Key to Third-Instar Chrysomyinae (Diptera: Calliphoridae) from Carrion in the Continental United States

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ABSTRACT The introduction of 4 Chrysomya Robineau-Desvoidy spp. to the Americas has made obsolete previously published keys to Nearctic calliphorid larvae, particularly those covering the subfamily Chrysomyinae. To assist forensic entomologists, ecologists, and public health workers, we provide a key to 3rd instars of 8 chrysomyine species reported from or likely to occur in carrion within the continental United States. The rare (in the United States) species Cochliomya aldrichi Del Ponte, C. minima Shannon, and Chloroprocta idioidea (Robineau-Desvoidy) are not included because specimens and suitable descriptions were unavailable.

KEY WORDS blow fly, maggot, forensic entomology, larval morphology, invasion

ANY INVESTIGATION of carrion arthropods in North America now must consider 4 new blow flies. These members of the Old World genus Chrysomya Robineau-Desvoidy recently have become widespread in the Americas (Baumgartner and Greenberg 1984) and 2, C. albiceps (Macquart) and C. megacephala (F.), have become established in the contiguous United States (Olsen and Sidebottom 1990, Wells 1991, Baumgartner 1993, Martin et al. 1997). The other 2 species, C. rufifacies (Wiedemann) and C. chloropyga (Wiedemann) (=C. putoria), may be here soon. Although C. albiceps has not been reported in the New World outside of South America, the similar appearance of this species to C. rufifacies would make it difficult to monitor if it were spreading north through Central America, a region already occupied by the latter species (Baumgartner and Greenberg 1984). Almost certainly there is no climatic barrier to keep C. albiceps from reaching a large portion of the United States. In Europe, C. albiceps larvae have been recorded as far north as Zurich, Switzerland (Rognes 1997). The previous range of C. chloropyga spans the length of Africa (Schumann 1986). Along with C. albiceps and C. megacephala, this species entered this hemisphere via southern Brazil, and it has since spread at least as far north as Panama (see Materials and Methods). This species has the potential to seasonally invade the United States.

Adults of these invaders may be separated from the native U.S. fauna using the keys of Hall (1948) and Dear (1985) (readers who rely on Hall’s monograph should consult Dear for nomenclature changes), but the information needed to recognize the larval forms is scattered widely. Forensic entomologists, ecologists, and public health workers in the United States need a single publication that separates the larvae of these species from native members of the same subfamily, Chrysomyinae (calliphorid larvae with an incomplete peritreme, Fig. 1). We present herein a key to the 3rd instars of the common carrion-feeding Chrysomyinae now known, or likely to occur, in carrion in the continental United States. Three species, Cochliomya aldrichi Del Ponte, C. minima Shannon, and Chloroprocta idioidea (Robineau-Desvoidy), were not included because neither specimens nor suitable descriptions were available. The first 2 apparently are rare in the continental United States, and C. idioidea is unlikely to be collected in this country far from the coast of southern Texas (Hall 1948). All other Chrysomyinae in this region are obligate parasites, and their immature stages should not be found in carrion (Hall 1948, Sabrosky et al. 1989).

Materials and Methods

Third instars of the following species were examined, Cochliomya macellaria (F.) from a laboratory colony established from Kerr County, TX, USA, and others reared from adults collected in San Ramon, Peru; Phormia regina (Meigen) from a laboratory colony established with individuals from Chicago, IL, and wild larvae from Sonoma County, CA, USA; Protophormia terraenovae (Robineau-Desvoidy) from a laboratory colony established from Pullman, WA, USA; Compsomyia aspilalis (Bigot) [=Paraculula wheelri (Hough)] collected from Santa Clara, CA, USA; Chrysomya albiceps from Alexandria, Egypt, and from Campinas, Sao Paulo, Brazil; C. rufifacies from Kerr County, TX, USA, and from Okinawa, Japan; C. chloropyga reared from adults collected in San Ramon, Peru, and from Chilibre, Panama; and C. megacephala...
Fig. 1. Spiracular plate of *C. macellaria*. Arrow indicates incomplete portion of peritreme.

Fig. 2. *C. albiceps*.

Fig. 3. (A) *C. albiceps* and (B) *C. rufifacies*. Arrows indicate apical spines on tubercles.
collected from Laloki, Papua New Guinea, and from a laboratory colony established from the island of Oahu, HI, USA, and from Okinawa, Japan. At least 20 individuals of each species were examined. Vouchers have been retained in the senior author’s collection.

Whole larvae were examined in fluid with a dissection stereomicroscope. Spine patterns were sometimes difficult to see if the larva was not fully extended by placing the specimen (alive or dead) in boiling water. Selected specimens of each species were dissected and mounted in Berlese fluid for examination and photography with a compound microscope. When necessary, specimens were cleared in a solution of 10% KOH at room temperature. Specimens were prepared for scanning electron microscopy by fixation in osmium tetroxide followed by critical-point drying and gold/palladium sputter-coating. For information on larval anatomy consult Erzinclioglu (1985) and Liu and Greenberg (1989).

The characters used to separate larvae or adults of C. albiceps and C. rufifacies are variable, and a small proportion of individuals may be difficult to distinguish based on morphology (Tantawi and Greenberg 1993). An alternative method for identifying problematic specimens is based on mitochondrial DNA sequence data (Wells and Sperling 1999).

Fig. 4. Posterior dorsum of C. chloropyga showing covering of fine setae.

Fig. 5. Wet mount of C. megacephala anterior cephalopharyngeal skeleton. The pigmented base of the accessory sclerite is visible as a spot below the mouth hook.

Fig. 6. Posterior view of anal protuberance showing spinal pattern for (A) C. macellaria and (B) P. regina.
Key to 3rd Instars of Chrysomyinae from Carrion in the Continental United States

1. Larva with rows of conspicuous tubercles (Fig. 2) .................................................. 2
   Larva without tubercles ...................................... 3

2. Dorsal tubercles with relatively small apical spines, usually pointed toward center (Fig. 3A), scales on base of tubercles without pigmented points .................. Chrysomya albiceps
   Dorsal tubercles with relatively large apical spines, usually pointed away from center (Fig. 3B), scales on base of tubercles with pigmented points ............. Chrysomya rufifacies

3. Covering of fine setae present, most conspicuous on posterior dorsum (Fig. 4) ................. Chrysomya chloropyga
   Covering of fine setae absent ..................................... 4

4. Oral sclerite pigmented ........................................... 5
   Oral sclerite unpigmented ............................................. 6

5. Oral sclerite partially pigmented, visible as dark spot beneath mouth hooks (Fig. 5) ............... Chrysomya megacephala
   Oral sclerite completely pigmented, visible as a spike between mouth hooks ..................................... Compsomyiops callipes

6. Pigmented spines above anus forming a V-shaped pattern (Fig. 6A); dorsal spines absent on posterior margin of segment 11 ......................... Cochliomyia macellaria
   Pigmented spines above anus forming an oval cluster (Fig. 6B); dorsal spines present on posterior margin of segment 11 .................................... 7

7. Medial posterior papillae (P1 in Fig. 7A) relatively small; distance between medial posterior papillae ≥ distance between medial and lateral papillae (P3); most spines double-pointed ......................... Phormia regina
   Medial posterior papillae relatively large; distance between medial posterior papillae < dis-

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