Larvae and pupae of New Guinea Tabanidae (Diptera). I.
Species of Chrysops Meigen

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Abstract. Information on the immature stages of Australasian Tabanidae found in published literature dealt with only 17 species, all so far known only from Australia and none representing the genus Chrysops Meigen. Two of the four Australasian species of Chrysops are found on the island of New Guinea, and both, C. albicinctus Wulp and C. australis Ricardo, are described and illustrated.

Introduction

As presently accepted by most students of the Tabanidae, the family includes approximately 4,000 species representing at least 130 genera distributed among five subfamilies, three with three tribes and two with one tribe each. Mackerras (1964) recognized 119 species representing three subfamilies, five tribes, and 11 genera in the fauna of the Papuan Subregion, an area encompassing all of New Guinea and most of the neighboring islands and, based on Mackerras’ map (Mackerras 1964, p. 71), lying between 0° and 120° S latitude and between 129° and 155° W longitude. In two subsequent papers Mackerras (1971, 1972) described 16 additional species and made other taxonomic changes resulting in a recognized Subregional fauna of 135 species in 12 genera representing the same subfamilies and tribes noted in his 1964 treatise. A few subsequent papers covering other parts of the Australasian and Oceanian Regions have included taxonomic changes involving the fauna of the Papuan Subregion. Daniels (1989) summarized all but one of these and prepared the most recent faunal list for the Regions which includes 135 species in 13 genera for the Subregion. Chainey (1988), which was not mentioned by Daniels (1989), elevated Lilaea Walker to generic status and provided the description of a new species, Lilaea (Cyanolilaea) ismayi Chainey, from Papua New Guinea thereby increasing the known fauna for the Subregion to 136 species in 14 genera.

Considering the entire Australasian and Oceanian Regions, the review of the literature revealed descriptive information on the larvae, pupae, and/or eggs of 17 species, all currently known only from Australia. Taylor (1917) described the eggs Pseudotabanus silvester (Bequaert) [as Mesomyia (Pseudo-

...tabanus) australis (Ricardo)] The larvae and pupae of Tabanus particaecus Hardy and T. townsvilli Ricardo and the pupa of Lilaea (L.) fuliginosa (Taylor) were described by Johnston and Bancroft (1920). Hill (1921) described the larvae and pupae of T. pallipennis Macquart, T. townsvilli Ricardo, T. dorsobimaculatus Macquart [as nigritarsis Taylor], and L. (L.) fuliginosa (Taylor), and also the eggs of the first two listed. The larvae and pupae of Scapta (S.) auriflua (Donovan) were described by Fuller (1936) who also described (Fuller 1937) the larvae and pupae of Dasybasis froggatti (Ricardo), D. gentilis (Erichson), and D. neobasalis (Taylor). In four papers English (1949, 1953, 1955, 1961) described the larvae and pupae of five species, two in 1955 and one in each of the other years as follows: first, D. macrophthalmalma (Schiner) [as oraria (English)]; second, Ectenopsis (E.) angusta (Macquart); third, S. (Pseudoscione) vicina (Taylor); and S. (Myioscapta) muscula English, and fourth, Caenaprosopon trichocerum (Bigot). The larva and pupa of Cydistomyia casuarinae (English, Mackerras and Dyce) [as Chalybosoma casuarinae] were described by English and Dyce (1957).

Materials and Methods

The materials and methods used in this study were essentially like some of those described by previous authors including Teskey (1969), Goodwin and Murdock (1974), Burger (1977), and Goodwin (1982).

As the areas sampled were shoreline mud, the primary collecting tool was a wood-framed sieve approximately 45 cm on a side and 12 cm in depth. The bottom of the sieve was a wire mesh with approximately 3 mm by 3 mm openings. Samples of mud or soil were dug out by hand or with a small
shovel and placed in the wood-framed sieve. The sieve was partly submerged in water and agitated up, down, and from side to side to break up and flush particles through the bottom mesh. At 10-15 second intervals, until the sample had been thoroughly searched, the frame was elevated and searched for larvae. Each search included partly inverting the sieve to look for larvae that might be crawling through the wire mesh. All field-collected larvae were placed individually in small vials containing a small amount of water and/or material from their habitat for transport to the laboratory.

Larvae were reared in small, numbered, plastic bottles, the numbers corresponding to those in a rearing log containing habitat data. Two media were used: 1) non-nutrient agar-agar of slightly less than 1% concentration in water as described by Roberts (1966); and 2) moist sand. Larvae were generally not fed for the first 2-3 weeks in hopes that food deprivation might influence them to pupate. When feeding was required, small cubes of raw beef liver about 5 mm by 5 mm were provided once a week. About 24 hours after each feeding remaining liver was removed and discarded. In addition, larvae being reared in the agar-agar medium were transferred to clean medium after feeding as blood from the liver greatly reduced visibility.

All rearing bottles were checked daily. When a pupa was found, the larval exuviae were recovered. For specimens in agar-agar, the larval exuviae could be recovered with forceps without removing the pupa. For specimens in sand, the pupa was carefully, but temporarily, set aside so that the sand could be searched. Once the larval exuviae were recovered, sand was replaced in the rearing bottle, a small circular depression was made in the sand, and the pupa was placed head upward into this depression.

Each larval exuviae were placed in a small amount of water to clean away debris. After initial cleaning, the exuviae were placed in a petri dish containing 70% ethyl alcohol, and the petri dish was placed on the stage of a dissecting microscope. Using forceps and a blunt probe with the last 3-4 mm bent at an angle of about 30 degrees, the larval exuviae were teased and stretched lengthwise. The same instruments were then used to open the ecdysial slit. A syringe filled with 70% ethyl alcohol with a blunt-tipped needle was then used to 'inflate' the exuviae by slowly injecting alcohol into the ecdysial slit. The 'inflated' exuviae were stored in 70% ethyl alcohol in a vial bearing the same number as the rearing bottle from which the exuviae had come.

When an adult was found, it was set aside for 12-24 hours to allow integumental hardening and

Figure 1. A: dorsal view of head capsule; B: lateral view of generalized tabanid larva; C: lateral view of generalized tabanid pupa; D: ventral view of anterior one-half of generalized tabanid pupa; E: slightly latero-oblique view of posterior end of generalized tabanid pupa (Abbreviations: a.l.-anallobe; a.m.s.- anterior mesonotal seta; a.o.s.- anterior orbital seta; a.r.-antennal ridge; a.s.p.-abdominal spiracle; a.s.p.f'-anterior spinous fringe; an.r.-anal ridge; ant.-antenna; ant.pb.-anterior pubescence; ast.-aster; b.a.s.-basal alar seta; c.s.-callus seta; c.t.-callus tubercle; ceph.b.-cephalic brush; cly.-clypeus; ct.sp.-cephalothoracic suture; d.c.-dorsal comb; d.t.-dorsal tubercle of aster; e.p.s.-epicranial suture; f.s.-frontal suture; f.t.-frontal tubercle; i.c.-lateral comb; i.o.s.-lateral orbital seta; l.t.-lateral tubercle of aster; max.p. & mx.p.-maxillary palp; md.-mandible; p.m.s.-posterior mesonotal seta; p.o.s.-posterior orbital seta; p.s.p.-posterior spinous fringe; pb.ext.-pubescent extension; pl.-pleuron; pl.s.-pleural setae; post.pb.-posterior pubesence; pseudopodium; pseu.ph.-pseudopodial pubescence; siphem.-siphon; st.-stermite; st.sp.-stigmatal spine; sp.f.-spinous fringe; sp.p.-spiracular prominence; th.1.-first tibia; th.2.-second tibia; tg.-tergite; tg.s.-tergal setae; th.sp.-thoracic spiracle; v.c.-ventral comb; v.s.-vertexal setae; v.t.-ventral tubercle of aster; w.-wing).
coloration to occur. Adults were then killed, pinned, and labeled in the usual manner. The pupal exuviae were removed, rinsed in 70% ethyl alcohol to clean away debris, and placed in the vial with its corresponding larval exuviae.

Measurements of the larval head capsule and spacings between the integumentary striations were made using the larval exuviae. All other larval measurements were made using live larvae. All pupal measurements and counts of spines were made using the pupal exuviae.

**Larval and Pupal Morphology**

Figures 1A-1E illustrate the larval and pupal morphological features used in the descriptions below. For a more detailed discussion of larval and pupal morphology please refer to one of the papers cited above in the first paragraph of Materials and Methods.

**The Genus Chrysops Meigen**

The genus Chrysops is well represented in Africa, South America, the entire northern hemisphere, and to a lesser degree in the Oriental Region, but it is poorly represented in the Australasian and Oceanian Regions where only six species are listed by Daniels (1989). Using Weber's line as the boundary between the Oriental Region and the Australasian/Oceanian Regions, Burger and Chainey (Burger, personal communication) recognize only four species of Chrysops in the Australasian and Oceanian Regions (C. albicinctus Wulp, C. atrivittatus Schuurmans Stekhoven, C. australis Ricardo, and C. signifer Walker). Burger and Chainey (Invertebrate Taxonomy, in press) are 'sinking' the subspecies of C. australis previously recognized from New Guinea.

Based on examination of larvae and pupae of 36 species, Teskey (1969) recognized two distinct larval forms, one form with a respiratory siphon having a stigmatal spine and the other lacking the spine. In all other aspects the larvae and pupae were sufficiently similar to allow Teskey (1969) to develop generic characterizations which are quoted below:

The larvae are characterized by the following features: length at maturity usually less than 18 mm; third antennal segment as long or longer than second; striations present dorsally and ventrally on all segments, although sometimes absent laterally; three pairs of pseudopodia on each of first seven abdominal segments; respiratory siphon on those species not bearing a stigmatal spine two to five times longer than its basal diameter; pubescence present on median lateral surfaces of anal segment. The pupae may be diagnosed by: length usually less than 15 mm; two pairs of callus setae; antennal sheaths curved anterodorsally and exceeding epicranial suture; abdominal fringes on each segment composed of a single row of spines; absence of dorsal and lateral pairs of preanal combs. (Teskey 1969, p.22)

The larvae and pupae of Nearctic Chrysops are moderately well known. Larvae and pupae of only a few Afrotopical, Neotropical, Palaearctic, and Oriental species are known. To date, the immature stages of no Australasian or Oceanian species have been described. The larvae and pupae of both New Guinea species are described herein. Both larvae are of the type which lacks the stigmatal spine, and both conform readily to the generic characterizations cited above except that the pupa of one species (based on a single specimen) has only one seta on each callus tubercle, a condition previously noted for C. brunneus Hine, a Nearctic species (Goodwin, 1976).

**Chrysops albicinctus Wulp**

Mature larva (Figure 2): Length 13-18 mm, whitish with contrasting pale brownish pubescent markings. Head capsule 1.73 mm long, greatest width 0.48 mm. Anal segment 2.16 mm long, ca. 1.5 times its greatest width. Respiratory siphon 0.6 mm long, ca. 3.6 times its basal diameter; stigmatal spine absent. Striations present on all non-pubescent aspects of all segments; striations separated 0.031-0.037 mm dorsally and ventrally, slightly more compressed laterally. Anterior pubescence narrowly encircles all thoracic and first four abdominal segments, absent midlaterally from abdominal segment V and midlaterally and midventrally from VI and VII; anterior annuli of thoracic segments not widened laterally and without posterior projections. Pseudopodial pubescence forming complete annuli on the first seven abdominal segments, united with anterior pubescence dorsolaterally on all seven and ventrolaterally only on first
four; pseudopodial pubescent annulus on abdo­
minal segment VII with short dorsolateral and vent­
rolateral posterior projections reaching nearly to
middle of segment. Posterior pubescence encircling
abdominal segment VII where it is expanded ante­
riorly over most of lateral surface, crossing a little
more than one-third length of segment. Anal seg­
ment entirely pubescent except for a narrow non­
pubescent anterior ring dorsally from which a non­
pubescent triangular area extends posteriorly, the
non-pubescent area middorsally crossing 0.20–0.25
the length of the segment.

Pupa: Length 13-15 mm; yellowish-brown with­
out obvious darkened areas. Antennal ridges not
separated into median and lateral portions, only
the former indicated by small protrusions elevated
c. 0.02 mm above wide notch at midline. Callus
tubercles bisetose, irregularly triangular in basal
outline, each tapering to a somewhat sinuous ridge
that runs dorsolaterally; elevated 0.09–0.10 mm above
general surface. Frontal tubercles absent. Anten­
nal sheaths 0.47–0.51 mm long, 0.36–0.42 mm wide,
exceeding epicranial suture. Thoracic spiracles ca.
0.46–0.51 mm long; spiracular prominence exceed­ing
dorsal thoracic margin 0.16–0.18 mm. Abdomi­
nal fringes uniseriate, complete on segments II­
VII; dorsal fringe on tergite VII of 44–50 spines.
Ventral or ventrolateral preanal combs of 20–24 or
6–8 spines. Dorsal, lateral and ventral tubercles
0.10–0.12, 0.26–0.29, and 0.12–0.14 mm long, re­
spectively; all tapered to pointed apices; dorsals
directed dorso-posteriorly, laterals directed latero­
posteriorly, ventrals directed ventro-posteriorly.

Collections and comments: More than 50 larvae
of this species were collected of which 41 were
placed in containers for rearing. The others were
preserved in 70% ethyl alcohol. Only 10 adults,
including both sexes, were obtained. The pupal
duration was noted for only 5 specimens and ranged
from 5–7 days.

The first location was the crocodile rearing
facility 6 km outside Lae along the Markham High­
way. Apparently full-grown larvae were collected
at this location in January, February, April and
May of 1997. All larvae were found in highly organ­
ic, silty mud at the margin of a narrow, shallow,
manmade drainage ditch which received the out­
flow water from crocodile rearing ponds and feed­
ing pens. The water was rarely more than 20 cm
deep. The surface of the stream was only 0.5–1.0 m
wide. The margins of the ditch supported mainly
grasses in the area where the larvae were found,
but the larvae were in the silty mud and not

Figure 3. Lateral view of larva of Chrysops australis Ricardo.

associated with the root mats of the shoreline
grasses.

The other two locations were on the Markham
Ranch about 55 km outside of Lae along the
Markham Highway. Apparently full-grown larvae
were collected on the Markham Ranch only in
September of 1997. One of these locations, the one
yielding most of the larvae, was along the edge of a
shallow, sluggish stream. The area yielding the
larvae was sandy silt, richly organic, and com­
pletely devoid of vegetation. The other location, also
along a sluggish stream, was bounded and shaded
by trees; vegetation grew almost to the edge of the
water, and the mud was firmer and not obviously
sandy. As before, the larvae were in the mud and
not associated with root mats.

Chrysops australis Ricardo

Mature larva (Figure 3): Length 13-18 mm,
yellowish-white with contrasting dark brownish
pubescent markings. Head capsule 1.96 mm long,
greatest width 0.46 mm. Anal segment 2.42 mm
long, ca. 2.0 times its greatest width. Respiratory
siphon 0.96 mm long, ca. 4 times its basal diameter;
stigmatal spine absent. Striations present on all
non-pubescent aspects of all segments; striations
separated 0.031–0.037 mm dorsally and ventrally,
slightly more compressed laterally. Anterior pu­
bescence narrowly encircles all segments except
anal; prothoracic anterior annulus with a fan­
shaped caudally directed projection on each side;
meso- and metathoracic anterior annuli distinctly
widened laterally but without distinct posterior
projections. Pseudopodial pubescence forming com­
plete annuli on all seven pseudopodial segments,
united with anterior pubescence dorsolaterally and
ventrolaterally on all. Abdominal segment VII en­
tirely pubescent posterior to pseudopodial annulus
laterally; dorsally the posterior one-half of segment
is non-pubescent and ventrally the entire area
behind pseudopodia is non-pubescent. Anal seg­
ment entirely pubescent except for a very narrow
non-pubescent anterior ring.

Female pupa: length 13 mm; yellowish-brown
without obvious darkened areas. Antennal ridges
not evident; the area usually occupied by antennal ridges swollen but not ridged; no median notch. Callus tubercles unisetose, oval in basal outline, irregularly ridged apically; elevated 0.13-0.14 mm above general surface. Frontal tubercles absent. Antennal sheaths 0.57 mm long, 0.38 mm wide, exceeding epicranial suture. Thoracic spiracles ca. 0.48 mm long; spiracular prominence exceeding dorsal thoracic margin 0.12 mm. Abdominal fringes uniseriate, complete on segments II-VII; dorsal fringe of tergite VII of 28 spines. Ventrolateral pre-anal combs of 6-7 spines. Dorsal, lateral and ventral tubercles 0.12, 0.18, and 0.14 mm long, respectively; all with pointed apices; dorsals directed dorso-posteriorly, laterals directed latero-posteriorly but with a distinct upward curve; ventrals directed ventro-posteriorly.

Collections and comments: Only two larvae of this species were collected. The first died shortly after its collection in February of 1997. The second larva, collected on 24 May 1997, had a pupal duration of 6 days, pupating on 29 September and emerging on 4 October. Both larvae were collected from the habitat at the crocodile rearing facility noted above for C. albicinctus.

Literature Cited


