

**Redefinition of *Kirrara* Harker
with a Redescription of *Kirrara procera* Harker
(Ephemeroptera: Leptophlebiidae: Atalophlebiinae)**

by

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The genus *Kirrara* Harker (Ephemeroptera: Leptophlebiidae: Atalophlebiinae) is redefined based on the type species *K. procera* Harker. The phylogenetic relationships of the genus are discussed. *K. procera* is redescribed and the nymph and egg of the species are described for the first time. Distributional data for the species are presented.

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INTRODUCTION

Kirrara was first established by Harker (1954) using material collected by R. J. Tillyard in 1936. In establishing the genus Harker described two species: *Kirrara procera*, which was designated the type species, and *K. amenia*. Subsequently Harker (1957) described a third species, *K. algona*. All three species were described only from imaginal and subimaginal material, and no nymphal characters were included in the generic description. In spite of this *Kirrara* nymphs have twice been illustrated, once by Harker (1954) as a nymph of "leptophlebiid genus (?)" and once by Riek (1970) as the nymph of *Kirrara*. Nymphs of *Kirrara* have also been included in identification keys (e.g. Williams 1980).

Tsui and Peters (1975) described the morphology of the thorax, tentorium and abdominal terga of "*Kirrara amenia*" in detail. However, it now appears that the material supplied to these authors had been misidentified. The nymphal material which they described was *Kirrara procera* and only the adult material was *K. amenia*.

In the present study the genus *Kirrara* is redefined based on the type species. The species *amenia* and *algona* are excluded from the redefined genus and the establishment of their affinities awaits further study. Both species appear to belong to a different phyletic line than *Kirrara*.

METHODS

Nymphs used in the present study were collected using an FBA type square framed pond net fitted with nylon mesh with a nominal aperture size of 300 μ . Nymphs were preserved in the field with Kahle's solution (Norris and Upton 1974) and on return to the laboratory were transferred to a solution of 70% ethanol and 5% glycerine in water. Mouthparts and abdominal gills were dissected off with the aid of a stereomicroscope and mounted in Canada Balsam on slides, without prior clearing. Illustrations were made with the aid of a drawing tube attached to a Wild M7A stereomicroscope.

Imagines were mostly obtained by attracting them to a 250W mercury vapour lamp suspended above a white cotton sheet on the stream bank. Some specimens were also obtained by placing mature nymphs in simple *in-situ* rearing cages similar to those described by Edmunds, Jensen and Berner (1976), while some male imagines were collected with a hand net as they swarmed above the stream. Imagines were preserved in the same manner as the nymphs.

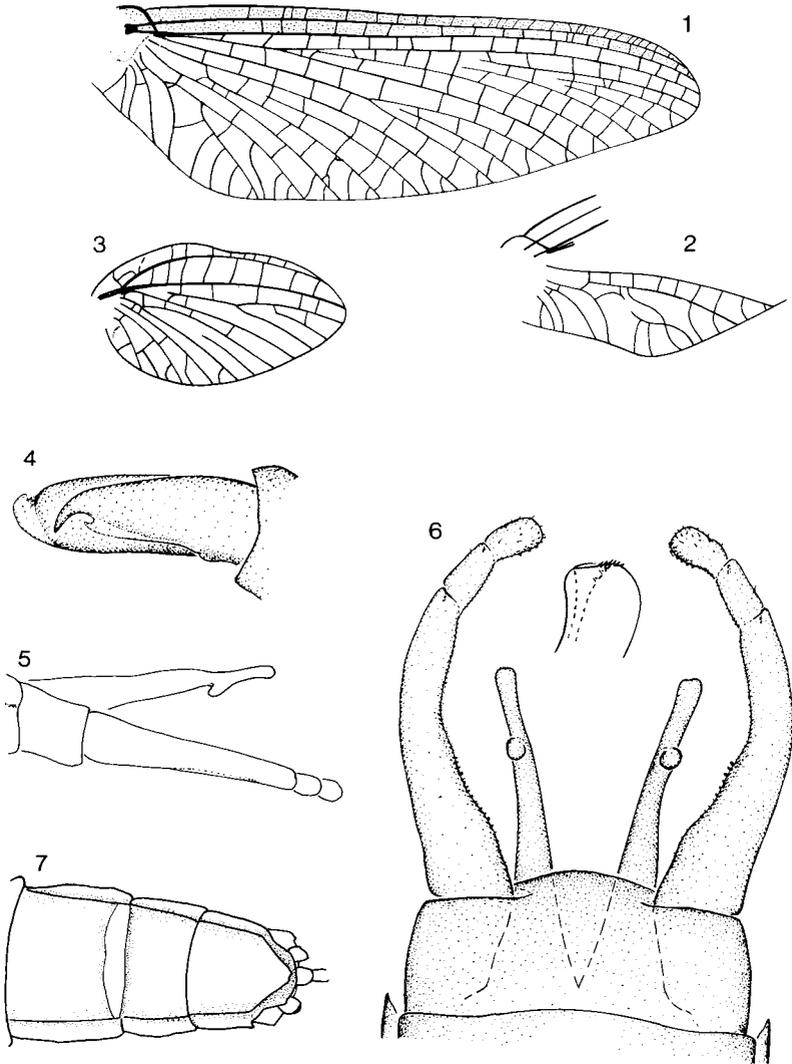
Eggs were obtained from a single egg mass extruded by a female imago. The eggs were taken through 90% and 100% ethanol and then 1:1 ethanol/amyl acetate. They were then critical point dried in a Balzers Union critical point dryer, mounted on aluminium stubbs and gold coated using a Balzers Union sputter coater. The eggs were examined and photographed using a JEOL 35SM scanning electron microscope (SEM).

DESCRIPTIONS

Kirrara Harker, 1954.

Kirrara Harker, 1954: 259; Riek, 1970: 240.

Imago. Length of ♂: body, 12.3-14.9 mm; fore wings, 12.7-15.2 mm. Length of ♀: body, 13.6-17.5 mm; fore wings, 16.1-18.6 mm. Eyes of ♂ meet on meson of head, upper portion circular shaped dorsally, lower portion $\frac{3}{4}$ length of upper portion; eyes of ♀ separated on meson of head by a length 2 times the maximum width of an eye. Wings (Figs. 1-3): maximum width of fore wings more than $\frac{1}{3}$ maximum length of fore wings; vein Rs of fore wings forked less than to a little more than $\frac{1}{4}$ of distance from base to margin; vein MA forked more than $\frac{1}{2}$ of distance from base to margin, fork symmetrical; vein MP₂ attached at base to veins MP₁ and CuA with a cross vein (Fig. 1), attachment of vein MP₂ to MP₁ a little more than $\frac{1}{5}$ of the distance from base to margin, base of vein MP₂ nearer to vein CuA than to vein MP₁; attachment to vein ICu₁ variable but usually vein ICu₁ attached to veins CuA and CuP with a cross vein (Fig. 1), remainder of Cu-A area as in Figs. 1 & 2; cross veins numerous. Costal margin of hind wings convex (Fig. 3) with concavity located $\frac{1}{2}$ distance from base; apex of wings acute, rounded; cross veins numerous. Legs: ratios of segments of ♂ fore legs, 0.83 : 1.00 (4.5 mm) : 0.08 : 0.28 : 0.26 : 0.19 : 0.13. Claws of a pair dissimilar, one apically hooked with a small opposing hook (Fig. 4), other obtuse, pad-like. Male genitalia (Figs. 5 & 6): segment 2 of forceps equal in length to segment 3, segment 2 of forceps $\frac{1}{5}$ length of segment 1, apex of segment 3 blunt; base of



Figs. 1-7: Imago of *Kirrara procera*: 1, Forewing of female; 2, Variation of CuA area of forewing; 3, Enlarged hindwing of female; 4, Tarsal claw of male; 5, Lateral view of male genitalia; 6, Ventral view of male genitalia with enlarged view of penis tip; 7, Terminal sternites of female.

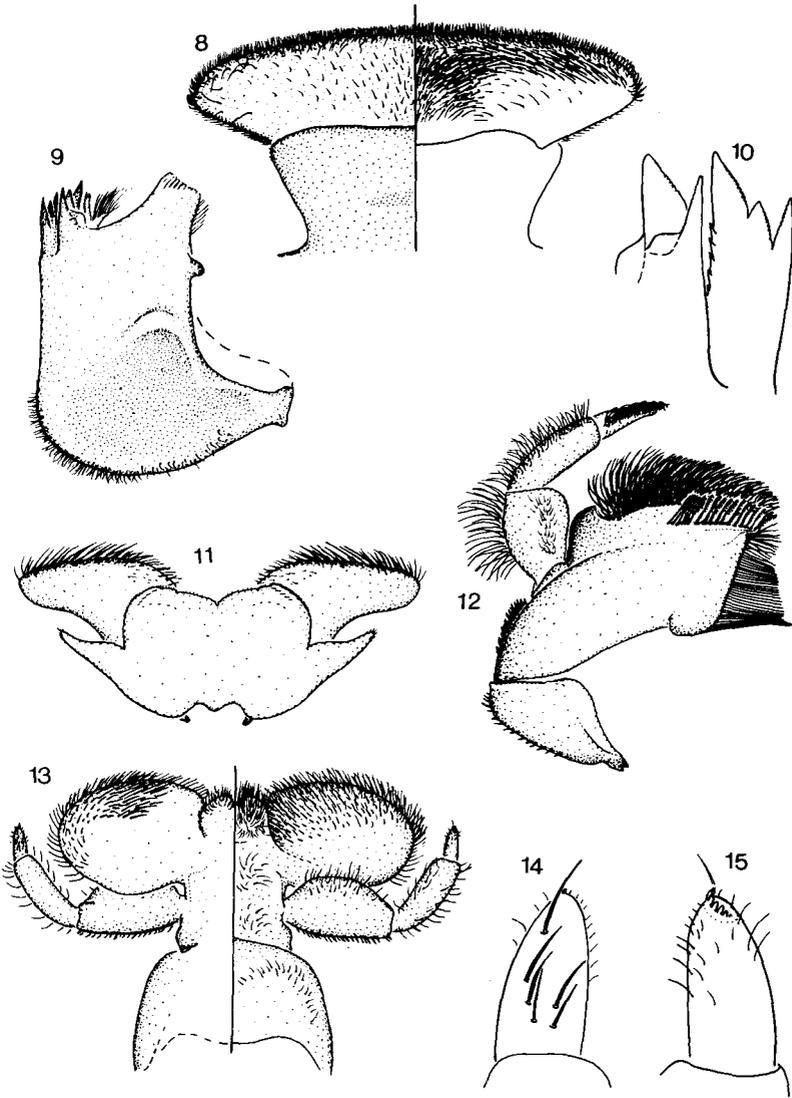
forceps broad, its inner margin forming an angular bend below middle of forceps; length of styliger plate along median line more than $\frac{1}{3}$ maximum width, posterior margin of styliger plate medially rounded; penes divided except at base, penes long, slender, broader at base, apex of each penis lobe with a row of small spines (Fig. 6), each penis lobe with a subapical, ventral, short, knob-like

projection. Ninth sternum of ♀ shallowly cleft apically (Fig. 7). Terminal filament a little longer than cerci.

Mature nymph. Head prognathous. Antennae a little longer than maximum length of head. Mouthparts (Figs. 8-15): labrum greatly expanded laterally; dorsal hair on labrum as in fig. 8; submedian and anterior areas of hair ventrally. Clypeus as in fig. 8. Left mandible as in fig. 9; apical margins of inner and outer incisors with small serrations (Fig. 10). Lingua of hypopharynx with well developed lateral processes, paired submedian longitudinal row of long hair on internal dorsal surface, apex of submedian lobes with internal submarginal rack-like processes, anterior margin deeply cleft; superlingua as in fig. 11 with a row of hair along anterior margin, lateral margins blunt. Segment 2 of maxillary palpi a little longer than length of segment 1; segment 3 of palpi a little longer than $\frac{1}{2}$ length of segment 2, triangular; a v-shaped ridge near ventral, inner, anterolateral margin of maxillae; hair on maxillae as in fig. 12. Labium as in fig. 13; segment 2 of palpi a little shorter than length of segment 1; segment 3 of palpi $\frac{1}{3}$ length of segment 2, triangular; paraglossae ventral to glossae. Short hair on dorsum of body, hair longer on vertex of head and longitudinal axis of thoracic and abdominal terga; a small keel-shaped median spine on posterior margin of meso- and metathoracic nota and a longer keel-shaped median spine on abdominal terga 1-9, base of spine covers entire median line of each tergum (Fig. 16), spines progressively larger posteriorly. Legs (Figs. 17-19): maximum width of tibiae a little greater than maximum width of tarsi (Fig. 17); tibiae in cross section triangular (Fig. 18) outer margin of femora indented near apex so tibiae can withdraw partially into femora (Fig. 18); apex of claws hooked and narrow, denticles on claws about equal size (Fig. 19). Gills (Fig. 20 & 21): gills on segments 1-7, gills 2-7 together form a suction cup disc on venter of abdomen (Fig. 20); dorsal portion of gills 1-7 plate-like except small inner lobe present on dorsal portion of gills 1-2, ventral portion of gills 1 small, ventral portion of gills 2-7 greatly reduced; dorsal portion of gills heavily sclerotized at base of gills 1-7, along main trunk of gills of gills 3-7, along main trunk and recurved ventrally toward inner margin of gills 2, and on anterior proximal margin of gills 3-7; dorsal portion of gills 2-7 thick except along margin; dorsal portion of gills 2 laterally expanded and nearly meet along midline of sternum 1 (Fig. 20); dorsal portion of gills 7 folded longitudinally and curved ventrally to meet along midline of sternum 9 (Fig. 20); main trunk of tracheae of dorsal portion of gills short, thick, along median line of gills, except thickening absent in dorsal portion of gills 2, tracheae greatly branched, pigmented to hyaline; main trunk of tracheae of ventral portions of gills 2-7 indistinct, tracheal branches few, tracheae lightly pigmented; ventral portion of gills 1 as in fig. 21. Posterolateral spines on abdominal segments 2-7, spines wide, bifurcated (Fig. 20), spines progressively larger posteriorly; blunt posterolateral projections on abdominal segments 8-9. Terminal filament a little longer than cerci.

Type Species. *Kirrara procera* Harker, by original designation.

Discussion. *Kirrara* can be distinguished from all other genera of the Leptophlebiidae by the following combination of characters. In the imagines: (1) vein MP_2 of the fore wings is attached to vein MP_1 with a cross vein a little more than $\frac{1}{5}$ of distance from the base to margin (Fig. 1): (2) costal margin of hind wings is



Figs. 8-15: Mouthparts of mature nymph of *Kirrara procera*: 8, Labrum with dorsal view to the left; 9, Left mandible; 10, Detail of mandibular incisors; 11, Hypopharynx; 12, Maxilla; 13, Labium with dorsal view to the left; 14, Dorsal view of final segment of labial palp; 15, Ventral view of final segment of labial palp.

convex (Fig. 3); (3) claws of a pair are dissimilar (Fig. 4); (4) penes are long and slender and are divided except at the base, each lobe has a subapical, ventral, short, knob-like projection (Fig. 5); and (5) ♀ does not possess a genital extension. In the nymph: (1) labrum is greatly expanded laterally (Fig. 8); (2)

abdominal gills 2-7 together form a suction cup disc on the venter of the abdomen (Fig. 20); (3) abdominal gills 1-7 possess a plate-like dorsal portion and a small to greatly reduced ventral portion (Fig. 21); (4) a small keel-shaped median spine is present on the posterior margin of the meso- and metathoracic nota and a larger keel-shaped median spine occurs on abdominal terga 1-9 (Fig. 16); and (5) apical margins of inner and outer incisors of mandibles possess small serrations (Fig. 10).

Based on the studies of Towns and Peters (1980), *Kirrara* belongs to the *Atalophlebioides* s.s. lineage as *Kirrara* possesses all but one of the derived character states listed in Table 1 of their paper. Towns and Peters (1980) list "prosthecal tuft greatly reduced" as a derived character state for the lineage; however, the posthecal tuft is not reduced in *Kirrara* (Fig. 9).

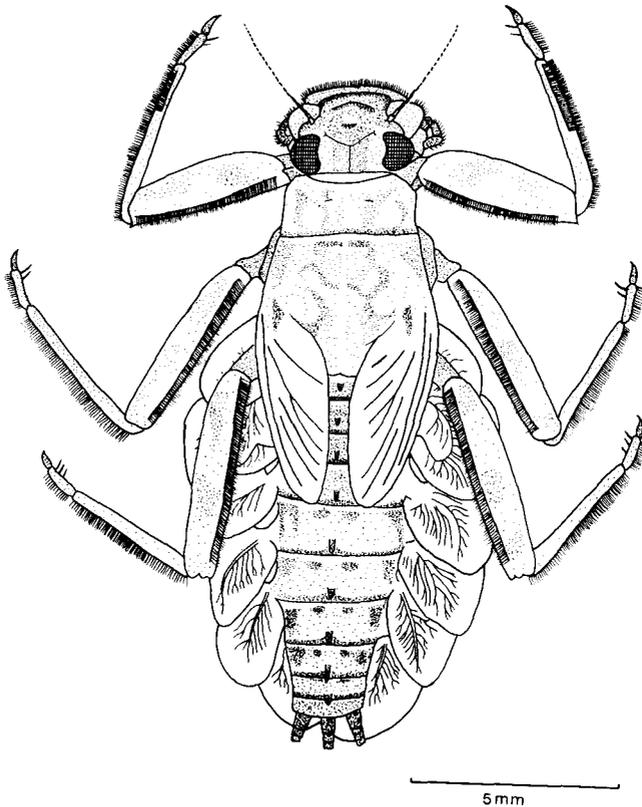
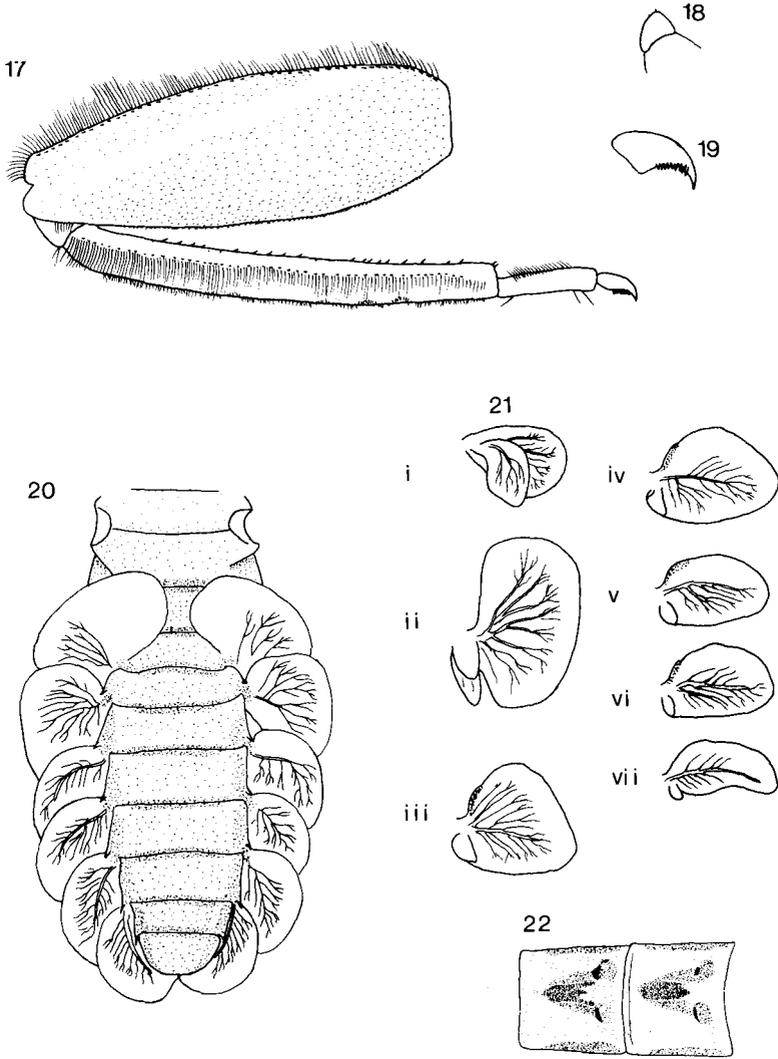


Fig. 16: Dorsal view of mature nymph of *Kirrara procera*.



Figs. 17-22: *Kirrara procera*: 17, Leg of mature nymph; 18, Cross section of tibia of nymphal leg; 19, Enlarged view of nymphal claw; 20, Ventral view of abdomen of mature nymph; 21, Gills of mature nymph; 22, Dorsal abdominal pattern of male imago.

Based on named genera, *Kirrara* appears to be closely related to *Atalophlebioides* and *Deleatidium* from New Zealand, as all three genera possess the derived character state "apical margins of inner and outer incisors of mandibles possess small serrations". However, *Kirrara* can be distinguished from *Atalophlebioides* and *Deleatidium* by the following combinations of characters. In the imagines: (1) penes are divided except at base and are long and slender (Fig. 5); and (2) apex of each penis lobe possesses a row of small spines (Fig. 6). In the

nymph: (1) labrum does not possess an anteromedian hood or denticles (Fig. 8); (2) abdominal gills 2-7 together form a suction-cup disc on the venter of the abdomen (Fig. 20); and (3) abdominal gills 1-7 possess a plate-like dorsal portion and a small to greatly reduced ventral portion (Fig. 21). As so few genera of the *Leptophlebiidae* occurring in Australia have been studied in detail, the sister group of *Kirrara* may be in Australia.

Peters, Peters and Edmunds (1978) noted that the nymphal modification of the suction-cup abdominal gills has been independently derived in three geographical areas. While *Deleatidium* from New Zealand and *Kirrara* from Australia both belong to the *Atalophlebioides* lineage, the gill modification in *Deleatidium* involves abdominal gills 1-7 and the gill modification in *Kirrara* involves abdominal gills 2-7. Until related genera in Australia can be studied, the evolution of the gill modification within the lineage is not certain.

Kirrara procera Harker, 1954

Kirrara procera Harker, 1954: 259.

Kirrara amenia (partim), Tsui and Peters, 1975: 509 (nymphal description).

Male imago (in alcohol). Dimensions given in Table 1. General colour golden brown. Upper portion of eyes golden brown, lower portion grey. Head golden brown, vertex black. Antennae golden brown, flagellum paler. Basal half of ocelli black, apical half golden brown. Thorax golden brown, carinae darker, sutures paler. Legs golden brown, apex of femora blackish brown, apex of prothoracic tibiae blackish brown, apex of prothoracic tarsal segments with a narrow, transverse, blackish brown line. Wings (Figs. 1-3): longitudinal and cross veins of fore and hind wings golden brown, except all veins of hind wings paler; membrane of fore and hind wings hyaline, except cells of C and Sc of fore wings lightly washed with golden brown. Abdomen: golden brown; terga 1-8 with a median, blackish brown v-shaped mark as in fig. 22, mark indistinct on terga 1 and 8; terga 1-8 with a sublateral, longitudinal, blackish brown bar as in fig. 22; lateral margins of terga 1-7 lightly washed with blackish brown; spiracles and tracheae hyaline; sternal ganglia lightly washed with blackish brown. Genitalia (Figs. 5 & 6): golden brown. Caudal filaments golden brown, narrow darker annulations at articulations.

Female imago (in alcohol). Dimensions as given in Table 1. Eyes grey. Colour

Table 1. Dimensions of imagines of *Kirrara procera*.

Dimension	Males			Females		
	Range (mm)	Median (mm)	n	Range (mm)	Median (mm)	n
Total Body Length	12.3-14.9	14.0	11	13.6-17.5	14.5	10
Fore Wing Length	12.7-15.2	14.0	22	16.1-18.6	16.8	20
Fore Wing Breadth	3.6-4.4	4.2	21	4.7-5.8	5.1	20
Hind Wing Length	2.5-3.4	2.9	20	3.1-3.8	3.4	17
Hind Wing Breadth	1.3-1.8	1.6	21	1.5-1.9	1.8	17
Cerci Length	20-26	23	10	20-23	21	7
Terminal Filament Length	23-30	25	6	21-24	22	3

and markings as in ♂ imago, except darker and more distinct; vertex of head paler than ♂ imago.

Mature nymph (in alcohol). Head: dorsum dark brown, carinae darker, sutures paler; venter pale. Thorax: dorsum brown, carinae darker, sutures paler; venter pale. Legs: brown, except dorsal surface of femora darker, tibiae paler; inner surface of tibiae washed lightly with darker brown near middle of segment. Abdomen: brown, venter paler; marks as in ♂ and ♀ imagines, except tergal marks less distinct. Gills: membrane pale brown, tracheae grey. Caudal filaments brown.

Egg. Subovoid (Fig. 23) approximately 22 μ in length and 150 μ in width. Chorion consisting of roughly hexagonal plates. One end of egg produced into more of a point than the other, but no associated differentiation of chorion. Centre of each chorionic plate with adhesion structure which appears to be a suction structure rather than a knob terminated coiled thread. Micropyle simple, funnellform, positioned toward middle of long axis of egg.

The above redescription is based on material listed below. All material was collected by the senior author and is preserved in alcohol. At present all specimens are held in the I.C. Campbell collection at East Caulfield, but will be deposited in the Australian National Insect Collection, Canberra. The following abbreviations are used: i = imagines, s = subimagines, n = nymph.

AUSTRALIA

Victoria: Aberfeldy River, Walhalla Rd; 13.xii.1977 2♀; 11.i.1979 1♀; 4.i.1980 18♀; 23.i.1980 2♂; 20♀; 9.xii.1980 7♂, 6♀. Dargo River, Dargo; 13.iii.1977 7n. Mitta Mitta River, u/s Dartmouth Dam; 20.iii.1972 1♀. Wannangatta River, Hawkhurst Bridge; 24.iii.1978 3♀; 3.xii.1978 39♂, 1♀. Wellington River, Licola Rd; 23.i.1978 1♂, 5♀; 10.i.1979 2♂; 28.xi.1979 1♀s; 20.xii.1979 2♀. Yarra River, 3 km u/s East Warburton; 14.ii.1980 2♂.

New South Wales: Chichester River, Chichester; 22.i.1977 15n. Gloucester River, Rawdon Vale; 21.i.1977 12n. Goodradigby River, Wee Jasper; 16.xi.1977 14n. Jounama Creek, Talbingo; 27.xii.1979 13♂, 8♀. Murrumbidgee River, Bolairo; 17.xi.1977 5n. Williams River, Chichester Road; 22.i.1977 11n.

Discussion. The CuA area of the fore wings varies in about 40% of the specimens listed above. The cubital intercalaries vary even between the two wings of a specimen (Figs. 1 & 2) and the number of veinlets between ICu₂ and the wing margin also varies. The specimens examined in the present study were generally smaller than those examined by Harker (1954) (Table 1).

Harker (1954) recorded a holotype male and an allotype female imago both collected by R. J. Tillyard from the upper Murrumbidgee River at Adaminaby on 2.xii.1936, as well as a morphotype subimago also collected by Tillyard at Bolaro (sic) on 10.ii.1936. Bolairo Station is located on the upper Murrumbidgee near Adaminaby, and it seems likely that there was only one collection site.

The British Museum (Natural History) holds the female imago designated as the allotype together with two subimagines, one male and one female, both labelled "RJT Bolairo 10.ii.1936" and both also labelled as paratypes. It is not possible to tell whether the paratype labels were placed on the specimens by Harker, or subsequently. The genitalia of the male subimago have been mounted on a slide and were apparently used, as the slide and illustration are almost identical, for Harker's illustration of the genitalia of the male imago of the species. There is also a note pinned in the collection by Kimmins in 1969 stating that the holotype was missing at that time.

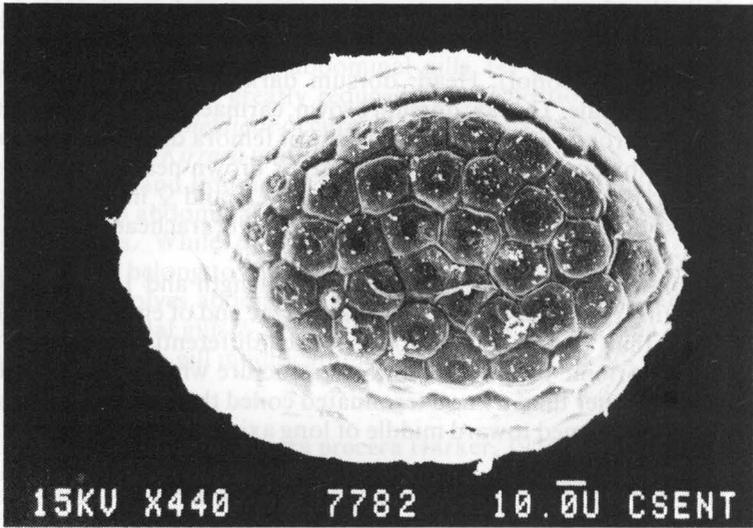


Fig. 23: Scanning electron micrograph of egg of *Kirrara procera*.

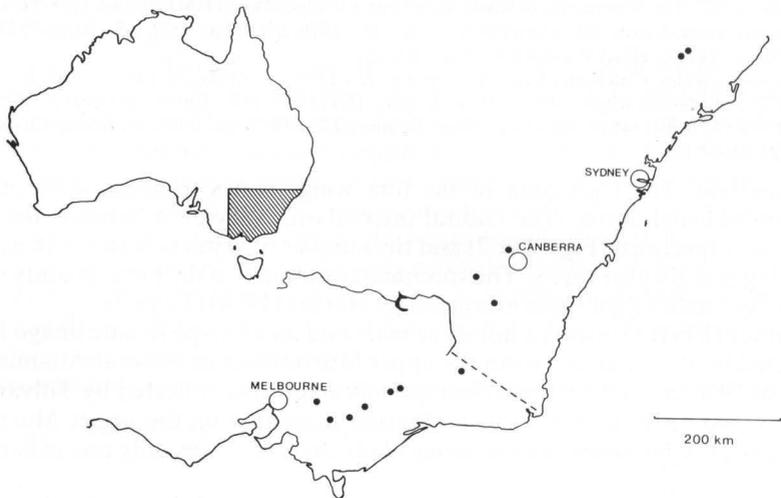


Fig. 24: Localities from which *Kirrara procera* has been collected.

We do not believe that the holotype has been lost, but that Harker mistakenly identified a male subimago as an imago. We believe that the male subimago, collected by Tillyard on 10.ii.1936 at Bolairo is the holotype.

The British Museum also holds two further male subimagines collected by Tillyard on 10.iii.1936 at Bolairo, which are not mentioned and apparently not

seen by Harker. We do not know the location of the material collected by B. McMillan to which she refers, but it does not appear to be held in the British Museum.

The species was originally described from two localities: the upper Murrumbidgee River at Bolairo Station (the type locality), and the Tumut-Talbingo Road, both in New South Wales. The senior author has collected nymphs, but not imagines, from the first locality. The second locality is greatly altered since Harker's material was collected in 1947. The road formerly followed the Tumut River, however, this entire stretch of the river has been inundated as a part of the Snowy Mountains hydroelectric scheme, and the road was relocated. The senior author found the species abundant in Jounama Creek, a former tributary of the Tumut River near Talbingo.

Elsewhere the species is fairly widespread in eastern Victoria and occurs at least as far north as Barrington Tops in New South Wales although it may well occur further north than this. The localities from which the senior author has collected the species are indicated in fig. 14. The species does not occur in Tasmania.

ACKNOWLEDGEMENTS

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