Floral associations of cyclocephaline scarab beetles

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Abstract

The scarab beetle tribe Cyclocephalini (Coleoptera: Scarabaeidae: Dynastinae) is the second largest tribe of rhinoceros beetles, with nearly 500 described species. This diverse group is most closely associated with early diverging angiosperm groups (the family Nymphaeaceae, magnoliid clade, and monocots), where they feed, mate, and receive the benefit of thermal rewards from the host plant. Cyclocephaline floral association data have never been synthesized, and a comprehensive review of this ecological interaction was necessary to promote research by updating nomenclature, identifying inconsistencies in the data, and reporting previously unpublished data. Based on the most specific data, at least 97 cyclocephaline beetle species have been reported from the flowers of 58 plant genera representing 17 families and 15 orders. Thirteen new cyclocephaline floral associations are reported herein. Six cyclocephaline and 25 plant synonyms were reported in the literature and on beetle voucher specimen labels, and these were updated to reflect current nomenclature. The valid names of three unavailable plant host names were identified. We review the cyclocephaline floral associations with respect to inferred relationships of angiosperm orders. Ten genera of cyclocephaline beetles have been recorded from flowers of early diverging angiosperm groups. In contrast, only one genus, *Cyclocephala*, has been recorded from dicot flowers. Cyclocephaline visitation of dicot flowers is limited to the New World, and it is unknown whether this is evolutionary meaningful or the result of sampling bias and incomplete data. The most important areas for future research include: 1) elucidating the factors that attract cyclocephalines to flowers including floral scent chemistry and thermogenesis, 2) determining whether cyclocephaline dicot visitation is truly limited to the New World, and 3) inferring evolutionary relationships within the Cyclocephalini to rigorously test vicariance hypotheses, host plant shifts, and mutualisms with angiosperms.
Introduction

The Cyclocephalini (Coleoptera: Scarabaeidae: Dynastinae) is the second largest rhinoceros beetle tribe, currently containing 15 genera and nearly 500 described beetle species (Jameson et al. 2002; Ratcliffe 2003; Smith 2006). Cyclocephalines have a pantropical distribution, though the majority of the group’s generic and species diversity is concentrated in the New World (Ratcliffe 2003; Ratcliffe and Cave 2006). Most genera are sexually dimorphic, with males having enlarged protarsal claws and females having expanded elytral epipleura (Moore 2012). Cyclocephalines are important economically and ecologically as root pests (larvae) and pollinators (adults) (Ratcliffe 2003; Ratcliffe and Paulsen 2008). Adult cyclocephaline beetles can be found within the inflorescences of early diverging angiosperm groups (the family Nymphaeaceae, magnoliid clade, and monocots; Figure 1) and have been shown to contribute to pollination in the Annonaceae, Araceae, Arecaceae, Cyclanthaceae, Magnoliaceae, and Nymphaeaceae (Cramer et al. 1975; Beach 1982; Beach 1984; Young 1986; Young 1988b; Gotsberger 1989; Dieringer et al. 1999; Hirthe and Porembski 2003; Maia et al. 2012). Studies of these interactions indicate that some early diverging angiosperm groups offer rewards to cyclocephalines in the form of mating sites, food, and metabolic boosts associated with floral thermogenicity in return for pollination services (Gotsberger 1986; Young 1986; Seymour et al. 2009). Cyclocephaline visitation of dicot flowers is poorly known and little studied.

Cyclocephaline floral associations have been reported in journals, books, and monographs since the late 18th century. However, the prevalence, geographic scope, and biological importance of these records are difficult to gauge because publications summarizing cyclocephaline floral visitation are somewhat dated and report floral visitation only for specific plant families, geographic areas, or vegetation types (Henderson 1986; Gibernau 2003; Gotsberger and Silberbauer-Gottsberger 2006; Gibernau 2011). The fragmentary nature of these data and the citation of unpublished observations have hampered the ability to identify floral association trends within cyclocephaline genera and species.

The phylogeny of the Cyclocephalini was investigated for the first time by Clark (2011), and the generic-level relationships within the tribe remain an area of active research by M. R. Moore. Tribal circumscription of the Cyclocephalini is subject to change based on ongoing phylogenetic analyses. This research will provide an evolutionary framework for interpreting patterns of floral visitation. Compilation and synthesis of a checklist of floral associations is needed in order to understand the ecology of the Cyclocephalini within a phylogenetic context.

This checklist synthesizes data (plant and beetle species, geographic locality, and original citation) for the floral associations of adult
cyclocephaline beetles. Invalid nomenclature in the surveyed literature is identified and corrected; conflicting data, sources of error, and uncertainty in the data are identified; and unpublished floral association data from examined voucher specimens are added. The aim of this work is to promote future research of these ecological interactions by providing a comprehensive data set of the taxonomic and geographic scope of floral visitation for cyclocephaline beetles.

**Materials and Methods**

Literature was surveyed from 1758 (Linnaeus) to 2012. Keyword searches for all cyclocephaline genera (*sensu* Ratcliffe and Cave 2006; Clark 2011) were conducted in the following databases: BioOne® ([www.bioone.org](http://www.bioone.org)), BIOSIS Previews® ([http://apps.webofknowledge.com/](http://apps.webofknowledge.com/)), JSTOR ([www.jstor.org](http://www.jstor.org)), and Biodiversity Heritage Library ([www.biodiversitylibrary.org](http://www.biodiversitylibrary.org)). Every host plant reference from Pike et al. (1976) was checked for floral association data.

All reported cyclocephaline species names from the literature were verified by referencing the original species description and monographic treatments of the Dynastinae (Endrödi 1985; Ratcliffe 2003; Ratcliffe and Cave 2006). Synonyms or misspelled cyclocephaline species names in the literature were updated to reflect current nomenclature. All reported host plant names were verified using the peer-reviewed botanical taxonomic databases Tropicos ([www.tropicos.org](http://www.tropicos.org)) and The Plant List ([www.plantlist.org](http://www.plantlist.org)). Synonyms or misspelled plant names were updated to reflect current nomenclature based on The Plant List (2010). In some cases, scientific names in the literature could not be identified as valid or invalid (e.g., unavailable manuscript names or conflicting synonyms). Some unverified plant names were reported according to the original citation for the floral association, and the name was noted as unresolved. Occasionally, host plant and beetle species were not assigned an author in the reference for an association. This caused problems due to the prevalence of synonyms and homonyms in the plant and insect literature. Resulting ambiguities were rectified to the extent possible and explained in the remarks column (Appendix 1).

Borrowed specimens of cyclocephaline species allowed for direct evaluation of species-level identifications that were reported by several authors. Particularly, this included specimens of *Cyclocephala sexpunctata* Laporte (1840) and *C. brevis* Höhne (1847) collected by George Schatz, Helen Young (La Selva Biological Station, Costa Rica), Alberto Seres, and Nelson Ramirez (Henri Pittier National Park, Venezuela), with floral association data that were subsequently published or unpublished. Identifications of these specimens (or specimen vouchers) were critically examined (Moore 2011). Exemplar material borrowed from the University of Nebraska State Museum (authoritatively identified by B. C. Ratcliffe) and monographic treatments (Ratcliffe 2003; Ratcliffe and Cave 2006) served as the basis for evaluating species identifications as well as detailed images of some type specimens. The operating assumption was that the collectors and authors were consistent with their species-level determinations. Identifications deemed incorrect based on current taxonomy were updated and noted accordingly. Unpublished host plant data were also found with cyclocephaline specimens in collections. These specimens were collected by M. R. Moore and deposited at Wichita State University, Wichita, Kansas, USA, or loaned from the following institutions:
Concrete and anecdotal evidence of floral associations were also included in the checklist. The nature of the published association occasionally needed clarification or elaboration (e.g., cyclocephalines reported near flowers but not on them or museum specimens covered in resin and pollen). These clarifications were provided in the remarks column of Appendix 1. A large amount of unpublished and inaccessible data exists with regard to cyclocephaline floral visitation. These records provide ambiguous data for plant species, cyclocephaline species, locality, and associated voucher information. For example, Schatz (1990, Table 7.3) recorded known and predicted (without distinguishing the two) plant taxa pollinated by dynastines in the Neotropics. Schatz (1990, Table 7.4) recorded cyclocephaline plant visitation at La Selva Biological Station, but a large amount of data could not be extracted because of the non-specific nature of the record (i.e., the data were reported at the tribal-level rather than at the species-level). These inaccessible data are important because they report certain associations that are not recorded elsewhere in the literature. Repetitive data from these types of records were omitted from the checklist. Only unique generic or species-level plant associa-

Table 1. Previously unpublished cyclocephaline beetle floral association data.

| Scarab Taxa          | Plant Taxa              | Locality                          | Collector            | Depository |
|----------------------|-------------------------|-----------------------------------|----------------------|------------|
| *Cyclocephala atripes* Bates, 1888  | *Dieffenbachia tondii* Croat & Grayum | COSTA RICA: Heredia (La Selva Biol. Stat.) | M. Grayum           | 3 vouchers in INBC |
| *Cyclocephala brevis* Höhne, 1847 incertae sedis (Cyclocephala morphospecies 3 sensu Moore 2011) | *Dieffenbachia sequine* (Jacq.) Schott | VENEZUELA: Angua (Henri Pittier National Park) | A. Seres & N. Ramirez | 1 voucher in USNM |
| *Cyclocephala brevis* Höhne, 1847 incertae sedis (Cyclocephala morphospecies 4 sensu Moore 2011) | *Philodendron ligulatum* Schott | COSTA RICA: Heredia (La Selva Biol. Stat.) | H. Young          | 1 voucher in INBC |
| *Cyclocephala octopunctata* Burmeister, 1847  | *Philodendron sp.* | PANAMA: Colon (1 km E Rio Guanache Bridge) | B. Ratcliffe & M. Jameson | 1 voucher in USNM |
| *Cyclocephala ovalis* Bates, 1888  | *Annona dioica* A. St.-Hil. | BOLIVIA: Santa Cruz | uncredited | 1 voucher in USNM |
| *Cyclocephala rustica* (Olivier, 1879)  | Arecales                | BRAZIL: Manaus (Reserva Ducke) | S. Vidal             | 2 vouchers in USNM |
| *Cyclocephala santoritae* Ratcliffe, 1992a  | *Dieffenbachia sequine* (Jacq.) Schott | FRENCH GUIANA: Dept 973 (Nouragues) | H. Halsley & A. Henderson | 5 vouchers in USNM |
| *Cyclocephala sesquinica* Lapeirre, 1840 incertae sedis (Cyclocephala morphospecies 2 sensu Moore 2011) | *Alocasia macracanthos* (L.) G. Don | COSTA RICA: San José (Parque del Este) | Uncredited (likely collected by C. Valerio, see Valerio 1984) | 8 vouchers in UNSM |
| *Cyclocephala undata* (Olivier, 1879)  | *Dugetizia asteroricha* (Diele) R. E. Fr. | BRAZIL: Manaus | G. Gottsberger | 1 voucher in UNSM |
| *Eriocletes proba* Sharp, 1877  | *Dieffenbachia sequine* (Jacq.) Schott | FRENCH GUIANA (Nouragues Field Station) | M. Gibernau | 28 vouchers in UNSM |
| *Memoena signatae* (Höhne, 1923)  | *Socratea sp.* | VENEZUELA (Henri Pittier National Park) | A. Seres & N. Ramirez | 1 voucher in USNM |
tions were reported for the beetle tribe from these data sets. These non-specific records are reported at the end the checklist with the intention that they be reevaluated with the addition of more data.

**Results**

Based on species-specific records from the literature and voucher label data, at least 97 cyclocephaline species from nine or 10 genera (depending on the identity of the cyclocephaline reported by Gibbs et al. (1977)) were recorded in association with the flowers of at least 161 species representing 58 genera, 17 families, and 15 orders (Appendix 1). Examined voucher specimens occasionally had unique, unpublished, floral association data. Thirteen new plant associations are provided in Table 1. Examined voucher specimens that did not have unique data are noted in Appendix 1. The most specific data are summarized at the generic-level for the plant association (plant classification according to the Angiosperm Phylogeny Group III (2009)) in Table 2 and are provided in full detail (lowest-level taxonomy, geographic data, and references) in Appendix 1. Cyclocephaline beetle genera and their associations with angiosperm plant lineages were mapped onto the APG III angiosperm phylogeny (Figure 1).

Five of the 15 cyclocephaline genera were not reported as floral visitors in any of the surveyed literature: *Acrobolbia* Ohaus (1912), *Ancognatha* Erichson (1847), *Harpocoselis* Burmeister (1847), *Stenocrates* Burmeister (1847), and *Surutu* Martínez (1955). Preliminary phylogenetic analysis of the Cyclocephalini indicated that the Neotropical genus *Parapucaya* Prell (1934) (Dynastinae: Pentodontini) and the Indonesian archipelago genus *Neohyphus* Heller (1896) (Dynastinae: Oryctoderini) fall within a potential newly
defined Cyclocephalini (Clark 2011). These genera were included in the systematic literature searches but yielded no floral association records. The results of Clark (2011) hypothesized that the genus Erioscelis Burmeister (1847) is sister to all remaining genera of the Cyclocephalini + Neohyphyus + Parapucaya. Erioscelis was included in this checklist because of its documented visitation of several genera in the Araceae (also visited by other cyclocephalines) and its historical inclusion in the Cyclocephalini.

Floral associations that are less specific or ambiguous (non-specific records) were also reported (Appendix 1). For example, Listabarth (1996) reported dynastine scarabs, with no further species identification, on three species of Bactris palms (Arecales). These data include records for Scarabaeeidae, Dynastinae, and beetles on flowers that fit the general pattern of cyclocephaline floral visitation (nocturnal visitation of bowl-shaped, thermogenic inflorescences). Non-specific records were included in the checklist with the hope that they may be reevaluated with additional data.

Gathering and interpreting floral association data were complicated by the prevalence of synonyms, invalid names, and unavailable names in the literature. Based on The International Code of Zoological Nomenclature (ICZN 1999), an unavailable name is a name that is excluded from use due to the requirements of the code. For example, the unavailable name Cyclocephala inpunctata was reported in the surveyed literature (Gottsberger 1986, 1988). C. inpunctata has never been described in the literature. This name is unavailable and was likely reported in error. Based on published locality data for the floral association, images of the beetle (Gottsberger 1988; Figure 4a, 5 a-d), and subsequently published records, we consider this species to be Cyclocephala quatuordecimpunctata Man-nerheim (1829) (personal communication with B. C. Ratcliffe, April 2011). Synonyms of six cyclocephaline genus or species names were
reported in the surveyed literature; these invalid names were updated based on current nomenclature (Appendix 2). Synonyms of 25 plant genus or species names were reported in the surveyed literature and on voucher specimen label data; these invalid names were updated based on current nomenclature (Appendix 3).

Seven unresolved or unavailable plant names were reported from label data and in the surveyed literature (Appendix 4). According to The Plant List (2010), unresolved names are those for which “it is not yet possible to assign a status of either ‘accepted’ or ‘synonym.’” Two of these names, Philodendron atlanticum and Dieffenbachia longivaginata, were unavailable manuscript names (place-holder names for species that were later described) of Thomas Croat and Michael Grayum (Missouri Botanical Garden, St. Louis, Missouri, USA). These species were identified as Philodendron ligulatum Schott and Dieffenbachia tonduzii Croat and Grayum, respectively (personal communication with T. Croat and M. Grayum, April 2011). Xanthosoma macrorrhizas is an unavailable name that was reported by Valerio (1984). This species may be the cultivated, naturalized, non-native species Alocasia macrorrhizos (L.) G. Don (personal communication with T. Croat, April 2011).

Certain cyclocephaline species were commonly reported as floral visitors. For example, Cyclocephala sexpunctata had over 20 floral visitation records in the surveyed literature (Appendix 1). C. sexpunctata is externally nearly identical to C. brevis (sensu Ratcliffe 2003; Ratcliffe and Cave 2006). Research on these two species showed that they represent four, or potentially five, morphospecies (Moore 2011). This conclusion was based on male genitalic characters, the form of the female epipleuron, and extensive range and spatial data (Moore 2011). The taxonomy of the species C. sexpunctata and C. brevis remains unresolved (a possible species complex), and their floral associations were reported in detail (Moore 2011). Some voucher specimens for reported floral associations of C. sexpunctata and C. brevis remain to be examined, and some data will require reinterpretation after the examination of type specimens.

Discussion

Examination of cyclocephaline floral associations with respect to inferred relationships of angiosperm orders revealed that 10 of the 15 genera of cyclocephaline beetles have been recorded from flowers of early diverging angiosperm groups (the family Nymphaeaceae, magnoliid clade, and monocots; Figure 1). In contrast, only one genus, Cyclocephala, has been recorded from dicot flowers (Figure 1). Experimental and observational studies have demonstrated that cyclocephalines can act as pollinators in Nymphaeales, Magnoliales, Araceae, Pandanales, and Alismatales (Figure 1; Table 2) (Cramer et al. 1975; Beach 1982; Beach 1984; Young 1986; Young 1988b; Gottsberger 1989; Dieringer et al. 1999; Hirthe and Porembski 2003; Maia et al. 2012). In these early diverging plant groups, a wide set of floral traits and floral pollination syndromes indicate a correlation with cyclocephaline beetles (large pollen grains with sticky exudates, sturdy and funnel-shaped inflorescences or large disc-shaped flowers, timing of anthesis, and thermogenesis) (Thien et al. 2009; Gibernau et al. 2010). These angiosperm orders offer rewards to cyclocephalines in the form of mating sites, food, and heat resources associated with floral thermogenicity (Young 1986; Seymour et al. 2009).
Some cyclocephaline/flower associations are mutualistic (Cramer et al. 1975; Beach 1982; Beach 1984; Young 1986; Young 1988b; Gottsberger 1989; Dieringer et al. 1999; Hirthe and Porembski 2003; Maia et al. 2012). Ervik and Knudsen (2003) provide a compelling argument that scarab pollination of the Nymphaeaceae (Nymphales) is a mutualistic relationship that dates to the early Cretaceous. Whether this represents an example of coevolution is unclear, and only one study has addressed this hypothesis (Schiestl and Dötterl 2012). Schiestl and Dötterl (2012) argued that volatile organic compound production/detection systems arose in the Scarabaeoidea during the Jurassic, whereas floral volatile organic compounds arose in the Cretaceous/Paleocene. This was taken as evidence that early diverging angiosperm plant/scarab associations evolved due to a preexisting sensory bias in scarabs rather than as a result of coevolution (Schiestl and Dötterl 2012). However, coevolution could not be ruled out for the mutualism between cyclocephaline scarabs and aroid flowers (Schiestl and Dötterl 2012).

Floral visitation of the core eudicot clade (Figure 1) by cyclocephalines is poorly described and, in certain cases, differs significantly from a pollination mutualism. Such cases involve feeding and mating within flowers in which cyclocephalines have no apparent pollinating function and may destroy the reproductive capability of the plant. For example, in the Brazilian dicot Opuntia monocantha Haw. (Caryophyllales), Cyclocephala have been observed mating within the flowers and feeding on stamens (Lenzi and Inácio Orth 2011). Observations made on Echinopsis ancistrophora Speg. subsp. ancistrophora (Caryophyllales) flowers indicate that Cyclocephala visitors display destructive feeding behavior and do not contribute to reproduction (Schlumpberger et al. 2009). Cyclocephala metrica Steinheil (1874) was observed feeding on seeds in flower heads of Verbesina encelioides (Cav.) Benth. and Hook. f. ex A. Gray (Asterales) in Argentina (Hayward 1946). Seed predation in phytophagous scarabs is rare, the only other known example being some members of the subtribe Anisopliina (Scarabaeidae: Rutelinae: Anomalini) that feed on grass seeds (Poaceae) (Jameson et al. 2007).

In contrast to apparent destructive associations with dicots, only one detailed account provides evidence of a cyclocephaline beetle pollinating a eudicot. Prance (1976) observed male and female Cyclocephala verticalis Burmeister (1847) occupying the inflorescences of Lecythis, Corythophora, and Eschweilera (Ericales) in Amazonas, Brazil. C. verticalis was strong enough to lift the closed androphore flap of Lecythidaceae (Ericales) inflorescences and displayed selective feeding of floral parts, eating only staminode tissue at the apex of the androphore and leaving fertile stamens untouched (Prance 1976). Based on these observations, C. verticalis was considered a likely pollinator of some Lecythidaceae genera, though this hypothesis was not tested (Prance 1976).

Gottsberger (1986) considered cyclocephaline floral visitation of the dicot families Apocynaceae (Gentianales), Calophyllaceae (Malpighiales), and Sapotaceae (Ericales) to be opportunistic. In the absence of early diverging angiosperm host flowers, Gottsberger (1986) hypothesized that cyclocephalines would visit strongly scented flowers of other groups. Cyclocephalines have been shown to aggregate based on floral scent compounds alone (Gottsberger et al. 2012). Cyclocephaline species (and populations) likely are biased towards a wide range of floral scent.
compounds. Eudicot species with geographically variable floral scent profiles may evolve scents that incidentally stimulate cyclocephaline aggregation by randomly sampling the sensory bias range of scarabs present in that area (e.g., Schlumberger and Raguso 2008; Schlumberger et al. 2009). This scenario, if accurate, would lend support to the hypothesis of Schiestl and Dötterl (2012) that preexisting sensory biases in cyclocephalines have an important role in determining the host flower profile of a given cyclocephaline species.

Based on the assembled data (Appendix 1), cyclocephaline visitation of eudicots is limited to the New World. It is unknown whether this shift represents an evolutionary event that occurred in New World cyclocephalines. Observations of cyclocephalines on dicot flowers (Figure 1) have largely been made by chance and have not been the subject of rigorous experimentation or sampling protocols. Thus, it is quite possible that Old World cyclocephalines (Ruteloryctes, Pettonotus, and potentially Neohyphus) visit both early diverging angiosperm groups and dicot groups, but dicot associations have not been recorded. However, it is certain that the known diversity of host flowers lineages is much higher for New World cyclocephalines (15 orders, 17 families, and 58 genera) compared to Old World cyclocephalines (two orders, two families, and three genera) (Appendix 1). This correlation may indicate that the radiation of the cyclocephalines in the New World was accompanied by a subsequent increase in the diversity of their floral associations.

Cyclocephaline species are generally oligophagous or polyphagous. For cyclocephaline species with multiple host records, only seven species have been recorded from a single host plant genus (monophagous), 23 species have been reported from multiple host plant genera within a family (oligophagous), and 27 species have been recorded from multiple host plant families (polyphagous) (Appendix 1). Single inflorescences often contain multiple cyclocephaline species, and an extreme example is Dieffenbachia nitidipetiolata Croat and Grayum (Alismatales), which was visited by at least nine Cyclocephala species at La Selva Biological Station, Costa Rica (Young 1990; see Croat 2004 for plant identification). These multi-species aggregations might be explained if floral scents are serving as sex pheromones for multiple cyclocephaline species (Schatz 1990). This hypothesis may be supported by the observations of Gottsberger et al. (2012) that Cyclocephala literata Burmeister will aggregate due to floral scent compounds alone.

The consequences of polyphagous and oligophagous cyclocephalines for pollination efficiency have been experimentally addressed, indicating that cyclocephaline floral visitors are differentially important as pollinators due to an interaction between their relative abundance and specific behavior (Young 1986, 1988a, b, 1990). It is less clear how cyclocephalines species, which often mate inside inflorescences, maintain sexual isolation in close proximity to multiple congeneric cases. A single inflorescence may host large crowds of beetles, often more than 30 individuals (Maia et al. 2012). Sexual isolation may be maintained due to interspecific mating morphology (Moore 2012). Sexually dimorphic cyclocephaline species have enlarged protarsal claws (males), and the elytral epipleuron variably expanded into a shelf or flange (females). Morphological differences among epipleural expansions are useful for species-level identification in the Cyclocephalini (Ratcliffe 2003). Females have sclerotized patches, sometimes with setae, on the ventral portion of epipleural expansions (Moore
It is hypothesized that the interaction between the male protarsal claw, the female epipleural expansions, and the ventral portion of the female elytra serves as a pre-copulatory sexual isolation mechanism. Further sexual isolation between species is accomplished by species-specific differences in male genitalic structure (Moore 2012). The male protarsal claw and the female epipleuron may also be involved in intraspecific mate competition. For example, male Cyclocephala gravis Bates were observed clinging tightly to the epipleural structures of a female (guarding behavior), thus limiting the mating access of other C. gravis males (Moore 2012). Cyclocephaline beetles exhibit some similarity to hopliine scarabs (Scarabaeidae: Rutelinae: Hopliini), which are generalist flower visitors in South Africa (Ahrens et al. 2011). Sexual dimorphism has evolved independently several times within the Hopliini (Ahrens et al. 2011). Evolution of sexual dimorphism in hopliines could be tied to the group’s biology, as they feed and compete for mates within inflorescences (Midgeley 1992; Ahrens et al. 2011). Sexual dimorphism in cyclocephalines and hopliines may be analogous, driven by selection pressures related to oligophagous and polyphagous flower feeding, mating behavior, and host visitation.

Cyclocephaline beetles and floral associations provide an ideal system for investigating ecology (pollination, competition) and evolution (sexual selection, mutualisms). A well-founded phylogenetic framework for the Cyclocephalini is needed to advance this work. While ecological associations between beetles and early diverging angiosperm groups is fairly well-established, additional research is necessary to understand the ecological and historical associations of cyclocephaline beetles and dicots. Specifically, research is needed to address the apparent cyclocephaline diversification on New World dicots. Research on cryptic species of host plants and beetles is fundamental to understanding this system. This includes the role of floral volatile compounds in attracting cyclocephaline beetles and patterns of pollination, herbivory, and interspecific competition within floral hosts.

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Figure 1. Cyclocephaline beetle genera and their associations with angiosperm plant lineages (plant phylogeny from APGIII 2009). Icons denote beetle genera that are associated with angiosperm plant lineages. Numbers in the icons indicate the number of species for each beetle genus. If the number of beetle species is unresolved due to conflict in the literature, this is indicated with ~ symbol (the number may be X ± 1 species). If the beetle genus has not been satisfactorily associated with the plant lineage, it is denoted with a ? symbol. For each angiosperm plant lineage, the number of families and genera that the beetles are associated with is denoted with #f (number of families) and #g (number of genera). See Appendix 1 for data. High quality figures are available online.
### Appendix 1. Checklist of floral associations for the Cyclocephalini (Scarabaeidae: Dynastinae).

| Beetle Taxon | Plant Taxon | Geographic Locality | References | Remarks |
|--------------|-------------|---------------------|------------|---------|
| *Arriguatia brevisima* (Arron, 1911) | Anacaeae | FRENCH GUIANA | Ponchel 2006 | – |
| *Aspidolea fuliginea* Burmeister, 1847 | Oenocarpus bataua Mart. | BRAZIL: Pará | Martinez 1968 | – |
| *Aspidolea quadrata* Endrödi, 1980 | Montrichardia arborescens (L.) Schott | FRENCH GUIANA: Kourou, Sinnamary | Giberlau *et al.* 2003; Ponchel 2006 | – |
| *Augoderia nitidula* Burmeister, 1847 | Magnolia ovata (A. St.-Hil.) Spreng. | BRAZIL: Minas Gerais, São Paulo | Gibbs *et al.* 1977 | Gibbs *et al.* (1977) stated that the scarab was *A. nitidula*, but the figure legend reported the scarab species as *Cyclocephala nr. emarginata* Endrödi, 1966. Gottsberger (1986) reported the scarab species as *C. litoria*. |
| *Chalepides dilatatus* (Mannerheim, 1829) | NO DATA | BRAZIL | Mannerheim 1829 | – |
| *Chalepides sp.* | Victoria cruziana A. D. Orb. | ARGENTINA: Corrientes | Vallée and Girino 1972 | – |
| *Cyclocephala abrelata* Ratcliffe and Cave, 2002 | NO DATA | HONDURAS: Yoro (Parque Nacional Pico Bonito) | Ratcliffe and Cave 2002; Ratcliffe and Cave 2006 | Ten specimens of *C. abrelata* were collected in the flowers of an unidentified arid or palm (Ratcliffe and Cave 2002). |
| *Cyclocephala aequatorialis* Spruce | Phytelephas aequatorialis | ECUADOR: Cánar, Cotopaxi, Esmeraldas, Manabí, Pichincha | Balslev and Henderson 1987; Ervik *et al.* 1999 | – |
| *Cyclocephala alazonia* Ratcliffe, 2003 | NO DATA | COSTA RICA: Alijuela (Reserva Biológica Monteverde, Estación Eladio, Peñas Blancas Reserve) | Ratcliffe 2003 | The two known specimens of *C. alazonia* are covered with pollen, suggesting feeding inside of a flower (Ratcliffe 2003). |
| *Annona maricata* L. | Cyclocephala amazonea (Linnaeus, 1767) | COSTA RICA | Villalta 1988 | – |
| *Astrocaryum alatum* Loomis | NO DATA | PANAMA | Ratcliffe 2003 | – |
| *Attalea butyracea* (Mutis ex. L.) Wess. Boer | NO DATA | COLOMBIA | Núñez-Avellanedla and Neira 2009 | – |
| *Baculis coloradonis* L. H. Bailey | COSTA RICA: Heredia (La Selva Biological Station) | COSTA RICA | Beach 1984; Ratcliffe 2003, citing pers. comm. from J. Beach and H. Young | – |
| *Baculis gispaea* Kunth | COSTA RICA: Heredia (La Selva Biological Station); Limon (Guápiles, Estacion Experimental de Los Diamantes) | Mora-Urri and Solis 1980; Mora-Urri 1982; Beach 1984; Gottsberger 1986; Rickson *et al.* 1990; Ratcliffe 2003, citing pers. comm. from J. Beach and H. Young | – |
| *Baculis hondurensis* Standl. | COSTA RICA: Heredia (La Selva Biological Station) | COSTA RICA | Bullock 1981 | – |
| *Cryosophila williamsii* P. H. Allen | COSTA RICA: Heredia (La Selva Biological Station) | COSTA RICA | Henderson 1984; Silberbauer-Gottsberger 1990 | – |
| *Cyclanthus bipartitus* Poit. ex. A. Rich. | COSTA RICA: Heredia (La Selva Biological Station) | COSTA RICA | Beach 1982 | Beach (1982) reported the scarab as *C. nr. amazonea*. Ratcliffe (2003) recorded *C. amazonea* from La Selva Biological Station, thus this is probably a correct identification. |
| *Cymbeleptalum lanigiceps* Schery | PANAMA: Colón | PANAMA: Colón | Murray 1993 | – |
| *Cymbeleptalum longipes* Bentli. ex Diels | PERU: San Martin | PERU: San Martin | Murray 1993 | – |
| *Montrichardia arborescens* (L.) Schott | FRENCH GUIANA | FRENCH GUIANA | Ponchel 2006 | – |
| *Phytelephas seemanii* O. F. Cook | COLOMBIA: Chocó | COLOMBIA: Chocó | Bernal and Ervik 1996; Ervik *et al.* 1999 | The scarab was reported as *Cyclocephala amazonea* (L.) (*C. amazonea* (L.)). |
| *Phytelephas sp.* | COLOMBIA: Nariño (Tumaco) | COLOMBIA: Nariño (Tumaco) | Pardo-Locarno *et al.* 2008 | – |
## Appendix 1. Continued.

| Species                                                                 | Location                      | collector(s)                  | Year(s)                      | Note                                                                 |
|------------------------------------------------------------------------|-------------------------------|-------------------------------|-----------------------------|----------------------------------------------------------------------|
| **Cyclocephala ambliposis** Dates, 1888                                 |                               |                               |                             |                                                                      |
| *Dieffenbachia nitidipoetioluta* Croat & Grayum                        | COSTA RICA: Heredia (La Selva Biological Station) | Young 1986; Young 1988a; Young 1988b; Young 1990; Beach 1999; Ratcliffe 2003 | The plant was reported as *D. longispatha* (Croat 2004).           |
| *Phileodendron anisotomum* Schott                                      | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Phileodendron playtoetiolatum* Madison                                | COSTA RICA: Heredia (La Selva Biological Station) | Beach 1998                   |                             |                                                                      |
| *Philodendron pterotum* K. Koch and Augustin                           | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Philodendron radiatum* Schott                                         | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Philodendron rothschuhianum* Engl. Croat & Grayum                     | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Philodendron tripartium* (Jacq.) Schott                               | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Syngonium sp.*                                                        | COSTA RICA: (Northern low lands) | Valerio 1984                  |                             |                                                                      |
| *Xanthosoma dagunense* Engl.                                           | COLOMBIA: Risaralda (Sanctuario de Fauna y Flora Otata-Quibayas) | Garcia-Robledo et al. 2004; Garcia-Robledo et al. 2005 |                             |                                                                      |
| *Xanthosoma robustum* Schott                                          | MEXICO: Chiaus (Sucumaco)     | Morón 1997                    |                             |                                                                      |
| *Xanthosoma sagittifolium* (L.) Schott                                 | MEXICO: Chiaus (Sucumaco)     | Morón 1997                    |                             |                                                                      |
| *Xanthosoma sp.*                                                       | COLOMBIA: Narilla (Tumaco)    | Pardo-Locarno et al. 2006     |                             |                                                                      |
| *Xanthosoma vandlandii* (Schott) Standl. *                              | COSTA RICA: San José (Granadilla de Curridabat) | Valerio 1988; Morón 1997     |                             |                                                                      |
| *Dieffenbachia nitidipoetioluta* Croat & Grayum                        | COSTA RICA: Heredia (La Selva Biological Station) | Young 1990                   | The plant was reported as *D. longispatha* (Croat 2004).           |
| *Philodendron pterotum* K. Koch and Augustin                           | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                             |                                                                      |
| *Philodendron radiatum* Schott                                         | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young; Beach 1998; Beach 1999 | The scarab was reported as *Cyclocephala ampliata* [sic] (Beach 1999). |
| *Philodendron sp.*                                                     | COSTA RICA                    | Ratcliffe 2003, citing pers. comm. from H. Young | The plant could possibly be *P. pterotum* or *P. radiatum* as reported by Croat (1997). |
| *Cyclocephala ampliata* Dates, 1888                                     |                               |                               |                             |                                                                      |
| *Dieffenbachia nitidipoetioluta* Croat & Grayum                        | COSTA RICA: Heredia (La Selva Biological Station) | Young 1986; Young 1988a; Young 1990; Ratcliffe 2003 | The plant was reported as *D. longispatha* (Croat 2004).           |
| *Dieffenbachia nitidipoetioluta* Croat & Grayum                        | PANAMA: Colón                 |                               |                             |                                                                      |
| *Dieffenbachia spp.*                                                   | COSTA RICA: Heredia (La Selva Biological Station) | Beach 1982                   | Beach (1982) noted *C. atripes* on two *Dieffenbachia* spp. (possibly *D. nitidipoetioluta* as described by Young [1986; 1988a; 1988b]) or *D. tonduzii* herein. |
| *Dieffenbachia tonduzii* Croat & Grayum                                | COSTA RICA: Heredia (La Selva Biological Station) | Label data of M. Grayum      | Three vouchers examined from INRB                                      |
| *Annona aurantiaca* Barb. Rodri.                                       | BRAZIL: Maranhão              | Gottberger 1986; Gottberger 1989; Gottberger and Silberbauer-Gottsberger 2006 |                             |                                                                      |
| *Annona coriacea* Mart.                                                | BRAZIL: Maranhão; Minas Gerais (Indianópolis); São Paulo | Gottberger 1986; Gottberger and Silberbauer-Gottsberger 1988; Gottberger 1989; Gottberger 1999; Silberbauer-Gottsberger et al. 2003; Gottberger and Silberbauer-Gottsberger 2006 |                             |
| Appendix 1. Continued. | Annona cornigolía A. St.-Hil. | BRAZIL: Minas Gerais (Indianópolis); São Paulo (Botucatu) | Gottsberger 1986; Gottsberger 1988; Gottsberger and Silberbauer-Gottsberger 1988; Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | Annona crassiflora Mart. | BRAZIL: Brasilia; Minas Gerais (Indianópolis); Goiás (Vila Propício); Minas Gerais (Indianópolis); São Paulo (Botucatu) | Gottsberger 1986, citing pers. obs. by Silberbauer-Gottsberger; Gottsberger 1988; Gottsberger 1989; Gottsberger 1999; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | Annona dioica A. St.-Hil. | BRAZIL: Minas Gerais (Indianópolis); São Paulo (Botucatu) | Gottsberger 1986; Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | Annona monticola Mart. | BRAZIL: Brasilia; Minas Gerais (Indianópolis) | Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | Annona tomentosa R. E. Fr. | BRAZIL: Brasilia; Minas Gerais (Indianópolis) | Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | Annona warmigiana Mello-Silva & Pirani | BRAZIL: Brasilia | Gottsberger 1986; Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| Caladium sp. | BRAZIL: Maranhão | Gottsberger 1986 | – |
| Colocasia esculenta (L.) Schott | BRAZIL: São Paulo | Gottsberger 1986 | The scarab was reported from cultivated C. esculenta. |
| Philodendron ptarianum Steyerm. var. ragonsum Bunt | VENEZUELA: Bolívar (Canaima National Park) | Ramírez 1992 | – |
| Philodendron mello-brasiliense Berle-Marx ex G. M. Barroso | BRAZIL: Minas Gerais (Indianópolis) | Gottsberger and Silberbauer-Gottsberger 2006 | – |
| Xanthosoma striatipes (Kuntz & C. D. Bouché) Madison | BRAZIL: São Paulo | Gottsberger 1986 | – |
| Cyclocephala bouardi Dechambre, 1979 | Bactris hirta Martt | BRAZIL: Amazonas | Küchmeister et al. 1998 | – |
| | Diefenbachia seguine (Jacq.) Schott | VENEZUELA: Aragua (Henri Pittier National Park) | Label data of A. Seres and N. Ramirez | A single voucher examined from USNM |
| | Philodendron ligatum Schott | COSTA RICA: Heredia (La Selva Biological Station) | Label data of H. Young | A single voucher examined from INBC |
| | Socrates sp. | VENEZUELA (Henri Pittier National Park) | Seres and Ramirez 1995 | Based on other observed specimens collected by Seres and Ramirez from this locality this scarab was reported as C. saxipincta and is Cyclocephala morphospecies 3 sensu Moore 2011 |
| | Xanthosoma sp. | VENEZUELA (Henri Pittier National Park, Rancho Grande) | Label data of A. Seres and N. Ramirez | A single voucher examined from USNM |
| | Xanthosoma undipes (K. Koch & C. D. Bouché) K. Koch | VENEZUELA (Henri Pittier National Park, Rancho Grande) | Seres and Ramirez 1995; Label data of A. Seres and N. Ramirez | The scarab was identified and reported as C. saxipincta (Seres and Ramirez 1995). A single voucher examined from USNM |
### Appendix 1. Continued.

| Species | Location | Collector | Year | Remarks |
|---------|----------|-----------|------|---------|
| *Cyclocephala brevis* Höhne, 1847 incertae sedis (Cyclocephala morphospecies 4 sensu Moore 2011) | | | | |
| *Cymbopteryx langiseta* Schery | PANAMA: Colón (Btw. Gatan and Pina) | Label data of N. A. Murray; Ratcliffe 2003 | A single voucher examined from UNSM | |
| *Philodendron sp.* | PANAMA: Colón (1 km E Rio Guanche Bridge) | Label data of B. Ratcliffe and M. Jameson | A single voucher examined from UNSM | |
| *Dieffenbachia longispatha* Engl. and K. Krause | PANAMA (Barro Colorado Island) | Beath 1999 | | The scarab was reported as *C. sexpunctata* which is not recorded from Barro Colorado Island (Ratcliffe 2003). |
| *Dieffenbachia nitidipetiolata* Croat and Grayum | COSTA RICA: Heredia (La Selva Biological Station) | Young 1990; Beath 1999 | | The scarab was reported as *C. sexpunctata* which is not recorded from La Selva (Ratcliffe 2003). The plant was reported as *D. longispatha*, which does not occur in La Selva (Croat 2004). |
| *Dieffenbachia oerstedii* Schott | COSTA RICA: San José (Granadilla de Curiñabat) | Valerio 1984 | | |
| *Philodendron fragrantissimum* (Hook.) G. Don | PANAMA (Barro Colorado Island) | Beath 1998 | | The scarab was reported as *C. sexpunctata* which is not recorded on Barro Colorado Island (Ratcliffe 2003). |
| *Philodendron ptyropleotomum* Madison | COSTA RICA: Heredia (La Selva Biological Station) | Beath 1998 | | The scarab was reported as *C. sexpunctata* which is not recorded on Barro Colorado Island (Ratcliffe 2003). |
| *Philodendron pterotum* K. Koch and Augustin | COSTA RICA: Heredia (La Selva Biological Station) | Croat 1997, citing pers. comm. with H. Young | | The scarab was reported as *C. sexpunctata* which is not recorded in La Selva (Ratcliffe 2003). |
| *Xanthosoma helleborifolium* (Jacq.) Schott | PANAMA (Barro Colorado Island) | Beath 1998 | | The scarab was reported as *C. sexpunctata* which is not recorded at Barro Colorado Island (Ratcliffe 2003). |
| *Xanthosoma mexicanum* Liebm. | PANAMA (Barro Colorado Island) | Beath 1998 | | |
| *Xanthosoma spermatophyllum* (Schott) Standl. | ECUADOR | Ohaus 1910 | | |
| *Annona mucicata* L. | COSTA RICA: Limón | Villalta 1988; Ratcliffe 1992a | | |
| *Baccauris hondurensis* Standl. | COSTA RICA: Heredia (La Selva Biological Station) | Bullock 1981; Ratcliffe 1992a | | |
| *Rhodospatha sp.* | COSTA RICA: Limón | Ratcliffe 1992a | | |
| *Cyclocephala brittonii* Endrődi, 1964 | | | | |
| *Magnolia tamaulipana* Vasquez | MEXICO: Tamaulipas (El Cielo Reserve) | Dieringer et al. 1998; Dieringer et al. 1999 | | |
| *Cyclocephala cælestis* Ratcliffe and Delgado, 1990 | | | | |
| *Cyclocephala camachicolus* Ohaus, 1910 | | | | |
| *Xanthosoma sp.* | ECUADOR (west side of Cordiller) | Ohaus 1910 | | |
| *Philodendron wendlandii* Schott | NO DATA | Ratcliffe 2003, citing pers. comm. from H. Young | | |
| *Dieffenbachia longispatha* Engl. and K. Krause | PANAMA (Barro Colorado Island) | Beath 1999 | | |
| *Xanthosoma helleborifolium* (Jacq.) Schott | PANAMA (Barro Colorado Island) | Beath 1998 | | |
| *Xanthosoma mexicanum* Liebm. | PANAMA (Barro Colorado Island) | Beath 1998 | | |
| *Cyclocephala carbonaria* Arrow, 1911 | | | | |
| *Nymphæa glandulifera* Rodschied | SURINAME | Cramer et al. 1975 | | |
| *Nymphæa rugosa* G. Mey. | BRAZIL: Amazonas (Manaus) | SURINAME | Cramer et al. 1975; Prance and Anderson 1976 | |
| *Victoria amazonica* (Poep.) J. C. Sowerby | BRAZIL: Amazonas | von Bayern 1897; Knuth et al. 1984; Geissner 1962 | | |
**Appendix 1. Continued.**

| Cyclotrichas celata       | Caladium bicolor (Aiton) Vent.                   | BRAZIL: Pernambuco (Goiana) | Maia and Schlindwein 2006 |
|--------------------------|-------------------------------------------------|-----------------------------|---------------------------|
|                           | Gearum brasilense N. E. Jr.                     | BRAZIL: Tocantins (Arraia)  | Gonçalves and Maia 2006   |
|                           | Philodendron acutatum Schott                    | BRAZIL: Pernambuco (Goiana, Igarassu) | Maia et al. 2010         |
|                           | Taccaurus ulei Engl. and K. Krause              | BRAZIL: Pernambuco          | Maia et al. 2010, citing unpublished data of A. C. D. Maia, C. Schlindwein and M. Gibernau; Maia et al. 2012 |

| Cyclotrichas cearensis   | Taccaurus ulei Engl. and K. Krause              | BRAZIL: Pernambuco          | Maia et al. 2012         |

| Cyclotrichas colasi      | Araceae                                         | FRENCH GUIANA               | Ponchel 2006             |
|--------------------------|-------------------------------------------------|-----------------------------|---------------------------|
|                           | Montrichardia arborescens (L.) Schott           | FRENCH GUIANA: Kourou, Sinnamary | Gibernau et al. 2003; Ponchel 2006 |
|                           | Montrichardia linifera (Arruda) Schott          | FRENCH GUIANA               | Ponchel 2006             |
|                           | Philodendron melinonii Brong. ex Regel          | FRENCH GUIANA: Kourou       | Gibernau et al. 2000; Ponchel 2006 |
|                           | Philodendron solimoense A. C. Sm.               | FRENCH GUIANA: (between Kourou and Sinnamary) | Gibernau et al. 1999; Ponchel 2006; Seymour et al. 2009 |

| Cyclotrichas conspicua   | Cyclanthus bipartitus Poit. ex A. Rich.         | COSTA RICA: Herédia (La Selva Biological Station) | Beach 1982 |
|--------------------------|-------------------------------------------------|-----------------------------|---------------------------|
|                           | Dieffenbachia nitipetiolata Croat & Grayum      | COSTA RICA: Herédia (La Selva Biological Station) | Beach 1982; Young 1988a; Young 1990 |

| Cyclotrichas consp. consp. | Dieffenbachia spp.                             | COSTA RICA: Herédia (La Selva Biological Station) | Beach 1982 |

| Cyclotrichas consp. consp. | Philodendron correae Croat                      | PANAMA: Bocas del Toro (near continental divide) | Croat 1997 |

| Cyclotrichas cribrata    | Astrocaryum aculeatus (Schott) Burret           | BRAZIL: São Paulo            | Luederwald 1926         |
|--------------------------|-------------------------------------------------|-----------------------------|---------------------------|
|                           | Philodendron bipinnatifidum Schott ex Endl.     | BRAZIL: São Paulo (Botucatu) | Gottsberger and Amaral 1984; Gottsberger 1986 |
|                           | Philodendron sp.                                | BRAZIL: São Paulo           | Luederwald 1926         |

| Cyclotrichas discicolor   | Bactris major Jacq.                            | COLOMBIA                    | Núñez-Avellaneda and Neita 2009 |

| Cyclotrichas discolor    | Aphrodrus natalis (Balslev & A. J. Henderson) Barfod | COLOMBIA: Chocó | Ervik et al. 1999 |
|--------------------------|--------------------------------------------------------|-----------------------------|---------------------------|
|                           | Areaceae                                               | PERU                        | Ponchel 2006             |
|                           | Oenocarpus bataua Mart.                                | COLOMBIA: Antioquia, Chocó, Meta | Núñez-Avellaneda and Rojas-Robles 2008; Núñez-Avellaneda and Neita 2009 |

| Cyclotrichas distincta   | Attalea funifera Mart.                               | BRAZIL: Bahia               | Vöckes 2002             |

| Cyclotrichas emarginata  | Araceae                                               | FRENCH GUIANA               | Ponchel 2006             |
|--------------------------|--------------------------------------------------------|-----------------------------|---------------------------|
|                           | Philodendron solimoense A. C. Sm.                      | FRENCH GUIANA               | Gibernau et al. 1999     |

| Cyclotrichas epistomalis | Asplenium sp.                                         | MEXICO                      | Racilhfe and Morón 1997  |
|--------------------------|--------------------------------------------------------|-----------------------------|---------------------------|
| Bates, 1888              | Astrocaryum mexicanum Liebm. ex Mart.                  | MEXICO: Veracruz (Los Tuxtlas) | Bárcuez et al. 1987; Aguirre et al. 2011 |
|                           | Astrocaryum sp.                                        | MEXICO                      | Racilhfe and Morón 1997  |
|                           | Monstera sp.                                           | MEXICO                      | Racilhfe and Morón 1997  | The plant was reported as Astrocaryon [sic] sp. |
### Appendix 1. Continued.

| Species                        | Common Name                          | Location                                      | collectors | References                                      | Notes |
|--------------------------------|--------------------------------------|-----------------------------------------------|------------|-------------------------------------------------|-------|
| *Cyclocephala forsteri*        | Endrödi, 1963                        | Acrocomia aculeata (Jacq.) Lodd. ex Mart.     | BRAZIL: Distrito Federal (Plana-Ltina Area), Mato Grosso do Sul | Scarlato et al. 1991; Núnez-Avellaneda and Neia 2009; de Oliveira and Ávila 2011 |       |
|                               |                                      | COLOMBIA                                      |            |                                                 |       |
|                               |                                      | Guatemala: Sololá (Las Tarrales Reserve)      |            |                                                 |       |
|                               |                                      | HONDURAS: Francisco Morazán (El Zamorano)     |            |                                                 |       |
| *Dieffenbachia longispatha*   | Englund. and K. Krause               | PANAMA (Barro Colorado Island)                |            |                                                 |       |
|                               | Engl.                               |                                              |            |                                                 |       |
|                               |                                      | COSTA RICA: Heredia (La Selva Biological Station) |            | Young 1986; Young 1988a; Young 1988b; Young 1990; Beath 1999; Ratcliffe 2003 | The plant was reported as D. longispatha (Croat 2004). |
|                               |                                      | PANAMA: Colón                                 |            |                                                 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Montrichardia arborescens*   | (L.) Schott                         | VENEZUELA: Guárico State (near Calabozo)     |            | Ramirez and Brito 1992                         |       |
|                               |                                      |                                              |            |                                                 |       |
| *Philodendron grandipes*      | K. Krause                            | COSTA RICA: Heredia (La Selva Biological Station) |            | Young 1986; Croat 1997; Croat 1997, citing pers. comm. with H. Young |       |
|                               |                                      |                                              |            |                                                 |       |
| *Xanthosoma helleborifolium*  | (Jacq.) Schott                      | PANAMA (Barro Colorado Island)                |            | Beath 1998                                     |       |
|                               | Engl.                               |                                              |            |                                                 |       |
| *Xanthosoma mexicanum*        | Liebm.                              |                                              |            |                                                 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala gregaria*       | Heyn. and Taschenberg, 1907          | Xanthosoma daguense Engl.                     | COLOMBIA: Risaralda (Sanctuario de Fauna y Flora Otún-Quimbaya) | García-Robledo et al. 2004; García-Robledo et al. 2005 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala guianae*        | Endrödi, 1969                        | Oenocarpus bacaba Mart.                      | BRAZIL: Amazonas | Küchmeister et al. 1998                        |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala hardyi*         | Endrödi, 1975                        | Victoria amazonica (Poeppl.) J. C. Sowerby   | BRAZIL: Amazonas | Endrödi 1975; Prance and Arias 1975; Seymour and Matthews 2006 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala iani*           | Ratcliffe, 1992b                     | Annona nitida Mart.                          | BRAZIL: Amazonas | Ratcliffe 1992b                                |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala inca*           | Endrödi, 1966                        | Attalea insignis (Mart.) Drude                | COLOMBIA | Núñez-Avellaneda and Neia 2009                  |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala jalapensis*     | Casey, 1915                          | Magnolia schiedesona Schill.                 | MEXICO: Veracruz (Xalapa area) | Dieringer and Delgado 1994; Dieringer and Espinosa 1994 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Dieffenbachia nitidipetiolata* | Croat & Grayum                   | COSTA RICA: Heredia (La Selva Biological Station) |            | Young 1986; Young 1988a; Young 1990 | The plant was reported as D. longispatha (Croat 2004). |
|                               |                                      |                                              |            |                                                 |       |
| *Philodendron radiatum*       | Schott                              | NO DATA                                      |            | Croat 1997                                     |       |
|                               | (Engl.) Croat & Grayum               |                                              |            |                                                 |       |
|                               |                                      | COSTA RICA: Heredia (La Selva Biological Station) |            | Young 1987                                     |       |
|                               |                                      |                                              |            |                                                 |       |
| *Philodendron tripartitum*    | (Jacq.) Schott                      | COSTA RICA: Heredia (La Selva Biological Station) |            | Croat 1997, citing pers. comm. from H. Young |       |
|                               |                                      |                                              |            |                                                 |       |
| *Xanthosoma daguense*         | Engl.                               | COLombia: Risaralda (Sanctuario de Fauna y Flora Otún-Quimbaya) |            | García-Robledo et al. 2004; García-Robledo et al. 2005 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala laminata*       | Burmeister, 1847                     | Cereus pernambucensis Lerm.                   | BRAZIL: Rio de Janeiro | Rosa et al. 1995; Rosa et al. 1999; Lachance et al. 2001 |       |
|                               |                                      |                                              |            |                                                 |       |
| *Cyclocephala lateritia*      | Höhne, 1923                         | Annona crassiflora Mart.                     | BRAZIL: Goiás (Vila Propício) | Cavalcante et al. 2009 |       |
|                               |                                      | Araceae                                       | BRAZIL: Pará | Martínez 1968 | The search was reported as Cyclocephala lateritia (sic). |
|                               |                                      |                                              |            |                                                 |       |

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For more information, visit [http://www.insectscience.org](http://www.insectscience.org)
| Appendix 1. Continued. |
|------------------------|
| **Dieffenbachia nitidipetiolata** Croat & Grayum | COSTA RICA: Heredia (La Selva Biological Station) | Young 1986; Young 1988a; Young 1990 | The plant was reported as *D. longispitha* (Croat 2004). |
| **Philodendron cretopsum** Croat & Grayum | COSTA RICA: Heredia (La Selva Biological Station) | Ratcliffe 2003 | – |
| **Philodendron jodavistanum** G. S. Bunting | PANAMA: Panaman | Croat 1997 | – |
| **Philodendron pterocatum** K. Koch and Augustin | PANAMA (Former Canal Zone) | Croat 1997 | – |
| **Philodendron radiatum** Schott | NO DATA | Croat 1997 | – |
| **Philodendron rothschukianum** (Engl.) Croat & Grayum | COSTA RICA: Heredia (La Selva Biological Station) | Ratcliffe 2003 | – |
| **Cyclocephala lymyrima** Bates, 1888 | **Annona crossiflora** Mart. | BRAZIL: Sao Paulo | Gottsberger 1986; Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | – |
| | **Magnolia ovoata** (A. St.-Hil.) Spreng. | BRAZIL: Sao Paulo | Gottsberger 1986; Gottsberger 1989; Gottsberger et al. 2012 | – |
| **Cyclocephala laterata** Burmeister, 1847 | **Acacia pennata** (L.) Wild. | NO DATA | Ratcliffe and Morón 1997 | – |
| | **Ficus** sp. | NO DATA | Morón 1997 | – |
| | **Hibiscus rosa-sinensis** L. | NO DATA | Ratcliffe and Morón 1997 | – |
| | **Psidium** sp. | NO DATA | Morón 1997 | – |
| **Cyclocephala hanulata** Burmeister, 1847 | **Pithecellobium dulce** (Reebk.) Bentham | NO DATA | Ratcliffe and Morón 1997 | The plant was reported as *Pithecellobium* (sic) *dulce*. |
| | **Pithecellobium** sp. | COLOMBIA: Valle del Cauca | Stechauner-Rohringer and Pardo-Locarno 2010 | – |
| **Cyclocephala lutea** Endrödi, 1966 | Cactaceae | BRAZIL: Pará | Martínez 1968 | – |
| **Cyclocephala maxima** Burmeister, 1847 | **Araucaceae** | GUATEMALA: Sololá (Las Tarrales Reserve) | Label data of M. Moore | Four vouchers deposited in WICH |
| | **Malmea degreassa** (Baill.) R. E. Fr. | MEXICO: Michoacán | Murray 1993 | – |
| | **Philodendron jodavistanum** G. S. Bunting | PANAMA: Panamán | Croat 1997 | – |
| | **Philodendron giganteum** Schott | Guadeloupe archipelago | Ponchel 2006 | – |
| | **Xanthosoma robustum** Schott | MEXICO: Chiapas (Cacahuitán and Chiapa de Corzo) | Morón 1997; Morón 1997, citing pers. comm. from Beutelspacher; Ratcliffe and Morón 1997 | – |
| | **Xanthosoma wendlandii** (Schott Standl.) | COSTA RICA: Guanacaste (Nicoya) | Valero 1988 | – |
| **Cyclocephala marginata** Kirsch, 1870 [1871] | **Atala e butyracea** (Muttis ex. L.) Weis. Boer | COLOMBIA | Niñez-Avellaneda and Neita 2009 | – |
| | **Atala microcarpa** Mart. | BRAZIL: Amazonas | Küchmeister et al. 1998 | – |
| **Cyclocephala mcycoforis** Hönle, 1923 | **Acrecomia aculeata** (Jacq.) Lodd. ex Mart. | BRAZIL: Distrito Federal (Planaltina Area) | Scarlato et al. 1991 | – |
| | **Atala gerasis** Barb. Rodr. | BRAZIL | Gottsberger and Silberbauer-Gottsberger 2006 | – |
| **Cyclocephala melanae** Bates, 1888 | **Philodendron schottianum** H. Wendl. ex Schott | COSTA RICA: Cartago | Croat 1997 | – |
### Appendix 1. Continued.

| Species | Location | Author | Year | Notes |
|---------|----------|--------|------|-------|
| *Annona coriacea* Mart. | BRAZIL: São Paulo | Gottsberger 1986 | — | |
| *Brugmansia arbores (L.) Steud.* | BRAZIL: São Paulo | Ohaus 1910; Gottsberger 1986 | — | The plant was reported as *Datura arbores* without assigning authorship. The name *D. arbores* was used by three authors and is a synonym of the species listed to the left. The identity of the association with *Brugmansia* sp. is ambiguous. |
| *Brugmansia x candida* Pers. | ECUADOR | — | — | |
| *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J. Presl | COLOMBIA | Hay *et al.* 2012 | — | |
| *Cactaceae* | FRENCH GUIANA | Ponech 2006 | — | |
| *Datura inoxia* Mill. | USA: New Mexico | Cockerell 1897 | — | |
| *Datura sp.* | USA: Arizona, California, New Mexico | Moore 1937; Saylor 1945; Linsley 1960 | — | |
| *Datura wrightii* Regel | USA: Arizona | Raguso *et al.* 2003 | — | |
| *Kielmeyera variabilis* Mart. & Zucc. | BRAZIL: São Paulo | Gottsberger 1986 | — | |
| *Magnolia ova* (A. St.-Hil.) Spreng. | BRAZIL: São Paulo | Gottsberger 1986 | — | |
| *Mandevilla longiflora* (Desf.) Pichon | BRAZIL: São Paulo | Gottsberger 1986 | — | |
| *Porcelia magnifica* (Schery) R.E. Fr. | PANAMA: Veraguas | Murray 1993 | — | |
| *Cyclocephala metrica* Steinheil, 1874 | ARGENTINA: Salta | Hayward 1946 | Reported to feed on the seeds of *V. enceioloides*. |
| *Cyclocephala munda* Kirsch, 1870 [1871] | PERU: Loreto (Estación Biológica Madre Selva) | García-Robledo *et al.* 2005 | — | |
| *Monstere absonii* Schott var. absonii | COSTA RICA: Puntarenas (Monteverde) | Ratcliffe 2003, citing pers. comm. from A. Smith | — | |
| *Philodendron brennarti* Croat | COSTA RICA: San José (vicinity of Vara Blanca) | Croat 1997 | — | |
| *Philodendron sp.* | NO DATA | Valcro 1984 | — | |
| *Philodendron tysonii* Croat | PANAMA: Chiriquí (near continental divide) | Croat 1997 | — | |
| *Xanthosoma undipes* (K. Koch & C. D. Bouché) K. Koch | COSTA RICA: Guanacaste (Peñas Blancas), Puntarenas (Monteverde) | Goldwasser 1987; Goldwasser 2000; García-Robledo *et al.* 2005, citing pers. comm. with T. Croat | The plant was reported as *Xanthosoma robustum* Schott (García-Robledo *et al.* 2005, citing pers. comm. with T. Croat). |
| *Cyclocephala ohausiana* Höhne, 1923 | BRAZIL: Minas Gerais, São Paulo | Gottsberger 1986; Gottsberger 1988; Gottsberger and Silberbauer-Gottsberger 1988; Gottsberger 1989; Gottsberger and Silberbauer-Gottsberger 2006 | — | |
| *Xanthosoma sritatipes* (Kunth & C. D. Bouché) Madison | — | — | — | |
| *Cyclocephala ocypunctata* Burmeister, 1847 | BRAZIL: Goiás (Goiânia and Vila Propício) | Cavalcante *et al.* 2009 | — | |
| *Annona dioica* A. St.-Hil. | BOLIVIA: Santa Cruz | Label data of uncredited collector | Single voucher examined from UNSM | |
| *Cyclocephala ovulum* Bates, 1888 | ARGENTINA | Hayward 1946 | — | |
| *Helianthus sp.* (girsasool) | — | — | — | |
| *Inga sp.* | ECUADOR: Napo ( Yasuni Research Station) | Label data of Mary Liz Jameson | Plant voucher examined from WICH | |
| *Cyclocephala paraguayensis* Arrow, 1903 | BRAZIL: São Paulo | Gottsberger 1989 | — | |
| *Kielmeyera variabilis* Mart. & Zucc. | BRAZIL: São Paulo | Gottsberger 1986 | — | |
### Appendix 1. Continued.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona montana* Maefad. | BRAZIL: Amazonas (Manaus) | Webber 1981 | The scarab was reported from cultivated *A. montana*. |
| *Annona muricata* L. | BRAZIL: Amazonas (Manaus) | Webber 1981 | – |
| *Annona nitida* Mart. | BRAZIL: Amazonas (Manaus) | Webber 1981 | – |

#### Cyclocephala picata
Burmeister, 1847

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Xanthosoma robustum* Schott | MEXICO: Venecruz | Morón 1977 | – |

#### Cyclocephala prolongata
Arrow, 1902

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Attalea anygdalina* Kuntz | COLOMBIA: Nínez-Avellaned and Neta 2009 | – | – |

#### Cyclocephala as. putrida
Burmeister, 1847

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Nymphaea lasiophylla* Mart. & Zucc. | BRAZIL (northeastern) | Wiersma 1987 | – |

#### Cyclocephala quadripunctata
Höhne, 1923

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Aphandra natalis* (Batslelf & A. J. Henderson) Barford | COLOMBIA: Chocó | Ervik *et al.* 1999 | – |
| *Attalea insignis* (Mart.) Drude | COLOMBIA: Nínez-Avellaned and Neta 2009 | – | – |
| *Phyletafre macrocarpa* Ruiz & Pav. | COLOMBIA: Chocó | Ervik *et al.* 1999 | – |

#### Cyclocephala quatuordecimpunctata
Mannerheim, 1829

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona aurantica* Barb. Rodr. | BRAZIL: Mato Grosso | Silberbauer-Gottberger *et al.* 1997 | Anecdotal, citing Gotsberger (1989) and Gotsberger and Silberbauer-Gottberger (1988). This association was not verifiable in cited literature. |

#### Cyclocephala cornifolia
St.-Hil.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona cornifolia* A. St.-Hil. | BRAZIL: Minas Gerais (Indianápolis); São Paulo (Botucatu) | Gotsberger 1986; Gotsberger 1988; Gotsberger 1999; Gotsberger and Silberbauer-Gottberger 2006 | The scarab was reported as *C. inpunctata* (Gotsberger 1986) |

#### Cyclocephala crassiflora
Mart.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona crassiflora* Mart. | BRAZIL: Brasilia (Chapada dos Veadeiros, north of Brasilia); Goiás; Minas Gerais (Indianápolis); São Paulo (Botucatu) | Gotsberger 1986; Gotsberger and Silberbauer-Gottberger 2006 | The scarab was reported as *C. inpunctata* (Gotsberger 1986) |

#### Cyclocephala dioica
A. St.-Hil.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona dioica* A. St.-Hil. | BRAZIL: Mato Grosso; Minas Gerais (Indianápolis); São Paulo (Botucatu) | Gotsberger 1986, citing pers. obs. by Silberbauer Gotsberger; Gotsberger 1988; Gotsberger 1999; Gotsberger and Silberbauer-Gottberger 2006 | The scarab was reported as *C. inpunctata* (Gotsberger 1986) |

#### Cyclocephala hybrid forms 1 & 3

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona hybrid forms 1 & 3* | BRAZIL: Mato Grosso | Silberbauer-Gottberger *et al.* 1997 | – |

#### Cyclocephala mainean *R. E. Fr.* x *Annona coriacea* Mart.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona mainean* R. E. Fr. x *Annona coriacea* Mart. | BRAZIL: Mato Grosso | Gotsberger and Silberbauer-Gottberger 2006 | – |

#### Cyclocephala monticola
Mart.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona monticola* Mart. | BRAZIL: Minas Gerais | Gotsberger and Silberbauer-Gottberger 2006 | – |

#### Cyclocephala tomentosa
R. E. Fr.

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Annona tomentosa* R. E. Fr. | BRAZIL: Brasilia; Minas Gerais (Indianápolis) | Gotsberger 1989; Gotsberger 1999; Gotsberger and Silberbauer-Gottberger 2006 | – |

#### NO DATA

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *NO DATA* | BRAZIL | Mannerheim 1829 | – |

#### Cyclocephala queratinum
Burmeister, 1847

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Montrichardia arboresens* (L.) Schott | FRENCH GUIANA | Ponchel 2006 | – |
| *Nymphaceae* | FRENCH GUIANA | Ponchel 2006 | – |

#### Cyclocephala rondoniana
Raccliff, 1992b

| Species | Distribution | Sources | Notes |
|---------|--------------|---------|-------|
| *Attalea ataloides* (Barb. Rodr.) Wess. Boer | BRAZIL: Amazonas | Küchmeister *et al.* 1998 | – |
### Appendix 1. Continued.

| Species and Taxonomy | Location | Description | Voucher Details | Notes |
|----------------------|----------|-------------|-----------------|-------|
| **Cyclocephala rubescens**<br>Bates, 1891 |  |  |  | C. rubescens is not recorded in Panama (Ratcliffe 2003). |
| *Philodendron grayumii*<br>Croat | PANAMA; Cocle (near El Copé) |  |  |  |
| *Cyclocephala rubrovia*<br>Arrow, 1911 |  |  |  |  |
| Areaceae | FRENCH GUIANA | Ponchel 2006 |  |  |
| Areaceae | BRAZIL: Manaus (Reserva Duque) | Label data of J. Gottsberger; Ponchel 2006 | A single voucher examined from UNSM |  |
| Areaceae | FRENCH GUIANA |  |  |  |
| Areaceae | BRAZIL: Manaus (Reserva Duque) | Label data of S. Vidal | Two vouchers examined from deposited UNSM |  |
| **Cyclocephala rustica**<br>(Olivier, 1789) |  |  |  |  |
| Caladium bicolor (Alton) Vent. | SURINAME | Pellmyr 1985; Label data of M. Gibernau | Two vouchers examined from in UNSM |  |
| Dieffenbachia seguine (Jacq.) Schott | FRENCH GUIANA (Nouragues) | Label data of M. Gibernau | Five voucher specimens examined from UNSM |  |
| *Philodendron calicosum* K. Krause | NO DATA |  |  |  |
| *Philodendron pterianum* Steyerm. | NO DATA |  |  |  |
| **Cyclocephala santartae**<br>Ratcliffe, 1992a |  |  |  | The plant voucher is listed as Ramirez 1163 by Croat (1997). In the Tropicos database Ramirez 1163 is a specimen of *Philodendron calicosum* K. Krause. |
| Attalea insignis (Mat.) Drude | COLOMBIA | Núñez-Avellaneda and Netta 2009 |  |  |
| Oenocarpus sp. | ECUADOR: Napo | Label data of H. Bailes and A. Henderson | Three voucher specimens examined from UNSM |  |
| **Cyclocephala sarpedon**<br>Ratcliffe, 1992b | Oenocarpus bacaba Mart. |  |  |  |
| Areaceae | GUATEMALA: Sololá (Las Tarrales Reserve); Huehuetenango (Zapoté) | Label data of M. Moore; Label data of F. Capistran; Bates 1888 | Two specimens deposited in WICH. A single voucher examined from UVGC (Capistran). |  |
| Xanthosoma robustum Schott | MEXICO: Chiapas (Cacaahaotán); Guerrero (Mochitan, Achauiolita) | Morón 1997; Label data of L. Delgado | A single voucher examined from UVGC. Morón (1997) reported this beetle as *C. sexpunctata*. |  |
| Xanthosoma sagittifolium (L.) Schott | MEXICO: Chiapas (Cacaahaotán) |  |  |  |
| Xanthosoma sp. | GUATEMALA: Quetzaltenango (El Palmar near Finca El Faro) | Label data of E. Cano | A single voucher examined from UVGC. |  |
| Xanthosoma wordlandii (Schott) Standl. | MEXICO: Chiapas (Cacaahaotán) | Morón 1997 |  |  |
| **Cyclocephala sexpunctata**<br> Laporte, 1840 incertae sedis (*Cyclocephala* morphospecies 1 sensu Moore 2011) |  |  |  |  |
| Alocasia macrorrhizos<br>(L.) G. Don | COSTA RICA: San José (Parque del Este) | Label data of uncredited collector; Valero 1984 | Eight voucher specimens examined from UNSM |  |
| Areaceae | PANAMA: Chiriquí (La Fortuna, Quebrada Al Trail) | Label data of J. Ashe & A. Brooks | A single voucher examined from KSEM |  |
| *Philodendron tripartitum*<br>(Jacq.) Schott | COSTA RICA: San José (Parque del Este) | Label data of uncredited collector | Two vouchers examined from UNSM |  |
| Xanthosoma sp. | COSTA RICA: Alajuela (San Ramon, Río S. Iverenciio) | Label data of A. Solis | A single voucher examined from INBC |  |
### Appendix 1. Continued.

| Species | Collection Details | Location | Year | Notes |
|---------|--------------------|----------|------|-------|
| *Philodendron grandipes* K. Krause | NO DATA | Croatia | 1997 | – |
| *Philodendron grayumii* Croat | PANAMA: Coclé (near El Coped) | PANAMA: Panamá | Croatia 1997 | – |
| *Philodendron sagittifolium* Liebm. | PANAMA: Panamá | PANAMA: Panamá | Croatia 1997 | – |
| *Philodendron solimoensense* A. C. Sm. | FRENCH GUIANA | Gibernau *et al.* 1999 | – |
| *Xanthosoma poeppligii* Schott | PERÚ: Loro (Estación Biológica Madre Selva) | Gibernau *et al.* 2005 | – |
| *Xanthosoma undipes* (K. Koch & C. D. Bouché) K. Koch | COSTA RICA: Cartago (San Ramón de la Unión), Guanacaste (Péinas Blancas), Puntarenas (Monteverde) | Gibernau *et al.* 1997; Seis *et al.* 1995; Goldwasser 1997; Gibernau *et al.* 2000; Gibernau *et al.* 2005 | – |
| *Xanthosoma wendlandii* (Schott) Standl. | COSTA RICA: Heredia (Santo Domingo); Alajuela (Alajuela) | Valero 1988 | – |
| *Philodendron solimoensense* A. C. Sm. | FRENCH GUIANA | Gibernau and Barba 2002 | – |
| *Philodendron squamiferum* Poir. | FRENCH GUIANA: Kourou | Gibernau and Barba 2002 | – |
| *Annona purpurea* Moc & Sessé ex Dunl | MEXICO: Michoacán | Murray 1993 | – |
| *Cymbopetalum ballonianii* R. E. Fr. | MEXICO: Veracruz | Murray 1993 | – |
| *Cymbopetalum costaricense* (Donn. Sm.) R. E. Fr. | MEXICO: Heredia (La Selva Biological Station) | Schatz 1985 | – |
| *Cymbopetalum gracile* R. E. Fr. | MEXICO: Guerrero | Murray 1993 | – |
| *Cymbopetalum hintonii* Lundell | MEXICO: Jalisco | Murray 1993 | – |
| *Cymbopetalum torulosum* G. E. Schatz | MEXICO: Veracruz | Schatz 1985 | – |
| *Malmea aff. depressa* (Baill.) R. E. Fr. | ESTACION BIOLÓGICA LOS TUXTLAS | Schatz 1987 | – |
### Appendix 1. Continued.

| Species                                      | Location/Collection Details                                      | Reference(s)                       |
|----------------------------------------------|------------------------------------------------------------------|------------------------------------|
| *Annona montana* Macfad.                     | BRAZIL: Amazonas (Amazonia) Webber 1981                           | The scarab was reported from cultivated *A. montana*. |
| *Annona muricata* L.                        | BRAZIL: Amazonas (Manaus) Webber 1981                           | The scarab was reported from cultivated *A. muricata*. |
| *Annona sp. ex aff. Annona paludosa* Asch.  | BRAZIL (Amazonia, near Paracutaba) Göttsberger 1989               |                                    |
| *Annona Section* Piaannona                   | NO DATA Schatz 1987                                               |                                    |
| *Aphandra natolica* (Balslev & A. J. Henderson) Barfor | ECUADOR: Morona-Santiago (20 km south of Sucia) Ervik 1993         |                                    |
| *Attalea spectabilis* Mart.                  | BRAZIL: Amazonas (Duque Forest Reserve) Küchmeister *et al.* 1993 |                                    |
| *Bactris gasipaes* Kunth                      | PERU: Huánuco (Pachitea) Listabarth 1992                          |                                    |
| *Bactris hirta var. pectinata* (Mart.) Govaerts | BRAZIL: Manaus (Reserve 1501 of Biological Dynamics of Forest Fragments Project) Henderson *et al.* 2000 |                                    |
| *Bactris sp.*                                | PERU: Huánuco (Pachitea) Listabarth 1992                          |                                    |
| *Carluvicia drudei* Mast.                    | COSTA RICA: Puntarenas Anderson and Gómez-P. 1997                 |                                    |
| *Carluvicia palmaia* Ruiz & Pav.             | COSTA RICA: Puntarenas Anderson and Gómez-P. 1997                 |                                    |
| *Cymbopogon sternophyllum* Donn. Sm.         | MEXICO: Chiapas Murray 1993                                       |                                    |
| *Diospyros nitida* Mart.                     | NO DATA Pellmyr 1985, citing pers. comm. from J. Beach           | The plant was reported as *D. nitida* [sic]. |
| *Duguetia spixiana* Mart.                    | PERU: Madre de Dios (Tambopata) Maas *et al.* 2003                 |                                    |
| *Echinopsis ancirophyra* Spec. subsp. ancistrophora | ARGENTINA Slumpberger *et al.* 2009                             |                                    |
| *Elaeis oleifera* (Kunth) Cortés             | NO DATA Hardon 1969, citing unpublished data of J. J. Hardon     |                                    |
| *Hancornia speciosa* Gomes                   | BRAZIL: Minas Gerais Göttsberger 1986                             |                                    |
| *Magnolia ovoida* (A. St.-Hil.) Sprang.      | BRAZIL: São Paulo Göttsberger 1986                               |                                    |
| *Oenocarpus bacaba* Mart.                    | BRAZIL: Amazonas Küchmeister *et al.* 1998                        |                                    |
| *Opuntia monacantha* Haw.                    | BRAZIL: Santa Catarina (Florianópolis) Lenzi and Inácio Orth 2011 |                                    |
| *Philodendron aurutiliolum* subsp. aurutiliolum* Schott | COSTA RICA: Heredia (La Selva Biological Station) Grayum 1996       |                                    |
| *Philodendron psittacinum* Steyerm. var. rugosum Bunt. | VENEZUELA: Bolivar (Canaima National Park) Ramírez 1989         | Two unidentified *Cyclocephala* species came to *P. psittacinum*. One scarab species was identified as *C. atricicapilla* [sic] (= *C. atricapilla* in Ramírez 1992). |
| *Porcelia sp.*                               | NO DATA Schatz 1987, citing pers. comm. from P. J. M. Maas       |                                    |
| *Prosakia sp.*                               | BRAZIL: Minas Gerais Göttsberger 1986                             |                                    |
| *Syngonium sanconna* (Kunth) H. Karst.       | COLOMBIA Núñez-Avellaneda and Neita 2009                          |                                    |
| *Syngonium triplum* Birdsey ex Croat         | COSTA RICA Croat 1981, citing pers. comm. from T. Ray             |                                    |
| *Tabernaemontana* sp.                       | BRAZIL: Minas Gerais Göttsberger 1986                             |                                    |
| *Wettinia quintana* (O. F. Cook & Doyle) Burret | COLOMBIA: Chocó (El Anagral Biological Station) Núñez *et al.* 2005 |                                    |
| *Xanthosoma undipes* (K. Koch and C. D. Bouché) Koch | VENEZUELA (Henri Pittier National Park) Seres and Ramírez 1995 |                                    |
| *Xanthosoma wendlandii* (Schott) Standl.    | COSTA RICA: Guanacaste (Carmona de Naundayre) Valerio 1988        |                                    |
## Appendix 1. Continued.

| Species | Location | Reference | Notes |
|---------|----------|-----------|-------|
| Astrocyrum alatum Loomis | COSTA RICA | Villa 1988; Ratcliffe 2003 | — |
| Annona muricata L. | COSTA RICA | Bullock 1981 | — |
| Bactris coloradonis L. Bailey | COSTA RICA | Ratcliffe 2003 | — |
| Bactris hondurensis Standl. | COSTA RICA | Bullock 1981 | — |
| Oenocarpus batatae Mart. | COLOMBIA: Antioquia, Chocó, Meta | Nunez-Avellaned and Rojas-Robles 2008 | — |
| Xanthosoma sagittifolium (L.) Schott | MEXICO: Chiapas (Cacahauatan) | Morin 1997 | — |
| Xanthosoma wendlandii (Schott) Standl. | MEXICO: Chiapas (Cacahauatan) | Morin 1997 | — |
| Cyclanthus bipartitus Poit. ex A. Rich. | VENEZUELA (Henri Pittier National Park) | Seres and Ramirez 1995 | — |
| Dieffenbachia nitidipetiola Croat & Grayum | COSTA RICA: Heredia (La Selva Biological Station) | Young 1986; Young 1988; Young 1990 | C. tutillina is not recorded in Costa Rica (Ratcliffe 2003). The plant was reported as D. longispatha (Creay 2004). |
| Dieffenbachia seguine (Jacq.) Schott | VENEZUELA: Aragua (Henri Pittier National Park) | Ratcliffe and Cave 2006; Label data of A. Seres and N. Ramirez | The plant was reported as D. seguine [sic] (Ratcliffe and Cave 2006). A single voucher was examined from UNSM. |
| Philodendron macroglossum Schott | VENEZUELA (Henri Pittier National Park) | Seres and Ramirez 1995 | — |
| Xanthosoma sp. | ECUADOR | Ohaus 1910; Label data of A. Seres and N. Ramirez | A single voucher examined from UNSM |
| Xanthosoma undipes (K. Koch and C. D. Bouché) K. Koch | VENEZUELA (Henri Pittier National Park) | Seres and Ramirez 1995 | — |
| Cyclanthus tylifera Höhne, 1923 | Philodendron squamiferum Poir. | FRENCH GUIANA: Kourou | Gibernau and Barahi 2002; Ponchel 2006 | — |
| Annona foetida Mart. | BRAZIL: Amazonas (Manaus) | Gottsberger 1999, citing unpublished data of A. C. Weber and G. Gottsberger | — |
| Annona montana Macfad. | NO DATA | Gottsberger et al. 1998 | — |
| Bactris hirta Mart. | BRAZIL: Amazonas | Küchmeister et al. 1998 | — |
| Cympodecatum eunervum N. A. Murray | BRAZIL: Amazonas (Duque Forest Reserve) | Weber and Gottsberger 1993 | — |
| Duguetia asterotricha (Diels) R. E. Fr. | BRAZIL: Manaus | Label data of G. Gottsberger | A single voucher examined from UNSM |
| Duguetia riparia Huber | BRAZIL: Amazonas | Küchmeister et al. 1998 | — |
| Duguetia sul (Diels) R. E. Fr. | BRAZIL: Amazonas | Küchmeister et al. 1998 | — |
| Malmia manausensis Maas & Miralha | NO DATA | Gottsberger et al. 1998 | — |
| Montrichardia arborescens (L.) Schott | FRENCH GUIANA | Ponchel 2006 | — |
| Cyclanthus variabilis Burmeister, 1847 | Attalea geraniensis Barb. Rodr. | BRAZIL: São Paulo | Gottsberger 1986 | — |
| Montrichardia arborescens (L.) Schott | FRENCH GUIANA: Kourou, Sinnamary | Gibernau et al. 2003; Ponchel 2006 | — |
| Montrichardia linifera (Arruda) Schott | FRENCH GUIANA | Ponchel 2006 | — |
| Nympheaeaceae | FRENCH GUIANA | Ponchel 2006 | — |
| Cycloopshpala variolosa Burmeister, 1847 | Philodendron bipinnatifidum Schott ex Endl. | BRAZIL: São Paulo (Botucatu) | Gottsberger and Aamaral 1984; Gottsberger 1986 | — |
| Philodendron sp. | BRAZIL: São Paulo (Botucatu) | Gottsberger and Aamaral 1984 | — |
| Cycloopshpala vestita Höhne, 1923 | Annona muricata L. | BRAZIL (northeastern) | Cavalcante 2000; Maia et al. 2010, citing unpublished data of Maia, Schindwein and Gibernau | — |
| Montrichardia arborescens (L.) Schott | FRENCH GUIANA: Kourou, Sinnamary | Gibernau et al. 2003; Ponchel 2006 | — |
### Appendix 1. Continued.

| Genus                        | Species                              | Location                      | Collection Data                                      | Notes                                                                 |
|------------------------------|--------------------------------------|-------------------------------|------------------------------------------------------|----------------------------------------------------------------------|
| **Cyclocephala verticalis**  | Burneister, 1847                     |                               |                                                      |                                                                      |
| *Corythophora rimoswa* W. A. | Rodrigue                            | BRAZIL: Amazonas (Manaus)     | Prance 1976                                          |                                                                      |
| *Escheviella decolorans*     | Sandwith                             | BRAZIL: Amazonas (Manaus)     | Prance 1976                                          |                                                                      |
| *Escheviella* sp.            |                                     | BRAZIL: Amazonas (Manaus)     | Prance 1976                                          |                                                                      |
| *Lecithis lurida* (Miers)    | S. A. Mori                           | BRAZIL: Amazonas (Manaus)     | Prance 1976                                          |                                                                      |
| *Nymphadora amazonum*        | Mart. & Zucc.                        | SURINAME                      | Cramer et al. 1975; Prance and Anderson 1976         |                                                                      |
| *Nymphaea conardii*          | Wiersema                             | VENEZUELA: Barinas (Sosa)     | Wiersema 1987                                        |                                                                      |
| *Nymphaea rugosa* G. Mey.    |                                     | BRAZIL: Pará (Belém)          | Cramer et al. 1975; Prance and Anderson 1976         |                                                                      |
| *Victoria amazonica* (Poeppl) | J. C. Sowerby                       | GUYANA: Upper Takutu-Upper   | Prance and Arias 1975; Seymour and Matthews 2006     |                                                                      |
|                             |                                      | Essequibo (Kararambu Ranch)  |                                                      |                                                                      |
| **Cyclocephala williamsi**   | Ratcliffe, 1992a                     | Psidium sp.                   | Ratcliffe 1992a; Ratcliffe 2003                      |                                                                      |
| *Annona sp. ex aff. Annona*  | densuscima Mart.                     | BRAZIL (lower Rio Purús)     | Gottsberger 1989                                     | The scarab was attracted to floral odors but was not collected in inflorescences (Gottsberger 1989). |
|                              |                                      |                               |                                                      |                                                                      |
| **Dieffenbachia nitidipetala** | Croat & Grayum                     | COSTA RICA (La Selva Biological Station) | Young 1986; Young 1988a; Young 1988b; Young 1990; Beath 1999; Ratcliffe 2003 | The plant was reported as *D. longispina* (Croat 2004). |
| *Dieffenbachia sp.*          |                                     | COSTA RICA (La Selva Biological Station) | Label data of M. Grayum | A single voucher examined from INBC |
| **Philodendron anisotomum**  | Schott                               | COSTA RICA (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                                                                      |
| *Philodendron aurantifolium* | Schott                               | COSTA RICA (La Selva Biological Station) | Label data of M. Grayum; Grayum 1996 | A single voucher examined from INBC. *Grayum (1996)* reported this beetle as *E. proba* Sharp, which does not occur in Costa Rica (Ratcliffe 2003) |
| *Philodendron brevipes*      | Schott                               | COSTA RICA (La Selva Biological Station) | Grayum 1996; Croat 1997 | Beetle was reported as *E. proba* Sharp (Grayum 1996; Croat 1997), which does not occur in Costa Rica (Ratcliffe 2003) |
| *Philodendron gaudíipes*     | K. Krause                            | COSTA RICA: Limón             | Croat 1997                                           |                                                                      |
| *Philodendron guttiferum*    | Kunth                                | COSTA RICA (La Selva Biological Station) | Morón 1997, citing pers. comm. from A. Solis |                                                                      |
| *Philodendron jodavistanum*  | G. S. Bunting                        | COSTA RICA (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                                                                      |
| *Philodendron radianum*      | Schott                               | COSTA RICA (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                                                                      |
| *Philodendron rotshackianum* | (Engl.) Croat & Grayum               | COSTA RICA (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                                                                      |
| *Philodendron tripartitum*   | (Jacq.) Schott                       | COSTA RICA (La Selva Biological Station) | Croat 1997, citing pers. comm. from H. Young |                                                                      |
| *Symposium schottianum*      | Wendl. ex Schott                     | COSTA RICA (La Selva Biological Station) | Morón 1997, citing pers. comm. from A. Solis; Beath 1998; Label data of M. Grayum | Three vouchers examined from INBC                                     |
### Appendix 1. Continued.

| Species | Genera | Location | Collector(s) | Data Source | Notes |
|---------|--------|----------|--------------|-------------|-------|
| *Erioscelis emarginata* (Mannerheim, 1829)  
  *Philodendron bipinnatifidum* Schott ex Endl.  
  *Xanthosoma striatipes* (Kunth & C. D. Bouché) Madison | Araceae | BRAZIL: Pará | Martínez 1968 | – |
| NO DATA | BRAZIL | Mannerheim 1829 | – |
| *Dieffenbachia seguine* (Jacq.) Schott  
  *Montrichardia arborescens* (L.) Schott  
  *Philodendron squamiferum* Poeppl. | Dieffenbachia seguine  
  (Nouragues Field Station) | FRENCH GUIANA | Label data of M. Gibernau | 28 vouchers examined from UNSM |
| *Astrocaryum alatum* Loomis  
  *Bactris coloradonis* L. H. Bailey  
  *Bactris hondurensis* Standl.  
  *Bactris longiseta* H. Wendl. ex Burret | Astrocaryum alatum  
  (La Selva Biological Station) | COSTA RICA: Heredia  
  (La Selva Biological Station) | Bullock 1981 | – |
| *Mimeoma acuta* (Arrow, 1902) | Bactris spp. | PANAMA | Ratcliffe 2003 | – |
| *Mimeoma englemani* Ratcliffe, 1977  
  *Mimeoma maculata* (Burmeister, 1847)  
  *Mimeoma signatoides* (Höhn, 1923) | *Astrocaryum paramaca*  
  (Huatulco National Park) | FRENCH GUIANA | Poncet 2006; Poncet 2010 | The plant was reported as *Astrocaryum paramaca* (sic). |
| *Peltonotus malayensis* Arrow, 1910  
  *Peltonotus nasutus* Arrow, 1910  
  *Ruteloryctes morio* (Fabricius, 1798)  
  *Nymphaea lotus* L.  
  *Nymphaea sp.*  
  *Echinopsis anistophora* Spg. subsp. anistophora  
  *Rhodospatha sp.* | *Epipremnum falcifolium*  
  Eng. | BRUNEI | Jameson and Wada 2004 | – |
| *Amorphophallus paenunifolius* (Dennst.) Nicolson | THAILAND: Changwat  
  (Thung Yai Wildlife Sanctuary) | Grimm 2009 | – |
| *CÔTE d’IVOIRE: Zanzan* (Comité National Park)  
  *SENÉGAL: Kaolack, Tambacounda* | *Nymphaea sp.*  
  (West Indies) | Fabricius 1798 | Reports as a destructive, nocturnal scarab. Based on photographs, the beetle is probably cyclocephaline (in litt. with B. Schlumpberger, April 2011). |
| *Echinopsis anistophora* Spg. subsp. anistophora | ARGENTINA | Schlumpberger and Raguso 2008 | – |
| *Rhodospatha sp.* | COSTA RICA: Heredia  
  (La Selva Biological Station) | Schatz 1990 | – |
### Appendix 1. Continued.

| Genus                  | Country       | Location          | Collector       | Notes                                                                 |
|-----------------------|---------------|-------------------|-----------------|----------------------------------------------------------------------|
| *Bactris gasipae* Kunth | PERU          | Huánuco           | Listabarth 1996 | This scarab was reported as a most rare visitor (Listabarth 1996).    |
| *Bactris maraja* Mart. | PERU          | Huánuco           | Listabarth 1996 | This scarab was reported as a most rare visitor (Listabarth 1996).    |
| *Bactris bifida* Mart. | PERU          | Huánuco           | Listabarth 1996 | This scarab was reported as a most rare visitor (Listabarth 1996).    |
| *Bognera recondita* (Madison) Mayo & Nicolson | BRAZIL | Amazonas (Lago Cauzi near Atalaia) | Gonçalves and Maia 2006; Bogner 2008, citing unpublished data of E. G. Gonçalves | The authors did not explicitly state the locality of the association data, although extensive observations of *B. recondita* were made only in Amazonas, Brazil. |
| *Homalomena* sp.      | MALAYA        |                  | Grayum 1990, citing pers. comm. From G. E. Schatz | This is likely a misidentification. *Peltomota* was not in the Cyclocephalini prior to 2006 (Smith 2006). These beetles could be *Parastaxis* spp. (Scarabaeidae: Rutelinae), species of which are known visitors of *Homalomena* spp. on Borneo (Malaysia) (Momose et al. 1998; Chen et al. 2011). |
| *Monotera cœpitha* Madison | PANAMA | Chiriquí         | Grayum 1990   | –                                                                      |
| *Ambandra decasperma* O. F. Cook | COLOMBIA | Valle del Cauca (Buenaventura) | Cook 1927 | –                                                                      |
| *Annona montana* Macfad. | COSTA RICA | Heredia (La Selva Biological Station) | Bawa et al. 1985b | –                                                                      |
| *Asimina* sp.         | NO DATA       |                  | Gottsberger 1988 | –                                                                      |
| *Attalea speciosa* Mart. | BRAZIL | Maranhão (Lago Verde); Pará (Serra Norte, Canaã) | Anderson et al. 1988 | –                                                                      |
| *Chloropsipha* spp.   | NO DATA       |                  | Madison 1981   | –                                                                      |
| *Eudianthus funifer* (Poit.) Lindm. subsp. *funifer* | PERU (Lower Rio Liulapiachus, Panguana Field Station) | Gottsberger 1991 | –                                                                      |
| *Homalomena hennelli* Croat and Grayum | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron bipinnatifidum* Schott ex Endl. | BRAZIL | Minas Gerais (Lagoa Santa) | Warming 1883 | –                                                                      |
| *Philodendron davidsonii* Croat | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron grandipes* K. Krause | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron ligulatum* Schott | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron venosum* (Wild. Ex Schult. & Schult.f.) Croat | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron radiatum* Schott | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Philodendron rotshaeukianum* (Engl.) Croat & Grayum | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Porcella* sp.        | NO DATA       |                  | Gottsberger 1988 | –                                                                      |
| *Syngonium schottianum* H. Wendl. ex Schott | NO DATA |                  | Grayum 1984 | –                                                                      |
| *Xanthosoma robustum* Schott | NO DATA |                  | Grayum 1984 | –                                                                      |
### Appendix 1. Continued.

| Coleoptera | Philodendron acuminatissimum Engl. | NO DATA | Madison 1979 | Inflorescences of this plant species rotate to capture water after anthesis which is a strategy to drive beetles out of the spathe (Madison 1979). |
|------------|---------------------------------|---------|--------------|----------------------------------------------------------------------|
|            | Philodendron cruentospathum Madison | NO DATA | Madison 1979, citing pers. comm. from C. H. Dodson |
|            | Philodendron senatocarpium Madison | NO DATA | Madison 1979 | Inflorescences of this plant species are often filled with water which is a strategy to drive beetles out of the spathe (Madison 1979). |
|            | Philodendron venosum (Willd. ex Schult. & Schult.f.) Croat | NO DATA | Madison 1979 | Inflorescences of this plant species are often filled with water which is a strategy to drive beetles out of the spathe. Scarabs have been reported from *P. venosum* (Grayum 1984). |
|            | Rhodospatha forgetii N. E. Br. | NO DATA | Grayum 1986, citing pers. comm. from G. Schatz | The beetles could be cyclocephalines based on the observations of Schatz (1990). |
|            | Xanthoxoma sagittifolium (L.) Schott | NO DATA | Madison 1979 | The plant species displays a “drowning” strategy similar to *Philodendron* (Madison 1979). |

**Evidence of beetle feeding**

| Nymphaea oxypetala Planch. | VENEZUELA | Wiersema 1987 | – |

### Appendix 2. Cyclocephaline synonyms reported in the floral association literature.

| Valid Name | Synonym (Reported Name) | Reference |
|------------|-------------------------|-----------|
| *Cyclocephala amazona* (Liinaeus, 1767) | *Cyclocephala signata* (Fabricius, 1781) | Mora-Urpi and Solís 1980, Mora-Urpi 1982, Gotti-berger 1986 |
| *Cyclocephala brevis Hohn, 1847* | *Cyclocephala pubescens* Burmeister, 1847 | Valério 1984, Valério 1988 |
| *Cyclocephala epistomalis* Bates, 1888 | *Cyclocephala molis* Endrodi, 1963 | Prance 1980 |
| *Cyclocephala maffia* Burmeister, 1847 | *Cyclocephala maffia* (Lindem) Burmeister, 1847 | Poncet 2006 |
| *Cyclocephala melanopelephala* (Fabricius, 1775) | *Cyclocephala dimidiata* Burmeister, 1847 | Cockerell 1897, Moore 1977, Saylor 1945, Tinsley 1960 |
### Appendix 3.
Plant synonyms reported in floral association literature and on voucher specimen label data.

| Valid Name | Synonym (Reported Name) | Reference |
|------------|-------------------------|-----------|
| *Annona warmingiana* Mello-Silva & Piriápolis | *Annona pygmaea* (Warms.) Warm. | Gotschberger 1986; Gotschberger 1989 |
| *Astrocaryum aculeatissimum* (Schott) Burret | *Astrocaryum aryu* Mart. | Luederwalt 1926 |
| *Attalea speciosa* Mart. | *Ovirgynia phalerata* Mart. | Anderson et al. 1988 |
| *Attalea spectabilis* Mart. | *Ovirgynia spectabilis* (Mart.) Burret | Küchmeister et al. 1993 |
| *Bactris coloradon* L. H. Bailey | *Bactris porciflora* Burret | Beach 1984; Ratcliffe 2003 |
| *Bactris hirta* var. *pectinata* (Mart.) Govaerts | *Bactris hirta* var. *spruceana* (Trall) A.J.Hend. | Henderson et al. 2000 |
| *Bactris hondurensis* Standl. | *Bactris wendlandiana* Burret | Bullock 1981; Ratcliffe 1992a |
| *Bavaria maraja* Mart. | *Bavaria monticola* Barb. Rodr. | Listbarth 1996 |
| *Brugmansia* sp. | *Datura arborea* (no author) | Ohaus 1910; Gotschberger 1986 |
| *Cryosophila williamsii* P. H. Allen | *Cryosophila albida* Bartlett | Henderson 1984; Silberbauer-Gotschberger 1990 |
| *Datura innoxia* Mill. | *Datura meteloides* DC. ex Dunal | Cockrell 1897 |
| *Lecythis lurida* (Miers) S. A. Mori | *Holodiscus jaranum* Huber ex Duke | Prance 1976 |
| *Mandevilla longiflora* (Desf.) Pichon | *Macrospiphon longiflora* (Desf.) Müll. Arg. | Gotschberger 1986 |
| *Magnolia ovata* (A. St.-Hil.) Spreng. | *Talauma ovata* A. St.-Hil., 1824 | Gibbs et al. 1977; Gotschberger 1986; Gotschberger 1989 |
| *Oenocarpus* sp. | *Jessenia* sp. | Label data of Balslev and Henderson. Three specimens deposited in UNSM |
| *Nymphaea glandulifera* Rodschied | *Nymphaea blanda* var. *fenzliana* (Lehm.) Casp. | Cramer et al. 1975 |
| *Philodendron bipinnatifidum* Schott ex Endl. | *Philodendron selloum* C. Koch | Gotschberger 1986; Gotschberger and Amaral 1984; Gotschberger and Silberbauer-Gotschberger 1991 |
| *Philodendron venosum* (Willd. ex Schult. & Schult.F.) Croat | *Philodendron karstenianum* Schott | Grayum 1984 |
| *Phytelephas aequatorialis* Spruce | *Pseudanthera aequatorialis* (Spruce) O. F. Cook | Balslev and Henderson 1987 |
| *Tabernaemontana* sp. | *Pexchiera* sp. | Gotschberger 1986 |
| *Victoria amazonica* (Poepp.) J. C. Sowerby | *Victoria regia* Lindl. | von Bayern 1897; Knuth et al. 1904; Gessner 1962; Martínez 1968 |
| *Xanthosoma mexicanum* Liebm. | *Xanthosoma pilosum* K. Koch & Augustin | Beath 1998 |
| *Xanthosoma sagittifolium* (L.) Schott | *Xanthosoma violaceum* Schott | Morón 1997 |
| *Xanthosoma striatipes* (Kunth & C. D. Bouché) Madison | *Caladium striatipes* (Kunth & C. D. Bouché) Schott | Schrottky 1910; Gotschberger 1986; Gotschberger 1989 |
| *Xanthosoma wendlandii* (Schott) Standl. | *Xanthosoma hoffmannii* [sic] (Schott) Schott | Morón 1997 |
## Appendix 4. Unavailable and unresolved plant names from the floral association literature and voucher specimen label data.

| Valid Name | Reported Name | Reference or Label Data |
|------------|---------------|-------------------------|
| *Alocasia macrorhizos* (L.) G. Don (pers. comm. with T. B. Croat, May 2011) | *Xanthosoma macrorhizas* | Valerio 1984; Label data of unaccredited collector |
| *Dieffenbachia tonduzi* Croat & Grayum (pers. comm. with T. B. Croat and M. Grayum, May 2011) | *Dieffenbachia longivaginata* Croat & Grayum *ined.* | Label data of M. Grayum. Beetle voucher specimens deposited at INBC |
| *Philodendron ligulatum* Schott (pers. comm. with T. B. Croat and M. Grayum, May 2011) | *Philodendron atlanticum* Croat & Grayum | Grayum 1984; Label data of H. Young |
| *Philodendron ptarianum* Stey. or *Philodendron rugosum* Bogner & G.S.Bunting | *Philodendron ptarianum* Stey. var. *rugosum* Bunt. | Ramírez 1989; Ramirez 1992 |
| Unresolved | *Cereus pernambucensis* Lem. | Rosa et al. 1995; Rosa et al. 1999; Lechance et al. 2001 |
| Unresolved | *Kielmeyera variabilis* Mart. & Zucc. | Gottsberger 1986 |
| Unresolved | *Malmea manausensis* Maas & Miraíha | Gottsberger et al. 1998 |

*ined: a name only that appears in an unpublished manuscript and is thus invalid.*