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An overview of the biology of the Afrotropical butterfly genus *Crudaria* Wallengren, 1875 (Lepidoptera: Lycaenidae: Aphnaeinae), including some new observations

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Abstract: An overview of the biology of the lepidopteran genus *Crudaria* is presented, including detailed notes on, and illustrations of, the morphology and life history of the constituent species. Aphytophagy is recorded for the first time in one of the three currently recognized species and it is inferred to probably also occur in a second. Oviposition on Asteraceae is recorded for the first time for the genus. A diversity of biological characteristics within the genus are highlighted and their potential taxonomic significance is discussed. Both *C. capensis* and *C. wykehami* are confirmed as good species and we find their morphological characters to be reasonably stable. Although small regional differences were found in the male genitalia of *C. leroma*, they were found to be unreliable as primary taxonomic characters. Maximum likelihood and Bayesian consensus trees of *Crudaria* based on mitochondrial DNA show *C. leroma* as two separate clades - east and west. A further molecular study, using additional genes and more material, is needed to refine the phylogeny inferred here and before any taxonomic changes are made. In addition, formal designation of a *leroma* type is recommended in order to relate to one or other of the groups of *C. leroma* sensu lato.

Key words: Aphytophagous, entomophagous, trophallaxis, maximum likelihood, ML, bootstrap, molecular tree, mitochondrial DNA, Caffraria, dish organs, dew patches, tubercles, dorsal nectary organ, DNO, tentacular organ, TO, genitalia, uncus, saccus, vinculum, anal tuft, sclerite, symbiont, *Anoplolepis custodiens*, *Anoplolepis steingroeveri*, *Tetraena retrofracta*, *Vachellia*.

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INTRODUCTION

Over the past twenty years an interest in these dull, grey-brown butterflies has produced a collection of data and photographs by Heath that forms the basis of this review. These data have been augmented by recent biological and molecular research conducted by the authors

Crudaria is a small genus of butterflies, colloquially known as 'Greys'. The genus is classified in the myrmecophilous lycaenid subfamily Aphnaeinae. Of the 17 genera in the subfamily, six have been shown to contain at least one parasitic species. *Crudaria* was suspected to be another (Pierce, *et al*. 2002).

The type species of the genus, *leroma* Wallengren (1857), was initially placed in the genus *Arhopala* Boisduval (1832). Trimen (1870) reassigned it to *Zeritis* Boisduval [1836] and finally Wallengren (1875) erected *Crudaria* as a monotypic genus for it. The genus is presently comprised of three recognised species – *Crudaria leroma* (Wallengren, 1857), *C. capensis* van Son, 1956 and *C. wykehami* Dickson, 1983.

Crudaria is most closely related to *Cigaritis* Donzel, 1847, also within the Aphnaeinae (Boyle *et al*., 2014; Williams, 2018), and some larval traits are also shared with that genus (Clark & Dickson, 1971: 161). Two species of *Crudaria*, *C. capensis* and *C. wykehami*, are restricted to the southern Cape provinces of South Africa but *C. leroma* sensu lato (s.l.) occurs widely in southern Africa, including parts of South Africa, Botswana, Namibia, Malawi, Mozambique and Tanzania (Mecenero *et al*., 2013). *C. leroma* has many variable characteristics and is thought to represent more than one species (Kielland, 1990; Pringle *et al*., 1994; Heath, 1997a; Mecenero *et al*., 2013; Terblanche, 2017).

The life history of *C. leroma* was described and illustrated in considerable detail by Clarke (1951) and partly repeated in Clarke & Dickson (1971). Terblanche (2017) studied diversity and ecology In the Tswala Kalahari Reserve in the Northern Cape Province, focussing on *Crudaria* species as part of the Tswala Kalahari Butterfly Project. This resulted in the discovery of a potentially new species and new records of host plants and host ants. We have updated these plant and ant associations based on our research and present them here in Tables 1 & 2. However, the potentially new species 'TAS 6' is not included in this

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study as the authors have not yet seen it. Terblanche, *op. cit.*, also noted that *Anoplolepis custodiens* is an associated ant species of *C. leroma* in the Eastern Kalahari Bushveld Bioregion.

Balona & Williams (2018) described interactions between *Anoplolepis* ants and a larva of *C. leroma* at Grootgeluk Bush Camp near Moogopong, Limpopo Province.

In this study we identify and review some of the morphological, behavioural and molecular traits within the *Crudaria* genus and highlight and discuss the traits that might have taxonomic significance. In some aphnaeine genera (*Crudaria*, *Trimenia* Tite & Dickson, *Cesa* Seven, *Lipaphnaeus* Aurivillius, *Chloroselas* Butler and *Pseudaletis* Druce) females possess a densely compacted 'anal tuft' of specialized, deciduous setae at the distal end of the abdomen (Evans, 1937; Eliot, 1973; Heath, 1997a). Eliot (1973: 389) considered the presence of these tufts as unsuitable for higher classification due to their occurrence in widely separated genera. Indeed, their random occurrence within the Aphnaeinae, among the Hesperiidae, and even among some moth genera, lends support to that view. Nevertheless, we investigate whether the characteristics of the anal tuft might have some taxonomic relevance within the genus.

MATERIALS & METHODS

Localities: The four localities in the Eastern Cape Province for *Crudaria wykehami* that are discussed herein are:

Huntly Glen Farm, Bedford, Baviaans River District (32°24′10″ S; 26°06′08″ E)
Wolwefontein, south of Steytlerville (33°17′20″ S; 24°49′17″ E)
South-west of Willowmore (33°21′16″ S; 23°26′03″ E)
Witmos, north of Cookhouse, Great Fish River District (32°31′32″ S 25°44′43″ E)

The latter is a locality known to many lepidopterists. It has a disused railway siding on a mountain slope, formerly a locality for *Chrysoritis beulah* (Quickelberge), below which was a large patch of thorn veld where *Crudaria leroma* were ubiquitous; also present were the other two *Crudaria* taxa, *C. capensis* and *C. wykehami*. This particular locality was uprooted and ploughed in September 2017; hence the original thorn veld area at Witmos is no more, although other similar habitats may exist nearby.

Sources of material and observations: We have examined over 500 *Crudaria* specimens, pinned or photographed from many varied sources, including museums and private collections. The specimens examined and/or photographed are listed in a Specimen Data Sheet (Table 4); each specimen is given an identification (ID) number [1] to [506] (note square brackets) for cross-referencing with photographs and data for the study.

Genitalia: The first author has made over 100 dissections of *Crudaria* genitalia, including both sexes. These are stored in vials or on microscope slides in the Heath collection. Dissection methods are based on those adopted by van Son (1956) and Stempffer (1967). This entails flattening parts of the armature or individual components to reveal their profiles. Male and female genitalia of all three existing *Crudaria* species have been examined in detail and photographs taken of the principal components. A subset of these can be seen in a selection of photographs illustrated in Plates 2 & 3.

Photography: Photographs of live adults and early stages were taken using an Olympus OM-D E-M5 camera with an Olympus M.Zuiko Digital ED 60mm f2.8 macro lens and a Nikon D80 camera with AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED lens. Genitalia were photographed with the aid of a Celestron digital microscope. During initial work some genitalia were photographed on slide transparencies using an Olympus OM2 film camera mounted on a bellows. It was necessary to edit many of these following their subsequent digitisation. The digital editor used was Affinity Photo. Close-up 'focus merged' (stacked) photographs of *Crudaria* eggs we had collected in the Eastern Cape Province, and two female abdominal tuft photographs, were taken for us between 2010–2011 by S.E. Woodhall. Examination of anal tuft setae was done using a Zeiss Opton dissection microscope.

Host ants: The two species of ant referred to here belong to the subfamily Formicinae and are *Anoplolepis custodiens* (F. Smith, 1858) and *A. steingroeveri* (Forel, 1894). The identification of the ants was based on the book *Ants of southern Africa* by P. Slingsby (2017). Specimens collected for this study were mounted on points and stored in the Heath ant collection. Samples of these were accessioned to the Iziko South African Museum, Cape Town, by Nokuthula Mbanyana-Nhleko.
Anoplolepis custodiens: Acc. no. SAM-HYM-C028307
Anoplolepis steingroeveri: Acc. no SAM-HYM-C028308
Anoplolepis steingroeveri: Acc. No. SAM-HYM-C028309
Note that *A. custodiens* could be regarded as a species complex: "……it is probable that there is more than one species within what is currently called *A. custodiens* ……." (H. Robertson, pers. comm., 27/03/2018).

Female anal tuft: The colour of the anal tuft, where known, was assessed for 206 female *Crudaria* specimens (Table 4, column 4). An approximate distribution for females of *C. leroma* have their tuft colour plotted on a mean average rainfall map (Fig. 51)**.** The localities were plotted using the R packages "maps" (Becker *et al*., 2016) and "ggplot2" (Wickham, 2016) using R v. 3.2.3 (R Core Team, 2015) and then overlaid onto the rainfall map. The rainfall map is redrawn from Dintwe *et al*., 2014 and is based on data compiled in Hijmans *et al*., 2005. The tuft colour in the plots is based on the perceived colour evident from photographs; they are not comprehensive, but limited to data available to this study.

Tuft setae: Individual setae extracted from the tufts of 21 *Crudaria* females were examined and typical examples

are illustrated in Fig. 1.

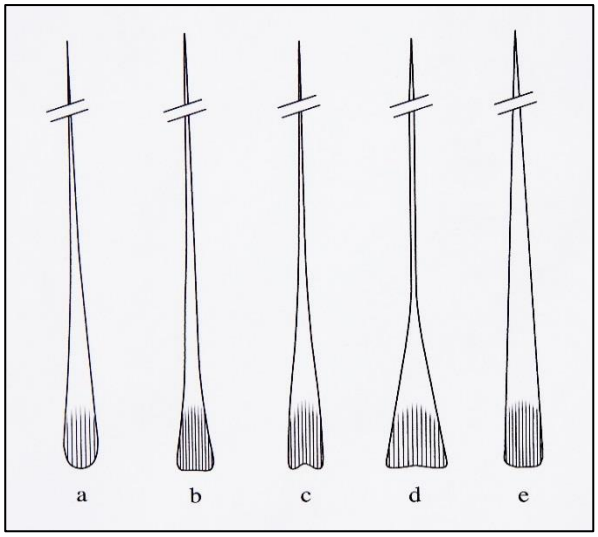


Figure 1 – Specialized setae on anal tufts of *Crudaria* females

Hindwing tail length: We measured the tail length of 171 photographed specimens. These measurements are listed in Table 4, column 5. Tail length here is measured in terms of (hind wing space 2) cilia length; hence tail length = number of cilia lengths (including terminal scales) protruding from cilia +1.

Larval morphology: The dorsal nectary organ (DNO), also known as the 'honey-gland' or 'Newcomer's gland', is located dorsally at the distal end of the seventh abdominal segment, and provides a sugary secretion to ants. The tentacular organs (TOs) are a pair of fleshy, eversible organs terminally equipped with specialised white setae that produce a volatile substance that affects ant behaviour (Cottrell, 1984). Each TO is housed in a tubular structure, referred to here as a 'tubercle', located dorso-laterally on the eighth abdominal segment. Dish organs or 'dew-patches' are saucer-like glands (Fig.2), present on the dorsum of later larval instars that provide a secretion for host-ants (Clark, 1951) Dish organs are unusual structures that are uniquely shared with species of *Cigaritis* Donzel (=*Spindasis*) (Clark & Dickson, 1971).

A Heath

Figure 2 – *C. wykehami* dew patch (Huntly Glen, E Cape)

Molecular studies:
Genomic DNA was extracted from the abdomen of 17 *Crudaria* specimens (see Table 3) using QIAgen DNeasy Tissue Kits (Qiagen Inc., qiagen.com). We then sequenced 1220 bp of mitochondrial DNA from *cytochrome c oxidase subunit I* (COI) using the protocol described in Kaliszewska *et al*. (2015). All the *Crudaria* COI sequences available, as well as COI sequences for three outgroup taxa, were downloaded from GENBANK. The resulting 23 COI sequences were assembled using ClustalX (Larkin *et al*., 2007) and reconstructed phylogenetic hypotheses using maximum likelihood and Bayesian inference methods with GARLI 0.951 (Zwickl, 2006) and MrBayes 3.2.6 (Ronquist & Huelsenbeck, 2003).

Stable isotope study:
The analysis of carbon and nitrogen stable isotopes from tissues of organisms can indicate trophic interactions between taxa (Peterson & Fry, 1987). The ratio of heavy versus light isotopes of nitrogen ($\delta^{15}N$) is typically enriched by 3–4 ‰ per trophic level, and the ratio of carbon heavy versus light isotopes ($\delta^{13}C$) is typically enriched by 0.4 ‰ per trophic level (Peterson & Fry, 1987; Post, 2002). Thus, when comparing tissues from plants, ants and butterflies from a given locality the individuals with the more enriched isotope values tend to be higher up the food chain.

Abbreviations: E Cape – Eastern Cape Province; W Cape – Western Cape Province; N Cape – Northern Cape Province; KZN – KwaZulu-Natal Province; NHM – Natural History Museum, London; NHMS – Natural History Museum, Stockholm.

RESULTS

Genus *Crudaria* Wallengren, 1875

Type-species: *Arhopala leroma* Wallengren, 1857, by monotypy.

Adult morphology (Plate 1, Figs 5–16):
Head broad; proboscis very broad in males (not so in females); eyes glabrous; palps long, porrect, second segment laterally compressed and clothed mostly in white scales, third segment long and slender; frons with pale ochre and white scales and some hair-like scales, edged with white scales; antennae about half the length of costa, club undifferentiated, segment scaling checkered with white, terminal segment naked, the nudum tapering narrowly down to the base. Foreleg tarsus of male not segmented, ending in a curved pointed claw; female tarsus segmented, ending in two curved terminal claws.
Wings: Forewing with 11 veins, hind wing cell short. Upper side greyish-brown to dark brown, end of forewing cell often darkened, a fine dark brown marginal line on the outer margin of both wings; an obsolete tornal lobe on hind wing, black, sometimes with a small patch of metallic scales proximally; hind wing space 1 sub-marginally, with an obscure orange or whitish patch outwardly flanked by an even more obscure darkened

patch; similar darkened sub-marginal patches or spots also faintly visible in spaces 2 to 6. A filiform tail at vein 1b (A1+2), tipped with a few long scales. Underside: Ground colour variable, from whitish to beige and sometimes dull pink; spots paler than ground colour but flanked proximally and distally by dark brown spots or markings; both wings with a post-discal row of spots. Hind wing has a disco-cellular spot or marking, a mid-cell spot and a small black spot in the basal area of the cell; the obsolete tornal lobe black, flanked by an indistinct pale orange smudge. Some of the spots, especially in the forewing, may have metallic silvery scaling.

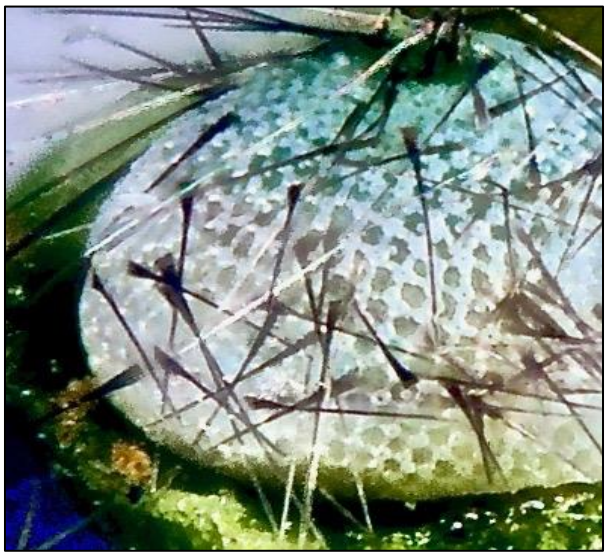
Genitalia:
Male (Plate 2, Figs 17–32; Plate 3, Figs 33–40):
Uncus: Two large semicircular lobes clothed with long fine hairs, separated by a median, dorsal concavity. Subuncus (brachia): Curved with a very small elbow-like protrusion on outer margin that is variable in size and may be absent in some specimens. Valves: Sub-triangular viewed in a separately flattened state, apical lobe narrow and clothed with fine hairs, tip rounded; *in situ* the two valves connected dorsally by membrane. Aedeagus (phallus): Proximal half swollen; asymmetric (sinuous) viewed dorsally with anterior dorsal opening offset to right; apex obliquely truncate. Furca (lower fultura): V-shaped, with pair of wing-like lateral flaps from tops of V. Vinculum joined (not merged) with tegumen, very slender dorsally and sometimes weakly sclerotized between margins; gradually broadens ventrally to form broad, rounded saccus. Figs 17–32 illustrate the flattened genitalic armature of *Crudaria* males from various regions; the saccus and uncus being subject to regional variation that may be taxonomically significant. Figs 33–40 show individual components that can be compared to illustrate their relative uniformity.
Female (Plate 3, Figs 41–48).
Ostium: Posteriorly edged with V-shaped sclerite; anteriorly edged with pair of back-to-back C-shaped sclerites; latter variable in size, often distorted or extended proximally. Anal palps: Densely clothed with fine hair on distal margin. Figs 41–48 show that there is no character state in the female genitalia that is both consistent and taxonomically informative.

Tails and anal tufts: The colour of the female anal tuft in *C. capensis* is greyish-brown and in *C. wykehami* it is dark brown. Based on our examination of pinned material and photographs, we noted that some populations of *C. leroma* s.s. have white tufts but others have dark brown tufts (Fig. 3); these colours were seen to stay consistent within each population. In our examination of photographs we found that some specimens of *C. leroma* from KZN had an indeterminate or mid-tone color. An approximate distribution of *C. leroma* s.s. populations is shown on a mean average rainfall map (Plate 3); the colour of the plots signifying the colour of female anal tufts in each of the population plots.
Specialised setae: The basic structure of an anal tuft seta is that of a very fine hair-like brittle rod, one end of which is gradually tapered to a point; the other end is gradually broadened, flattened and splayed out as a paddle-shaped blade, which is widest at its extremity. The pointed end of each seta is weakly attached to the distal end of the female abdomen outer casing, hundreds of these forming a dense tuft surrounding the oviduct and anal palps. The setae of 37 specimens from various localities were examined and examples of these setae blades are illustrated in Fig. 1.

S E Woodhall

Figure 3 – Female anal tufts of *Crudaria* species.
Left = 3a – *C. leroma*; right = 3b – *C. wykehami*

These blade shapes are variable between populations of *Crudaria* but a more extensive study would be required to determine the extent to which the individual shapes relate to species and to what extent they vary within populations. The setae may also vary in length but measurements could not be made as it was outside the scope of equipment at hand. In most populations they are gradually splayed and squarely truncated at the distal end and with eight to ten fine longitudinal ridges at the termen (Fig. 1b). In some populations the setae blades are more abruptly and broadly splayed, with up to 14 ridges (1d). Some setae blades have a more rounded tip (1a), whilst others are slightly concave (1c).



S E Woodhall

Figure 4 – *C. wykehami* ovum close-up (Huntly Glen, E Cape)

Oviposition: When an ovum is laid, it drags some setae with it. Some females have been observed to rub their anal tuft over the ovum after oviposition. The majority of these setae have their blade ends adhering to the ovum, with their sharp end pointed outwards. The first ova

Fig. 5 – *C. leroma* male recto [472] Type (NHMS-TOBI000003364)

Fig. 6 – *C. capensis* male recto [506]

Fig. 7 – *C. wykehami* male recto [411] Holotype

Fig. 8 – *C. leroma* male verso [472] Type (NHMS-TOBI000003364)

Fig. 9 – *C. capensis* male verso [506]

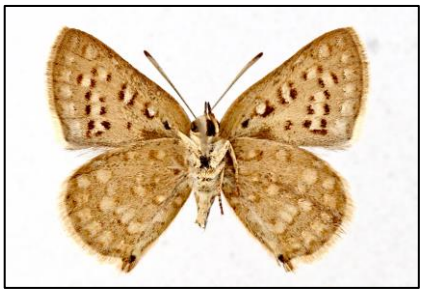


Fig. 10 – *C. wykehami* male verso [411] Holotype

Fig. 11 – *C. leroma* female recto [468] Type (NHMS-TOBI000003363)

Fig. 12 – *C. capensis* female recto [401]

Fig. 13 – *C. wykehami* female recto [059]

Fig. 14 – *C. leroma* female verso [468] Type (NHMS-TOBI000003363)

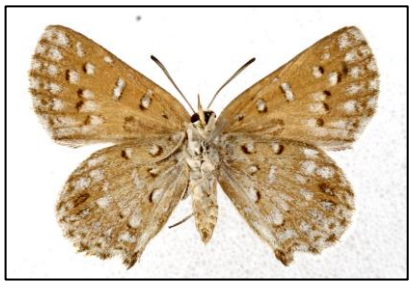


Fig. 15 – *C. capensis* female verso [410]

Fig. 16 – *C. wykehami* female verso [059]

PLATE 1

Described *Crudaria* species: *C. leroma* Figs 5, 8, 11, 14 "Type" specimens. All photographed by T.Malm (© 2018 Naturhistoriska riksmuseet). Original photo; light levels and contrast adjusted. Made available by the NHMS under Creative Commons Attribution 4.0 (International Public License, CC-BY 4.0). *C. capensis* Figs 6, 9 male [506]; Fig. 12 female [401], Fig. 15 female [410] S of Tierkloof near Fraserburg (courtesy NHM). *C. wykehami* Figs 7, 10 holotype male [411] (courtesy NHM); Figs 13, 16 female [059] Huntly Glen, E Cape.

Figure 17 – *C. capensis* [375] Gamkaberg NR, W Cape

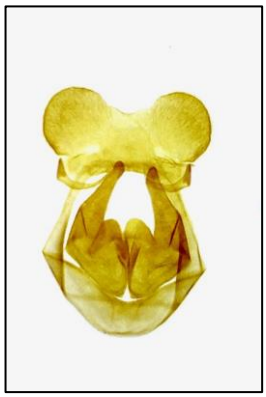


Figure 18 – *C. wykehami* [233] Huntly Glen, E Cape

Figure 19 – *C. leroma* s.l. [184] Beaufort West, W Cape

Figure 20 – *C. leroma* s.l. [204] Calitzdorp, W Cape

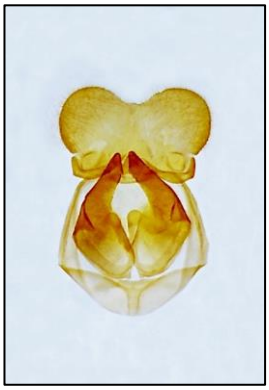


Figure 21 – *C. leroma* s.l. [249] Oshivelo (Namibia)

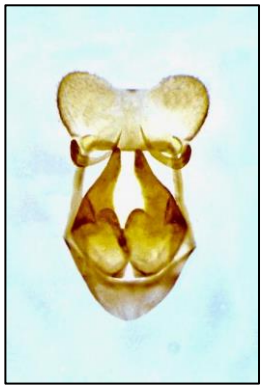


Figure 22 – *C. leroma* s.l. [407] Oshivelo (Namibia)

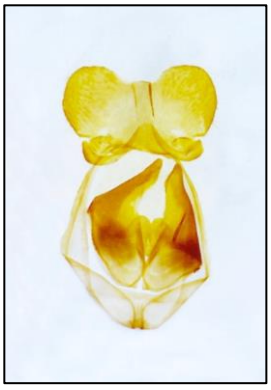


Figure 23 – *C. leroma* s.l. [460] Kalahari Gemsbok NP, N Cape

Figure 24 – *C. leroma* s.s. [459] Tarkastad, E Cape

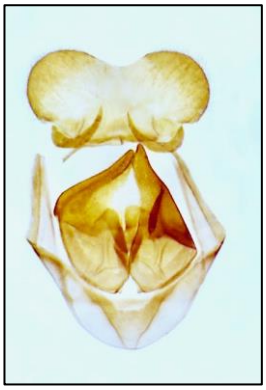


Figure 25 – *C. leroma* s.s. [458] Witmos, E Cape

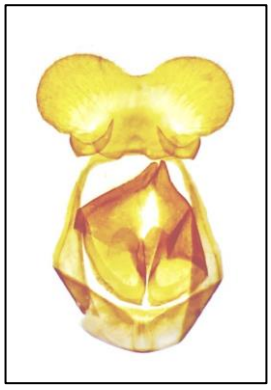


Figure 26 – *C. leroma* s.l. [395] Nylstroom, Limpopo

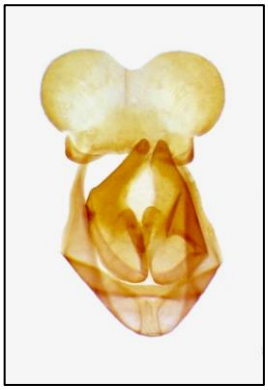


Figure 27 – *C. leroma* s.l. [435] Mt Mabu (Mozambique)

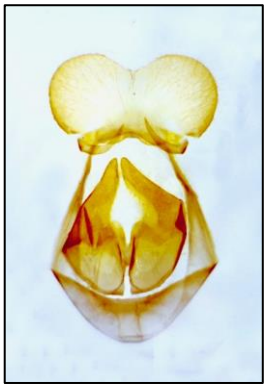


Figure 28 – *C. leroma* s.l. [402] Chalinze (E. Tanzania)

Figure 29 – *C. leroma* s.l. [439] Vumba (Zimbabwe)

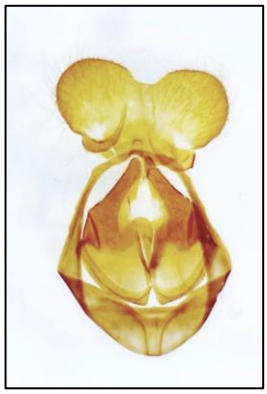


Figure 30 – *C. leroma* s.l. [444] Chinoyi (Zimbabwe)

Figure 31 – *C. leroma* s.l. [409] Christon Bank (Zimbabwe)

Figure 32 – *C. leroma* s.l. [141] Kranskloof, KZN

PLATE 2

Crudaria species male genitalia: Depicted in a similar manner to drawings by van Son (1956: 507), but with aedeagus removed and armature flattened.

Figure 33 – *C. capensis* [005] Gamkaberg NR, W Cape (aedeagus – lateral view)

Figure 34 – *C. wykehami* [009] Huntly Glen, E Cape (aedeagus – lateral view)

Figure 35 – *C. leroma* s.s. [175] Witmos, E Cape (aedeagus – lateral view)

Figure 36 – *C. wykehami* [023] Huntly Glen, E Cape (aedeagus – dorsal view)

Figure 37 – *C. leroma* s.s. [004] Witmos, E Cape (aedeagus – dorsal view)

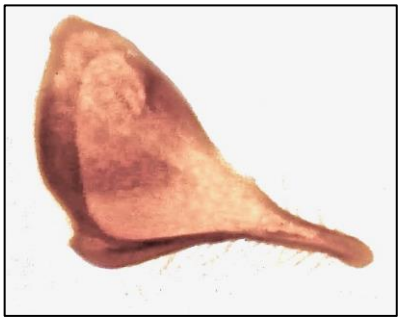


Figure 38 – *C. wykehami* [023] Huntly Glen, E Cape (valve – flattened)

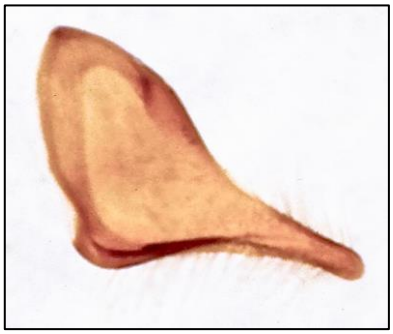


Figure 39 – *C. leroma* s.s. [115] Queenstown, E Cape (valve – flattened)

Figure 40 – *C. capensis* [011] Gamkaberg NR, W Cape (valve – flattened)

Figure 41 – *C. leroma* s.l. [032] Matopos (Zimbabwe) (ostium – flattened)

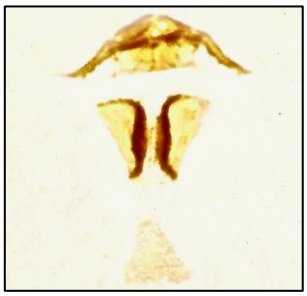


Figure 42 – *C. wykehami* [046] Huntly Glen, E Cape (ostium – flattened)

Figure 43 – *C. wykehami* [038] Huntly Glen, E Cape (ostium – flattened)

Figure 44 – *C. wykehami* [038] Wolwefontein, E Cape (bursa copulatrix)

Figure 45 – *C. leroma* s.s. [031] Witmos, E Cape (bursa copulatrix)

Figure 46 – *C. wykehami* [044] Huntly Glen, E Cape (anal palps - flattened)

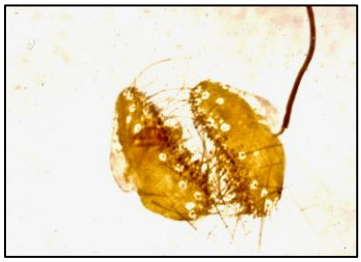


Figure 47 – *C. capensis* [035] Gamkaberg NR, W Cape (anal palps - flattened)

Figure 48 – *C. leroma* s.l.[036] Otavi (Namibia) (anal palps - flattened)

PLATE 3

Crudaria species genitalic components: Figs 33–40 males; Figs 41–48 females

oviposited by a female are densely covered by these deciduous setae (Fig. 49) but as the female's anal tuft gets depleted of setae so the ova laid become less densely covered (Fig. 4); later ova have few or no setae adhering to them (Fig. 50).

S E Woodhall

Figure 49 – *C. leroma* ovum close-up (Witmos, E.C.)

A Heath

Figure 50 – *C. wykehami* ova (Wolwefontein, E.C.)

Early stages: The early stages of *Crudaria leroma* were described in Clark (1951); those of *C. wykehami* are described below. The early stages of *C. capensis* have not yet been recorded.

Host plants: These are mostly Fabaceae but Zygophyllaceae and Asteraceae (this study) are also used. Current data on *Crudaria* host plants and ant-associations are summarised in Tables 1 & 2, respectively. Note that host plants are not necessarily food plants.

Host ants: Neither Clark (1951), Clark & Dickson (1971) or van Son (1956) provided any information on the ant species associated with *Crudaria*. Pringle (in Pringle *et al*., 1994: 227), recorded *Anoplolepis custodiens* ants being associated with *Crudaria leroma* larvae (later revised to *C. wykehami*) from the Baviaans River area. It was later realized by the authors (this study) that the *Crudaria* species concerned was *C. wykehami* and not *C. leroma* as first thought. Heath & Claassens (2003:12) recorded *A. custodiens* for *C. leroma* but did not state the locality. Terblanche (2017) recorded *A. steingroeveri* for a putative new *Crudaria* species from the Tswalu Kalahari Reserve, Northern Cape Province. In this study we record *A. steingroeveri* associated with *C. capensis* and *A. custodiens* with *C. leroma* from Harare, Zimbabwe. All three existing *Crudaria* species have been recorded from Witmos, along with both associated ant species: *Anoplolepis custodiens* and *A. steingroeveri*.

Notes on *Crudaria leroma* sensu stricto (s.s.) (Wallengren,1857)

Type material (Plate 1 – Figs 5, 8, 11, 14): There is a pair of specimens in the NHMS, both having labels stating "Type" and "Caffraria". In Wallengren's time Caffraria was applied to the eastern part of the old Cape Province. Despite the word "Type", the label is not of the usual sort for Wallengren types (T. Malm, pers. comm.). However, in this study we are treating the male (Figs 5, 8) as a provisional *leroma* holotype. It is interesting to note that in his description Wallengren made no mention of a tail or anal tuft, yet they are conspicuous on the respective 'type' specimens; hence Wallengren's description might have been based on a worn specimen.

Tails and anal tufts: The anal tuft on the 'type' female in the NHMS is white (Fig. 3) and the length of tail in both sexes is 2.5 times the cilia length. Note that the anal tuft colour is white on all *leroma* females so far recorded from the Eastern Cape (n=16), and the tails were found to be 1.5–2.5 times the cilia in length (n=32).

Genitalia (Plate 2 – Figs 24, 25; Plate 3 – Figs 35, 37)
Uncus: Almost all of the eastern *C. leroma* examined had uncus lobes that were semi-circular whilst lobes on western material (Western Cape and Namibia) generally (but not always) have a semi-ovoid profile. The concavity between lobes in most *leroma* material from Namibia and the Western Cape was fairly shallow and mostly flat-bottomed, whilst the concavity from most eastern material was rounded or V-shaped.
Vinculum: The amount of sclerotin is variable and sometimes absent (leaving a semi-transparent membrane) between its margins.
Saccus: Eastern populations generally have a larger saccus than those in the west. However, we found that both sizes of saccus occur in the Eastern Cape specimens.

Early stages: Clark (1951) described the life history of this taxon in considerable detail, from ova obtained in the Eastern Cape (precise locality not given); his excellent account is treated here as representing *C. leroma* s.s. In April 2016 Renzo Perissinotto photographed *Crudaria leroma* larvae (identified by AH since the larval head capsule and the tubercles were black) and pupae beneath a rock at Hofmeyr, Marien in the Eastern Cape.

Oviposition/ host plants: In November 2010 a female *C. leroma* was observed ovipositing on a stem of

Vachellia karroo (Fabaceae) at Witmos (AH & ZAK). The ovum was white and densely covered in white setae from the female's abdominal tuft (Fig. 49). Kaliszewska (2015) has showed that the carbon and nitrogen stable isotope values for *C. leroma* from Witmos (E. Cape) are consistent with *C. leroma* being herbivorous.

Host ants: Pringle *et al*. (1995) mentioned an association with *A. custodiens*, however, the *Crudaria* species concerned was later identified as *C. wykehami* (ELP & AH). Perissinotto (see above) photographed the attending ants and AH identified them as *A. steingroeveri*.

Notes on *Crudaria leroma* sensu lato (s.l.)

Morphological variation: Examination of pinned material from *leroma* populations in Africa has revealed morphological groupings of possible taxonomic significance. Their upper sides vary between grey and brown despite the general underside pattern of spots being constant. However, despite the constancy of the underside pattern, the markings vary considerably in size, colour, contrast and position, even within populations.

Tails and female anal tufts: The filiform (thread-like) tail on the hind wing vein 1b varies in length between geographic regions (Table 6).

Table 6 – Female anal tuft colour and tail: cilia ratio for *C. leroma* s.l. from various geographical regions

Region*	Female anal tuft colour (n)	Tail: Cilia (n)
1	white (59)	1.5–2.5 (53)
2	white (13)	2–3 (21)
3	white, buff or brown (34)	2–3 (16)
4	white, some with brown tufts (39)	2.3–4 (23)
5	brown, some with white tufts (29)	2.5–4.5 (19)
6	brown (8)	3.5–5.5 (13)

* 1 = E Cape, W Cape, N Cape, Free State; 2 = Namibia, Botswana; 3 = KZN; 4 = Gauteng, North-West, Mpumalanga, Limpopo; 5 = Zimbabwe, Zambia, Malawi; 6 = Tanzania, Mozambique

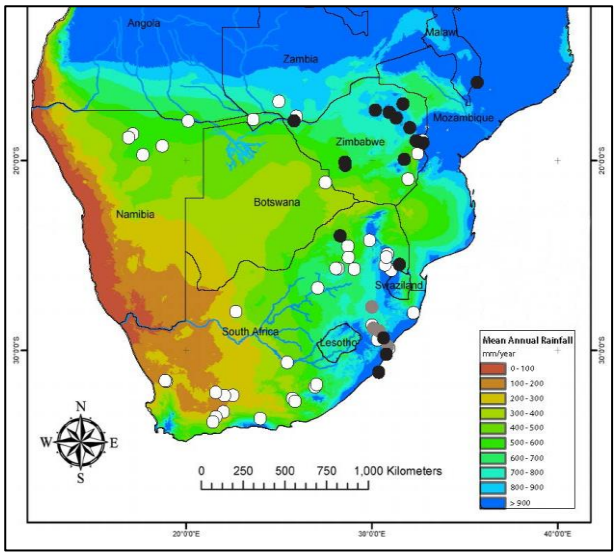


Figure 51 – Variation in the female anal tuft colour of *C. leroma* s.l. with rainfall, from white dots (white tufts) to grey dots (buff tufts) to black dots (brown tufts)

An approximate distribution of the female anal tuft colour for *C. leroma* s.l. is plotted on the rainfall map Figure 51**.**

Genitalia (Plates 2 – Figs 19–23, 26–32; Plate 3 – 41, 48)
Aedeagus: Despite the difficulty of maintaining a similar perspective for photographs, due to its sinuous shape, it was possible to view many examples during the dissection process (n=87). No appreciable or consistent variation was observed among them.
Valves: Although rather variable regarding the obtuse angle and length of apical lobe there is no consistent difference in the flattened valve profile (n=14), or between them and four specimens of *C. wykehami*.

Host ants: In February, 2018 Julio Balona observed interactions between *C. leroma* and *A. custodiens* ants near Mookgopong, Limpopo Province (Balona & Williams, 2018). In March 2018 at Lion's Den, Chinhoyi, Zimbabwe, Jono Francis observed *C. leroma* associated with *A. custodiens* ants.

Oviposition/ host plants: S.E. Woodhall photographed *C. leroma* ovipositing on a species of *Amphiglossa* (Asteraceae) (Fig. 52) at the Gamka Eco Estate at Huis River Pass, Calitzdorp, W.C. in December 2013.

S E Woodhall

Figure 52 – *C. leroma* ovipositing on a species of *Amphiglossa* DC (Asteraceae) [426] at the Gamka Eco Estate, W.C.

The anal tuft was white. In March 2018 at Lion's Den, Chinhoyi, Zimbabwe, Jono Francis observed *C. leroma* ovipositing on *Vachellia rehmanniana* (Fabaceae). The ova were white but the tuft setae were dark brown.

General observations: *Crudaria* species occur on relatively low-lying, flat, often arid ground; sometimes near dry river beds with *Vachellia* vegetation present. However, on two occasions in the Western Cape Province, a male specimen of *C. leroma* was taken on the summit of a mountain; one on a high prominence of the Groot Swartberg and the other on the summit of Gamka Mountain (Gamka Mountain Nature Reserve). Both specimens were noticeably smaller than average for the

species but the genitalia were typical of Western Cape material (AH, unpublished observation).

Notes on *Crudaria capensis* van Son, 1956

Adult morphology (Figs 6, 9, 12, 15): As described by van Son (1956). Male holotype is in the Ditsong National Museum of Natural History, Pretoria, South Africa.

Tails and anal tufts: Tails absent, anal tufts mid-tone, greyish-brown.

Genitalia:
Male (Plate 2 – Fig. 17; Plate 3 – Figs 33 & 40):
Uncus lobes semi-circular in profile and the concavity between them is consistently very shallow; vinculum weakly sclerotised between its margins, narrow dorsally, broadening significantly towards a large and rounded saccus; valves triangular, with distal apex less acute and elongated than in other *Crudaria* species. The flattened armature is illustrated in Fig. 17, aedeagus in Fig. 33 and flattened valve in Fig. 40.
Female (Plate 3 – Fig. 47): Typical of other *Crudaria* taxa, although the anal palps are weakly sclerotised and patchy on their anterior surface.

Oviposition/ host plants: During many visits to the Gamka Mountain Nature Reserve, W Cape (GMNR) since 1990 by the first author, *C. capensis* individuals were often observed flying around groups of *Tetraena retrofracta* (Zygophyllaceae) and occasionally settling on them; they were presumed to be ovipositing. This host-plant was originally listed as *Zygophyllum retrofractum* in Heath (1997a: 15). The same behaviour was noted among similar bushes in the riverbed at Laingsburg (I. Coetzer, *pers. comm*., 1990).

Host ants: At GMNR in October 2010, having collected a small series of adults, AH & ZAK found a pupa of *C. capensis* below one of the bushes of *T. retrofracta*. The pupa was just below ground level, beside the main stem and tended by *Anoplolepis steingroeveri* ants.

Trophic mode: Based on wing material of adults, their associated ants, and local plant material from the Gamka Mountain Nature Reserve, W Cape, a stable isotope study conducted by Kaliszewska (2015) strongly suggests that *C. capensis* is aphytophagous.

Type locality: The type locality for *C. capensis* van Son, 1956 was given as "Uniondale Road, C.P."

Notes on *Crudaria wykehami* Dickson, 1983

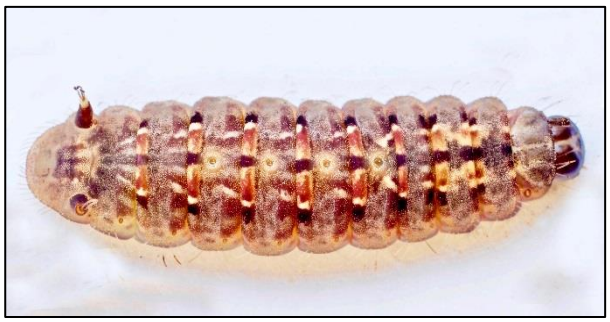
Adult morphology (Figs 7, 10, 13 & 16): As in the original description (Dickson, 1983).

Tails and anal tufts: Tail at hind wing vein 1b, no more than twice the length of the cilia, i.e. protruding from cilia by no more than one cilia length; female anal tuft always very dark brown (Fig. 3b).

Genitalia:
Males (Plate 2 – Fig. 18; Plate 3 – Figs 34, 36, 38):
Profiles of the two uncus lobes are mostly semi-circular; the concavity between them is deep and round-bottomed or slightly V-shaped. The rounded saccus is moderate to small. In the aggregate the valve, aedeagus or furca do not differ significantly or consistently from those of *C. leroma*.
Females (Plate 3 – Figs 42–44 & 46): Anal palps are sometimes weakly sclerotised on their proximal margins. Comparisons show the extent of intraspecific variation of the ostium; whilst between species there are no significant or consistent differences.

Oviposition/ host plants: Adults have been observed ovipositing on the leaves and stems of *Vachellia karroo* (Fabaceae) by the authors (AH & ZAK). This was noted both at Wolwefontein in November 2010, and at Huntly Glen in January 2011. The ova were 'duck-egg blue' when laid (Fig. 50) with some of the colour fading after a day or two. The setae adhering to the ovum from the female's anal tuft were dark brown (Fig. 4).

Morphology of final instar larva (Figs 53–55): Viewed dorsally, larval segments 3 to 8 are of similar width but reduced at each end. The anal portion is flattened dorsally. The head capsule is small, brown and shiny except for a V-shaped grey-green marking delineating the frons. The head-shield covers the retracted head when the larva is at rest; it is grey-green with three longitudinal markings in a lighter green. Several long, pale yellow setae, tipped with black, emanate from the anterior margin of the head-shield; they extend forward and curve slightly downwards.
The ground colour of the larva is mostly pale maroon or pale grey-green. Some areas, such as the lower lateral surfaces, are very finely speckled with white. Most surfaces are sprinkled with small mushroom-like setae that are white, translucent, or black.
Viewed dorsally each of the segments 2–9 is divided into three sections; the posterior section being the most colourful, having a median black rectangular patch flanked by a longer strip of red (sometimes green), suffused outwardly with yellow, followed by a short white patch, then another darker black patch. The anterior section of each segment is similar to the posterior but with the same colours subdued and dull, and with the opposing two white patches positioned closer together, thereby forming a whitish smear across two neighbouring segments. The mid-section has no distinct markings, having fine white speckling as well as mushroom-like setae on a dull maroon or green ground colour. The midsection on each of the four segments 5–8 have a 'dish organ' positioned medially. The three thoracic segments 1–3 have a more extensive dark median patch that extends to all three thoracic sections, hence creating a continuous dark median stripe leading to the head-carapace. It has been noted that early in the final instar, following ecdysis, the colours are more vivid but prior to pupation the colours become slightly faded.
The DNO is located medially against the distal margin of segment 10 (Fig. 54). On segment 11 a pair of 'Tubercles' is present. These consist of a brown tubular casing projecting dorso-laterally on either side. The

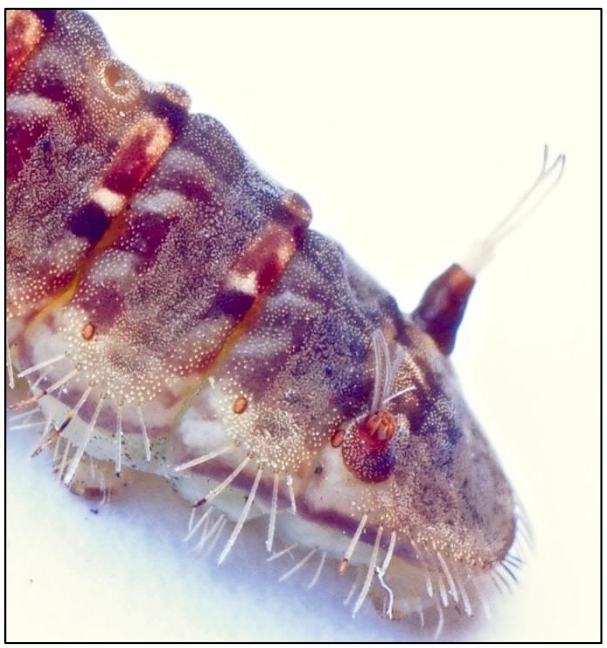


A Heath

Figure 53 – *C. wykehami* final instar larva (Huntly Glen, E Cape)

A Heath

Figure 54 – *C. wykehami* final instar (Huntly Glen, E Cape). Note secretion at DNO



A Heath

Figure 55 – *C. wykehami* final instar (Huntly Glen, E Cape). Note TOs everted from tubercles

upper rim of each casing is armed with fine spines; a white, fleshy TO, topped with setae, is contained within the casing and is everted like a piston when the larva is disturbed (Fig. 55). Lower sides and rear of the larva are fringed with pale yellow setae. Underside and prolegs are light green. The final (12th) anal segment is flattened and semi-circular when viewed dorsally. The surface is densely covered in very small setae, together with patches of larger mushroom-like setae.

A Heath

Figure 56 – *Anoplolepis custodiens* ant (Huntly Glen, E Cape)

Larval behaviour: At the farm Huntly Glen, near Bedford, Eastern Cape Province, *C. wykehami* larvae (Fig. 53) have often been found under rocks and slabs of masonry together with nests of their attendant ant *A. custodiens* (Fig. 56). In good years, groups of late instar larvae and pupae have been found in large numbers (sometimes in excess of 20 individuals beneath a single slab) and in close proximity to mature *V. karroo* trees. So far, no other species of *Crudaria* or of *Anoplolepis* have been recorded at this farm. While these groups of *C. wykehami* juveniles are often found within 2m of a tree trunk, they have also been found further away from any tree trunks. On one occasion, in November 2010, several larvae were found beneath a masonry slab (AH & ZAK). The slab was in excess of 3m from the trunk of the nearest *V. karroo*; the intervening ground was covered in coarse grass about 10cm high and the tree was very old; its trunk deeply fissured. It would have required an arduous climb of over four more metres before any leaves could have been reached. Under these circumstances it seemed to us that the larvae were unlikely to be travelling daily, to and fro, feeding on the tree foliage, and hence might be aphytophagous.

In 1985 one of the authors (ELP) collected some pupae and final instar larvae (of what was later identified as *C. wykehami*) from Huntly Glen farm and placed them in a formicarium together with some of their host-ants and sprigs of *Vachellia karroo*. None of the larvae fed on the leaves prior to eventual pupation.

In June 2016 Renzo Perissinotto found and photographed *Crudaria wykehami* larvae and pupae beneath a rock at Buckland's Farm, Cockscomb in the Eastern Cape Province. The attending ants were *A. custodiens* (Fig. 56). The identification of ant and *Crudaria* species is based on Perissinotto's photographs and dependent on

A Heath

Figure 57 – *C. wykehami* final instar brown head capsule (Huntly Glen, E Cape)

the observation that the larval head capsule and the tubercles are black in *C. leroma* (see Clark, 1951) as opposed to brown in *C. wykehami* (Fig. 57).
In late September 2017 at Huntly Glen farm two early final instar *C. wykehami* larvae were collected by one of the authors (AH) and kept isolated in a small container with three host-ants. For seven days the larvae were provided daily with a fresh sprig of *V. karroo*. The putative host-plant sprigs were always left untouched – providing further support for the hypothesis that *C. wykehami* larvae do not feed on *V. karroo*, and that they are aphytophagous.

Larval gut content: In September 2014, at Huntly Glen farm, Melissa Whitaker was shown some *C. wykehami* larvae by AH. She later analysed their gut contents (Whitaker *et al.*, 2016) but found no sign of plant material "*their guts are very weak, clear, and filled with liquid, in contrast to the large, bulky guts of other lycaenids*". In 2017 Mark Williams examined a pair of final instar larvae (done by histological examination of stained [Haematoxylin & Eosin] transverse sections of the larvae). He also noted the absence of plant material inside the gut; instead, there was "*a proteinaceous substance that contained many bacteria and other microbes*". Both Williams and Whitaker (pers. comm., 2017) considered these *C. wykehami* larvae to be aphytophagous and the observations made by the authors further support their assessments.

Pupa: When shedding its larval skin the pupa is often vigorously assisted in this process by one or more attending ants (Fig. 58). The pupa is 11.5 mm long, blunt and rounded, and characteristic of aphnaeine pupae. However, it lacks typical cremastral hooks. The abdominal portion is humped dorsally and curved down

Z A Kaliszewska

Figure 58 – *C. wykehami* pupa shedding larval skin, actively assisted by host ants (Huntly Glen, E Cape)

Z A Kaliszewska

Figure 59 – Two *C. wykehami* pupa found beneath slab of masonry (Huntly Glen, E Cape)

distally; its spiracles are positioned just above the wing casing; a series of very prominent dark brown protuberances are positioned above the spiracles. The pro-thorax is prominent and followed by a mid-dorsal depression.
Initially the pupa is yellow, with the abdominal segments turning brown and the thorax and wings turning black just before emergence. Most pupae found were secured very loosely to the underside of a rock, whilst some were lying in ant runnels or attached to a dead twig beneath a rock. Without visible cremastral hooks it is unclear as to how the pupae remain attached (Fig. 59).

Parasitoids: In November 2002 AH collected 12 *C. wykehami* pupae from beneath a single masonry slab at Huntly Glen Farm in order to rear fresh adults. An unidentified species of wasp (Hymenoptera) emerged from five of the pupae and a tachinid fly (Tachinidae) emerged from another. Four pupae produced *C. wykehami* adults.

Type locality: The type locality for *C. wykehami* is given as "Western Cape Province: Fraserburg (5/1/1982) C. Wykeham". In 1993 Wykeham described the precise collecting locality to A. Heath. It is ~2.5km south of Teekloof Pass and just within the Western Cape boundary. The validity of the type locality has been

questioned (Heath, 1997a: 16; Mecenero *et al*., 2013: 460); partly because *C. wykehami* has not since been recorded from that locality, despite an extensive search by A. Heath & A.K. Brinkman on 30 December 1993 and twice later by Victor, Ernest & Anne Pringle. These extensive searches revealed only *C. leroma* and *C. capensis* to be present. Diary records show that Mr. Wykeham was present and collecting at Huntly Glen farm, Bedford, Eastern Cape on the day prior to the recorded date of holotype capture, and it appears very likely that this farm is where *C. wykehami* was actually collected. Thus Huntly Glen is designated as the valid type locality for *C. wykehami*.

Note also that a female specimen from the same "Fraserberg" locality, and designated as the allotype female of *C. wykehami* by Dickson, was deposited in the Natural History Museum, London. However, it has since been examined by the first author and confirmed as a female of *C. capensis* (see underside, Fig. 15).

Comparative characteristics in *Crudaria* taxa

Molecular phylogeny (provisional):

Maximum likelihood and Bayesian consensus trees of *Crudaria* (Fig. 60), based on mitochondrial DNA, show four clades:

1a - *C. leroma* (Namibia) (95 bootstrap, 1 posterior probability support)

1b - *C. leroma* (East & West Cape) (94 95 bootstrap, 0.99 posterior probability support)

2 - *C. capensis* (East & West Cape) (single sample)

3 - *C. wykehami* (East Cape) (100 bootstrap, 1 posterior probability support)

4 - *C. leroma* (Eastern southern Africa and East Africa) (61 bootstrap, 0.99 posterior probability support)

The two sub-clades 1a and 1b each have high support values, and jointly they have moderate support (77 bootstrap and 0.94 posterior probability), thus the Namibian *C. leroma* are sister to the Western Cape *C. leroma*, and together are distinct from the other clades. The status of *capensis*, clade 2 is as described by van Son (1956) and even though we cannot determine its relationship relative to the other clades it is not in contention here. Clade 3 + 4 has moderate support (76 bootstrap and 0.94 posterior probability).

The *wykehami* clade 3 has excellent support (100 bootstrap and 1.0 posterior probability). Although clade 4 has a strong posterior probability (0.97), it has a relatively low bootstrap support both at its base (61) and between most of the individuals within it. It contains specimens of varied morphology, i.e. the tail, female anal tuft and genitalia, and it also contains a *C. leroma* specimen from Witmos even though there is another *C. leroma* specimen from Witmos in sub-clade 1b. Despite the weakness of support within clade 4, the other internal nodes of the tree strongly suggest that *C. leroma* consists of more than one species.

Female anal tufts: The colour of the anal tuft of the

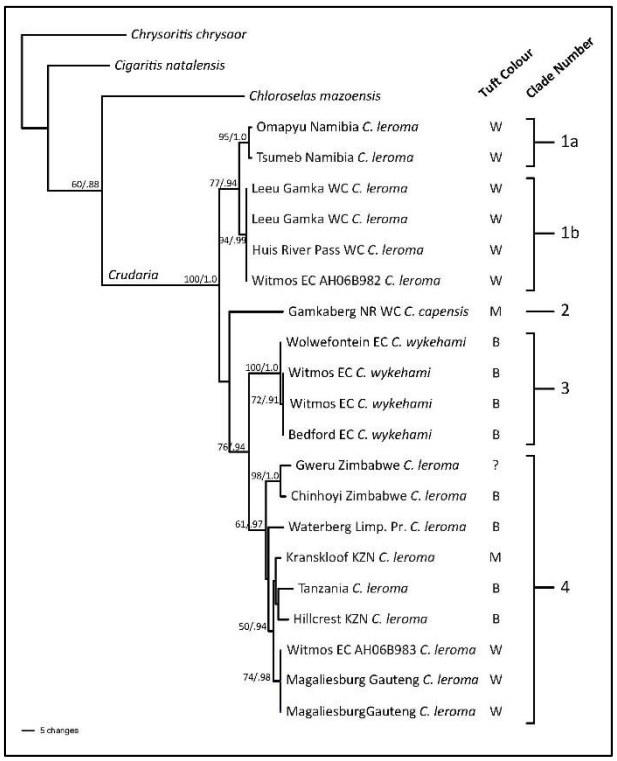


Figure 60 – Maximum likelihood phylogenetic estimate of 20 *Crudaria* and 3 outgroup species based on 1220 bp of the COI mitochondrial marker. The numbers at the nodes indicate maximum likelihood bootstrap support and the Bayesian posterior probability respectively. The taxa are labelled by locality and current species name. The letters to the right of the taxon labels indicate the colour of the female anal tufts observed at the given localities. W = white, B = brown, and M = mid-tone.

NHMS female *leroma* 'type' from the Eastern Cape is ivory or whitish (Fig. 61) and the tail is short (2.5 times the cilia); the same as all other *C. leroma* examined from the Eastern Cape. This is in contrast to the consistently dark brown tuft and even shorter tail of *C. wykehami*. Further east, and from KwaZulu-Natal to Tanzania, there are populations of *Crudaria* with brown anal tufts that lack all the characters defining *C. wykehami*, such as wing markings, genitalia, and tail.

The colour of tufts on *C. leroma* material from further north and east suggests that this tuft character might reflect a taxonomic entity, as it does for *C. wykehami* in the Eastern Cape. We illustrate the approximate localities of *C. leroma* s.l. specimens available to us, indicating whether they have brown anal tufts or white tufts based on photographs, pinned specimens or other records available to us (see Table 4). To date there is no record of any population of a *Crudaria* species having more than one abdominal tuft colour among its females. Some *C. leroma* specimens from KZN have an intermediate tuft colour; these are shown as grey on the map (Fig. 51).

Genitalia:

C. capensis: Uncus lobes are mostly semi-circular; the concavity between them is broad, curved or flat-bottomed but always very shallow; vinculum weakly

Figure 61 – Anal tuft of Type female (NHMS-TOBI000003363)

sclerotised and broad ventrally; saccus very large and rounded with median sclerites spaced widely apart (Plate 2 – Fig. 17). The flattened valve profile (Plate 3 – Fig. 40) is variable but usually resembles a right-angle triangle, differing markedly from valves in other taxa (that are more finger-like). In his description, van Son (1956) made informative comparisons between *C. capensis* and *C. leroma*, supported by illustrations of both species and sexes. We agree with his comparisons, except for some inaccuracies that are evident in his depiction and comparison of the female genitalia of *C. leroma* (for comparison see Plate 3 – Fig. 41) and the anal palps of *C. capensis* (Plate 3 – Fig. 47). Nevertheless, the features in the male genitalia are consistent enough to treat it as distinct.

C. wykehami: Uncus lobes semi-circular; concavity between them is deep and rounded or slightly V-shaped; vinculum membranous or only partially sclerotised between marginal sclerites; saccus moderate to small and rounded with median sclerites spaced moderately apart but very indistinct (see Plate 2 – Fig. 18; Plate 3 – Figs 34, 36, 38).

C. leroma s.s. [A] (male 'Type' "Caffraria" NHMS [472] Fig. 70): Uncus lobes semi-circular; concavity between them moderate and rounded; vinculum partially sclerotised between marginal sclerites; saccus small with median sclerites spaced apart and forming a U-shape (Fig. 62).
C. leroma s.s. [B] (two E Cape samples - Witmos [470] and Tarkastad [459]): Uncus lobes semi-ovoid; concavity between them shallow but rounded or flat; vinculum membranous or partially sclerotised between marginal sclerites; saccus moderate to small with median sclerites spaced apart and forming a U-shape (Fig. 24).
C. leroma s.s. [C] (two E Cape samples – Witmos [458][371]): Uncus lobes semi-circular; concavity between them shallow but rounded; vinculum membranous or partially sclerotised between marginal sclerites; saccus large with median sclerites V- or Y-shaped (Fig. 25) .
C. leroma s.l. [D] (W.C. populations): Uncus lobes semi-ovoid; concavity of moderate depth but mostly flat-bottomed; saccus moderate to small with median sclerites spaced apart (Figs 19 & 20).
C. leroma s.l. [E] (Namibian populations; including the Kalagadi Transfrontier Park, N Cape): Uncus lobes semi-oval; concavity of moderate depth but mostly flat-bottomed; saccus moderate with median sclerites spaced close together (Figs 21 to 23).
C. leroma s.l. [F] (north-eastern populations, KZN, Gauteng to Tanzania): Uncus lobes mostly semi-circular; concavity of moderate depth and rounded; saccus moderate to large with median sclerites variable (Figs 30 to 35). Note the large saccus in Fig. 31.
C. leroma s.l. [G] (single sample - Kranskloof, KZN [141]): Uncus lobes semi-circular; concavity of moderate depth and flat-bottomed but exceptionally wide; saccus small with median sclerites U-shaped and spaced well apart (Fig. 32).

Figure 62 – *C. leroma* male genitalic armature flattened; aedeagus removed (NHRS-TOBI000003364)

To summarise: Based on the results of our research there appear to be two *leroma* clades, one East and the other West; a representative of each occurs in the Eastern Cape. The western clade (W Cape and Namibia) is relatively homogeneous but the eastern clade (KZN, Gauteng, and

north-eastwards to Tanzania) is heterogeneous and in need of further study.

DISCUSSION

Taxonomic inferences for *Crudaria leroma*

Genitalia of the two E Cape specimens listed above as *leroma* s.s. [B] show an affinity with material from the Western Cape s.l. [D], that is also inferred in the phylogenetic tree (clade 1b). This genitalic affinity is further supported regarding their short tails and white anal tuft. The molecular results also link this group with material from Namibia, inferred as conspecific.

The E Cape specimens listed above as *leroma* s.s. [C] have a genitalic affinity with some eastern material s.l. [F] that also have short tails and white anal tufts, including those from Pretoria and the Magaliesburg. However, they do share molecular clade 4 with material having brown tufts and longer tails too.

It can be seen that there might be two *leroma* species in the E Cape, but without a more extensive molecular study we are unable to confirm this. Likewise, it remains uncertain which of the two, the eastern or western *leroma* clades, most closely resembles the NHMS 'type' specimen.

Colour of ova: Clark (1951) states that *C. leroma* ova (from the Eastern Cape Province) are white. The *C. leroma* ovum from Witmos, illustrated here in Fig. 49, is also white. *Crudaria wykehami* ova from Huntly Glen and Wolwefontein (Figs 4 & 50) were greeny-blue when laid. The ova of *C. leroma* from Harare, Zimbabwe are white. The ova of *C. capensis* have yet to be recorded.

Anal tufts: It should be noted that all records of *C. leroma* from the Eastern Cape show their females as having white tufts and all females of *C. wykehami* have very dark brown tufts. All females of *C. capensis* have mid-tone grey tufts. These records suggest that tuft colour does have some taxonomic relevance.

Morphological character states: To date there is no evidence of any *C. leroma* population having both anal tuft colours, i.e. dark brown and white, or with greatly differing tail lengths. The two characteristics therefore appear to be consistent within each population or region. There are some specimens in KZN, however, that appear to have a mid-tone tuft, neither white nor dark brown. These are currently being investigated. Despite microscopically examining the tuft setae of 37 specimens we were unable to detect a pattern among the shapes of setae blades, but a much larger sample might yet do so.

Genitalia: Uniformity of the genitalia within the genus is typical of myrmecophilous lycaenids, as discussed by Heath (1997b) but, whilst the basic structure remains constant, there are small features that do vary between populations. These features are not wholly consistent, hence we regard the genitalia as possessing only secondary taxonomic characters, at best.

Ants: Although the more recent records of ant-associations may appear to imply a fixed association between a particular *Crudaria* species and its *Anoplolepis* symbiont, such records are sparse. It is thus too early to draw conclusions about specific relationships with ants, other than always being with the genus *Anoplolepis*.

Trophic behaviour: It comes as no surprise that aphytophagy occurs among *Crudaria* species since its closest relative *Cigaritis* also has species known to accept ant regurgitations and to feed on ant-brood (Pierce, 1995: 438).

Despite concluding that the larvae of *C. capensis* and *C. wykehami* are aphytophagous we have yet to determine what their larvae actually feed on. Are they carnivorous on ant-brood or do they perhaps feed by trophallaxis, or perhaps both, as in *Cigaritis takanonis* (Matsumura, 1906) and *C. acamas* (Klug, 1834) (Pierce *et al., op. cit.*).

Host plant: It is important to realise that a host plant used for oviposition might not be what a lycaenid larva actually feeds on, as demonstrated here by *C. wykehami*. In addition, a particular species of *Crudaria* may utilise more than one species of host plant.

Aphytophagy vs herbivory:

Crudaria is now the seventh genus in the Aphnaeinae subfamily known to contain at least one species with an aphytophagous larva. Of the approximately 40 entomophagous lycaenid larvae that do not belong to the two large lycaenid radiations Miletinae and *Lepidochrysops* (Pierce *et al*., 2002), almost a quarter occur in the subfamily Aphnaeinae. This is an unusually high proportion of aphytophagy for one group. Further study of these remarkable butterflies could lead to a better understanding of the evolutionary origins of this larval parasitism.

Validity of taxa

C. capensis: Although its status as a good species is not in contention, it is worth noting that its biological characteristics clearly set it apart from all other *Crudaria* species and potential species.

C. wykehami: It is evident that *C. wykehami* is a valid species and distinct from *C. leroma* s.s. based on differences observed in their trophic behaviour, the ovum colour, the wing markings and the consistent characters of anal tuft and tail. Their monophyly is also inferred from the provisional phylogenetic tree.

Eastern *C. leroma*: The individual specimens included in clade 4 are from a variety of geographic regions within the eastern half of the African continent, from KZN, Gauteng, Zimbabwe, Malawi and Mozambique to Tanzania. This clade has almost no bootstrap support, neither is there any uniformity in the morphology, e.g. anal tuft or the tail, to support monophyly. A more extensive molecular study, that includes many more

localities and several nuclear genes, would be needed to refine the phylogeny of this eastern clade and, indeed, of the genus.

Western *C. leroma*: The two groups within clade 1 are assumed here to be synonymous at the species level although differing marginally in wing size and tail length. We suggest that there could be a subspecific relationship between the three populations (Namibia, W Cape and E Cape).

Crudaria leroma (Eastern Cape): The COI tree suggests that there may be two *leroma* species within the Eastern Cape Province, as one occurs in clade 1 and the other in clade 4, but the phylogenetic inference is weak since it is based on those two specimens only, and the provisional phylogeny is based on only one gene.

Crudaria leroma sensu stricto: We do not know which of the above two clades (1 or 4) represents the *leroma* species described by Wallengren (1857). Discussions with Tobias Malm at the Swedish Museum of Natural History are ongoing to try and help resolve this. Until it is resolved, it might not be appropriate to make taxonomic changes at the species level. The genitalia of the male 'type' specimen at the NHMS (Fig. 62), having a relatively small saccus, favours the western group of *leroma* but the shapes of the uncus lobes suggest the eastern group. Other morphological characters are considered here as uninformative.

Further research: We trust that this study may prove a useful basis for further research on *Crudaria* species. There is a need for both molecular and life-history research, to better understand the phylogeny and, *inter alia*, the various relationships between lycaenids and their host-ants. When recording the early stages of *Crudaria* at a given locality it is recommended that the species of ant, the oviposition host-plant, and the actual food is also noted. The colour of the female tuft is yet another piece of the overall puzzle that should be recorded.

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TABLE 1 – *Crudaria* host plant associations
NB: Observation type: Oviposition* = aphytophagous

***Crudaria* species**	**Observation type**	**Host plant species**	**Plant family/ subfamily**	**Reference**	**Country/ Province (SA)**	**Locality**
C. leroma	Rearing	*Vachellia karroo*	Fabaceae/ Mimosoideae	Clark & Dickson, 1971	E Cape	
C. leroma		*Vachellia sieberiana*	Fabaceae/ Mimosoideae	Pringle *et al.*, 1994	Zimbabwe	
C. leroma		*Elephantorrhiza burkei*	Fabaceae/ Mimosoideae	Woodhall, 2005	South Africa	
C. leroma		*Vachellia hebeclada* subsp. *hebeclada*	Fabaceae/ Mimosoideae	Terblanche, 2017	N Cape	Tswalu Kalahari Reserve
C. leroma	Oviposition	*Vachellia rehmanniana*	Fabaceae/ Mimosoideae	This study	Zimbabwe	Lion's Den
C. leroma	Oviposition	*Amphiglossa* sp.	Asteraceae/ Asteroideae	This study	W Cape	Gamka Eco Estate
C. capensis	Oviposition*	*Tetraena retrofracta*	Zygophyllaceae/ Zygophylloideae	This study	W Cape	Gamkaberg NR
C. wykehami	Oviposition*	*Vachellia karroo*	Fabaceae/ Mimosoideae	This study	E Cape	Huntly Glen
C. sp. TAS 6		*Elephantorrhiza elephantina*	Fabaceae/ Mimosoideae	Terblanche, 2017	N Cape	Tswalu Kalahari Reserve

TABLE 2 – *Crudaria* host ant associations

***Crudaria* species**	**Associated ant species**	**Reference**	**Country/ Province (SA)**	**Locality**
C. leroma	*Anoplolepis custodiens*	Terblanche, 2017	N Cape	Tswalu Kalahari Reserve 1
C. sp. TAS 6	*Anoplolepis steingroeveri*	Terblanche, 2017	N Cape	Tswalu Kalahari Reserve 2
C. leroma	*Anoplolepis custodiens*	This study	Zimbabwe	Lion's Den
C. leroma	*Anoplolepis steingroeveri*	This study	E Cape	Hofmeyr Farm
C. capensis	*Anoplolepis steingroeveri*	This study	W Cape	Gamkaberg NR
C. wykehami	*Anoplolepis custodiens*	This study	E Cape	Huntly Glen
C. wykehami	*Anoplolepis custodiens*	This study	E Cape	Buckland's Farm

TABLE 3 – Crudaria specimens in CO1 phylogenetic tree

Ref. no.	**Sex**	***Crudaria* species**	**Anal tuft colour**	**Genitalia examined**	**Sample no.**	**Country/ Province (SA)**	**LOCALITY**
-	-	*C. capensis*	-	-	AAM98W799	W Cape	Gamkaberg NR
-	-	*C. leroma*	-	-	KR030438.MLIB0235	Namibia	Omapyu
-	-	*C. leroma*	-	-	HB95Y034	Namibia	Tsumeb
-	-	*C. leroma*	-	-	ZAK10N015	W Cape	Huis River Pass
-	-	*C. leroma*	-	-	AH95Y654	W Cape	Leeu Gamka
-	-	*C. leroma*	-	-	AH95Y658	W Cape	Leeu Gamka
470	M	*C. leroma*	-	Yes	AH06B982	E Cape	Witmos
-	-	*C. wykehami*	-	-	AH10E013	E Cape	Wolwefontein
-	-	*C. wykehami*	-	-	AH98U585	E Cape	Huntly Glen
-	-	*C. wykehami*	-	-	SQ02X474	E Cape	Witmos
-	-	*C. wykehami*	-	-	SQ02X473	E Cape	Witmos
-	-	*C. leroma*	-	-	AH00T497	Limpopo	Waterberg
-	-	*C. leroma*	-	-	AJG07N841	Zimbabwe	Gweru
416	F	*C. leroma*	B	-	AH14K006	Zimbabwe	Chinhoyi
-	-	*C. leroma*	-	-	SC99T162	Tanzania	Chalinze (25km SW)
141	M	*C. leroma*	-	Yes	AH14E115	KZN	Kranskloof
-	-	*C. leroma*	-	-	AP98W772	KZN	Hillcrest
-	-	*C. leroma*	-	-	AH06B983	E Cape	Witmos
-	-	*C. leroma*	-	-	KR030416.MLIB0236	Gauteng	Magaliesburg
-	-	*C. leroma*	-	-	KR030490.MLIB0621	Gauteng	Magaliesburg

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (only published "on-line").

NB: Anal tuft colours: W = White, M = midtone, B = brown. Coll. = Collection/ Collector: AH = A Heath; JW = J White; JB = J Ball; ELP = E Pringle; GAH = G. Henning; NHM = Natural History Museum London; SEW = S. Woodhall; AJG = A. Gardiner; NHMS = Natural History Museum Stockholm; NM = Natal Museum; DH = D. Hull; JF = Jono Francis; DNSM = ?; ML = ?

Ref. no.	Sex	*Crudaria* species	Anal tuft colour	Tail: cilia ratio	Genitalia examined	Mapped Fig. 51	Country/ Province (SA)	Locality	Date	Coll.
1	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Bromley	18.03.1967	AH
2	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos	01.11.1991	AH
3	M	*C. leroma*	-	-		-	E Cape	Cradock	08.01.1992	JW
4	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos	03.11.1991	AH
5	M	*C. capensis*	-	-	Yes	-	W Cape	Gamkaberg NR	10.01.1991	AH
6	M	*C. leroma*	-	-		-	E Cape	Witmos	12.12.2010	AH
7	M	*C. capensis*	-	-	Yes	-	E Cape	Gamkaberg NR	10.01.1991	AH
8	M	*C. wykehami*	-	-	Yes	-	E Cape	Willowmore	12.1992	AH
9	M	*C. wykehami*	-	-	Yes	-	E Cape	Willowmore	12.1992	AH
10	M	*C. wykehami*	-	-	Yes	-	E Cape	Willowmore	12.1992	AH
11	M	*C. leroma*	-	-	Yes	-	W Cape	Calitzdorp	29.10.1992	
12	M	*C. leroma*	-	-	Yes	-	N Cape	Kobee Mountain	04.11.1984	JB
13	M	*C. leroma*	-	-	Yes	-	Mpumalanga	Sabie	10.09.1971	JB
14	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein		JB
15	M	*C. leroma*	-	-	Yes	-	W Cape	Tierkloof	28.12.1982	JB
16	M	*C. leroma*	-	-	Yes	-	E Cape	Cradock	08.11.1969	JB
17	M	*C. leroma*	-	-	Yes	-	W Cape	Calitzdorp	21.10.1990	
18	M	*C. leroma*	-	-	Yes	-	E Cape	Queenstown	17.10.1969	JB
19	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein	20.11.1976	JB
20	M	*C. leroma*	-	-	Yes	-	W Cape	Kobee Mountain	26.10.1985	JB
21	M	*C. leroma*	-	-	Yes	-	Namibia	Otavi	11.12.1973	GAH
22	M	*C. leroma*	-	-	Yes	-	Limpopo	Pienaar's River	26.12.1973	GAH
23	M	*C. wykehami*	-	-	Yes	-	E Cape	Huntly Glen	15.10.1988	JB
24	M	*C. leroma*	-	-	Yes	-	KZN	Muden	18.10.1953	JB
25	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein	20.11.1976	JB
26	M	*C. leroma*	-	-	Yes	-	Limpopo	Waterberg		
27	M	*C. leroma*	-	-	Yes	-	N Cape	Tierkloof	28.12.1982	JB
28	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein	20.11.1976	JB
29	F	*C. leroma*	W	-	Yes	Yes	W Cape	Kobee Mountain	26.10.1985	JB
30	F	*C. leroma*	W	-	Yes	-	E Cape	Witmos	01.11.1991	AH
31	F	*C. capensis*	M	-	Yes	-	W Cape	Gamkaberg NR	25.10.1990	AH
32	F	*C. leroma*	B	-	Yes	Yes	Zimbabwe	Efifi, Matopos	29.10.1974	
33	F	*C. wykehami*	B	-	Yes	Yes	E Cape	Wolwefontein	20.11.1976	JB
34	F	*C. leroma*	W	-	Yes	Yes	W Cape	Kobee Mountain	26.10.1985	JB
35	F	*C. wykehami*	B	-	Yes	-	E Cape	Wolwefontein	20.11.1976	JB
36	F	*C. leroma*	W	-	Yes	Yes	E Cape	Witmos	01.11.1991	AH
37	F	*C. leroma*	B	-	Yes	-	Zimbabwe	Arcturus Mine		AH
38	F	*C. wykehami*	B	-	Yes	-	E Cape	Willowmore	12.1992	AH
39	F	*C. leroma*	W	-	Yes	Yes	W Cape	Vanwyksdorp	1990	AH
40	F	*C. leroma*	B	-	Yes	-	Zimbabwe	Hot Springs		
41	F	*C. leroma*	W	-	Yes	-	W Cape	Huis River Pass	17.10.1993	AH
42	F	*C. leroma*	W	-	Yes	-	N Cape	Tierkloof	28.12.1982	JB
43	F	*C. leroma*	W	3	Yes	-	Namibia			
44	F	*C. leroma*	M	2.7	Yes	-	Namibia		04.12.1973	GAH
45	F	Indeterminate	M	-	Yes	-	KZN	Port Edward	30.11.1990	ELP
46	F	*C. wykehami*	B	-	Yes	-	E Cape	Huntly Glen	17.10.1988	ELP
47	F	*C. leroma*	W	2	-	-	W Cape	Beaufort West NP	06.10.1987	ELP
48	F	*C. leroma*	W	2	-	-	W Cape	Beaufort West NP	12.11.1986	ELP
49	F	*C. leroma*	W	-	-	-	N Cape	Tierkloof	28.12.1982	JB
50	F	*C. leroma*	B	-	-	-	KZN	Mhlosinga		
51	F	*C. leroma*	W	-	-	Yes	E Cape	Queenstown	17.10.1969	JB
52	F	*C. leroma*	W	-	-	Yes	W Cape	Prince Albert		
53	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen		AH
54	F	*C. leroma*	W	-	-	-	N Cape	Tierkloof	28.12.1982	JB
55	F	*C. leroma*	W	2.3	-	-	N Cape	Tierkloof	28.12.1982	JB
56	F	*C. capensis*	M	-	-	-	E Cape	Witmos	02.11.1993	AH
57	F	*C. capensis*	M	-	-	-	E Cape	Witmos	02.11.1993	AH
58	F	*C. capensis*	M	-	-	-	E Cape	Willowmore		
59	F	*C. wykehami*	B	1.6	-	-	E Cape	Willowmore		
60	F	*C. leroma*	W	2	-	-	E Cape	Witmos		

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

61	F	*C. leroma*	W	-	-	-	E Cape	Witmos		
62	M	*C. leroma*	-	-	-	-	Limpopo	Crocodile Kloof		
63	F	*C. leroma*	B	4	-	-	Tanzania	Morogoro	27.09.1987	NHM
64	M	*C. leroma*	-	-	-	-	Tanzania	Morogoro	27.09.1987	NHM
65	M	*C. leroma*	-	-	-	-	Malawi	Mulanje	12.12.1912	NHM
66	F	*C. leroma*	B	-	-	-	Malawi	SW of Lake Shirwa	01.1914	NHM
67	F	*C. leroma*	B	-	-	Yes	Malawi	Mulanje	12.12.1912	NHM
68	F	*C. leroma*	?	-	-	-	Mozambique	Mt Chiperone	27.11.1913	NHM
69	F	*C. leroma*	?	-	-	-	KZN	Muden	19.09.1947	NHM
70	M	*C. leroma*	-	2	-	-	E Cape	Queenstown	17.10.1969	JB
71	F	*C. leroma*	W	-	-	-	KZN	Kloof	09.1926	NHM
72	M	*C. wykehami*	-	1	-	-	E Cape	Huntly Glen		AH
73	F	*C. capensis*	M	-	-	-	W Cape	Gamkaberg NR	25.10.1990	AH
74	M	*C. leroma*	-	-	-	-	KZN	Port Shepstone	19.12.1924	NHM
75	M	*C. leroma*	-	-	-	-	KZN	Malvern		NHM
76	F	*C. leroma*	W	-	-	Yes	KZN	Malvern		NHM
77	M	*C. leroma*	-	-	-	-	KZN	Empangeni	21.01.1914	NHM
78	F	*C. leroma*	W	-	-	Yes	KZN	Newcastle	26.08.1993	NHM
79	F	*C. leroma*	W	-	-	-	KZN	Newcastle	28.08.1893	NHM
80	F	*C. leroma*	W	-	-	-	KZN	Newcastle	28.08.1893	NHM
81	F	*C. leroma*	W	-	-	-	KZN	Newcastle	27.08.1893	NHM
82	F	*C. leroma*	B	-	-	-	KZN	Durban		NHM
83	F	*C. leroma*	W	-	-	Yes	KZN	Weenen	01.1895	NHM
84	M	*C. leroma*	-	-	-	-	KZN	Weenen	01.1895	NHM
85	M	*C. leroma*	-	-	-	-	KZN	Weenen	01.1895	NHM
86	M	*C. leroma*	-	-	-	-	KZN	Weenen	01.1895	NHM
87	F	*C. leroma*	W	-	-	-	KZN	Weenen	01.1895	NHM
88	F	*C. leroma*	W	-	-	Yes	KZN	Weenen	01.1895	NHM
89	M	*C. leroma*	-	-	-	-	N Cape	Kuruman	25.11.1923	NHM
90	F	*C. leroma*	?	-	-	-	N Cape	Kuruman	25.11.1923	NHM
91	F	*C. leroma*	B	-	-	Yes	Zimbabwe	Victoria Falls	11.01.1924	NHM
92	F	*C. leroma*	?	-	-	-	KZN	Newcastle	26.08.1893	NHM
93	M	*C. leroma*	-	-	-	-	Limpopo	Pienaar's River	10.10.1967	GAH
94	F	*C. leroma*	W	3.8	-	Yes	Mpumalanga	Sabie	15.01.1971	GAH
95	M	*C. leroma*	-	3	-	-	North West	Potchefstroom	16.12.1974	GAH
96	F	*C. capensis*	W	-	-	Yes	E Cape	Eastpoort		GAH
97	M	*C. leroma*	-	-	-	-	Namibia	Central Caprivi	12.08.1973	GAH
98	F	*C. leroma*	W	-	-	Yes	Namibia	Maroelaboom	23.11.1984	GAH
99	F	*C. leroma*	?	-	-	-	Namibia	Otavi	04.12.1973	GAH
100	F	*C. leroma*	W	-	-	Yes	E Cape	Glen Gray Falls	10.1967	GAH
101	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Gatooma	24.10.1967	JB
102	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos	15.10.1988	JB
103	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Arcturus Mine	17.11.1989	JB
104	M	*C. leroma*	-	-	Yes	-	Namibia	Oshivelo		
105		*C. leroma*	-	2.6	Yes	-	Namibia	Otavi	04.12.1973	GAH
106	M	*C. leroma*	W	2.5	Yes	Yes	Namibia	Kombat	09.12.1974	GAH
107	F	*C. leroma*	-	3	Yes	-	Mpumalanga	Barberton	03.11.1973	GAH
108	M	*C. capensis*	-	-	Yes	-	W Cape	Gamkaberg NR	25.10.1990	AH
109	M	*C. leroma*	-	2.2	Yes	-	W Cape	Gamkaberg NR	25.10.1990	AH
110	M	*C. leroma*	-	-	Yes	-	N Cape	Tierkloof	28.12.1982	JB
111	M	*C. leroma*	B	2	Yes	Yes	KZN	Port Edward	30.11.1990	ELP
112	F	*C. wykehami*	-	-	Yes	-	E Cape	Huntly Glen		AH
113	M	*C. wykehami*	-	-	Yes	-	E Cape	Willowmore	12.1992	AH
114	M	*C. leroma*	-	-	Yes	-	W Cape	Calitzdorp		
115	M	*C. leroma*	-	-	Yes	-	E Cape	Queenstown	17.10.1969	JB
116	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Gatooma	24.10.1967	JB
117	M	Indeterminate	-	-	Yes	-	KZN	Port Edward	30.11.1990	ELP
118	M	*C. capensis*	-	2	-	-	E Cape	Eastpoort		GAH
119	M	*C. capensis*	W	2	-	-	E Cape	Eastpoort		GAH
120	F	*C. leroma*	-	-	-	-	E Cape	Glen Gray Falls	10.1967	GAH
121	M	*C. leroma*	W	-	-	Yes	North West	Potchefstroom	23.09.1973	GAH
122	F	*C. leroma*	-	2.2	-	-	Namibia	Saltpan	30.02.1978	GAH
123	M	*C. leroma*	-	-	-	-	Zimbabwe	Arcturus Mine	20.09.1987	GAH
124	M	*C. leroma*	B	3.5	-	Yes	Zimbabwe	Arcturus Mine	20.09.1987	GAH
125	F	*C. leroma*	-	3.4	-	-	Zimbabwe	Arcturus Mine	20.09.1987	GAH

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

126	M	*C. leroma*	?	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
127	F	*C. leroma*	-	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
128	M	*C. leroma*	-	3	-	-	Mpumalanga	Barberton	25.10.1992	GAH
129	M	*C. leroma*	-	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
130	F	*C. leroma*	W	2.7	-	-	Mpumalanga	Barberton	25.10.1992	GAH
131	F	*C. leroma*	?	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
132	M	*C. leroma*	-	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
133	M	*C. leroma*	-	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
134	F	*C. leroma*	W	2.8	-	Yes	Mpumalanga	Barberton	25.10.1992	GAH
135	M	*C. leroma*	-	-	-	-	Mpumalanga	Barberton	25.10.1992	GAH
136	M	*C. leroma*	-	-	-	-	Namibia	Oshivelo	18.03.1988	GAH
137	M	*C. leroma*	-	2.5	-	-	Namibia	Oshivelo	18.03.1988	GAH
138	M	*C. leroma*	-	-	-	-	Namibia	Oshivelo	18.03.1988	GAH
139	M	*C. leroma*	-	2.2	-	-	Namibia	Oshivelo	18.03.1988	GAH
140	F	*C. leroma*	W	-	-	-	Namibia	Oshivelo	18.03.1988	GAH
141	M	*C. leroma*	-	-	Yes	-	KZN	Kranskloof NR	09.2013	ML
142	F	*C. leroma*	M	-	-	-	KZN	Kranskloof NR	09.2013	ML
143	F	*C. leroma*	W	2.3	-	Yes	Gauteng	Hornsnek	13.09.1986	SEW
144	M	*C. leroma*	-	2	-	-	Limpopo	Grootfontein	19.12.1999	SEW
145	M	*C. leroma*	-	3.2	-	-	Limpopo	Grootfontein	19.12.1999	SEW
146	F	*C. leroma*	?	2.8	-	-	Limpopo	Grootfontein	19.12.1999	SEW
147	M	*C. leroma*	-	2.5	-	-	Limpopo	Pienaar's River	26.11.1982	SEW
148	F	*C. leroma*	W	4	-		Limpopo	Jan Trichardt's Pass	14.02.1993	SEW
149	F	*C. leroma*	B		-	Yes	Zimbabwe	Moodie's Pass	25.11.1993	SEW
150	F	*C. leroma*	?	3.3	-	-	Zimbabwe	Mutare	20.09.1993	SEW
151	M	*C. leroma*	-	2.5	-	-	Namibia	Oshivelo	18.03.1988	GAH
152	M	*C. leroma*	-	-	-	-	N Cape	Griquastad	10.10.1986	GAH
153	M	*C. leroma*	-	-	-	-	N Cape	Griquastad	10.10.1986	GAH
154	M	*C. leroma*	-	-	-	-	Free State	Theron	03.1958	GAH
155	M	*C. leroma*	-	-	-	-	Zimbabwe	Christon Bank	15.10.1985	GAH
156	M	*C. leroma*	-	-	-	-	Limpopo	Naboomspruit	06.02.1983	GAH
157	M	*C. leroma*	-	-	-	-	North West	Potchefstroom	17.02.1985	GAH
158	M	*C. leroma*	-	4	-	-	Zimbabwe	Hot Springs	07.10.1985	
159	F	*C. leroma*	W	-	-	-	Gauteng	Wonderboom	14.10.1979	
160	F	*C. leroma*	W	3	-	Yes	Gauteng	Wonderboom	14.10.1979	
161	F	*C. leroma*	W	-	-	Yes	Limpopo	Naboomspruit	06.02.1983	GAH
162	M	*C. leroma*	-	-	-	-	Limpopo	Naboomspruit	06.02.1983	GAH
163	M	*C. leroma*	-	-	-	-	North West	Potchefstroom	17.02.1985	GAH
164	M	*C. leroma*	-	-	-	-	Limpopo	Warmbaths	24.01.1982	JB
165	M	*C. leroma*	-	2	-	-	N Cape	Griquastad	10.10.1986	GAH
166	M	*C. leroma*	-	2.5	-	-	Limpopo	Thabazimbi	03.03.1991	GAH
167	M	*C. leroma*	-	2	-	-	N Cape	Tierkloof	28.12.1982	JB
168	M	*C. wykehami*	-	1	-	-	E Cape	Huntly Glen	06.12.1969	JB
169	M	*C. leroma*	-	-	-	-	W Cape	Beaufort West NP	11.11.1986	ELP
170	M	*C. leroma*	-	2.4	-	-	W Cape	Beaufort West NP	22.10.1986	ELP
171	M	*C. leroma*	-	2.2	-	-	N Cape	Kalahari Gemsbok NP	25.10.1987	ELP
172	F	*C. leroma*	?	-	-	-	KZN	Port Edward	30.11.1990	ELP
173	F	*C. leroma*	?	-	Yes	-	Zimbabwe	Hot Springs	14.10.1967	JB
174	F	*C. leroma*	?	-	-	-	Zimbabwe	Arcturus Mine	17.11.1989	JB
175	F	*C. leroma*	?	-	Yes	-	Zimbabwe	Hot Springs	14.10.1967	JB
176	F	*C. leroma*	W	-	-	-	E Cape	Witmos	11.11.1970	ELP
177	F	*C. leroma*	W	-	-	-	E Cape	Witmos	29.10.1970	ELP
178	F	*C. leroma*	W	-	-	-	E Cape	Witmos	10.11.1970	ELP
179	F	*C. leroma*	W	-	-	-	E Cape	Witmos	15.10.1988	JB
180	M	*C. leroma*	-	-	-	-	E Cape	Witmos	15.10.1988	JB
181	F	*C. leroma*	W	2	-	-	E Cape	Bouersfontein	04.11.1993	AH
182	M	*C. leroma*	-	2	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
183	M	*C. leroma*	-	2	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
184	M	*C. leroma*	-	2	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
185	M	*C. leroma*	-	2	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
186	F	*C. leroma*	W	2	-	Yes	W Cape	Beaufort West NP	01.11.1993	AH
187	F	*C. leroma*	W	2.1	-	-	W Cape	Beaufort West NP	01.11.1993	AH
188	F	*C. leroma*	W	2.1	-	-	W Cape	Beaufort West NP	01.11.1993	AH
189	M	*C. leroma*	-	-	-	-	Free State	Norval's Point		AH
190	F	*C. leroma*	W	2	-	Yes	Free State	Norval's Point		AH
191	F	*C. leroma*	W	1.9	-	-	W Cape	Leeu Gamka	24.10.1993	AH

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

192	F	*C. leroma*	W	2	-	-	W Cape	Leeu Gamka	24.10.1993	AH
193	M	*C. leroma*	-	2	-	-	W Cape	Leeu Gamka	24.10.1993	AH
194	M	*C. leroma*	-	2	-	-	W Cape	Leeu Gamka	24.10.1993	AH
195	M	*C. leroma*	-	2	-	-	W Cape	Leeu Gamka	24.10.1993	AH
196	F	*C. leroma*	W	2	-	-	W Cape	Prince Albert	31.10.1993	AH
197	F	*C. leroma*	W	1.9	-	-	W Cape	Prince Albert (20km)	31.10.1993	AH
198	M	*C. leroma*	-	2	-	-	W Cape	Prince Albert (20km)	31.10.1993	AH
199	F	*C. leroma*	W	2	-	-	W Cape	Prince Albert (20km)	31.10.1993	AH
200	M	*C. leroma*	-	2.2	-	-	W Cape	Prince Albert (20km)	31.10.1993	AH
201	F	*C. leroma*	W	2	-	-	W Cape	Prince Albert (20km)	31.10.1993	AH
202	F	*C. leroma*	W	-	-	-	W Cape	Huis River Pass	17.10.1993	AH
203	M	*C. leroma*	-	2	Yes	-	W Cape	Huis River Pass	17.10.1993	AH
204	M	*C. leroma*	-	2	Yes	-	W Cape	Huis River Pass	17.10.1993	AH
205	F	*C. leroma*	W	1.7	-	Yes	W Cape	Huis River Pass	17.10.1993	AH
206	F	*C. leroma*	W	1.9	-	-	W Cape	Huis River Pass	17.10.1993	AH
207	M	*C. leroma*	-	1.8	-	-	W Cape	Huis River Pass	17.10.1993	AH
208	F	*C. leroma*	W	-	-	-	E Cape	Bouersfontein	04.11.1993	AH
209	F	*C. leroma*	W	2	-	-	E Cape	Bouersfontein	04.11.1993	AH
210	M	*C. leroma*	-	2	-	-	E Cape	Bouersfontein	04.11.1993	AH
211	M	*C. leroma*	-	2.2	-	-	E Cape	Bouersfontein	04.11.1993	AH
212	F	*C. leroma*	W	2	-	-	E Cape	Bouersfontein	04.11.1993	AH
213	M	*C. leroma*	-	2	-	-	E Cape	Bouersfontein	04.11.1993	AH
214	F	*C. leroma*	W	2	-	Yes	N Cape	Tierkloof	28.12.1982	JB
215	M	*C. wykehami*	-	1.3	-	-	E Cape	Willowmore	04.11.1993	AH
216	M	*C. wykehami*	-	1.3	-	-	E Cape	Willowmore	04.11.1993	AH
217	M	*C. wykehami*	-	1.3	-	-	E Cape	Willowmore	04.11.1993	AH
218	F	*C. wykehami*	B	1.6	-	Yes	E Cape	Willowmore	04.11.1993	AH
219	F	*C. wykehami*	B	2	-	-	E Cape	Willowmore	04.11.1993	AH
220	M	*C. wykehami*	-	1.8	-	-	E Cape	Wolwefontein	04.11.1993	AH
221	M	*C. wykehami*	-	1.8	-	-	E Cape	Wolwefontein	04.11.1993	AH
222	M	*C. wykehami*	-	1.3	-	-	E Cape	Wolwefontein	04.11.1993	AH
223	F	*C. wykehami*	B	2	-	-	E Cape	Wolwefontein	04.11.1993	AH
224	F	*C. wykehami*	B	2	-	-	E Cape	Wolwefontein	04.11.1993	AH
225	F	*C. leroma*	B	2	-	-	E Cape	Wolwefontein	04.11.1993	AH
226	F	*C. wykehami*	B	-	-	Yes	E Cape	Baviaanskloof	23.01.1989	JB
227	F	*C. wykehami*	W	2.6	-	Yes	E Cape	Baviaanskloof	23.01.1989	JB
228	M	*C. leroma*	-	4.7	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	AH
229	M	*C. wykehami*	-	1.5	-	-	E Cape	Huntly Glen	23.10	AH
230	F	*C. wykehami*	B	1.8	-	Yes	E Cape	Huntly Glen	23.10	AH
231	F	*C. wykehami*	B	1.3	-	-	E Cape	Huntly Glen	23.10	AH
232	F	*C. wykehami*	B	2	-	-	E Cape	Huntly Glen	23.10	AH
233	M	*C. wykehami*	-	1.3	Yes	-	E Cape	Huntly Glen	23.10	AH
234	M	*C. wykehami*	-	1.9	-	-	E Cape	Huntly Glen	23.10	AH
235	F	*C. leroma*	B	4.8	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	AH
236	F	*C. leroma*	W	-	-	Yes	Mpumalanga	Kowyn's Pass	31.09.1993	AH
237	F	*C. leroma*	B	3	-	Yes	Zimbabwe	Vumba	14.11.1993	AH
238	F	*C. leroma*	B	-	-	-	Zimbabwe	Vumba	14.11.1993	AH
239	M	*C. leroma*	-	4.1	-	-	Zimbabwe	Mazoe River	26.03.1972	
240	F	*C. leroma*	B	3.6	-	Yes	Zimbabwe	Mazoe River	28.11.1971	
241	F	*C. leroma*	B	3.3	-	Yes	Zimbabwe	Headlands	10.10.1984	
242	F	*C. leroma*	W	2.4	-	Yes	Namibia	Namutoni	07.12.1986	GAH
243	M	*C. leroma*	-	3	-	-	Namibia	Namutoni	07.12.1986	GAH
244	F	*C. leroma*	W	2.6	-	-	Namibia	Oshivelo	18.03.1988	GAH
245	F	*C. leroma*	W	2.5	-	-	Namibia	Oshivelo	18.03.1988	GAH
246	F	*C. leroma*	W	2.6	-	-	Namibia	Oshivelo	18.03.1988	GAH
247	F	*C. leroma*	W	2.8	-	-	Namibia	Oshivelo	18.03.1988	GAH
248	F	*C. leroma*	W	2.8	-	-	Namibia	Oshivelo	18.03.1988	GAH
249	M	*C. leroma*	-	-	Yes	-	Namibia	Oshivelo	18.03.1988	GAH
250	M	*C. leroma*	-	3	Yes	-	Namibia	Oshivelo	18.03.1988	GAH
251	F	*C. leroma*	M	2.5	-	-	KZN	Umtamvuma	04.12.0980	NM
252	F	*C. leroma*	B	-	-	-	KZN	Maritzburg	29.11.1975	NM
253	F	*C. leroma*	B	2.9	-	-	KZN	Umkomaas	03.02.1973	NM
254	F	*C. leroma*	B	2.8	-	Yes	KZN	Umkomaas	03.02.1973	NM
255	M	*C. leroma*	-	2.5	-	-	KZN	Umkomaas	03.02.1973	NM
256	M	*C. leroma*	-	2.3	-	-	KZN	Umkomaas	20.10.1973	NM
257	F	*C. leroma*	W	-	-	Yes	N Cape	Olifantshoek	24.03.1982	NM

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

258	M	*C. leroma*	-	2.9	-	-	N Cape	Olifantshoek	24.03.1982	NM
259	M	*C. leroma*	-	2.3	-	-	N Cape	Olifantshoek	24.03.1982	NM
260	F	*C. leroma*	W	-	-	-	E Cape	Witmos	02.11.1993	JB
261	F	*C. leroma*	W	-	-	-	E Cape	Witmos	02.11.1993	JB
262	F	*C. wykehami*	B	-	-	Yes	E Cape	Witmos	02.11.1993	JB
263	F	*C. leroma*	W	-	-	-	E Cape	Bouersfontein	04.11.1993	JB
264	M	*C. leroma*	-	-	-	-	W Cape	Huis River Pass	17.10.1993	AH
265	M	*C. leroma*	-	-	-	-	E Cape	Witmos		DNSM
266	M	*C. wykehami*	-	-	-	-	E Cape	Huntly Glen	20.10.1970	DNSM
267	F	*C. wykehami*	B	2	-	-	E Cape	Steytlerville	01.01.1994	AH
268	F	*C. leroma*	W	2.4	-	-	N Cape	Tierkloof	30.12.1993	AH
269	M	*C. leroma*	-	2.7	-	-	KZN	Eshowe	10.10.1979	DNSM
270	M	*C. leroma*	-	2	-	-	KZN	Eshowe	10.10.1979	DNSM
271	M	*C. leroma*	-	3	-	-	KZN	Eshowe	10.10.1979	DNSM
272	M	*C. leroma*	-	-	-	-	KZN	Ladysmith	19.10.1993	DNSM
273	M	*C. leroma*	-	-	-	-	KZN	Ladysmith	19.10.1993	DNSM
274	M	*C. leroma*	-	-	-	-	KZN	Amanteku	11.04.1982	DNSM
275	M	*C. leroma*	-	-	-	-	KZN	Ladysmith	23.11.1993	DNSM
276	F	*C. leroma*	W	-	-	-	KZN	Ladysmith	23.11.1993	DNSM
277	F	*C. leroma*	W	-	-	Yes	KZN	Ladysmith	23.11.1993	DNSM
278	F	*C. leroma*	M	-	-	-	KZN	Ladysmith	23.11.1993	DNSM
279	M	*C. leroma*	-	-	-	-	KZN	Ladysmith	23.11.1993	DNSM
280	M	*C. leroma*	-	-	-	-	KZN	Itala	13.02.1993	
281	M	*C. leroma*	-	3	-	-	KZN	Itala	13.02.1993	
282	M	*C. leroma*	-	3	-	-	KZN	Itala	13.02.1993	
283	F	*C. leroma*	W	-	-	-	KZN	Weenen	12.11.1986	DNSM
284	M	*C. leroma*	-	2.5	-	-	N Cape	Prieska	09.11.1992	DNSM
285	M	*C. leroma*	-	-	-	-	W Cape	Beaufort West 15k N	12.11.1986	DNSM
286	M	*C. leroma*	-	-	-	-	W Cape	Beaufort West	12.11.1986	DNSM
287	M	*C. leroma*	-	2.3	-	-	KZN	Umkomaas	20.10.1973	DNSM
288	F	*C. leroma*	M	-	-	-	KZN	Eston	12.10.1974	DNSM
289	F	*C. leroma*	W	-	-	Yes	KZN	Albert Falls	02.1993	
290	F	*C. leroma*	W	-	-	-	KZN	Muden	26.02.1983	DNSM
291	F	*C. leroma*	W	-	-	Yes	W Cape	Beaufort West 44k W	30.12.1993	AH
292	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West 44k W	30.12.1993	AH
293	M	*C. leroma*	-	-	Yes	-	W Cape	Beaufort West 44k W	30.12.1993	AH
294	M	*C. leroma*	-	2.3	-	-	W Cape	Beaufort West 44k W	30.12.1993	AH
295	M	*C. leroma*	-	-	-	-	W Cape	Beaufort West 44k W	30.12.1993	AH
296	M	*C. leroma*	-	-	-	-	N Cape	Olifantshoek	24.03.1982	NM
297	F	*C. leroma*	W	-	-	-	N Cape	Olifantshoek	24.03.1982	NM
298	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West 44k W	30.12.1993	AH
299	M	*C. leroma*	-	-	-	-	KZN	Muden	24.12.1954	Ditsong
300	F	*C. leroma*	M	-	-	-	KZN	Muden	21.02.1952	Ditsong
301	F	*C. leroma*	W	-	-	-	KZN	Weenen	11.03.1902	Ditsong
302	F	*C. leroma*	?	4.6	-	-	Mozambique	Amatongas	19.09.1954	Ditsong
303	F	*C. leroma*	W	-	-	Yes	Zimbabwe	Hot Springs	22.12.1957	Ditsong
304	F	*C. leroma*	W	-	-	Yes	Namibia	Rundu	28.11.1946	Ditsong
305	F	*C. leroma*	W	-	-	-	KZN	Muden	12.04.1959	Ditsong
306	F	*C. leroma*	W	2.2	-	Yes	KZN	Hluhluwe	11.10.1953	Ditsong
307	F	*C. leroma*	M	-	-	Yes	KZN	Newcastle	27.08.1893	Ditsong
308	F	*C. leroma*	M	2.7	-	-	KZN	Durban		Ditsong
309	F	*C. leroma*	W	-	-	Yes	Mpumalanga	Elandshoek	15.11.1947	Ditsong
310	M	*C. leroma*	-	-	-	-	E Cape	Cockscomb	02.01.1965	Ditsong
311	M	*C. leroma*	-	3	-	-	KZN	Hluhluwe	11.10.1953	Ditsong
312	M	*C. leroma*	-	-	-	-	KZN	Newcastle	26.08.1893	Ditsong
313	F	*C. leroma*	W	-	-	Yes	Mpumalanga	Elandshoek	15.11.1947	Ditsong
314	M	*C. leroma*	-	-	-	-	KZN	Marion Hill	13.12.1926	Ditsong
315	F	*C. leroma*	W	4.5	-	-	Zimbabwe	Hot Springs	22.12.1957	Ditsong
316	M	*C. leroma*	-	3	-	-	Zimbabwe	Hot Springs	29.12.1963	Ditsong
317	M	*C. leroma*	-	3.2	-	-	Zimbabwe	Vumba	04.01.1945	Ditsong
318	M	*C. leroma*	-	-	-	-	KZN	Weenen	30.09.1903	Ditsong
319	M	*C. leroma*	-	-	-	-	E Cape	Ntholovane	11.06.1971	Ditsong
320	M	*C. leroma*	-	-	-	-	E Cape	Butterworth	28.10.1971	Ditsong

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

321	F	*C. leroma*	M	2.3	-	Yes	KZN	Muden	07.02.1952	Ditsong
322	F	*C. leroma*	W	-	-	Yes	Limpopo	Saltpan Pretoria		
323	M	*C. leroma*	-	-	-	-	Mpumalanga	Elandshoek	15.11.1947	Ditsong
324	M	*C. leroma*	-	-	-	-	N Cape	Griquastad	10.10.1986	GAH
325	M	*C. leroma*	-	-	-	-	N Cape	Griquastad	10.10.1986	GAH
326	F	*C. wykehami*	B	-	-	-	E Cape	Willowmore		AH
327	F	*C. wykehami*	B	-	-	-	E Cape	Willowmore		AH
328	F	*C. wykehami*	B	-	-	-	KZN	Port Edward	30.11.1990	ELP
329	M	*C. wykehami*	-	-	-	-	E Cape	Wolwefontein	04.11.1993	AH
330	M	*C. leroma*	-	-	-	-	Namibia	Oshivelo		AH
331	M	*C. leroma*	-	-	-	-	Mpumalanga	Blydepoort	22.02.1979	JB
332	M	*C. leroma*	-	-	-	-	Limpopo	Warmwaterberg	30.04.1981	JB
333	M	*C. leroma*	-	-	-	-	E Cape	Queenstown	17.10.1969	JB
334	M		-	-	-	-	E Cape	Witmos		
335	M	*C. capensis*	-	-	-	-	E Cape	Witmos	15.10.1988	JB
336	M	*C. leroma*	-	-	-	-	Mpumalanga	Steelpoort		
337	M	*C. leroma*	-	-	-	-	Limpopo	Naboomspruit		
338	M	*C. leroma*	-	-	-	-	Mpumalanga	Steelpoort		
339	F	*C. leroma*	W	-	-	-	Malawi	Cape Maclear		
340	M	*C. leroma*	-	-	-	-	Limpopo	Naboomspruit		
341	M	*C. leroma*	-	-	-	-	Limpopo	Warmwaterberg	30.04.1981	JB
342	F	*C. leroma*	?	-	-	-	N Cape	Kimberley		
343	M	*C. leroma*	-	-	-	-	N Cape	Warrenton		
344	M	*C. leroma*	-	-	-	-	N Cape	Warrenton		
345	F	*C. leroma*	?	-	-	-	Limpopo	Olifantshoek		
346	M	*C. leroma*	-	-	-	-	N Cape	Kimberley		
347	F	*C. leroma*	?	-	-	-	North West	Focheville		
348	F	*C. leroma*	W	-	-	-	North West	Focheville		
349	M	*C. leroma*	-	-	-	-	Limpopo	Waterpoort		
350	M	*C. leroma*	-	-	-	-	Mpumalanga	Steelpoort		
351	F	*C. leroma*	?	-	-	-	Gauteng	Hennops River		
352	M	*C. leroma*	-	-	Yes	-	Mpumalanga	Steelpoort		
353	F	*C. leroma*	?	-	-	-	North West	Focheville		
354	F	*C. leroma*	?	-	-	-	Mpumalanga	Steelpoort		
355	F	*C. leroma*	W	2.8	-	-	Limpopo	Grootfontein	19.12.1999	SEW
356	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Gatooma	24.10.1967	JB
357	F?	*C. leroma*	?	-	-	-	Namibia	Rundu	23.10.1994	AJG
358	M	*C. leroma*	-	2	-	-	N Cape	Springbok (12km N)	09.10.1994	AJG
359	M	*C. leroma*	-	2	-	-	N Cape	Springbok (12km N)	09.10.1994	AJG
360	M	*C. leroma*	-	-	-	-	N Cape	Springbok (12km N)	09.10.1994	AJG
361	M	*C. leroma*	-	2.1	-	-	N Cape	Springbok (12km N)	09.10.1994	AJG
362	F	*C. leroma*	?	1.7	-	-	N Cape	Springbok (12km N)	09.10.1994	AJG
363	F	*C. leroma*	B	2.6	-	-	Limpopo	Grootfontein	19.12.1999	SEW
364	F	*C. leroma*	W	2.8	-	Yes	Botswana	Francistown	18.01.1985	AJG
365	M	*C. leroma*	-	2.7	-	-	Botswana	Francistown	18.01.1985	AJG
366	M	*C. leroma*	-	3	-	Yes	Zambia	Livingstone (20km N)	22.12.1993	AJG
367	M	*C. leroma*	-	2.5	-	-	Zimbabwe	Arcturus Mine	13.09.1998	AJG
368	M	*C. leroma*	-	-	-	-	Zimbabwe	Moodie's Pass	25.11.1993	SEW
369	F	*C. leroma*	B	2.8	-	Yes	Zimbabwe	Glenville	27.07.1965	AJG
370	M	*C. leroma*	-	2.6	-	-	Zimbabwe	Glenville	27.07.1965	AJG
371	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos	12.11.2010	AH
372	F	*C. leroma*	B	4	-	Yes	Zimbabwe	Bloomfield		
373	M	*C. leroma*	-	3.9	-	-	Zimbabwe	Concession		
374	M	*C. leroma*	-	4.5	Yes	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
375	M	*C. leroma*	-	-	Yes	-	W Cape	Gamkaberg NR	18.10.2010	AH
376	F	*C. leroma*	B	-	-	-	Zimbabwe	Moodie's Pass	25.11.1993	SEW
377	F	*C. leroma*	W	-	-	-	Malawi	Mulanje	02.2005	ABRI
378	F	*C. leroma*	B	3.5	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
379	F	*C. leroma*	W	-	-	-	Limpopo	Jan Trichardt's Pass	14.02.1993	SEW
380	F	*C. leroma*	W	-	-	-	Zambia	Livingstone	22.10.2004	ABRI
381	M	*C. leroma*	-	2.7	Yes	-	Namibia	Oshivelo	18.03.1988	GAH
382	F	*C. leroma*	B	5	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
383	M	*C. leroma*	-	-	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
384	M	*C. leroma*	-	-	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
385	F	*C. leroma*	W	-	-	-	E Cape	Witmos	12.11.2010	AH
386	F	*C. leroma*	W	2.6	-	Yes	Namibia	Oshivelo	18.03.1988	GAH

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

387	F	*C. leroma*	?	2.5	-	-	Limpopo	Nylsvley	04.03.1989	SEW
388	F	*C. leroma*	W	2.6	-	-	Limpopo	Grootfontein	19.12.1999	SEW
389	F	*C. leroma*	W	2.8	-	-	Limpopo	Tubex Poort	19.04.2000	SEW
390	F	*C. leroma*	B	2.5	-	-	Limpopo	Grootfontein	19.12.1999	SEW
391	F	*C. leroma*	B	-	-	-	Limpopo	Grootfontein	19.12.1999	SEW
392	F	*C. leroma*	B	2.8	-	-	Limpopo	Grootfontein	19.12.1999	SEW
393	F	*C. leroma*	B	-	-	-	Limpopo	Grootfontein	19.12.1999	SEW
394	M	*C. leroma*	-	-	-	-	Limpopo	Grootfontein	19.12.1999	SEW
395	M	*C. leroma*	-	-	Yes	-	Limpopo	Grootfontein	19.12.1999	SEW
397	F	*C. leroma*	B	-	-	-	Limpopo	Grootfontein	19.12.1999	SEW
398	F	*C. leroma*	W	2.8	-	Yes	Limpopo	Tubex Poort	19.04.2000	SEW
399	F	*C. leroma*	B	5.5	-	Yes	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
400	M	*C. leroma*	-	3.9	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
401	M	*C. leroma*	-	5.5	Yes	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
402	M	*C. leroma*	-	4.1	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
403	M	*C. leroma*	-	5.2	Yes	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
404	F	*C. leroma*	B	4.8	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
405	F	*C. leroma*	W	3.9	-	-	Limpopo	Jan Trichardt's Pass	14.02.1993	SEW
406	F	*C. leroma*	W	-	-	-	Namibia	Oshivelo	18.03.1988	GAH
407	M	*C. leroma*	-	2.8	Yes	-	Namibia	Oshivelo	18.03.1988	GAH
408	M	*C. leroma*	-	-	-	-	Zimbabwe	Vumba	09.1989	ABRI
409	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Christon Bank	11.1981	
410	F	*C. capensis*	M	-	-	-	W Cape	Tierkloof	05.01.1982	
411	M	*C. wykehami*	-	-	-	-	E Cape	Huntly Glen	05.01.1982	
412	F	*C. wykehami*	B	1.3	-	-	E Cape	Huntly Glen	14.11.2010	AH
413	F	*C. leroma*	W	-	-	-	E Cape	Witmos	12.11.2010	AH
414	F	*C. leroma*	W	-	-	-	E Cape	Bouersfontein	04.11.1993	AH
415	F	*C. capensis*	?	-	-	-	W Cape	Gamkaberg NR	18.10.2010	AH
416	F	*C. leroma*	B	-	-	-	Zimbabwe	Chinhoyi	11.01.2014	AH
417	F	*C. leroma*	B	-	-	Yes	Zimbabwe	Odzi	14.01.1012	
418	F	*C. leroma*	B	-	-		Limpopo	Grootfontein	19.12.1999	SEW
419	F	*C. leroma*	B	-	-		Tanzania	Chalinze (25km SW)	16.09.1993	ABRI
420	F	*C. capensis*	M	-	-		W Cape	Gamkaberg NR	18.10.2010	AH
421	F	*C. leroma*	W	-	-	Yes	Gauteng	Loding	14.01.2012	SEW
422	M	*C. leroma*	-	-	-		KZN	Marchmont Farm		SEW
423	F	*C. leroma*	M	-	-	Yes	KZN	Kranskloof NR	20.09.2015	SEW
424	F	*C. leroma*	W	-	-		W Cape	Gamka Eco Estate	15.12.2013	SEW
425	?	*C. leroma*	-	-	-		W Cape	Gamka Eco Estate	15.12.2013	SEW
426	MF	*C. leroma*	-	-	-		W Cape	Gamka Eco Estate	15.12.2013	SEW
427	F	*C. leroma*	W	-	-		W Cape	Gamka Eco Estate	15.12.2013	SEW
428	M	*C. leroma*	-	-	-		W Cape	Gamka Eco Estate	15.12.2013	SEW
429	F	*C. leroma*	B	-	-	Yes	Limpopo	Khandizwe Mtn	11.11.1998	
430	M	*C. leroma*	-	-	-		Zimbabwe	Hot Springs	29.12.1963	Ditsong
431	F	*C. leroma*	W	-	-	Yes	Zambia	Mulobezi	29.01.2016	
432	F	*C. leroma*	W	-	-		Zambia	Mulobezi	29.01.2016	
433	F	*C. leroma*	W	-	-	Yes	Zimbabwe	Nduna		
434	F	*C. leroma*	W	-	-	-	Zimbabwe	Chinhoyi		
435	M	*C. leroma*	-	-	Yes	-	Mozambique	Mount Mabu	01.11.2010	ABRI
436	F	*C. leroma*	W	-	-	-	Gauteng	Golden Valley	12.2009	ABRI
437	F	*C. leroma*	W	-	-	-	Gauteng	Golden Valley	11.2003	ABRI
438	M	*C. leroma*	-	2.8	-	-	Zimbabwe	Christon Bank	01.1985	ABRI
439	M	*C. leroma*	-	4.3	Yes	-	Zimbabwe	Vumba	09.1989	ABRI
440	M	*C. leroma*	W	-	-	-	Namibia	Omapyu	01.2004	ABRI
441	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein	10.11.2009	AH
442	M	*C. wykehami*	-	-	Yes	-	E Cape	Wolwefontein	17.11.2010	AH
443	M	*C. wykehami*	-	-	Yes	-	E Cape	Huntly Glen	17.11.1010	AH
444	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Lion's Den		JF
445	F	*C. leroma*	B	-	-	-	Zimbabwe	Lion's Den		JF
446	F	*C. leroma*	B	-	-	-	Zimbabwe	Lion's Den		JF
447	M	*C. leroma*	-	-	Yes	-	Zimbabwe	Odzi	14.01.1012	AH
448	F	*C. leroma*	W	1.5	-	-	E Cape	Finchley Farm	7.11.2010	AH
449	F	*C. leroma*	W	1.5	-	-	E Cape	Finchley Farm	7.11.2010	AH
450	M	*C. leroma*	-	-	-	-	Zimbabwe	Harare		JF
451	F	*C. leroma*	W	-	-	-	E Cape	Witmos	01.11.1991	AH
452	F	*C. leroma*	B	-	-	-	Tanzania	Chalinze (25km SW)	16.09.1993	ABRI

TABLE 4 – Data sheet for *Crudaria* specimens examined as part of this study (contd.)

453	F	*C. leroma*	W	-	-	-	W Cape	Leeu Gamka 14km N		
454	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	11.1993	AH
455	M	*C. wykehami*	-	-	-	-	E Cape	Huntly Glen	14.11.2010	AH
456	M	*C. wykehami*	-	-	-	-	E Cape	Wolwefontein	10.11.2009	AH
457	M	*C. capensis*	-	-	-	-	E Cape	Witmos	02.11.1993	ELP
458	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos	05.11.1983	ELP
459	M	*C. leroma*	-	-	Yes	-	E Cape	Tarkastad	03.02.2018	ELP
460	M	*C. leroma*	-	-	Yes	-	N Cape	Kalahari Gemsbok NP	25.10.1987	ELP
461	M	*C. leroma*	-	-	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
462	M	*C. leroma*	-	-	Yes	-	W Cape	Beaufort West NP	01.11.1993	AH
463	M	*C. capensis*	-	-	Yes	-	W Cape	Gamkaberg NR	18.10.2010	AH
464	M	*C. capensis*	-	-	Yes	-	W Cape	Gamkaberg NR	18.10.2010	AH
465	M	*C. capensis*	-	-	Yes	-	W Cape	Gamkaberg NR	18.10.2010	AH
466	M	*C. capensis*	-	-	-	-	W Cape	Gamkaberg NR	18.10.2010	AH
468	F	*C. leroma*	W	2.5	-	-	E Cape	Caffraria		NHMS
469	M	*C. wykehami*	-	-	-	-	E Cape	Huntly Glen	14.11.2010	AH
470	M	*C. leroma*	-	-	Yes	-	E Cape	Witmos		
471	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	07.11.2008	AH
472	M	*C. leroma*	-	2.5	Yes	-	E Cape	Caffraria		NHMS
473	M	*C. leroma*	-	-	Yes	-	E Cape	Pearston	18.03.2017	ELP
474	M	*C. leroma*	-	-	Yes	-	E Cape	Waterford	11.03.2017	ELP
475	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	17.10.1970	ELP
476	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	25.10.1985	ELP
477	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	28.09.1970	ELP
478	F	*C. wykehami*	B	-	-	-	E Cape	Huntly Glen	28.09.1970	ELP
479	F	*C. wykehami*	B	-	-	-	E Cape	Willowmore	17.11.2005	ELP
480	F	*C. leroma*	W	-	-	-	E Cape	Witmos	05.11.1983	ELP
481	F	*C. leroma*	W	-	-	-	E Cape	Witmos	15.10.1988	JB
482	F	*C. leroma*	W	-	-	-	E Cape	Witmos	15.10.1988	JB
483	F	*C. leroma*	W	-	-	-	E Cape	Witmos	15.10.1988	JB
484	F	*C. leroma*	W	-	-	-	E Cape	Witmos	05.11.1983	ELP
485	F	*C. leroma*	W	-	-	-	E Cape	Witmos	20.12.1978	ELP
486	F	*C. leroma*	W	-	-	-	E Cape	Witmos	25.10.1979	ELP
487	F	*C. leroma*	W	-	-	-	E Cape	Witmos	19.10.1970	ELP
488	F	*C. leroma*	B	-	-	-	Limpopo	Tubex Poort	11.02.1978	SEW
489	F	*C. leroma*	W	-	-	-	E Cape	Somerset East	08.02.2004	ELP
490	F	*C. leroma*	W	-	-	-	N Cape	Prieska	21.10.1987	ELP
491	F	*C. leroma*	W	-	-	-	E Cape	Colesberg	20.10.1987	ELP
492	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West	22.10.1986	ELP
493	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West	22.10.1986	ELP
494	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West	11.11.1986	ELP
495	F	*C. leroma*	W	-	-	-	W Cape	Beaufort West	06.10.1987	ELP
496	F	*C. leroma*	W	-	-	-	W Cape	Huis River Pass	13.10.1993	ELP
497	F	*C. leroma*	W	-	-	-	N Cape	Kalahari Gemsbok NP	24.10.1987	ELP
498	F	*C. leroma*	W	-	-	-	N Cape	Kalahari Gemsbok NP	24.10.1987	ELP
499	F	*C. leroma*	W	-	-	-	N Cape	Kalahari Gemsbok NP	26.10.1987	ELP
500	F	*C. leroma*	W	-	-	-	N Cape	Kalahari Gemsbok NP	26.10.1987	ELP
501	F	*C. leroma*	W	-	-	-	N Cape	Kathu	21.11.2004	ELP
502	F	*C. leroma*	B	-	-	-	Mpumalanga	Steelpoort	13.10.1992	ELP
503	F	*C. leroma*	B	-	-	-	Mpumalanga	Ngodwana	13.09.1973	DH
504	F	*C. leroma*	B	-	-	-	Mpumalanga	Ngodwana	15.09.1973	DH
505	F	*C. leroma*	B	-	-	-	Zimbabwe	Shamva Mazoe Riv	28.11.1971	AH
506	M	*C. capensis*	-	-	-	-	W Cape	Gamkaberg NR	17.10.1993	AH