began to organise many expeditions to African locations, including Cameroon (1939, 1951), Senegal (1945-1956), Casamance, Senegal (1946), Mali (1946, 1947), Guinea (1946, 1954), Côte-d'Ivoire (1946, 1955), Guinea Bissau (1947), Air Mountains, Niger (1947), Senegalese Ferlo (1948, 1950), Mauritania (1948-1953), southern Nigeria (1949), Benin and Togo (1950), southern Togo (1950), Sudan region (border of Senegal with South of Sahara), Fernando-Poo Island, Equatorial Guinea (1951) and Niokolo-Koba National Park, Senegal (1955, 1956). These field trips and Villiers' collaborations with a network of foreign entomologists resulted in a decade (1945-1954) during which most of IFAN WAC specimens (73% of the total WAC holdings) were collected. The period of rapid growth of WAC holdings at IFAN ceased after Villiers returned to the Muséum National d'Histoire Naturelle (Paris) in 1956. Although he organised many subsequent trips to Africa between 1961 and 1977, that was a period of great change in the region. In the 1960s, most West African countries became independent and experienced major transitions and restructuring of administration.

The noteworthy periods of development for the IITAB WAC collection were 1950-1979, 1980-1989 and 1990-2009. Not surprisingly, IFAN's slower growth in the 1960s coincided with the lowest rate of growth for IITA's new collection. In the late 1970s, however, there were major pest outbreaks (e.g. Maize streak virus, cassava mealybug, cassava green mite, mango mealybug, fruit tree mealybug etc.) that led IITA scientists to establish collaborative integrated pest management programmes with Central and South American researchers at the International Center for Tropical Agriculture (CIAT) (Agouké et al. 1988, Ortiz 2017). These biological control programmes were very successful in importing, rearing and releasing natural enemies to manage these pests (Agouké et al. 1988, Ortiz 2017). During research trials for those projects, insects were sampled from agricultural lands. In fact, more than 40% of WAC specimens in the IITA museum were collected between 1979 and 1989 on cassava alone. It is likely that many coccinellids in the IITA collection were collected because the 1970s pest outbreaks pushed the institution to establish partnerships with stakeholders, international researchers and other African

research institutions. From 1990 to the present, records from the IITA museum show a very significant decrease in the number of coccinellids collected. This decreased rate of growth could be explained by the spectacular success of the biological pest control programme carried out by IITA on cassava, mango trees and other crops, thereby reducing the need for field sampling. In addition to the identified material referred to in the present paper, there is still a huge backlog of unidentified coccinellid specimens at IITAB. The non-WAC specimens obtained at that same time are another benefit from those same events and resulting collaborations.

Despite the success of IPM programmes and taxonomic expeditions led by IFAN and IITA in many African countries, it is clear that some groups of West African coccinellid genera with high known diversity were poorly sampled (e.g. species of *Adalia*, *Anisolemnia*, *Clitostethus*, *Coccinella*, *Diomus*, *Megalocaria*, *Micraspis*, *Nephus*, *Psyllobora*, *Rodolia*, *Scymnus* etc.). For example, 22 species of *Nephus* have been reported to occur in West Africa (KH), yet only 6 are represented in these collections.

This gap in taxonomic knowledge about lady beetles mirrors the situation seen in many other insect taxa in West Africa. The assessment of biodiversity in the region has been hampered historically by a lack of local taxonomic expertise, inaccessibility of scientific literature, rarity of reliable arthropod reference collections, limited scientific infrastructure and a lack of financial resources. Recent advances in systematics, especially in “cybertaxonomy,” now provide web-based taxonomic tools, diverse publication outlets and easy access to a wealth of digitised scientific resources including technical literature, high quality photographs, specimen data etc., thereby reducing the taxonomic impediment for researchers in places like West Africa. If coupled with strategic development of international, institutional collaborations to conduct biodiversity surveys and inventory projects, great progress could be made towards filling large taxonomic and geographical gaps in our knowledge of West African insects.

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References

- Agouunké D, Agricola U, Bokonon-Ganta HA (1988) *Rastrococcus invadens* Williams (Hemiptera: Pseudococcidae), a serious exotic pest of fruit trees and other plants in West Africa. Bulletin of Entomological Research 78 (4): 695-702. <https://doi.org/10.1017/S0007485300015558>
- Ali M, Ahmed K, Ali S, Raza G, Hussain I, Nafees MA, Anjum SI (2018) An annotated checklist of Coccinellidae with four new records from Pakistan (Coleoptera, Coccinellidae). Zookeys 803: 93-120. <https://doi.org/10.3897/zookeys.803.22543>
- Arnett R, Nishida G, Samuelson GA (1993) The insect and spider collections of the world. 2nd. Sandhill Crane Press, Inc., Gainesville, Florida, USA, 310 pp.
- Biranvand A, Tomaszewska W, Li W, Nicolas V, Shakarami J, Fekrat L, Hesami S (2017a) Review of the tribe Chilocorini Mulsant from Iran (Coleoptera, Coccinellidae). Zookeys 712: 43-68. <https://doi.org/10.3897/zookeys.712.20419>
- Biranvand A, Tomaszewska W, Nedvěd O, Khormizi MZ, Nicolas V, Caneparri C, Shakarami J, Fekrat L, Fürsch H (2017b) Review of the tribe Hyperaspidini Mulsant (Coleoptera: Coccinellidae) from Iran. Zootaxa 4236 (2): 311-326. <https://doi.org/10.11646/zootaxa.4236.2.6>
- Chazeau J, Couturier G (1985) Coléoptères Coccinellidae de Côte d'Ivoire: la faune de la forêt de Taï. Revue Française d'Entomologie 7 (5): 309-330.
- Coleman C (2015) Taxonomy in times of the taxonomic impediment - Examples from the community of experts on amphipod crustaceans. Journal of Crustacean Biology 35: 729-740. <https://doi.org/10.1163/1937240X-00002381>
- Comité Inter-états de Lutte contre la Sécheresse dans le Sahel (2016) Landscapes of West Africa – A window on a changing world. U.S. Geological Survey. EROS, Garretson, SD, US. URL: <https://eros.usgs.gov/westafrica/>
- Coutanceau J (2008) Le genre *Harmonia* (Mulsant, 1846) (Coleoptera Coccinellidae). Harmonia 1: 4-16.
- de Carvalho M, Bockmann F, Amorim D, de Vivo M, de Toledo-Piza M, Menezes N, de Figueiredo J, McEachran J (2005) Revisiting the taxonomic impediment. Science 307 (5708). <https://doi.org/10.1126/science.307.5708.353b>
- Eizaguirre S (2007) Revisión de los coleópteros coccinélidos de las Islas Canarias (Coleoptera: Coccinellidae). Boletín Sociedad Entomológica Aragonesa 41: 101-118.
- Escalona H, Ślipiński SA (2012) Generic revision and phylogeny of Microweiseinae (Coleoptera: Coccinellidae). Systematic Entomology 37 (1): 125-171. <https://doi.org/10.1111/j.1365-3113.2011.00601.x>
- Escalona H, Zwick A, Li H, Li J, Wang X, Pang H, Hartley D, Jermiin L, Nedvěd O, Misof B, Niehuis O, Ślipiński A, Tomaszewska W (2017) Molecular phylogeny reveals food plasticity in the evolution of true ladybird beetles (Coleoptera: Coccinellidae):

- Coccinellini). *BMC Evolutionary Biology* 17 (151): 1-11. [In English]. <https://doi.org/10.1186/s12862-017-1002-3>
- Evenhuis N (2019) The insect and spider collections of the world website. <http://hbs.bishopmuseum.org/codens/codens-inst.html>. Accessed on: 2019-6-15.
 - Fürsch H (1966) Die *Scymnus*-Arten Westafrikas (Col. Cocc.). *Entomologische Arbeiten aus dem Museum G. Frey Tutzing bei München* 17: 135-192.
 - Fürsch H (1975) Mission entomologique du Musée Royal de l'Afrique Centrale aux Monts Uluguru, Tanzanie: 6. Coleoptera Coccinellidae . *Revue Zoologique Africaine* 89 (3): 723-731.
 - Fürsch H (1979) Insects of Saudi Arabia. Coleoptera: Fam. Coccinellidae . *Fauna of Saudi Arabia* 1: 235-248.
 - Fürsch H (1987) Die afrikanischen Vertreter der Gattungen *Micraspis*, *Declivitata* und *Xanthadalia* . *Mitteilungen der Münchner Entomologische Gesellschaft* 77: 5-31.
 - Fürsch H (1991a) Annotated checklist of Coccinellidae from Senegal and Gambia. *Coccinella* 3 (1): 31-41.
 - Fürsch H (1991b) Die Epilachnini Afrikas südlich der Sahara (Coleoptera: Coccinellidae). *Zeitschrift für Entomologie* 1 (3): 217-320.
 - Fürsch H (1992) Coccinellids of the Kibale Forest Western Uganda: A comparison between virgin and managed sites. *Tropical Zoology* 5 (2): 155-166. <https://doi.org/10.1080/03946975.1992.10539190>
 - Fürsch H (2002) The *Lemnia* species of the Aethiopic region Insecta Coleoptera . *Faunistische Abhandlungen (Dresden)* 1: 285-305.
 - Fürsch H (2005) *Bulaea* Mulsant, 1850 and *Isora* Mulsant, 1950 Coleoptera Coccinellidae are synonymous. *Entomologische Zeitschrift Stuttgart* 115 (5): 227-232.
 - GBIF Secretariat (2019) *Hippodamia variegata* (Goeze, 1777). GBIF Backbone Taxonomy. Checklist dataset accessed via GBIF.org on 2019-09-26. URL: <https://www.gbif.org/species/1043082>
 - Giorgi JA, Vandenberg N, McHugh J, Forrester J, Ślipiński SA, Miller K, Shapiro L, Whiting M (2009) The evolution of food preferences in Coccinellidae . *Biological Control* 51 (2): 215-231. <https://doi.org/10.1016/j.biocontrol.2009.05.019>
 - Gordon R (1985) The Coccinellidae (Coleoptera) of America North of Mexico. *Journal of the New York Entomological Society* 93 (1): i-iii, 1-912.
 - Gordon R, González GF (2002) South American Coccinellidae (Coleoptera). Part IX: A systematic revision of *Scymnobi* Casey (Scymninae: Scymnini). *Frustula Entomologica* 25: 57-85.
 - Gordon RD (1987a) The first North American records of *Hippodamia variegata* (Goeze) (Coleoptera: Coccinellidae). *Journal of the New York Entomological Society* 95 (2): 307-309.
 - Gordon RD (1987b) A catalogue of the Crotch collection of Coccinellidae (Coleoptera). *Occasional Papers on Systematic Entomology* 3: 1-46.
 - Gordon RD, Canepari C (2008) South American Coccinellidae (Coleoptera), Part XI: a systematic revision of Hyperaspidini (Hyperaspidinae). *Annali del Museo Civico di Storia Naturale "G. Doria"* 99: 245-512.
 - Gropp R (2018) Specimens, collections, and tools for future biodiversity-related research. *BioScience* 68 (1): 3-4. <https://doi.org/10.1093/biosci/bix155>

- Heinrichs EA, Barrion AT (2004) Rice-feeding insects and selected natural enemies in West Africa: biology, ecology and identification. International Rice Research Institute (IRRI), Manila, 242 pp.
- Hodek I, Van Emden HF, Honek A (2012) Ecology and behaviour of the ladybird beetles (Coccinellidae). Wiley-Blackwell, Chichester, West Sussex; Hoboken, NJ, 600 pp.
<https://doi.org/10.1002/9781118223208>
- Holmes M, Hammond T, Wogan GU, Walsh R, LaBarbera K, Wommack E, Martins F, Crawford J, Mack K, Bloch L, Nachman M (2016) Natural history collections as windows on evolutionary processes. *Molecular Ecology* 25 (4): 864-881. <https://doi.org/10.1111/mec.13529>
- Hounkpati K, Forrester J, McHugh J (2019) Neotype designation for *Rodolia iceryae* Janson in Ormerod, 1887 (Coleoptera: Coccinellidae). *Zootaxa* 4563 (2): 396-400.
<https://doi.org/10.11646/zootaxa.4563.2.12>
- Ipert G (1999) Biodiversity of predaceous coccinellidae in relation to bioindication and economic importance. *Agriculture, Ecosystems & Environment* 74 (1): 323-342. [https://doi.org/10.1016/S0167-8809\(99\)00041-9](https://doi.org/10.1016/S0167-8809(99)00041-9)
- Jadwiszczak A, Węgrzynowicz P (2003) World Catalogue of Coccinellidae Part I — Epilachninae. Mantis, Olsztyn, 264 pp.
- Kabo-bah A, Diji C (2018) Sustainable Hydropower in West Africa: Planning, Operation, and Challenges. Academic Press, 232 pp. <https://doi.org/10.1016/B978-0-12-813016-2.00013-7>
- Klopper R, Smith G, Chikuni A (2002) The Global Taxonomy Initiative in Africa. *Taxon* 51 (1): 159-165. <https://doi.org/10.2307/1554974>
- Kobayashi N, Kumagai M, Minegishi D, Tamura K, Aotsuka T, Katakura H (2011) Molecular population genetics of a host-associated sibling species complex of phytophagous ladybird beetles (Coleoptera: Coccinellidae: Epilachninae). *Journal of Zoological Systematics and Evolutionary Research* 49 (1): 16-24. <https://doi.org/10.1111/j.1439-0469.2010.00581.x>
- Kovář I (2007) Coccinellidae. In: Löbl I, Smetana A (Eds) *Catalogue of Palaearctic Coleoptera*. Vol. 4. Elateroidea, Derodontoidea, Bostrichoidea, Lymexyloidea, Cleroidea, Cucujoidea. Apollo Books, Stenstrup, 71–74, 568–630 pp.
- Łączyński P, Tomaszewska W (2012) *Chapinaria*, new genus of Chilocorini from *Endochilus meridionalis* Sicard from Africa (Coleoptera: Coccinellidae). *Annales Zoologici* 62: 1-9. <https://doi.org/10.3161/000345412X633658>
- Lakhal MA, Ghezali D, Nedvěd O, Doumandji S (2018) Checklist of ladybirds of Algeria with two new recorded species (Coleoptera, Coccinellidae). *Zookeys* 774: 41-52. <https://doi.org/10.3897/zookeys.774.23895>
- Li W, Huo L, Wang X, Chen X, Ren S (2016) The genera *Exochomus* Redtenbacher, 1843 and *Parexochomus* Barovsky, 1922 (Coleoptera: Coccinellidae: Chilocorini) from China, with descriptions of two new species. *The Pan-Pacific Entomologist* 91 (4): 291-304. <https://doi.org/10.3956/2015-91.4.291>
- Mader L (1941) Coccinellidae. I. Teil. Exploration du Parc National Albert. Mission G. F. de Witte (1933-1935) 34: 1-206.
- Mader L (1954) Coccinellidae. III. Teil. Exploration du Parc National Albert, Mission G.F. De Witte (1933–1935) 80: 1-208.
- Medler JT (1980) *Insects of Nigeria: check list and bibliography*. American Entomological Institute, Ann Arbor, vii, 919 pp.

- Mikula P, Csanády A, Hromada M (2018) A critical evaluation of the exotic bird collection of the Šariš Museum in Bardejov, Slovakia. *Zookeys* 776: 139-152. <https://doi.org/10.3897/zookeys.776.24462>
- Miller SE, Rogo L (2001) Challenges and opportunities in understanding and utilisation of African insect diversity. *Cimbebasia* 17: 197-218.
- Mohamed KA, Abdel-Hakam AE, Sherif FH, Mohammad MMB (2018) Taxonomical revision on certain species of subfamily Chilocorinae (Coleoptera: Coccinellidae) in Egypt. *Academic Journal of Entomology* 11 (1): 18-28. <https://doi.org/10.5829/idosi.aje.2018.18.28>
- Nattier R, Jourdan H, Mille C, Chazeau J (2015) An annotated checklist of the Coccinellidae (Coleoptera) from New Caledonia. *Zootaxa* 4058 (3): 301-331. <https://doi.org/10.11646/zootaxa.4058.3.1>
- Nedved O, Kovář I (2012) Phylogeny and classification. In: Hodek I, van Emden HF, Honek A (Eds) *Ecology and behaviour of the ladybird beetles*. 1-12 pp. <https://doi.org/10.1002/9781118223208.ch1>
- Nematollahi MR (2016) Datasheet reports on *Diuraphis noxia* (Russian wheat aphid). Unpublished <https://doi.org/10.13140/RG.2.1.1156.8402>
- Nicolas V (2013) Additif à la faune des coccinelles de Mayotte (Coleoptera, Coccinellidae). *Harmomia, Coccinelles du Monde* 10: 3-4.
- Ortiz R (2017) IITA: 50 years after, transforming Africa's agriculture and nourishing rural development. International Institute of Tropical Agriculture, Ibadan, Nigeria. URL: <https://cgspace.cgiar.org/handle/10568/83011>
- Paulian R, Descarpentries A, Quentin RM (1983) André Villiers (1915-1983). *L'Entomologiste* 39 (4): 151-208.
- Poorani J (2002) An annotated checklist of the Coccinellidae (Coleoptera) (excluding Epilachninae) of the Indian Subregion. *Oriental Insects* 36 (1): 307-383. <https://doi.org/10.1080/00305316.2002.10417335>
- Riddick WE (2017) Identification of Conditions for Successful Aphid Control by Ladybirds in Greenhouses. *Insects* 8 (2). <https://doi.org/10.3390/insects8020038>
- Robertson J, Ślipiński SA, Moulton M, Shockley F, Giorgi A, Lord N, McKenna D, Tomaszewska W, Forrester J, Miller K, Whiting M, McHugh J (2015) Phylogeny and classification of Cucujoidea and the recognition of a new superfamily Coccinelloidea (Coleoptera: Cucujiformia). *Systematic Entomology* 40 (4): 745-778. <https://doi.org/10.1111/syen.12138>
- Sæthre MG, Godonou I, Hofsvang T, Tapa-Yotto GT, James B (2011) Aphids and their natural enemies in vegetable agroecosystems in Benin. *International Journal of Tropical Insect Science* 31 (1/2): 103-117. <https://doi.org/10.1017/S1742758411000191>
- Samways M, Osborn R, Hastings H, Hattings V (1999) Global climate change and accuracy of prediction of species' geographical ranges: Establishment success of introduced ladybirds (Coccinellidae, *Chilocorus* spp.) worldwide. *Journal of Biogeography* 26 (4): 795-812. <https://doi.org/10.1111/j.1365-2699.1999.00318.x>
- Scholtz CH, Mansell MW (2017) Insect biodiversity in the Afrotropical Region. In: Foottit RG, Adler PH (Eds) *Insect Biodiversity*. 1. USA, 16 pp. <https://doi.org/10.1002/9781118945568.ch5>
- Seago A, Giorgi JA, Li J, Ślipiński SA (2011) Phylogeny, classification and evolution of ladybird beetles (Coleoptera: Coccinellidae) based on simultaneous analysis of

- molecular and morphological data. *Molecular Phylogenetics and Evolution* 60 (1): 137-151. <https://doi.org/10.1016/j.ympev.2011.03.015>
- Shah MA, Khan AA (2014) Qualitative and quantitative prey requirements of two aphidophagous coccinellids, *Adalia tetraspilota* and *Hippodamia variegata*. *Journal of Insect Science* 14: 72-72. <https://doi.org/10.1093/jis/14.1.72>
 - Ślipiński A, Tomaszewska W (2010) Coccinellidae Latreille, 1802. In: Leschen RA, Beutel RG, Lawrence JF (Eds) *Handbook of Zoology. Arthropoda: Insecta. Coleoptera, Beetles, Volume 2: Morphology and systematics (Elateroidea, Bostrichiformia, Cucujiformia partim)*. Walter de Gruyter GmbH & Co. KG, Berlin/New York, 454– 472 pp.
 - Ślipiński SA (2007) Australian ladybird beetles (Coleoptera: Coccinellidae). Their biology and classification. *Australian Biological Resources Study*, Canberra, ACT, 286 pp.
 - Ślipiński SA, Pang H, Booth R (2012) Revision of the Australian Coccinellidae (Coleoptera) Part 8. Genus *Scymnus* Kugelann. *Annales Zoologici* 62 (4): 679-704. <https://doi.org/10.3161/000345412x659731>
 - Suarez A, Tsutsui N (2004) The value of museum collections for research and society. *BioScience* 54 (1): 66-74. [https://doi.org/10.1641/0006-3568\(2004\)054\[0066:TVOMCF\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2004)054[0066:TVOMCF]2.0.CO;2)
 - Szawaryn K, Bocak L, Ślipiński SA, Escalona H, Tomaszewska W (2015) Phylogeny and evolution of phytophagous ladybird beetles (Coleoptera: Coccinellidae: Epilachnini), with recognition of new genera. *Systematic Entomology* 40 (3): 547-569. <https://doi.org/10.1111/syen.12121>
 - Thomson S, Pyle R, Ah Yong S, Alonso-Zarazaga M, Ammirati J, Araya JF, Ascher J, Audisio TL, Azevedo-Santos V, Bailly N, Baker W, Balke M, Barclay ML, Barrett R, Benine R, Bickerstaff JM, Bouchard P, Bour R, Bourgoin T, Boyko C, Breure AH, Brothers D, Byng J, Campbell D, Ceríaco LP, Cernák I, Cerretti P, Chang C, Cho S, Copus J, Costello M, Cseh A, Csuzdi C, Culham A, D'Elia G, d'Udekem d'Acoz C, Daneliya M, Dekker R, Dickinson E, Dickinson T, van Dijk PP, Dijkstra K, Dima B, Dmitriev D, Duistermaat L, Dumbacher J, Eiserhardt W, Ekrem T, Evenhuis N, Faille A, Fernández-Triana J, Fiesler E, Fishbein M, Fordham B, Freitas AL, Friol N, Fritz U, Frøslev T, Funk V, Gaimari S, Garbino GT, Garraffoni AS, Geml J, Gill A, Gray A, Grazziotin F, Greenslade P, Gutiérrez E, Harvey M, Hazevoet C, He K, He X, Helfer S, Helgen K, van Heteren A, Hita Garcia F, Holstein N, Horváth M, Hovenkamp P, Hwang WS, Hyvönen J, Islam M, Iverson J, Ivie M, Jaafar Z, Jackson M, Jayat JP, Johnson N, Kaiser H, Klitgård B, Knapp D, Kojima J, Köljalg U, Kontschán J, Krell F, Krisai-Greilhuber I, Kullander S, Latella L, Lattke J, Lencioni V, Lewis G, Lhano M, Lujan N, Luksenburg J, Mariaux J, Marinho-Filho J, Marshall C, Mate J, McDonough M, Michel E, Miranda VO, Mitroiu M, Molinari J, Monks S, Moore A, Moratelli R, Murányi D, Nakano T, Nikolaeva S, Noyes J, Ohl M, Oleas N, Orrell T, Páll-Gergely B, Pape T, Papp V, Parenti L, Patterson D, Pavlinov IY, Pine R, Poczar P, Prado J, Prathapan D, Rabeler R, Randall J, Rheindt F, Rhodin AJ, Rodríguez S, Rogers DC, Roque F, Rowe K, Ruedas L, Salazar-Bravo J, Salvador R, Sangster G, Sarmiento C, Schigel D, Schmidt S, Schueler F, Segers H, Snow N, Souza-Dias PB, Stals R, Stenroos S, Stone RD, Sturm C, Štys P, Teta P, Thomas D, Timm R, Tindall B, Todd J, Triebel D, Valdecasas A, Vizzini A, Vorontsova M, de Vos J, Wagner P, Watling L, Weakley A, Welter-Schultes F, Whitmore D, Wilding N, Will K, Williams J, Wilson K, Winston J,

- Wüster W, Yanega D, Yeates D, Zaher H, Zhang G, Zhang Z, Zhou H (2018) Taxonomy based on science is necessary for global conservation. *PLOS Biology* 16 (3). <https://doi.org/10.1371/journal.pbio.2005075>
- Tomaszewska W, Ślipiński SA (2013) Revision of the genera *Erithionyx* Blackburn and *Wioletta* Ślipiński (Coleoptera: Coccinellidae: Coccidulini). *Australian Journal of Entomology* 52: 87-100. <https://doi.org/10.1111/aen.12002>
 - Tomaszewska W, Szawaryn K (2013) Revision of the Asian species of *Afidentula* Kapur, 1958 (Coleoptera: Coccinellidae: Epilachnini). *Zootaxa* 3608 (1): 26-50. <https://doi.org/10.11646/zootaxa.3608.1.2>
 - Tomaszewska W, Szawaryn K (2016) Epilachnini (Coleoptera: Coccinellidae)—A revision of the world genera. *Journal of Insect Science* 16 (1): 1-91. <https://doi.org/10.1093/jisesa/iew082>
 - United Nations (2014) Map No. 4533: Map of West Africa. Department of Field Support, Cartographic Section. <http://www.un.org/depts/Cartographic/map/profile/westafrica.pdf>. Accessed on: 2019-2-15.

Endnotes

- *1 This record is based on two specimens collected by R. Borowka on 12 AUG 1992 Citrus mussel scale in Chipata, Zambia. They were originally identified as “*Chilocorus serangium* Kunowi”.
- *2 This was treated as subspecies of *Exochomus nigrifrons* Gerstäcker, 1871 by Mader (1954: 88) (*Brumus nigrifrons nigerianus* Korschefsky). *Brumus nigrifrons nigerianus* was misspelled. Species of the genus *Brumus* Mulsant, 1850 were transferred to *Exochomus* Redtenbacher, 1843.
- *3 This record is based on a single specimen determined as “*Cydonia intermedia* Cramer” by Mader. The holotype for this species is from Abyssinia, now Ethiopia.
- *4 This is probably a *nomen nudum*.