A Preliminary Account of the East African Species of Cloeon Leach and Rhiithrodonotum gen. n. (Ephemeroptera)

by

M. T. GILLIES


Keys are given to males and females of 12 species of Cloeon known from Eastern Africa, including descriptions of C. awakensis sp. n. and C. formicarum sp. n. The new genus Rhiithrodonotum, presumed to be a parasitoid form, is defined in terms of the characters of the male forewings and the proportions of basal tarsal segments. Two species, premiium Kottage and Anaximander Kottage from Eastern Zaire, formerly included in Cloeon, are transferred to Rhiithrodonotum, and a new species, R. multisetos sp. n., is described from Tanzania.

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In an earlier paper I gave an introductory account of the genus Cloeon in West Africa, covering the 9 species known from the region at that time (Gillies, 1980). Keys were provided for males and females, together with descriptions of the nymphs of 6 species. The present paper deals with East Africa which, for these purposes, covers the eastern half of tropical Africa north of the Zambezi, including the High Sahaba Province of Zaire. A record from south-west Arabia, which from a zoogeographical point of view is part of the Afrotopical Region, is also included.

This task has been made easier by the fact that the mayfly fauna of certain of the Great Lakes has been relatively well studied, while a number of species of Cloeon have been described from Zaire. These locally intensive studies have been supplemented by my own collections, made in spare moments and widely scattered localities, which together make it possible to give a preliminary account of the fauna. Small bodies of water in the cooler, highland areas have received relatively little attention although I have recently acquired a valuable series of reared adults from pools near Nairobi, collected by Dr. Alan Hildrew. It is here
that species originally described from South Africa might be expected to occur. The fact that it now, apart from C. virgillia Barnard and the ubiquitous C. perkinsi Barnard, none of the southern forms have yet been established as occurring to the north may be connected with the paucity of collecting in the tropical highlands.

Kopelke (1980) described two species of Cloeon, C. permirum and C. insuetum, from eastern Zaire, the males of which possess forcipæ that are quite different from any other known species of Cloeon or, for that matter, from any other Baetid genus. A third species of this group occurs in Tanzania. For ecological as well as morphological reasons these 3 species are transferred to the new genus, Rheotheleceon.

This paper is intended to complement the study on West African Cloeon already published, and the descriptions and figures of species included are not reprinted here. It is suggested that, when Cloeon species are being studied, it might be found useful to consult both.

The adults of Cloeon are defined as possessing single marginal intercalaries and as lacking a hind wing. This definition also covers the problematical species Centropus crassistoma Demeulin from South Africa, whose generic position is still uncertain. It also covers certain species of Afrotropicalis Demeulin (see Gillies, 1979a) as well as the species now transferred to Rheotheleceon. Generic definitions in the Baetid family are strongly influenced by nymphal characters. But, since in only a minority of cases have the adults and nymphs of Afrotropical species been correlated, it is not possible at the present time to compile a reliable generic key to the family as a whole. The following key, however, should serve to separate the adults of Cloeon and Rheotheleceon from all other known forms.

PARTIAL KEY TO GENERA

OF EAST AFRICAN BAETIDAE (ADULTS)

<table>
<thead>
<tr>
<th>1. Marginal intercalaries double</th>
<th>Bauri, Centrella, and Pseudobauri</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal intercalaries single</td>
<td>Centropus, Centropus, and Afrotropicalis (in part)</td>
<td></td>
</tr>
<tr>
<td>2. Hind wing present</td>
<td>Centropus, Centropus, and Afrotropicalis (in part)</td>
<td></td>
</tr>
<tr>
<td>Hind wing absent</td>
<td>Afrotropicalis (in part)</td>
<td></td>
</tr>
<tr>
<td>3. Wing 1/3 extended, body square, abdomen almost equal in length of head and thorax together</td>
<td>Afrotropicalis (in part)</td>
<td></td>
</tr>
<tr>
<td>Wing usually longer than 3 mm, body elongate, abdomen much longer than head and thorax together</td>
<td>Afrotropicalis (in part)</td>
<td></td>
</tr>
<tr>
<td>4. Second hind tarsal segment equal to 2.5 times length of third; male forcipæ with small or minute third segment</td>
<td>Cloeon*</td>
<td></td>
</tr>
<tr>
<td>Second hind tarsal segment equal to 1.2 - 1.5 times length of third; male forcipæ with two segments only</td>
<td>Rheotheleceon</td>
<td></td>
</tr>
</tbody>
</table>

* In South Africa, Centropus crassistoma may key out here, since the proportions of the hind tarsal segments have not been described. The third segment of the male forcipæ is hooked, almost in the shape of a parrot's beak, and therefore differs unlike Cloeon.
The keys presented here cover the species known to occur in East Africa, north of the Zambezi, and also include the West African species C. bellam-Nasah not as yet recorded from this area. Those using the keys are warned that they may not always be reliable in specimens whose markings have faded through long preservation in fluid.
<table>
<thead>
<tr>
<th>South African south of</th>
<th>East Africa</th>
<th>West Africa</th>
<th>Sengwa- west Africa</th>
</tr>
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<tbody>
<tr>
<td>Limpopo</td>
<td>Zambia</td>
<td></td>
<td></td>
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</table>

**Cliron**

- *amanum Bernard* + ?
- *abertoni Esh. Pertiwa* +
- *udumii Hubbard* +
- *amanum* sp. n.
- *medleyi Navas*
- *bwezi Navas* +
- *spicily Buana* +
- *laurae* (Kimmins) +
- *propinquis Kuppe* +
- *rau Lee* (Chen) +
- *gambier Gillies* +
- *intenarmi Bernard* +
- *hooi Bernard* +
- *kimeres Kuppe* +
- *senegal Lezage* +
- *chordata sp. n.* +
- *bun originating Bernard* +
- *spicily Lezage* +

**Bitronothion**

- *sp. *n.* +
- *vivace (Kuppe)* +
- *parvum (Kuppe)* +

**KEY TO EAST AFRICAN SPECIES OF CLIRON**

**Females**

1. Cephal and subocular areas of "vogi unipunctatus" ........................................ 2

2. Petriquanta with a single cross-vein, abdominal markings obliterating of a continuous "w" and an interrupted "pe", internal line: - *cyphosidea* .......................... 2

3. Petriquanta with 2 cross-veins ......................................................... 4

4. Abdominal marking maximal on terga III and IV, all terga from II-X with lateral markings, overlaid on III and VI with deep maroon, dorso-lateral patches; 3rd furrow with a narrow, red, longitudinal line: - *longispina* .................................................. 5

5. Abdominal markings maximal on IV and VII, terga bearing large, brownish, dorso-lateral triangle; 3rd furrow uniform reddish brown. - *variae* ................................................ 5

6. Abdominal terga with strong markings, maximal on III and VI, with MA2 not extending more than about 2/3 distance to 3rd furrow between MA1 and MA2) .................................. 6

7. Abdominal terga not so; with MA2 extending up to or almost to cross-vein between MA1 and MA2) .................................. 7
MALIS

1. Pterostigma with single cross-vein; lateral margin of abdominal terga with a broad, opaque, white line extending along whole length of abdomen; abdominal markings: pterostigma with 2 opaque cross-veins, abdominal markings on thorax and tarsi as for 

2. Torso cylindrical and slender, 1.3 times as tall as broad; ovipositor blade-like, exceeding cerci by at least 1.5 times their length; abdominal markings: no cross-veins on tergum III, and VI; hind tarsus 2 times as long as tarsus 3.


11. Pterostigma with single cross-vein; abdominal markings as for Malis 9.


13. Pterostigma with single cross-vein; abdominal markings as for Malis 9.
The diagnostic characters of the nymphs of East African species of *Cheon* are given below. Those of *avrodaenum, demestum, rhodesiae* and *virideulatum* are not known, while the description of *stelligerum* is not available. *Typhlus* has the upper gill lamella much reduced and in *avrodaenum* the upper gill lamella is rudimentary. *Typhlus* is included in the South African species, *C. africanum*, except that in the latter species the upper gill lamella on segment VI is absent. In counting the lateral spines for identification, the spine on the posterior angle of segments VIII and IX is included in the count since it forms part of a continuous line of spines down the margin. Only in the case of *zanzibari* is this spine not present on any segment other than VIII. On the other segments it is convenient to ignore the spine at the posterior angle, since it is present in all species, and one simply notes the number of spines, or their absence, in the central part of the lateral margin.

As the account of the status of the East African *Cheon* follows, including descriptions of two new species. For synoptic descriptions and figures of the other species, the reader is referred to Gillies (1980) or to other sources where indicated.

**Cheon africanum** Esb. Pet.

As previously, I am treating all the older records of *africanum* from tropical Africa as being due to confusion with some other species, possibly in some cases with *avrodaenum*. The description given by Ulmer (1924) of *africanum* from the Algerian Sahara and Khinshasa, as well as those referred to by him as *C. marginale* Hag. (17) from Kinshasa and the Sudan (Ulmer, 1916), clearly refer to *C. perkinsi*. On this interpretation, *C. africanum* is at present to be regarded as a purely southern species.
Cloeos amaniesis sp. n.

A large species, the female with clear wings, the abdomen in both sexes with markings maximal on terga III and VI; maxillary palps of nymph with 7 segments.

*Male imago* (in spirit). Turbinate eyes, head and thorax pale orange; femora pale orange; tibiae and tarsi colourless; hind tarsal segment 2 equal to almost 2.5 times segment 3; wing veins clear except for dark red base of costal brace, no cross-veins before base, preostigma with 2-4 cross-veins. Abdominal segments II-VI translucent, dark red, posterior-lateral triangles on terga III and V, forcipet typical of the genus with minute, globular terminal segment, tails ringed.

Figs. 6–11. Mouthparts of *Cloio amaniesis*. 6 right mandible; 7 labrum; 8 left mandible; 9 maxilla; 10 hypopharynx; 11 labium.
Female imago (in spirit). Body generally pale orange; femora pale orange, tibiae and tarsi colourless, hind tarsal ratio as in male; wing membrane colourless, basal half of costa brace at junction with RI dark red, a similar dark spot at junction of R4-5 and MA; venation strongly developed (fig. 1), 4-5 cross-veins before bulla, stigma with 4-6 cross-veins; abdominal terga III and VI with postero-lateral dark red patches, median third of posterior margins of segments II-VI with narrow, transverse, dark red bands (fig. 4), lateral margins of sterna IV-VI each with a small longitudinal red streak, tails with alternating broad and narrow, red rings at joints.

Body, male 6.5-7.0 mm, female 8.0 mm; wing, male 6.5 mm, female 8.0 mm.

Nymph. Labial palps stout, clavate, maxillary palps with 2-segments (fig. 9); tarsal claws long with a double row of long teeth (fig. 14); upper gill lamellae well developed, present on gills I-VI; lateral abdominal spines present on segment VII (I-V), VIII (I-V), IX (I-IV) (fig. 12).

(below) female imago. TANZANIA: Arusha lake. 800 m. 25.vi.61, in British Museum (Natural History). Paratypes: 2 male imagines, 2 male subimagines, 2 female subimagines, all with 39000 nymphal skins, same provenance, vi.61

The female differs from all other African Cloeon by the combination of unpigmented wings, maximal abdominal markings on terga III and VI and stigma with more than 2 cross-veins. The male imago resembles rhodesiae, but differs in the proportions of the hind tarsal segments and in the absence of dark rings before the apices of the mesonota; the nymph is distinguished from other known species by the maxillary palps having 2 segments and by the absent or single lateral abdominal spine on segment VII; the denticles on the tarsal claws are also more prominent than in other described species.

Cloeon areolatum Navis

DISTRIBUTION IN EAST AFRICA. Uganda: Entebbe, Kampala (Kimmins, 1960).

The only other records of this species come from the Congo basin and West Africa, suggesting it may primarily be a species of the West African zoogeographical zone.

Studies on West African material have shown that the abdominal pattern of females of C. bellum, as figured by Gillies (1980), are more variable than was thought and that confusion may arise with C. areolatum. In such cases, the absence of pigment in the basal half of the costal region in areolatum, and the presence of oblique, marginal cross-veins in bellum serve to separate them.

Cloeon cylindrocolum (Kimmins)


In recording emergence cycles on Lake Victoria, Tjerneland (1960) noted that cylindrocolum could be "easily confused with some other species". It is interesting
to speculate as to whether he was referring to broad-eyed males of *cylindrocolum* (see Gilles, 1970b, 1980) or possibly to *arculatum*, whose males are now known to have cylindrical eyes.

Cloeon dentatum Kimmins

DISTRIBUTION IN EAST AFRICA. Uganda: Jinja (Kimmins, 1956), Entebbe (Gilles, 1980).

São Tomé and Príncipe (1960) recorded males swarming after sunset at Jinja.

Cloeon perkinsi Barnard


Probably the commonest and most widespread *Cloeon* in Africa. I have seen vast swarms of males, along with those of *scolitus*, swarming in the early morning sun in September, in the vicinity of Lake Kalimawe, near Goja in Tanzania.

Cloeon rhodesiae Barnard


A widespread but apparently not an abundant species. The nymph is unknown.

Cloeon scolitus Kimmins


A widespread and frequently abundant species. The nymphs are found in permanent or semipermanent waters, occasionally in temporary pools.

Cloeon sspilometus Lestage


An ubiquitous species throughout tropical Africa. I have 4 females collected in South Yemen, which appear typical. They evidently represent the Afrotropical element in the fauna of south-west Arabia.
A clear-winged species in both sexes; in life, the female pale green with burnt caramel markings on terga IV and VII, in the male the same markings on II, III and VII; hind tarsus 2.3 times as long as 3; maxillary pulp of nymphs with 3 segments.

**Male imago** (in spirit). Turbinate eyes orange brown; body generally dark orange; femora orange, tibiae and tarsi clear; wings with 2 stigmatic cross-veins; abdominal terga I-III orange laterally, IV-VI clear, VII clear but in life with dark lateral markings, VIII-X dark orange; tails clear; forcepts typical of the genus.

**Female imago** (in life). Generally pale green; pedicel of antenna brown at apex, base of filament likewise; thorax green, pronotum with median dark brown band, posterolateral corners of mesonotum with discrete dark brown spots; fore femur and tibia reddish through out, mid and hind femora faintly green with a red dot at extreme apex on inner side, tarsi clear; wings colourless (fig. 2) except for posterior half of costal bract and small portion of wing membrane together marked with a conspicuousumber spot (faded in preserved specimen); no cross-veins before bulla, 2 stigmatic cross-veins; abdomen pale green (fig. 3) with very small dashes of orange on lateral portions of terga II-VII, terga IV and VII with large, burnt
caramel triangles, that on VII forming a continuous bar across the middle, VIII colourless, IX and X white, orange posteriorly; tails with narrow, umber rings: venter unmarked.

Body, male 4.0-4.5 mm, female 5.0-6.0 mm; wings, male 4.0-4.5 mm, female 6.0 mm.

Nymph. Labial palps stout, clavate, maxillary palps with 3 segments (figs. 23, 21); tarsal claws with minute denticles (fig. 15); upper gill lamellae well developed on gills I-VI (figs. 16-18); lateral abdominal sponges on segment IX (7-8) only.

Holotype female image with associated nymphal skin. TANZANIA: Ambani lake, Ambani, 900 m, 22.vi-61; paratype, 1 male image, 3 nymphal skins; same provenance, vi.61.

Type in British Museum (Natural History).

Figs. 19-23. Mouthparts of Closs tonisanius. 19, right mandible; 20, left mandible; 21, maxilla; 22, labium; 23, labrum.
The female differs from all other African Cloeon by the combination of unpigmented wings and maximal abdominal markings on segments IV and VII; the nymph is distinguished from all other described species by the absence of lateral abdominal spines on all except the IXth segment.

**Cloeon virgillae** Barnard


Although the abdominal markings have faded, the 2 female specimens from Tanzania have the costal and subcostal areas uniformly tinted very pale brown and the paratergites with 2-3 cross-veins. Hind tarsus 2 is 2-2.5 times as long as tarsus 3. In East Africa, this South African species is evidently scarce in most districts.

**Cloeon viridellum** Westage

Only known as a single male from Lubumbashi, Shaba Province, Zaïre. The markings are somewhat unusual for Cloeon, the abdominal terga being dark brown with medial clear areas. The paratergites have 2 cross-veins (Demoulins, 1957).

**BIOLOGY OF CLOEON ADULTS**

**Cloeon** adults are often seen at light at night, resting on walls or screened windows. Kimmins (1955) reproduced a figure of the resting posture of *C. smaraceni*, as observed by Pr. Lewis Borrer. The abdomen is curved upwards so that the tip is pointing vertically while the tails are held at right angles and drooping a little so as to be almost parallel with the ground. This is a commonly seen posture for *smaraceni* and also for *rhodesiae*, but I have seen it in no other African Cloeon. It is also typical for *C. duperreum* in Europe. Borrer also described *perkinsi* as having a quite different posture, the tip of the abdomen being curved upwards and forward and with the tails extending over the head. This appears to have been an exceptional finding since, although *perkinsi* is such a common species I have never seen it resting in any except the normal posture for mayflies with the abdomen more or less parallel with the substrate.

Cillies (1975) commented on the fact that in tropical countries swimming of male Cloeon has only been noted in the cool season. This is particularly well marked in East Africa, where swimming at low altitudes was only observed in the months from May to October. On the other hand, in highland areas above, say, 1200-1500 m such records of swimming as I have refer to both cooler and warmer periods of the year. No explanation of this phenomenon has been put forward. On the Ugandan shores of Lake Victoria at Jinja (c. 1200 m above sea level) Tjellneland (1960) recorded *C. demissum* swimming in the early morning. Seasonal data were not presented, but light-trap catches of male imagines showed a bimodal
peak. catches being mainly confined to the first hour after sunset and the last hour before sunrise.

Ovoiviviparity has been reported in the Palaearctic C. dipurus and in several Oriental species, Gillies (1969). I have likewise observed it in 4 African species, smaragdi, gambiæ, perkinsi and cylindrocolum.

_Rhithrocoelen_ gen. n.

Separable from _Cloeon_ Leach by the male forceps and the proportions of the hind and mid tarsal segments. The forceps are characterised by loss of the terminal segment, the remaining 2 segments being fused and variously shaped. On the mid and hind legs, tarsal segment two equals 1.25 - 1.5 times segment three. Vein MA2 well developed, tending to reach as far as the cross-vein between MA1 and MP1.

The nymph is not known but, judging from the provenance of all known adults, it must be an inhabitant of torrents and therefore most unlikely to resemble _Cloeon_.

Type species. _R. permirum_ (Kopelke), in _Cloeon_.

_Cloeon_ differs from _Rhithrocoelen_ by the male forceps having a small, usually globular, third segment and, on the mid and hind legs, by tarsal segment two equaling 2 to 3 times segment three. Vein MA2 usually short, only in one known species, _C. dentatum_, reaching us to the cross-vein between MA1 and MP1.

_Cloeon dentatum_ is to a certain extent an intermediate between typical _Cloeon_ and _Rhithrocoelen_. The ratio of hind tarsal segments II : III is 2 : 1, while the male forceps retain the terminal third segment, thus clearly remaining in _Cloeon_. But the shape of the forceps is otherwise quite different from other species in the genus. Exact definition of the position of this species, like its relationship to _Rhithrocoelen_, must await the discovery of their nymphs.

There is also the question of the status of _Ctenoperlum crassum_ Demoulin. In possessing single marginal intercalaries in the fore wing and in lacking a hind wing it approaches _Cloeon_, although the hooked third segment of the forceps is anomalous. The proportions of the hind tarsal segments have not been described. The nymphal gills resemble those of the Palaearctic genus _Procloeon_, the mandibles _Cloeon_, while the labial palps resemble those of _Ctenoperlum_. Hind tarsal segment II was found to be shorter than in _Cloeon_, and given the fact that MA2 reaches up to the cross-vein between MA1 and MP1, its grouping with the species for which _Rhithrocoelen_ has been erected might have to be considered. It would follow from this that the unknown nymph of _Rhithrocoelen_ should be of the same type as _Ctenoperlum_, even though the latter inhabits "still, deep stretches of river" (Crass, 1974) similar to those favoured by _Procloeon_ in Europe. At the present time the question remains unsolved.

_Rhithrocoelen permirum_ (Kopelke), comb. n.

**DISTRIBUTION IN EAST AFRICA**: Zaire: Kalengo, Lake Kiva (Kopelke, 1980). Tanzania: by R. Sigl, 700 m below Amanti, 7 males, 2 male subimagines, iv.61, x.61, xi.61 ii.63.
The Tanzanian specimens agree well with the description and figures given by Kopelke (1960). The forecoxae differ, however, in a number of minor points, notably in the basal segment, which is divided in the sagittal plane into a medio-lateral portion and an inner portion which, viewed from the ventral aspect, is at a much deeper level (fig. 25). The internal projection at the base of the basal segment is also longer and appears to arise from a broader base. The apex of the IXth segment, while similar in outline, appears to lack the internal structure depicted by Kopelke. It seems preferable for the moment to regard these differences as within the limits of variation of the species. The specimens were caught in a light-trap beside the River Sigi, at a point where the river plunges down the mountainous in a series of cascades.

**Rhithroscelion indicator** sp. n.


**Female imago** (in spirit). Head and thorax orange brown; legs colourless, hind tarsus tarsus III 1:4:1; wings vitreous, MA2 reaching to cross-vein, no cross veins before bulla, stigma with 5 cross-veins; abdominal terga II-VII with posterior margins broadly banded reddish pink, posterior half of IX and terga X pink, tails white. A single, dark orange, apparently unembryonated egg mass is present in the tube.

Body, Male 6.0-7.0 mm; wing, male 6.0-7.0 mm, female 5.5-6.0 mm.

Holoctype male imago, TANZANIA: Gorja, South Pare District, 600 m, 2.vii. 51, in British Museum (Natural History). Paratypes, 4 males, 1 female, same provenance; Shire, West Usambarra Mountains, c. 1800 m, 1 male, below Arusha, 700 m, 2 males.

This species differs from *R. permumum* by the finger-like aspect of the forecoxae, the distal segment being subequal to the basal segment, while the terminal, blade-like portion is shorter and much shorter; the apex of the IXth sternum, posterior to the forecoxae base, is more evenly tapered than in *permumum*. The tried species in the genus, *R. inuactum* (Kop.) has quite distinct forecoxae.

The specimens were mainly collected at rest on vegetation over small mountain streams near the base of the South Pare Mountains at Gorja and in a similar site high up in the Western Usambaras in montane forest. The specimens from near Arusha came from light-trap collections beside the River Sigi. It is evidently widely distributed in northern Tanzania. A female of *Rhithroscelion* was caught at Amahi, but since the female of *permumum* is not known, the identity of this species cannot be established.
Figs. 24-27. Genital structures of *Chloeon* and *Gastrochroeoidea* spp.: 24, *Chloeon maniaceus*; 25, *Gastrochroeoidea permixta*, the two sides shown from different angles; 26, *A. indicosa*, on the left lateral view, on the right ventral view; 27, *A. inornata* (redrawn from Enderlein, 1903).
Rhododendron insecum (Kopelka), comb. n.

The forest in this species are scooter towards the tip and have a thumbshaped projection towards the base on the inner side (fig. 27). Distrbution in East Africa: Zaire: Kahungu stream by Lake Kivu (Kopelka).

Acknowledgements

I am indebted to Dr. R. Bailey of Chelsea College, University of London, for a collection of specimens from the Ngimbuka Munga Reserve in Tanzania, and to Dr. A. A. Jackson of Queen Mary College, University of London, for a valuable series of named specimens from temporary pools in Kenya.

Location of Collecting Sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
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<td>Bugiri</td>
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<td>Lisihowe</td>
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<td>Chisumu</td>
<td>10°47'S, 35° 1'E</td>
<td>Lubambu</td>
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<td>Entebbe</td>
<td>0° 7'N, 30° 35'E</td>
<td>Mulangwa</td>
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<td>Palwach</td>
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<td>1° 35'N, 39° 10'E</td>
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Table 2: Diagnostic characters of sympatric East African species of C. oxyceras:

<table>
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<th>Characteristic</th>
<th>No. of segments</th>
<th>Maxillary palps</th>
<th>Number of lateral scales in abdominal tegument</th>
<th>IV*</th>
<th>V*</th>
<th>VI*</th>
<th>VII*</th>
<th>VIII*</th>
<th>IX*</th>
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<td>1.4</td>
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<td>-</td>
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* Number excludes spines in posterior angle.

** Number includes spines in posterior angle.
REFERENCES


