Biosystematics of New Zealand Longicorn Beetle Genera *Coptomma* Newman and *Calliprason* White (Coleoptera: Cerambycidae: Cerambycinae)

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Abstract

A revision of the New Zealand cerambycid genera *Coptomma* Newman and *Calliprason* White is made and the scope of these genera is redefined. The genus *Navomorpha* White is synonymised with *Coptomma*. Two species, *N. textoria* and *N. philpotti*, are synonymised with *Coptomma lineata* (Fabricius). Four monotypic genera, *Stenopotes* Pascoe, *Drotus* Sharp, *Pseudocalliprason* Broun, and *Epheus* Broun, are synonymised with *Calliprason*. As a result of this revision, the present number of species in *Coptomma* and *Calliprason* has increased to five, respectively. A new species, *C. marrisi*, is described for *Coptomma*. All known species of these two genera are redescribed. A key to species for each genus is given. Terminalia of both sexes are illustrated and described.

The phylogeny of all species of these genera is analysed cladistically. The monophyly of *Coptomma* and *Calliprason* is confirmed with the former being supported by 5 good synapomorphies and the latter by 11. Subdivisions of each genus are discussed.

Biological knowledge of the two genera is summarised except *Calliprason elegans* and *C. costifer*. *Coptomma* is widely distributed in both main islands, Stewart Island and Great Island of the Three Kings Islands; *Calliprason* is widely distributed in the North Island and the Chatham Islands, rarely in the South Island. The distribution of each species is mapped and discussed.

Acknowledgements

I would like to thank the many people who have contributed in their own way to my thesis.

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CHAPTER 1
GENERAL INTRODUCTION

1.1 The Project

The cerambycidae are a group of beetles whose larvae bore inside trees and other woody plants. Some species are serious pests in New Zealand, such as *Oemona hirta* (Fabricius), attacking citrus and grape vines, and *Navomorpha lineata* (Fabricius), damaging Douglas Fir and *Cryptomeria* trees (Dumbleton, 1957; Bain, 1976). Sound systematic and distributional knowledge is needed to help design control strategies for pest species and approaches to biodiversity conservation. However, the taxonomy of New Zealand cerambycids is still very unsettled, making applied entomological research and pest control difficult.

Preliminary examination of all museum cerambycid collections in New Zealand at the beginning of this project showed that in the subfamily Cerambycinae, there were numerous monotypic genera but generic status of many seemed not justified. During the course of the preliminary study, I found that two distinct and very different groups of species, which were assigned to seven different genera, might be in fact two distantly related genera. The first group included two genera, *Coptomma* Newman with one species and *Navomorpha* White with six species, and the second consisted of five monotypic genera, *Calliprason* White, *Pseudocalliprason* Broun, *Drotus* Sharp, *Stenopotes* Pascoe and *Epheus* Broun. Obviously, these genera needed revising and species needed redescribing. In addition, the relationship between species within each group has not previously been studied from a cladistic perspective. Considering the significance of these two groups of cerambycids and the amount of time needed for their revisions, I decided to work on their systematics for my one-year masterate programme.

1.2 Historical Background to the Taxonomy of the Two Selected Groups

Fabricius (1775) described three species, *variegatum, sulcatum* and *lineatum* under the genus *Callidium*. In 1840, Newman erected a new genus *Coptomma* for the species *C. virgatum* [= *C. variegatum* (Fabricius)] and *C. textorium* Newman. Three years later Dieffenbach (1843) transferred *Callidium sulcatum* and *C. lineatum* to *Coptomma*.

White (1855) proposed the genus *Navomorpha* accommodating species *Coptomma lineatum* (Fabricius), *C. sulcatum* (Fabricius) and *C. acutipenne* White. The number of species in *Navomorpha* increased to six in 1926.

White (1843) described a species, *sinclairi*, under a new genus *Calliprason,* and another species, *marginatum*, under the same genus three years later (White, 1846). Broun (1880) proposed a new genus *Pseudocalliprason* based on the type species *C. marginatum*. New genera and species *Stenopotes pallidus*, *Drotus elegans* and *Epheus costifer* were described by Pascoe (1875), Sharp (1877) and Broun (1886), respectively.

The genera and species of my selected groups are listed in Table 1.1.

Table 1.1 Taxonomic framework of the selected groups of cerambycids at the commencement of the project in 1997

Genus	Species
Coptomma	*variegata* (Fabricius), 1775
Navomorpha	*sulcata* (Fabricius), 1775
	lineata (Fabricius), 1775
	stictica Broun, 1893
	philpotti Brookes, 1926
	douei Lucas, 1863
	textoria (Newman), 1840
Calliprason	*sinclairi* White, 1843
Pseudocalliprason	*marginatum* (White), 1846
Stenopotes	*pallidus* Pascoe, 1875
Drotus	*elegans* Sharp, 1877
Epheus	*costifer* Broun, 1886

1.3 Relationships

There has been almost no work on relationships between species within each group apart from fragmentary comments of the relationships between some genera made by Broun (1880, 1893). For example, Broun (1880) pointed out that *Pseudocalliprason marginatum* should be placed near *Calliprason sinclairi*. He also stated (1893) that *N. stictica* was similar to *N. lineata*. Needless to say, such relationships would be brought to light through a phylogenetic analysis of those species using modern methods and techniques.

1.4 Distribution Records

The distribution records of known species (Fabricius, 1801; D'Urville, 1835; Newman, 1840; Dieffenbach, 1843; White, 1846; White, 1855; Redtenbacher, 1868; Bates, 1874; Pascoe, 1875; Broun, 1880; Hudson, 1934; Bain, 1976; Zondag & Bain, 1976) are listed in Table 1.2. No further description of distribution based on overall consideration of recent collection has been made, an omission which needs rectifying as a basis for work in pest quarantine and management, and conservation of beneficial species.

Table 1.2 Distribution records of the species at the commencement of the project in 1997

Species	Distribution
Coptomma	
variegata	New Zealand [mis-recorded as Australia by Newman (1940)]
Navomorpha	
sulcata	New Zealand: Auckland, Christchurch, Tairua
lineata	New Zealand
stictica	New Zealand: Clevedon, Pohangina, Kaitoke, Wainui-o-mata
philpotti	New Zealand
douei	New Caledonia
textoria	New Zealand [mis-recorded as Australia by Newman (1940)]
Calliprason	
sinclairi	New Zealand: Tairua, Whangarei Heads, Wellington
Pseudocalliprason	
marginatum	New Zealand: Tairua, Gollan's Valley, Whangarei
Stenopotes	
pallidus	New Zealand: Waikato, Tairua, Whangarei Harbour, Wellington, Auchland, Katikati
Drotus	
elegans	New Zealand: Tairua
Epheus	
costifer	New Zealand: Wellington, Tuakau, Waikato, Kaeo

1.5 Main Aims of This Study

On the basis of the above knowledge of those longicorn beetles, the present study aims to :

1) Provide a thorough taxonomic revision of the above genera, evaluation of taxonomically useful characters, provision of identification keys to species, descriptions of new species and re-descriptions of known species.

2) Describe distribution and biology aspects of those genera.

3) Undertake a phylogenetic analysis of the revised genera using cladistic methods.

CHAPTER 2
TAXONOMY OF THE GENERA *COPTOMMA* AND *CALLIPRASON*

2.1 Introduction

In this chapter I will focus on the taxonomic treatment of the two groups previously mentioned, including taxonomic revisions of genera, descriptions and illustrations of new and known species, and keys to these species.

In the present study, five species, *variegata, sulcata, lineata, stictica* and *marrisi*, are recognised in the genus *Coptomma* and five species, *pallidus, marginatum, sinclairi, costifer* and *elegans*, in the genus *Calliprason*. Having examined hundreds of specimens and evaluated many taxonomic characters, I am convinced that these two genera are monophyletic.

2.2 Materials and Methods

2.2.1 Specimens Examined

More than 450 specimens have been examined during the course of the study. Types of most species were examined by me or by S. Shute in The Natural History Museum, in London, where the types are deposited. Specimens borrowed from the following institutions, abbreviated as shown in the text, were deposited in the institutions where they were borrowed.

AMNZ	Auckland Museum, Auckland
ANIC	Australian National Insect Collection, CSIRO, Canberra
CMNZ	Canterbury Museum, Christchurch
FRNZ	Forest Research Institute, Rotorua
JNNZ	J'Nunn Collection, Dunedin
LUNZ	Lincoln University, Canterbury
BMNH	The Natural History Museum, London
NZAC	New Zealand Arthropod Collection, Auckland
MONZ	Museum Of New Zealand, Wellington
OMNZ	Otago Museum, Dunedin
WMNZ	Whangarei Museum, Whangarei

Material examined is listed in latitudinal order. Area codes of specimen locality are shown in Fig. 2.1 (Crosby *et al.*, 1976).

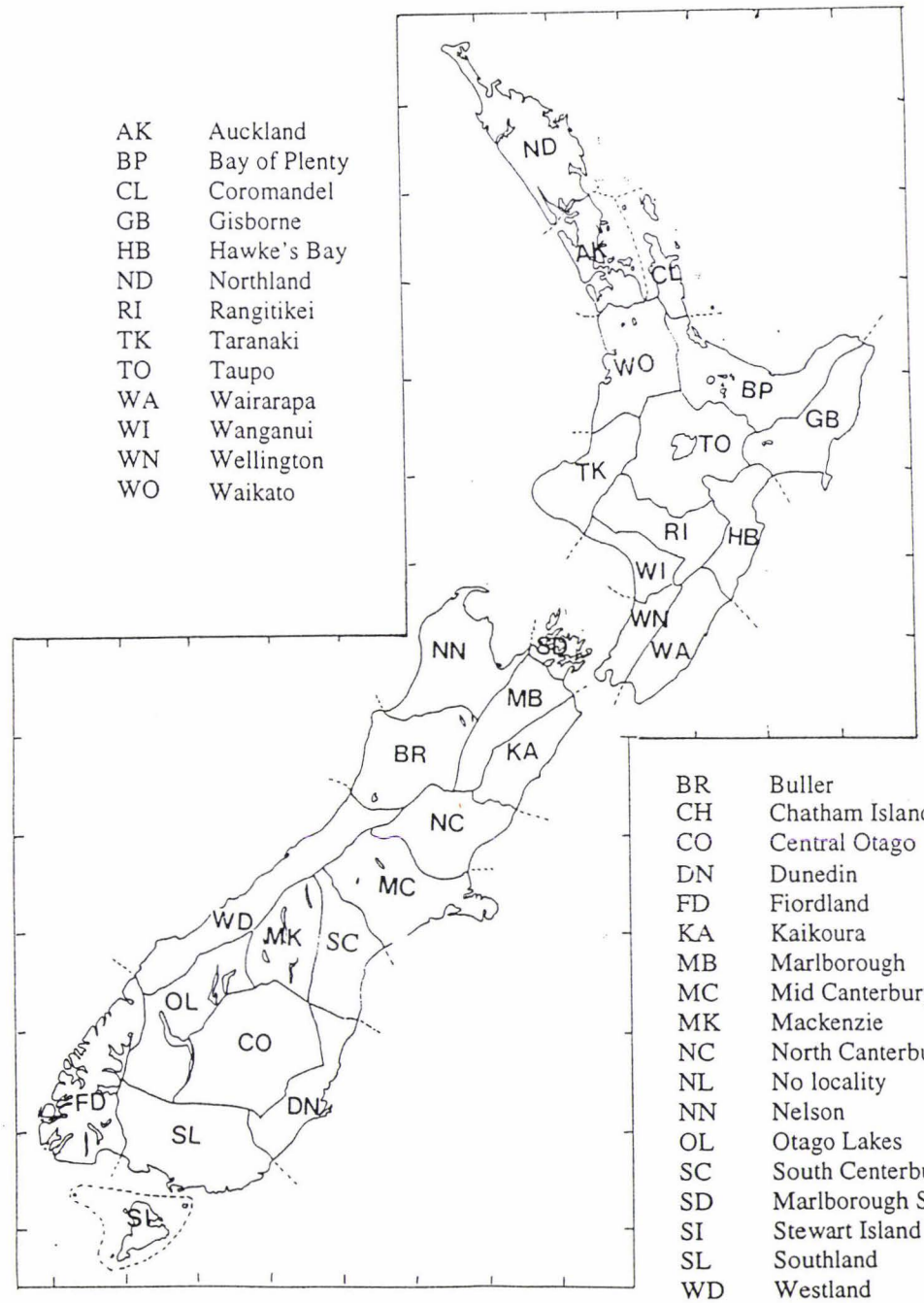


Fig. 2.1. Specimen localities in New Zealand showing area codes in text (from Crosby *et al.*, 1976)

2.2.2 Measurements and Illustrations

External measurements were made under a stereo microscope (Olympus VM), and measurements of terminalia under a compound microscope (Olympus BH), using ocular micrometers. All measurements of length are the greatest length. For example, the length of the elytra is between shoulder and apex; basal 1/6 – 4/6 of elytra 120mm long

is between a point 20mm backward from shoulder and a point 40mm forward from apex. Drawings were made under the above microscopes with the aid of camera lucida attachments. The entire body of each species (dorsal view) was illustrated as photographs.

2.2.3 Dissections of Terminalia

The terminalia were prepared by soaking the whole beetle in the water bath at 80°C for 20 – 30 minutes depending on the size of the beetle, then fastening the softened beetle using insect pins, carefully removing the terminalia with a pair of tiny sharp forceps without removal of abdomen, and clearing them in 10% KOH at 25°C for 24 hours. The terminalia were then washed with distilled water, dehydrated with 70% and absolute ethanol and mounted in Euparal as a permanent slide for male, and for female preserved in a vial with 75% ethanol plus 5% glycerine.

2.2.4 Terminology

Terminology for terminalia adopted in this paper partially follows Sharp and Muir (1912), Ehara (1954), Hutcheson (1980), and Wang (1993) and that for others partially follows Wang (1993) in general.

Introductory explanatory diagrams (Figs 2.2-46) cover much of the terminology used for morphological features. The following list is a limited glossary of terms pertaining to the text.

INDICATION OF ORIENTATION OF BODY

Fig. 2.2 shows the body orientation used in the description, including: longitudinal, or anterior to posterior; dorsoventral, or dorsal (upper) to ventral (lower); transverse, or lateral (outer) through the longitudinal axis to the opposite lateral; for appendages, such as the elytra, basal refers to near the body and apical to distant from the body. In addition, structures may be described as medial if they are nearer to the midline (median line), or lateral if they are closer to the body margin.

HEAD (Figs 2.3-5)

Eyes. The eye is generally emarginate internally and divided into upper lobe and lower lobe incompletely (Fig. 2.3).

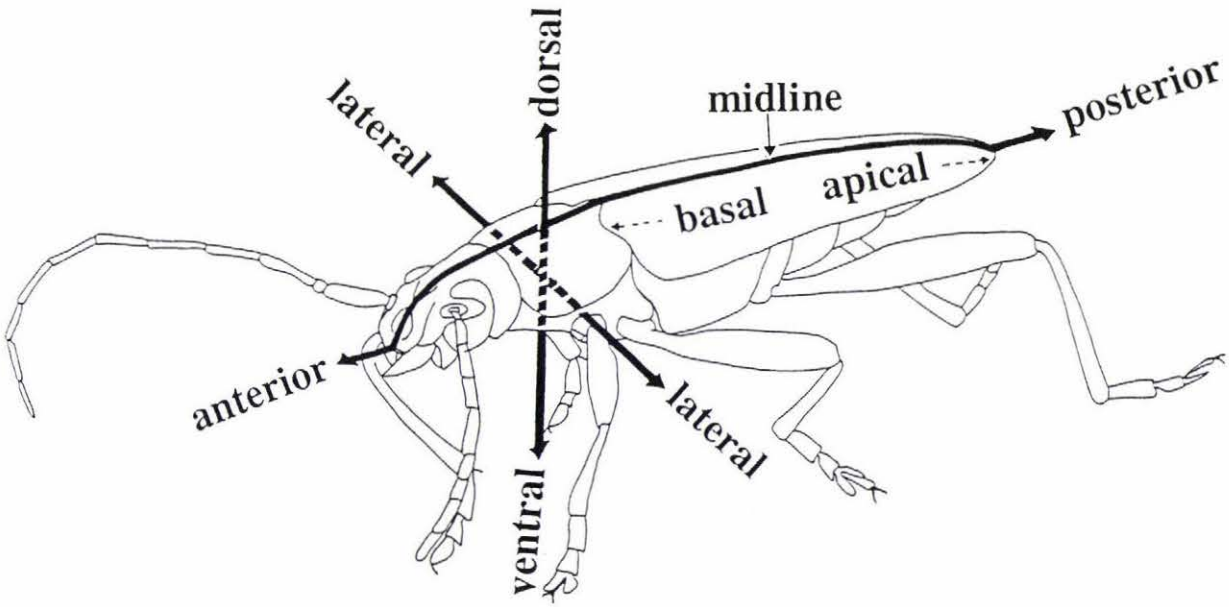


Fig. 2.2 The major body axes and the relationship of parts of the appendages to the body, shown for *Coptomma lineata*.

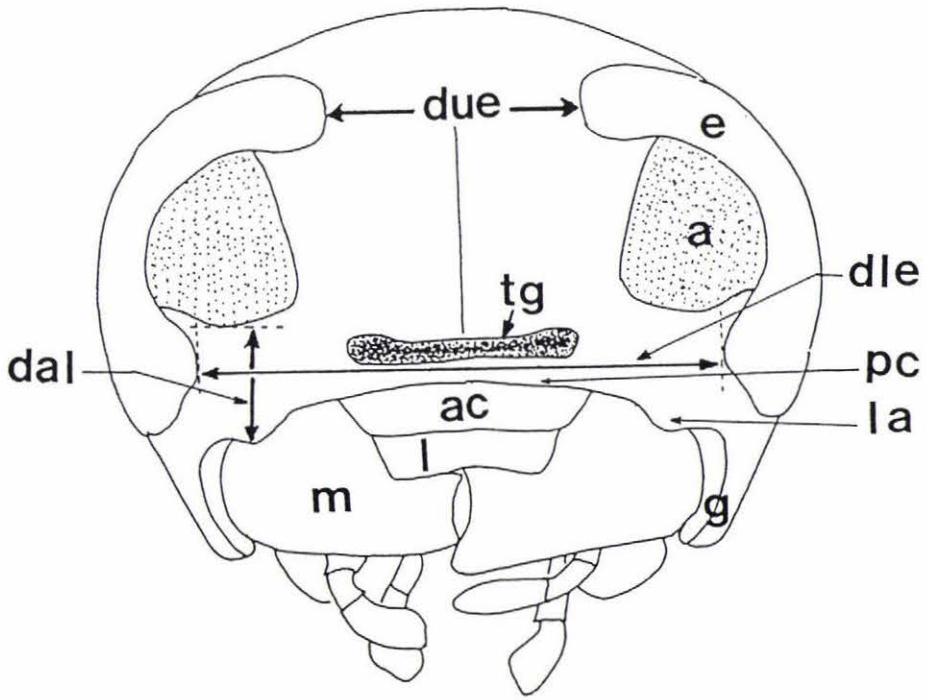
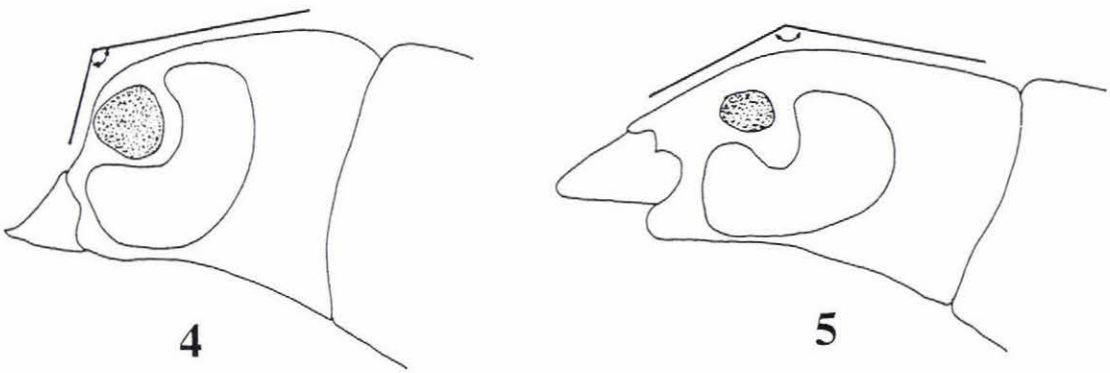


Fig. 2.3. Head of *Coptomma variegata*, front view. Terms and measurements described in the text: **a,** antennal socket; **ac,** anteclypeus; **dal,** distance between antennal socket and lateral angle of postclypeus; **dle,** distance between lower lobes of eyes; **due,** distance between upper lobes of eyes; **e,** eye; **g,** gena; **l,** labrum; **la,** lateral angle of postclypeus; **m,** mandible; **pc,** postclypeus; **tg,** transverse groove between tentorial pits.

Antennal sockets. The antennal socket is a cavity holding the antenna and is located between eyes.

Frons. The frons is the area between eyes (antennal sockets) and bordered anteriorly by the base of the postclypeus and posteriorly by the vertex. Features of hairs, proportion of height vs width of the frons, and angle of frons with vertex (Figs 2.4-5) are used in the taxonomy.



Figs 2.4-5. Heads of: **4,** *Coptomma variegata*; **5,** *C. sulcata*. Lateral view.

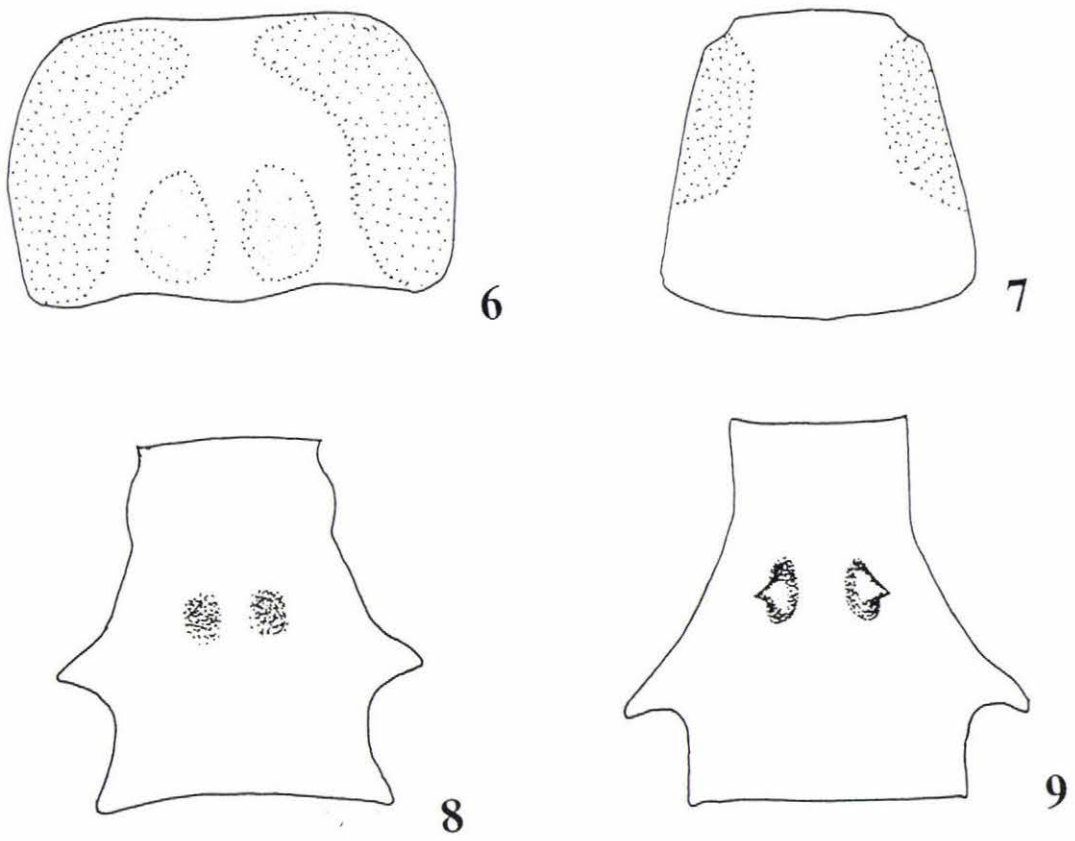
Antennae. The antenna is eleven-segmented, fifiform with segment 1 (scape) most robust, segment 2 (pedicel) smallest, and the segment 3-11 (flagellum) linear.

Measurements of head. These measurements include the distance between upper lobes of eyes, distance between lower lobes of eyes, distance between antennal socket and lateral angle of postclypeus (Fig. 2.3).

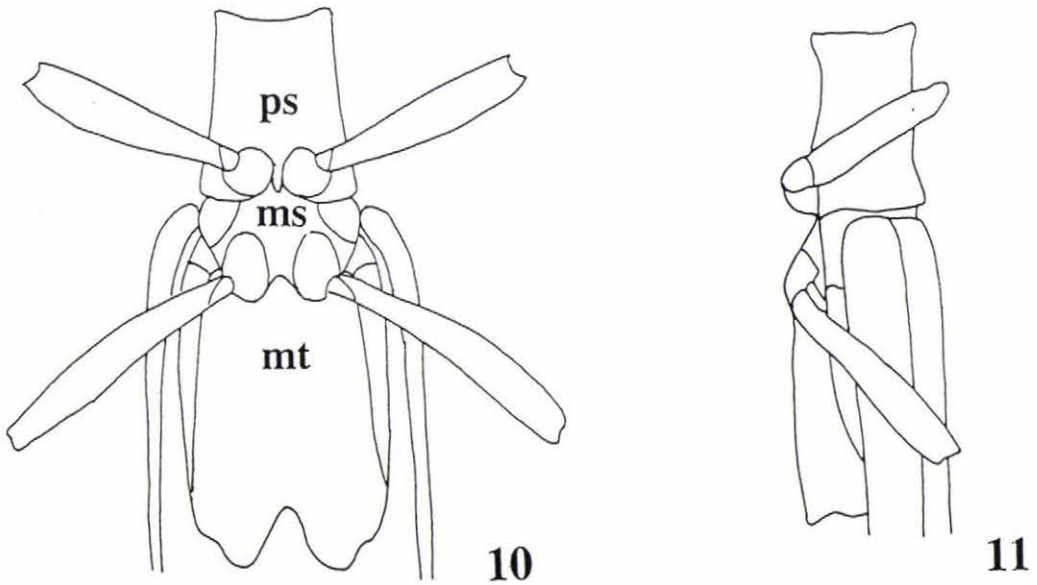
THORAX (Figs 2. 6-21)

Prothorax and mesothorax. The prothorax tends to be longer than wide giving it an elongate taper appearance in most species but ranges to a state of being as wide as long in *C. variegata*. Pronotum may be smooth, punctuate throughout, punctuate on sides of disc (Figs 2.6-7), tuberculate (Fig. 2.8) or spinose (Fig. 2.9) on disc. Lateral sides of pronotum may be rounded (Figs 2.6-7) or spinose (Figs 2.8-9).

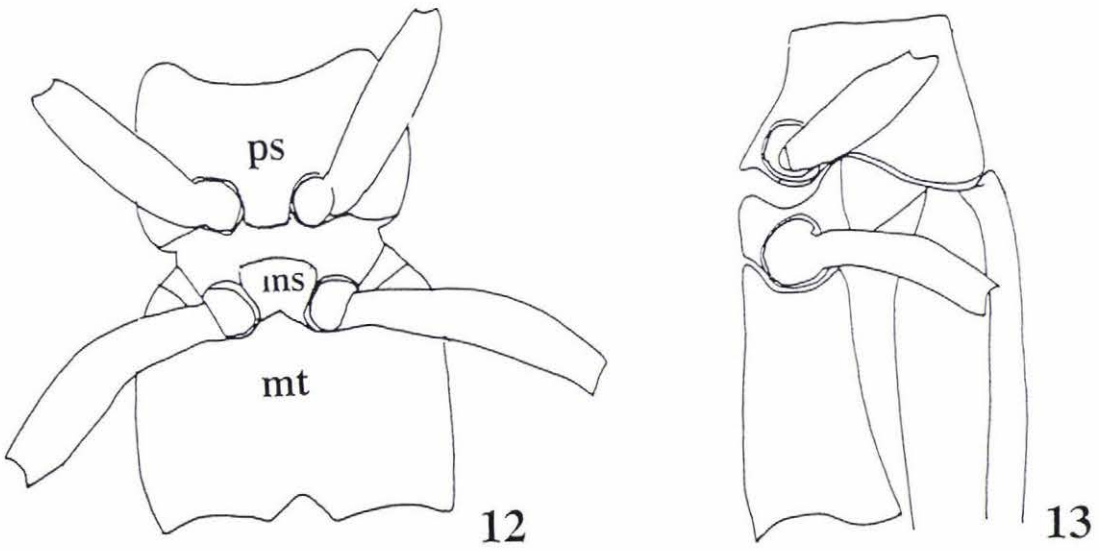
The prosternal and mesosternal processes may be simple in *Calliprason* (Figs 2.10-11), vertical or produced in *Coptomma* (Figs 2.12-15).



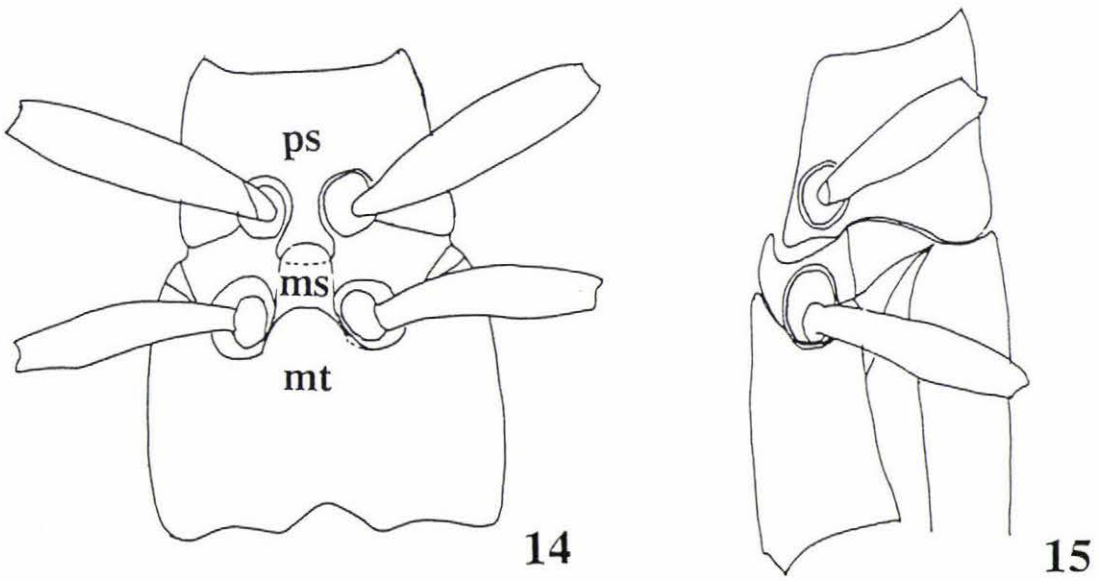
Figs 2.6-9. Pronota of four species beetles, dorsal view: **6,** *Coptomma variegata*; **7,** *C. stictica*; **8,** *Calliprason sinclairi*; **9,** *C. marginatum*.



Figs 2.10-11. Sterna of *Calliprason pallidus* **10,** ventral view; **11,** lateral view; **ps**, prosternum; **ms**, mesosternum; **mt**, metasternum.

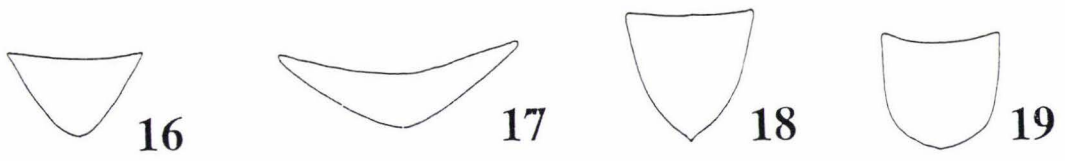


Figs 2.12-13. Sterna of *Coptomma variegata*: **12,** ventral view; **13,** lateral view; **ps**, prosternum; **ms**, mesosternum; **mt**, metasternum.



Figs 2.14-15. Sterna of *C. lineata*: **14,** ventral view; **15,** lateral view; **ps**, prosternum; **ms**, mesosternum; **mt**, metasternum.

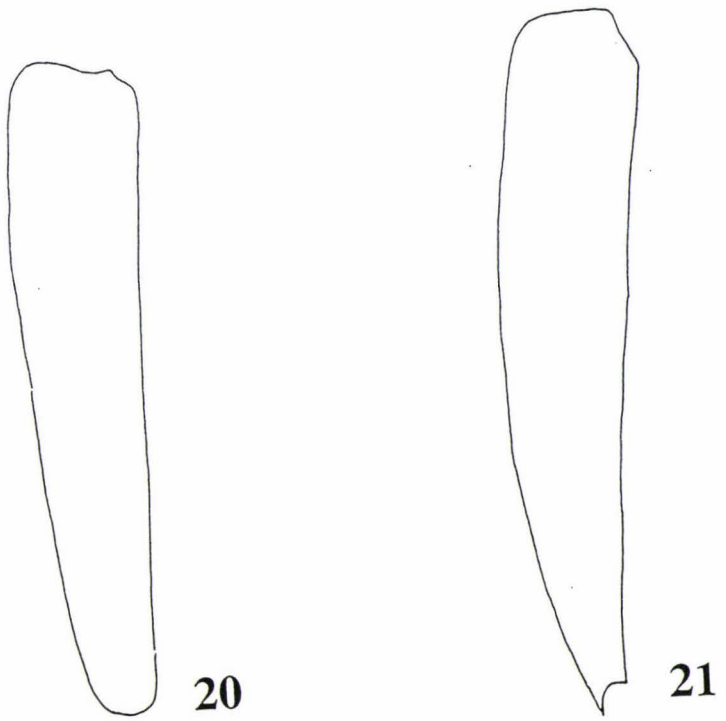
The shape of the scutellum varies from triangular to parabola (Figs 2.16-19).



Figs 2.16-19. Scutella, dorsal view: **16,** *Coptomma sulcata*, equilaterally triangular; **17,** *C. variegata*, transversely triangular; **18,** *Calliprason marginatum*, curvilinearly triangular; **19,** *C. costifer*, parabola.

Metathorax. The only readily visible part of the metathorax is the metasternum, which may be punctuate or impunctuate.

Elytra. The elytra are elongate, apices vary from rounded (Fig. 2.20) to spined at margin (Fig. 2.21). The disc of the elytra has bands or stripes of coloured, depressed hairs in *Coptomma*, and has punctures, a depressed or erect hairs arising from each in *Calliprason*.

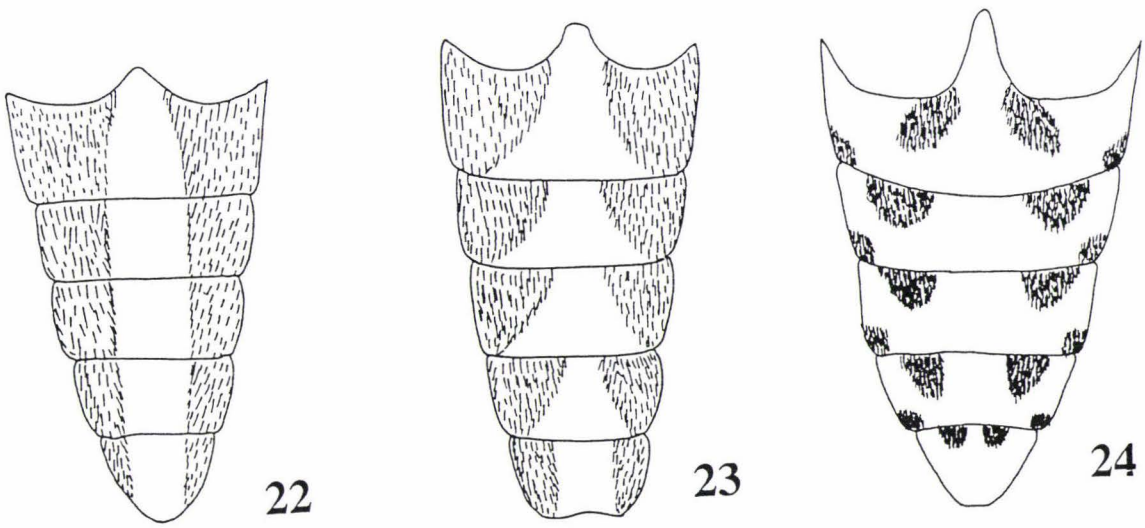


Figs 2.20-21. Left elytra, dorsal view: **20,** *Coptomma variegata*; **21,** *C. sulcata*.

Legs. The femur has depressed hairs that may form coloured patterns. Relative length of basal segment and the sum of the second and third segments of hind tarsus varies between species.

ABDOMEN (Figs 2.22-24)

The abdominal ventrites may be punctate and have depressed hair patterns (Figs 2.22-24).

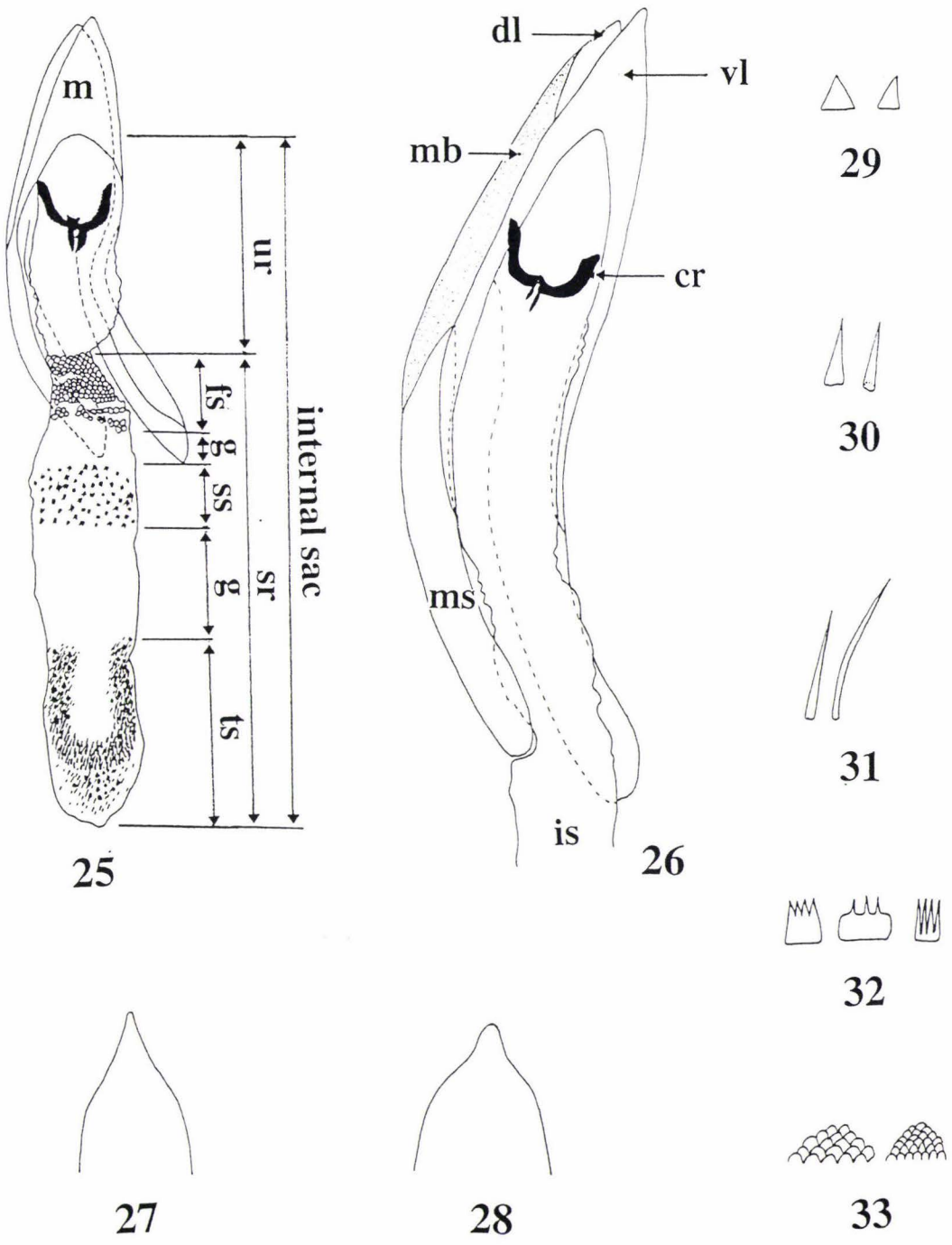


Figs 2.22-24. Sternites, ventral view: **22,** *Coptomma sulcata*; **23,** *C. lineata*; **24,** *C. variegata*.

TERMINALIA (Figs 2.25-46)

The male terminalia examined include aedeagus, tegmen, the eighth sternite and tergite. The female terminalia include genital segment 9 (ovipositor) and efferent system.

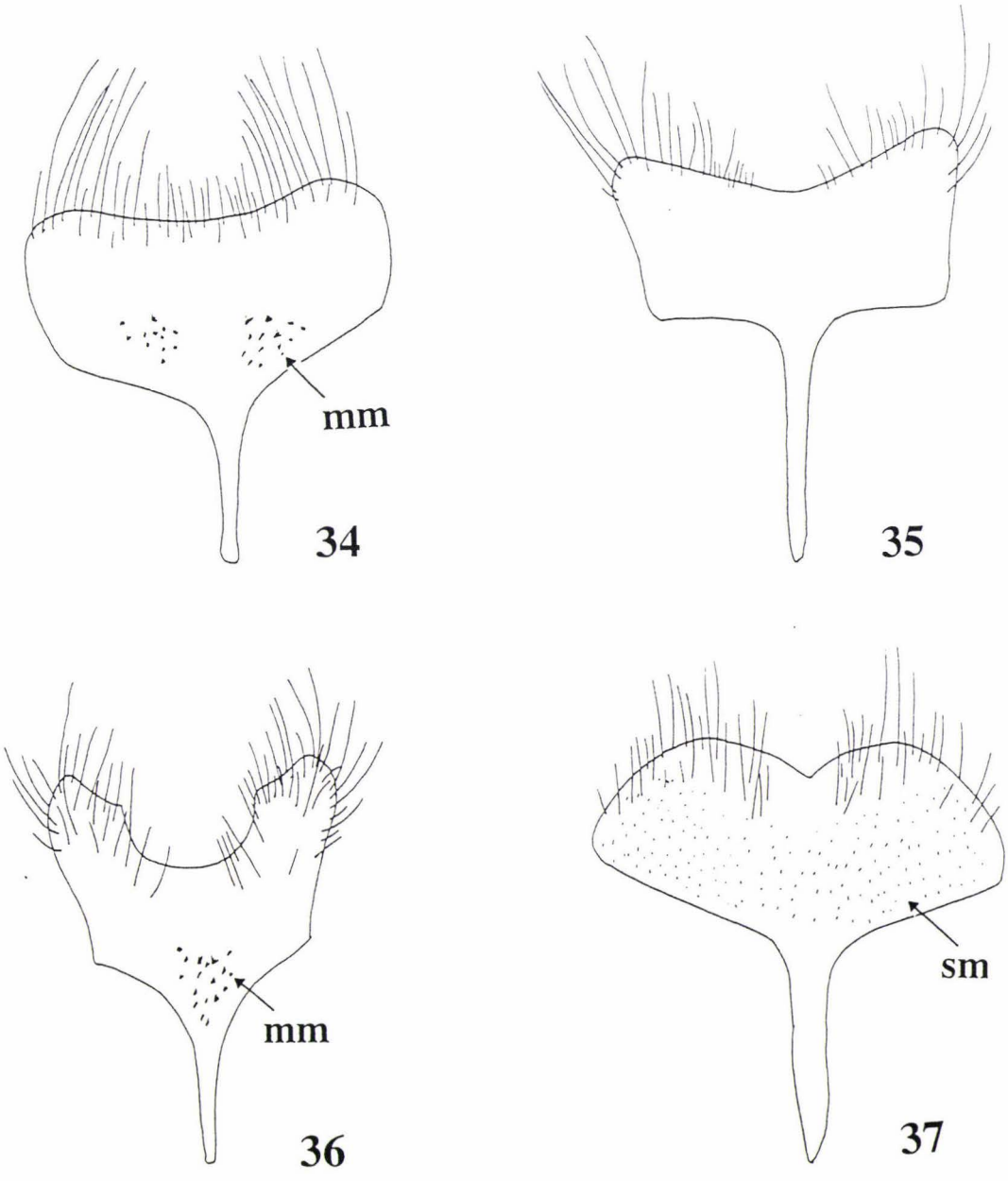
Aedeagus. This includes 1) a median lobe with a pair of median struts and 2) an internal sac (Fig. 2.25). Generally, the median lobe is represented by a strongly chitinized tube. The apical part of median lobe is divided laterally into two lobes, separated by a membrane running along each side, from median orifice to the base of median struts (Fig. 2.26). The apex of the ventral lobe varies from pointed (Fig. 2.27), to strongly projected (Fig. 2.28). The median lobe generally differs in ventral view interspecifically. The internal sac is membranous and divided into 2 regions: basal unspined region and terminal spined region. Spined region has 2-3 sections (Fig. 2.25),



Figs 2.25-33. Aedeagus: **25,** median lobe and internal sac of *Coptomma variegata*, ventral view: **fs**, first section; **m,** median lobe; **sr,** spined region; **ss,** second section; **ts,** third section; **g,** unspined gap; **ur,** unspined region; **26,** median lobe of *Coptomma sulcata*, lateral view: **cr,** chitinous rod; **dl,** dorsal lobe; **is,** internal sac; **mb,** membrane between ventral and dorsal lobes; **ms,** median strut; **vl,** ventral lobe; **27-28,** ventral lobe: **27,** pointed; **28,** strongly projected; **29-33,** types of spines and processes: **29,** simple small and short; **30,** simple small and long; **31,** simple large and long; **32,** multi-branched; **33,** scale-like.

each section has different patterns and shape of spines or processes and internal chitinous structures. The forms of spines and processes are shown in Figs 2.29-33.

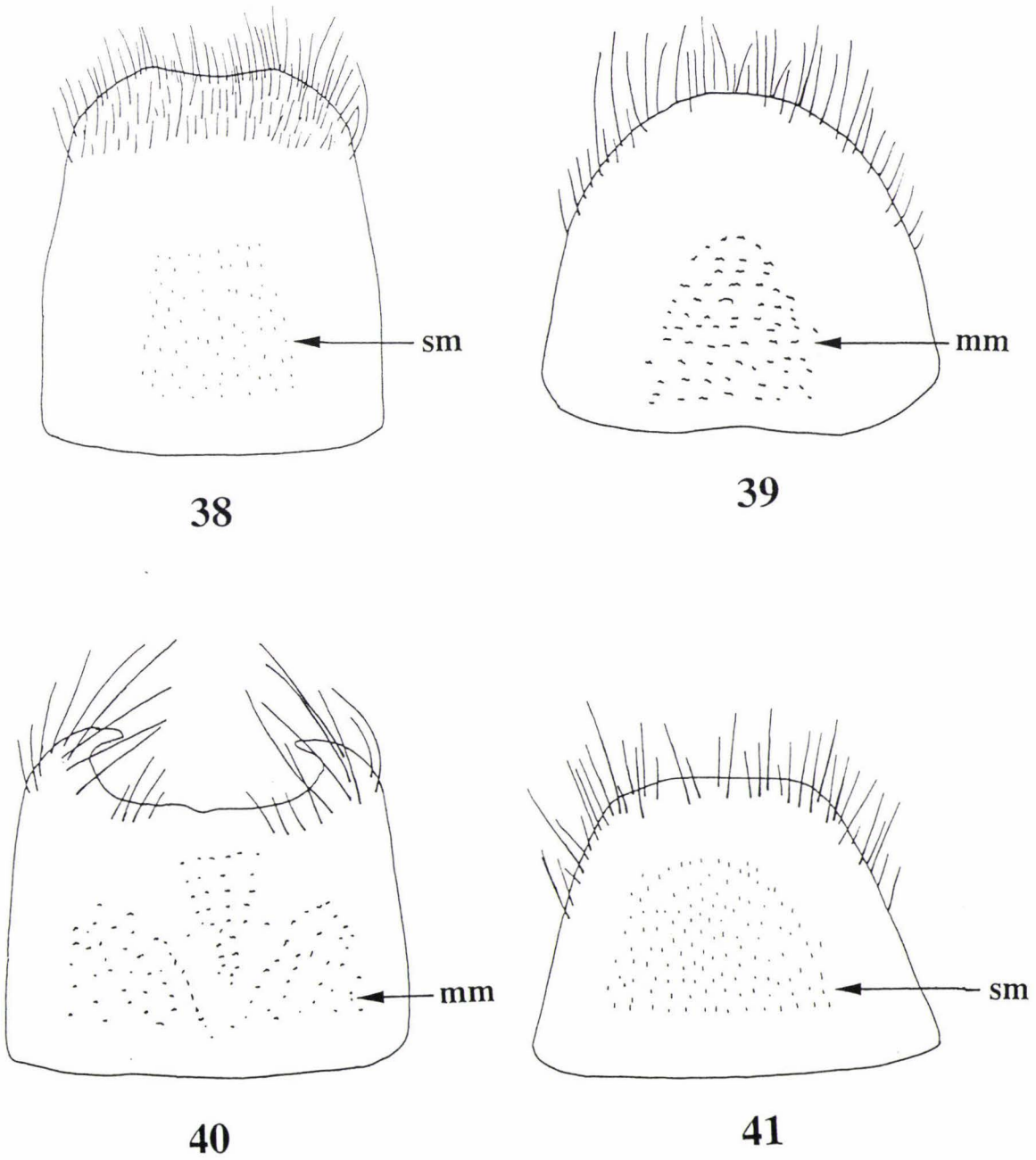
Eighth sternite of male. The shape of this part varies interspecifically and its lateral sides may be rounded (Fig. 2.34), subparallel (Fig. 2.35-36), obliquely truncate (Fig. 2.37). Setae arise from it terminally (Fig. 2.34) or sublaterally and terminally (Figs 2.35-37) but may be present (Fig. 2.34) or absent (Figs 2.35-37) in the mid-terminal area of the



Figs 2.34-37. Eighth sternites of male: **34,** *Coptomma variegata*; **35,** *C. lineata*; **36,** *C. sulcata*; **37,** *Calliprason pallidus;* **mm,** multi-branched microspines; **sm,** simple microspines.

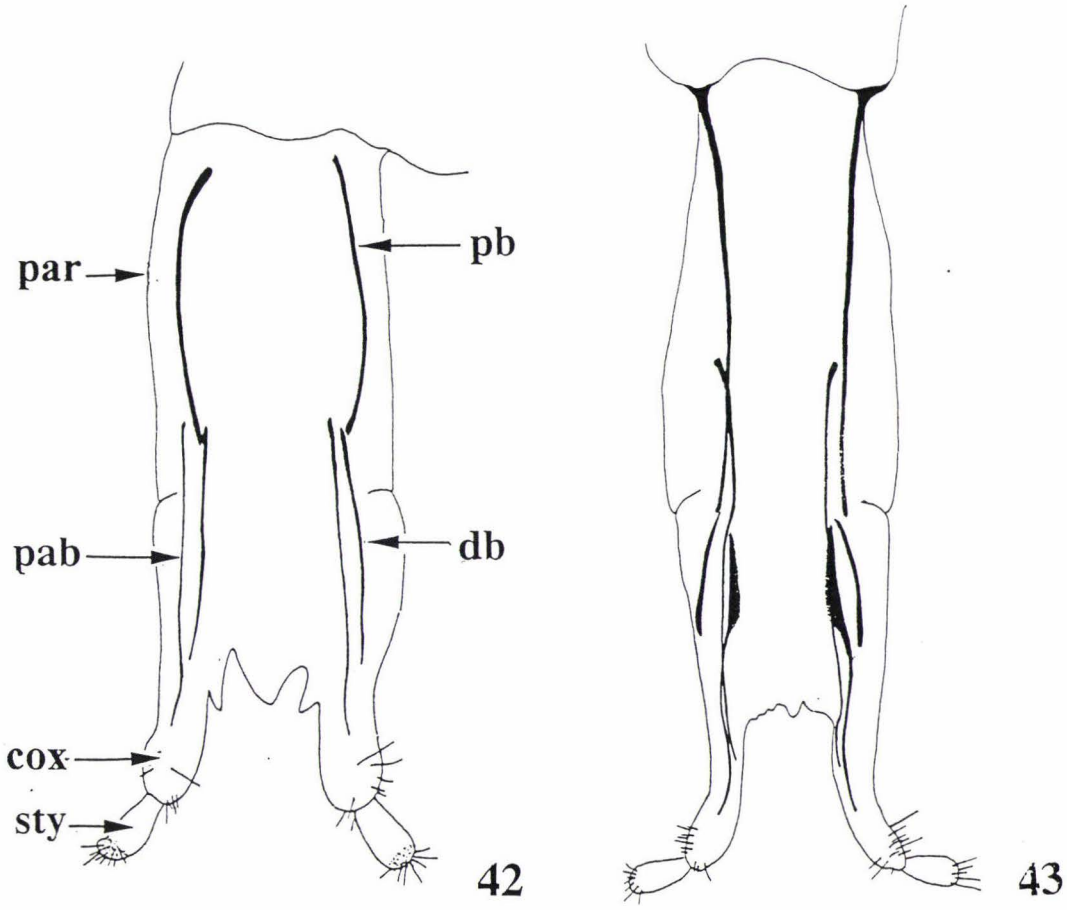
sternite. There are microspines on its ventral surface in some species (Figs 2.34, 2.36 and 2.37).

Eighth tergite of male. The shape of the terminal part may be slightly emarginate (Fig. 2.38), rounded (Fig. 2.39), clearly emarginate (Fig. 2.40), or truncate (Fig. 2.41). There are microspines or multi-branched spines on its middle area (Figs 2.38-41).



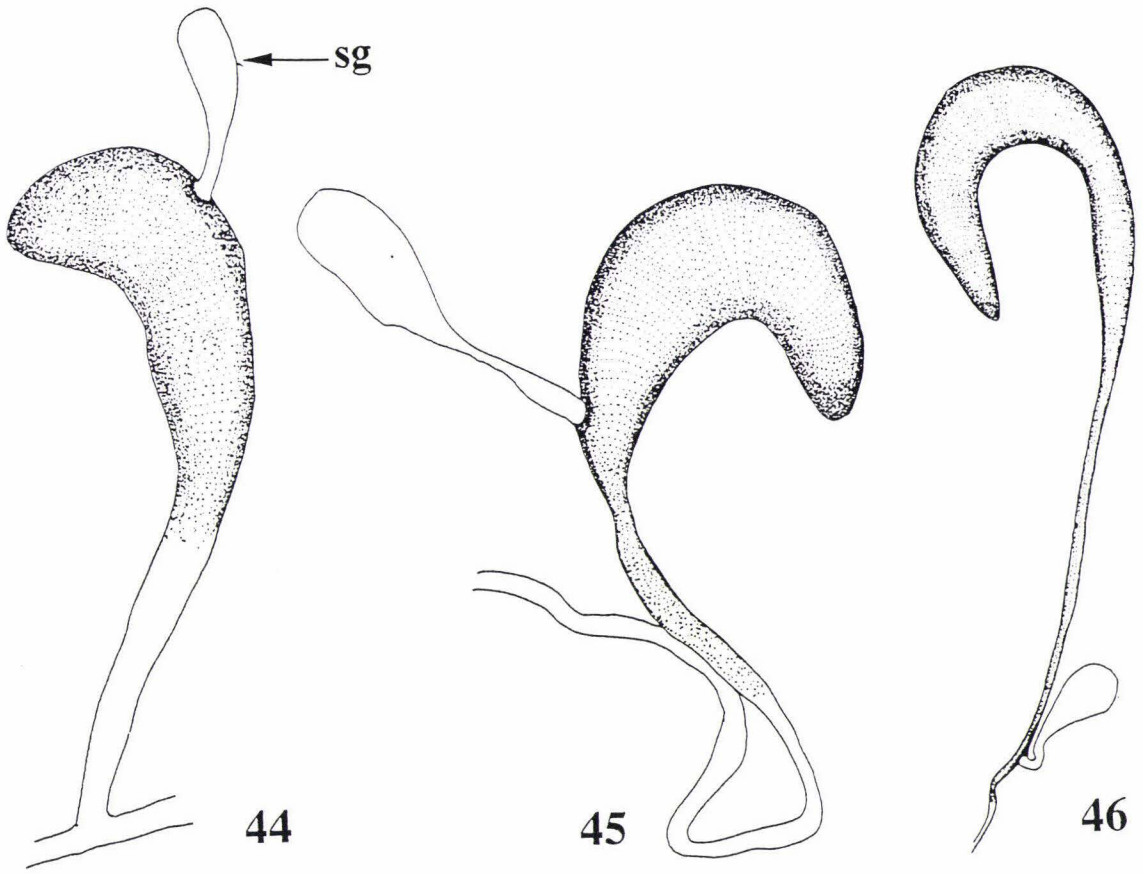
Figs 2.38-41. Eighth tergites of male: **38,** *Coptomma lineata*; **39,** *C. variegata*; **40,** *C. sulcata*; **41,** *Calliprason pallidus*; **mm,** multi-branched microspines; **sm,** simple microspines.

Ovipositor. Ovipositor includes paraproct, coxite and stylus (Figs 2.42-43). In genera *Coptomma* and *Calliprason*, the paraprocts are strengthened longitudinally by longitudinal rods, including proctiger baculi, dorsal baculi, and paraproct baculi (Figs 2.42-43). Coxite and stylus are rather similar in general shape throughout the genera *Coptomma* and *Calliprason*. The shape and the relative length of proctiger baculi and dorsal baculi vary between species.



Figs 2.42-43. Ovipositor: **42**, *Coptomma sulcata*; **43**, *Calliprason pallidus*. **cox,** coxite; **db,** dorsal baculi; **pab,** paraproct baculi; **par,** paraproct; **pb,** proctiger baculi; **sty,** styli.

Efferent system of female. The efferent system is the internal reproductive system, and includes the ovaries, lateral oviducts, lateral branches of the uterus, ulterus and spermatheca and spermathecal gland. The structures of those organs are rather similar in general shape throughout *Coptomma* and *Calliprason* but the shape of spermatheca and position of spermathecal gland on spermatheca (Figs 2.44-46) allow females of most species to be reliably identified.



Figs 2.44-46. Spermatheca: **44,** *Coptomma variegata;* **45,** *C. lineata*; **46,** *Calliprason marginatum.* **sg,** spermathecal gland.

2.2.5 Descriptions and Keys

A brief diagnosis is given to *Coptomma* and *Calliprason*. Detailed descriptions are provided for the genera and all species in hand. Keys to all species in each genus are given. Characters used in keys to species and in the *Comments* section for each species are for practical purposes and do not necessarily reflect the phylogenetic relationships.

2.2.6 Ecological and Distributional Records

The ecological and distributional records are from collection notes of each specimen examined and literature. These data will be listed in the *Biology* and *Distribution* sections for each species.

Scientific names of host plants follow Kelsey and Dayton (1942), Lucy and Edgar (1970), Healy and Edgar (1980), Allan (1982), and Webb *et al* (1988).

2.3 Taxonomy of the Genus *Coptomma*

Introduction

Before the present study commenced, one species had been recognised in the genus *Coptomma* and six species in the genus *Navomorpha* (Lacordaire, 1869; Bates, 1874; Broun, 1880, 1893; Aurivillius, 1912; Blair, 1937). In this study, I propose the synonymies *Navomorpha* with *Coptomma* because they share generic characters such as both prosternal and mesosternal processes vertical or produced, and pronotum with longitudinal hairy stripes. One new species is included in the genus. These changes bring the total number of species of *Coptomma* to six. However, the New Caledonian species *N. douei* is not included in this study because no specimen has been seen.

The Genus *Coptomma* Newman

Coptomma Newman, 1840:18. – Dieffenbach, 1843:278; White, 1846:20; D'Urville, 1855:274, t. 17, fig.1. White, 1855:335; Lacordaire, 1869:222; Bates, 1874:23; Broun, 1880:589; Aurivillius, 1912:488; Hudson, 1934:115; Blair, 1937:266; Duffy, 1963:150; Kuschel, 1990:67. [Type species: *Coptomma virgatum* Newman, 1840:18.]

Tmesisternus Serville, 1834:72. – D'Urville, 1835:469; Dieffenbach, 1843:278 (synonymy with *Navomorpha*); Thomson, 1860:357; 1864:360; Redtenbacher, 1868:178; Aurivillius, 1912:488. [Type species: *Callidium variegatum* Fabricius, 1775:1849, by monotypy.] **syn. nov**

Navomorpha White, 1855:334. – Thomson, 1860:356; 1864:360; Redtenbacher, 1868:178; Lacordaire, 1869:224; Hutton, 1873:164; Bates, 1874:24; Broun, 1880:590; 1893:1284; Aurivillius, 1912:488; Hudson, 1934:116; Blair, 1937:266; Dumbleton, 1957:620; Duffy, 1963:151; Bain, 1976:1; Grehan, 1982:1; Kuschel, 1990:67. [Type species: *Coptomma lineatum* Dieffenbach, 1843:279.] **syn. nov.**

Naomorpha – Gemminger & Harold, 1873:2984. (mis-spelling).

Diagnosis

Distinguished by vertex-frontal region of head and pronotum with longitudinal hairy stripes; elytra with longitudinal hairy stripes or oblique fasciae; base of pronotum partly embraced by elytra; prosternal process vertical or slightly produced backward; mesosternal process vertical or produced forward; elytra with rare or no punctures and abdomen sternites nitid on middle line, with triangular pattern of coloured depressed hairs on lateral sides.

Description.

Size small to median for Cerambycidae, robust.

Colour. Body greenish-brown, reddish brown to black. Two longitudinal stripes of yellowish-white hairs starting between frons and vertex and extending to posterior margin of pronotum. Each elytron with longitudinal stripes or oblique fasciae of yellowish-white hairs. Sternites with yellowish-white hairs on sides.

Head. Narrower than prothorax; width of frons between 1.5 and 3.5 times height; distance between lower lobes of eyes 2.3-4.6 times distance between antennal socket and lateral angle of postclypeus, and about 1.1-2.6 times distance between upper lobes of eyes. Scape moderate, thick, about as long as or longer than third segment.

Thorax and abdomen. Pronotal disc smooth and nitid. Prosternal process vertical or slightly produced backward (Figs 2.12-15). Mesosternal process vertical or produced forward (Figs 2.12-15). Scutellum equilaterally or transversely triangular (Figs 2.16-17). Metasternum nitid and with sparse hairs and punctures. Elytra smooth and nitid. Abdomen hardly punctured.

Male terminalia. Apex of median lobe pointed (Fig. 2.27). Internal sac divided into 2 regions: basal unspined region and terminal spined region; spined region with 2 or 3 sections: all sections with 1 to 3 kinds of spines, including simple spines, multi-branched spines and scale-like spines. Eighth sternite rounded, parallel, subparallel or obliquely truncate at lateral sides; apex truncate or emarginate with setae; multi-branched microspines or no microspines on ventral surface (Figs 2.34-36). Apex of eighth tergite rounded or emarginate (Figs 2.38-40)

Ovipositor. Each paraproct baculi starting from basal 2/7 and extending to apical 1/10; length of proctiger baculi 0.4-0.5 times or 1-1.4 times as long as dorsal baculi (Fig. 2.42); spermatheca slightly or clearly curved; spermathecal gland arise near apex or base (Figs 2.44- 45).

Distribution (Figs 2.49, 2.53, 2.57, 2.64, 2.68)

Widely distributed in North Island, South Island, Stewart Island and Three Kings Islands

Key to the Species of *Coptomma* Newman

1 Angle of frons with vertex < 100^0; prothorax wider than long; mesosternal process vertical and slightly produced forward, not covering prosternal process .....*C. variegata* (Fabricius)

Angle of frons with vertex > 100^0; Prothorax longer than wide; mesosternal process distinctly produced forward and overhanging and covering prosternal process 2

2 Two longitudinal stripes of coloured hairs on sides of vertex–frontal region subparallel between antennae; antennal segment 3 distinctly longer than segment 4; apices of elytra sharply spined at margin.....*C. sulcata* (Fabricius)

Two longitudinal stripes of coloured hairs on sides of vertex–frontal region approached between antennae; antennal segment 3 as long as segment 4; apices of elytra rounded.....3

3 Depressed hairs on pronotal disc and elytra spotted or clustered .....*C. stictica* (Broun)

Depressed hair on pronotal disc and elytra uniformly arranged in longitudinal grooves.....4

4 Width of frons < 1.9 times height; longitudinal stripe of coloured hairs near elytron suture starting from base; inner side of hind femur without hairs..... ... ...*C. lineata* (Fabricius)

Width of frons > 2.2 times height; longitudinal stripe of coloured hairs near elytron suture starting from basal 1/7 – 1/8; inner side of hind femur with hairs .....*C. marrisi* sp. nov.

Coptomma variegata (Fabricius)

(Figs 2.47, 2.25, 2.34, 2.39, 2.48, 2.44, 2.49)

Callidium variegatum Fabricius, 1775:189. – Gmelin, 1790:189; Olivier, 1790:252; 1795:25, t. 5, fig. 58; Fabricius, 1801:340.

Tmesisternus variegatum Serville, 1834:72. - Thomson, 1860:357; 1864:360.

Tmesisternus variegatus. –D'Urville,1835:469; Dieffenbach, 1843:278; Redtenbacher, 1868:178; Hutton, 1873:164.

Coptomma virgatum, Newman, 1840:18. - Dieffenbach, 1843:278 (synonymy).

Coptomma variegatum. – Dieffenbach, 1843:278; White, 1846:20; Blanchard, 1853:274, t. 17, fig.1. White, 1855:335; Lacordaire, 1869:222; Bates, 1874:23; Broun, 1880:589; Aurivillius, 1912:488; Hudson, 1934:115; Blair, 1937:266; Duffy, 1963:150; Kuschel, 1990:67.

Material Examined

Callidium variegatum. Holotype could not be located. Material compared with BMNH specimens by S. Shute (BMNH): 1♂, Motueka, 15.i.1968, C. Lackner (CMNZ); 1♀, Putaruru, 21.iv.1961 (AMNZ).

Coptomma virgatum. Holotype could not be located. The type was originally deposited in Children Museum. Part of Children Collection was moved to BMNH. However, as far as I know, the type is not in BMNH.

Other material. 39♂, 32♀. **ND**: 1♀, Maungaturoto, in garden, 1.vi.1989, Mrs. L. Mack (NZAC); 1♀, Hen Island, 14.i.1932, A. E. Brookes (NZAC); 1♀, as above but 14-20.i.1932 (MONZ); 1♀, Kaitaia, 13.iii.1958, L. S. Malthus (AMNZ); 3♂, Tauraroa, 25.xii.1949, E. Fairburn (WMNZ); 1♂, Whangarei, ii.1959, E. McCherson, terminalia slide No. *Coptomma* m-970417-2 (AMNZ). **AK**: 1♂, Wenderholm, North Auckland, 2.iii.1990, A. Tennyson (MONZ); 1♂, Piha (36°57'S, 174°24'E), 29.i.1948, terminalia slide No. *Coptomma* m–970421-1 (AMNZ); 1♀, Wellsford, i.1954, M. Fawn (AMNZ); 1♂, Torbay, Auckland, 3.xi.1949 (AMNZ); 1♂, Port Waikato, ii.1976, A. Tannoir (CMNZ); 1♀, Wenderholm, 10.i.1988, J. S. Dugdale (NZAC); 1♂, Auckland, Milford,

6.xii.1890, Henderson (NZAC); 1♀, Tawharanui, vi.1958, F. Shepherd (NZAC); 1♀, Karekare, Summer, 1983-84, M. F. Tocker (NZAC); 1♂, as above but Wokefield (CMNZ). **WO**: 1♀, Glen Afton, 8.iii.1958, M. Machen (NZAC); 1♂, Matamata, 19.iii.1959 (NZAC); 1♀, 1♂, Otorohanga, 23.iii.1945 (AMNZ); 1♂, Katikati, 18.iii.1932 (AMNZ); 1♂, Horahora, Cambridge, 20.ii.1959, A. Head (AMNZ); 1♂, Ngaruawahia, iv.1960, K. Lourie, terminalia slide No. *Coptomma* m-970417-1 (AMNZ); 1♀, Okauia, 1930, A. E. Brookes, terminalia No. *Coptomma* f-970415-2 (NZAC); 1♀, Putaruru, 21.iv.1961, on neck of person (AMNZ). **GB**: 1♀, Awaters River Valley, Pohutu, 60m, Swept dead kowhai branches, 17.iii.1893, R.F. Gilbert (CMNZ); 1♀, Wairoa South (AMNZ). **TO**: 1♀, Mt. Tongariro, 1960m, under rock, 17.xii.1985, R.M. Emberson & P. Syrett (LUNZ); 1♂, Mt. Ngaruhoe 2271m, 26.i.1980, A. K. Walker (NZAC); 1♀, Taupo, Acacia Bay, 20.ii.1947, J.S. Armstrong (NZAC); 1♂, Taupo, 20.i.1952, C.R. Foskeit (MONZ). **TK**: 1♂, Mt. Egmont, 4.ii.1933, H. Murray (MONZ). **HB**: 1♀, Portland Island, 1923, C. Robson (AMNZ). **WI**: 1♂, Palmerston North, 14.xii.1962, R. Penman (NZAC); 1♀, as above but 24.xii.1958, B. Wright (NZAC); 1♀, as above but W. Penman, terminalia No. *Coptomma* f-970416-2 (NZAC); 1♂, Johnson Pk., Feilding, iii.1960, R. Rovve (AMNZ). **WA**: 1♂, Masterton, i.1962, W. B. H. Smith, terminalia slide No. *Coptomma* m-970415-1 (NZAC). **WN**: 1♀, Days Bay, Wellington, 2.iii.1995, E. W. Dawson (MONZ); 1♂, Nikau Street, Eastbourne, in basement, 14.xi.1988, A. Girdlestone (MONZ); 1♀, Browns Bay, Paremata, ii.1984, K. E. Jenkins (MONZ); 1♀, York Bay, Wellington, 3.vi.1969 (MONZ); 1♀, Wairarapa, Featherston, i.1963, A. McDougall (MONZ); 1♂, Silver Stream, 19.vi.1911, O'Connor (MONZ); 1♂, Titahi Bay, 1.i.1912, O'Connor (MONZ); 1♂, Akatarawa, 19.vii.1952, M. Remington (MONZ); 1♂, Paraparaumu, 1976, J. Nunn (JNNZ). **NN**: 1♂, Nelson, ii.1960 (NZAC); 1♂, Motueka, 15.i.1968, C. Lackner (CMNZ); 1♀, Nelson, 29.i.1965, J. I. Townsend, terminalia No. *Coptomma* f–970416-1 (NZAC); 1♂, Kohaihai River, 26.xii.1930, J. S. Armstrong (NZAC); 1♀, Nelson, i.1960 (NZAC). **SD**: 1♀, Tory Channel, Telro Bay, in flight, 1.i.1993, J. W. M. Marris (LUNZ). **KA**: 1♀, Oaro, in cobweb, 20.iii.1982, G. Talbot (LUNZ); 1♀, Wharf, 10.iii.1947, Watt, terminalia No. *Coptomma* f-970414-1 (LUNZ); 1♀, Thames, 14.iv.1961, R. Thorpe (AMNZ); 1♀, Kowhai log whaka, xii.1960 (LUNZ). **WD:** 1♂, Hickson, ii.1973 (CMNZ). **CO**: 1♀, Blue lake Garvie Mts., 5000m, 4.i.1934, E. M. Heine (MONZ). **DN**: 1♂, Dunedin, 14.xii.1989, A.

C. Harris (CMNZ); 1♂, Dunedin, 18.iii.40.1940 (NZAC). **NL**: 4♂, no locality (CMNZ); 1♂, 1♀, no locality, Wakefield (CMNZ); 2♂, no locality, 4.ii.1923, 1920-1923, J.F. Tapley (CMNZ).

Description:

Male

Body length: 14.1 - 23.5 mm.

Colour (Fig. 2.47). Labrum, clypeus and two terminal segments of antennae yellowish-brown, remaining parts reddish-brown to black. A band of yellowish hairs in transverse groove between tentorial pits extending backwards to emargination of each eye. Two longitudinal stripes of yellowish hairs in shallow grooves starting between frons and vertex and extending to posterior margin of pronotum; one such stripe near each side of pronotum; region beyond side stripes with hairy spots arising from large punctures; a yellowish hairy stripe on each of lateral-ventral sides, extending between posterior and

Fig. 2.47. Dorsal view of *C. variegata*. Scale line: 5mm.

anterior 1/3 – 1/4. Elytron with yellow hairy spots, concentrated near base in form of an oblique line and near middle as a transverse one. Each side of first 4 visible sternites with 2 yellowish hairy spots, lateral one smaller than inner one (Fig. 2.24). Hind femur with an oblique pale hairy spot on upper side.

Head. Narrower than prothorax; sparsely punctured, with a fine impressed line between two longitudinal hairy stripes; frons very short, less than 100^0 angle with vertex (Fig. 2.4); width of frons 3-3.5 times height; distance between lower lobes of eyes 4-4.6 times distance between antennal socket and lateral angle of postclypeus, and 1.8-2.6 times distance between upper lobes of eyes. Antennae extending beyond elytra by a third of their length; scape moderate, thick, about as long as third segment; segment 4 shorter than segment 3, segment 5 or segment 6.

Thorax and abdomen. Prothorax wider than long; disc of pronotum nitid, with a pair of coarsely punctured depressions near anterior and posterior ends, respectively (Fig. 2.6). Prosternal process vertical and slightly produced backward (Fig. 2.12-13). Mesosternal process vertical and slightly produced forward (Fig. 2.12-13); scutellum transversely triangular (Fig. 2.17). Metasternum with sparse hairs and punctures. Elytra nitid with shallow punctures; each with a highly raised longitudinal costa near suture; apex rounded (Fig. 2.20). Legs with fairly dense hairs. Abdomen nitid and hardly punctured.

Male terminalia. Apex of median lobe pointed (Fig. 2.27). Spined region of internal sac more than twice as long as unspined region; spined region divided into three sections: first section with fairly dense scale-like processes only; second section as long as first section, with dense multi-branched spines only; third section about twice as long as second section, with dense mixture of simple small and long spines and multi-branched spines; a U-shaped dark area in third section, consisting of dense simple large and long spines only; an unspined gap between first and second sections about as long as 2/3 first section; an unspined gap between second and third sections as long as third section; a pair of internal chitinous rods near basal internal sac (Fig. 2.25). Eighth sternite rounded at lateral sides, basal and apical sides parallel; apex almost truncate with setae; fairly dense multi-branched microspines on ventral surface (Fig. 2.34). Apex of eighth tergite rounded (Fig. 2.39).

Female

Body length: 15.1-24.1mm

Antennae shorter than body. Distance between lower lobes of eyes 3.5- 4.2 times distance between antennal socket and lateral angle of postclypeus. Disc of pronotum without punctured depressions.

Ovipositor. Each paraproct baculi extending from about basal 3/5 to apical 1/10; length of proctiger baculi 2 - 2.5 times length of dorsal baculi (Fig. 2.48).

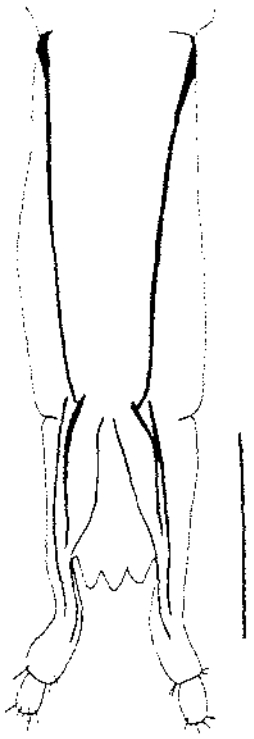


Fig. 2.48. Ovipositor of *C. variegata*, ventral view. Scale line: 1mm.

Spermatheca. Slightly curved; spermathecal gland arising near apex (Fig. 2.44).

Variation

It may be difficult to find microspines on ventral surface of male eighth sternite in some specimens.

Biology

Host plants: *Beilschmiedia tawa* Benth (Miller, 1925), *Edwardsia (or Sophora) tetraptera* Miller (Gourlay, 1960), dead *Acacia decurrens* (Wendl.) Willd., *A. mearnsii* De Wild., *Albizia lophantha* Benth. and *Sophora microphylla* Miller (Kuschel,1990). Adults were collected in flight, cobweb, garden and under rock during January to April, November and December.

Distribution (Fig. 2.49)

Widely distributed in both North and South Islands between about 35^0s to 46^0s, including ND, AK, WO GB, TO, TK, HB, WI, WA, WN, NN, SD, KA, WD, CO and DN, but rather abundant in ND, AK and WN.

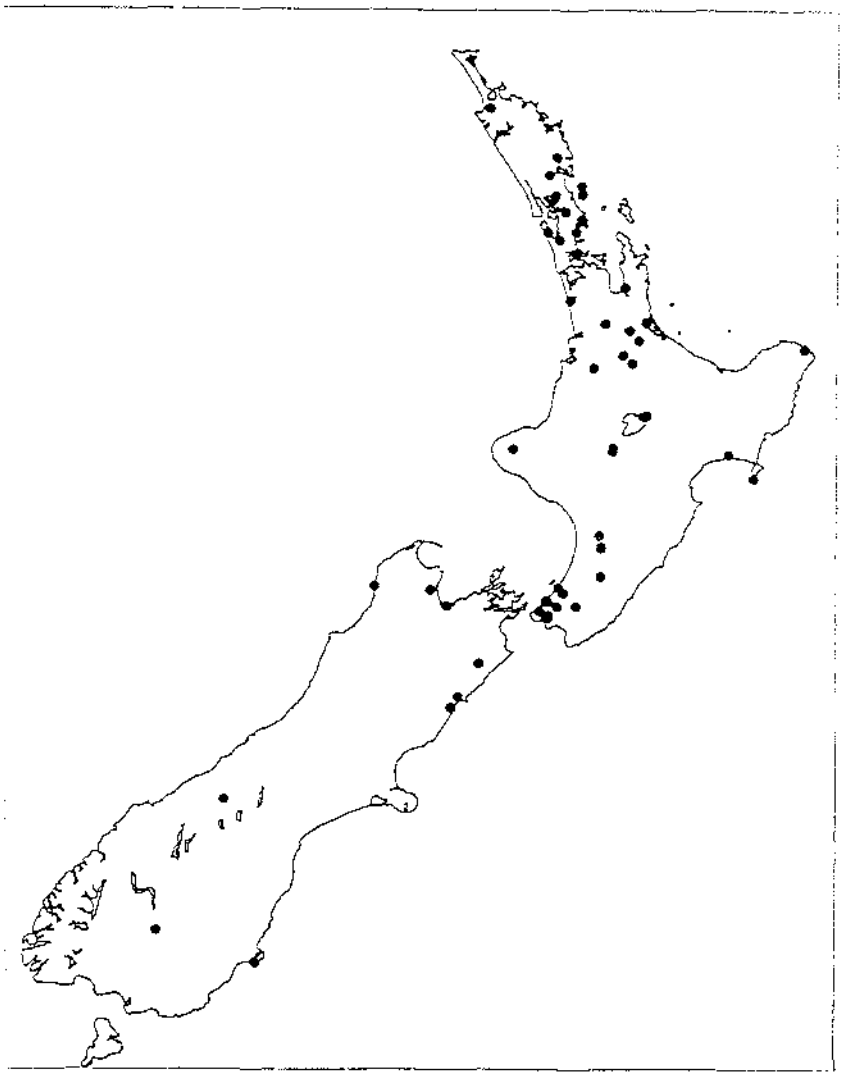


Fig. 2.49. Distribution of *C. variegata*.

Comments

According to Fabricius' (1775) and Newman's (1840) original descriptions, *C. virgatum* is a synonym of *C. variegatum*. The original distribution record of *C. virgatum* was obviously incorrect. This species is not in Australia.

This species resembles *C. stictica* (Fig. 2.58) but differs in having the body size bigger, colour darker; a band of yellowish hairs in transverse groove between tentorial pits extending backwards to the emargination of each eye; prothorax wider than long; hairs on elytron concentrated near base in form of an oblique line and near middle as a transverse one; each side of first 4 sternites with 2 yellowish hairy spots; hind femur with an oblique pale hairy spot on upper side.

Coptomma sulcata (Fabricius)

(Figs 2.50, 2.51, 2.36, 2.40, 2.42, 2.52, 2,53)

Callidium sulcatum Fabricius, 1775:189. – Gmelin, 1790:1849; Olivier, 1790:253; 1795:26, t. 4, fig. 48; Fabricius, 1801:340.

Coptomma sulcatum. – Dieffenbach, 1843:278; White, 1846:20.

Navomorpha sulcatum. – Bates, 1874:24; Broun, 1880:590; Hudson, 1934:116; Blair, 1937:266; Dumbleton, 1957:621.

Navomorpha sulcata. – White, 1855:334; Hutton, 1873:164; Aurivillius, 1912:489; Duffy, 1963:153; Kuschel, 1990:67.

Coptomma acutipenne White, 1846:20, t. 4, Fig. 2.

Navomorpha acutipennis. – White, 1855:334; Hutton, 1873:164; Bates, 1874:24 (synonymy).

Navomorpha neglectum, Broun, 1880:591. - Hudson, 1934:209.

Navomorpha neglecta. - Aurivillius, 1912:489; Brookes, 1926:446 (synonymy).

Material Examined

Callidium sulcatum. Holotype, no data (BMNH)

Coptomma acutipenne. Holotype, no data (BMNH)

Navomorpha neglectum. Holotype, not examined. Brookes (1926) examined the type and said it was a synonym of *C. sulcatum*.

Material compared with holotypes (C. sulcatum has the right hind leg and apical segment of the right antenna missing. C. acutipenne has denser pronotal punctuation) by S. Shute (BMNH). 2♂, Greymouth, 1885, Sharp (BMNH); 1♀, Kaikohe, 5.i.1940, C. E. Clarke (BMNH); 1♀, Auckland, Sharp (BMNH); 1♀, no locality, 1905, Fry (BMNH); 1♀, no locality, 1913, H. Swale (BMNH); 2♀, no locality, Pascoe (BMNH); 2♀, no data (BMNH); 1♂ ,Tinakori Hill, Wellington, on native *Rubus*, 7.x.1991 (JNNZ); 1♀, Hutt Valley, Wellington, 2.i.1928, E. Fairburn (MONZ).

Other material. 34♂, 64♀. **ND**: 1♀, Swept Valley, west side, Mt. Camel Pen, 10.x.1982, R. F. Gilbert (AMNZ); 1♀, Whangarei, 23.i.1964, E. Fairburn (WMNZ); 1♀, as above but 1915, W. Hearen (MONZ). 1♀, Hen Island, 14.xi.1932, A. E. Brookes (MONZ); 2♀, Waipoua SF, Waipoua River, on *Phebalium nudum*, 31.x.1985, R. C. Craw (NZAC); 1♀, Omahuta F, Kauri Sanctuary, *Agathis* forest swept, 8.xii.1895, J. W. Earty (AMNZ); 1♀, Omahuta SF, beaten at night, 10.x.1974, J. C. Watt (NZAC); **AK**: 1♀, Mauku, 12.xi.1944, E. Fairborn (WMNZ); 1♀, Auckland, Wakefield (CMNZ); 1♀, Titirangi, malaise trap in native bush, x.1980 (NZAC); 1♀, Auckland (CMNZ); 1♀, Auckland Domain, 10.xi.1892, J. W. Early, terminalia No. *Coptomma* f-970427-1 (AMNZ); 1♀, Wayby Gorge, Rodney, 27.xii.1926, A. Richardson (AMNZ). **CL**: 1♀, Mayor Island, Pohutukawa forest, xi.1959, J. C. Watt (NZAC); 1♀, Tahua JS, 11-15.ix.1895, B. H. Patrick (OMNZ); 1♀, Summit Cuvier I., 20.i.1972, K. A. J. Wise (AMNZ). **WO**: 1♀, Otewa Gorge, Waipa R., 19.i.1941 (AMNZ). **BP**: 1♀, Mt. Te Aroha, 300m, 6.iii.1985, R. C. Craw (NZAC); 1♀, as above but 900m, midday, on *Ixerba* flower, 10.i.1986, B. A. Holloway (NZAC); 1♂, as above but terminalia slide No. *Coptomma* m-970508-4 (NZAC); 1♂, Orete Forest, Te Pula, beaten from *Dacrydium cupressinum* branch trap, 19.x.1992, J. W. M. Marris (LUNZ); **GB**: 1♀, Wairoa, 20.x.1971, J. S. Dugdale, terminalia No. *Coptomma* f-970427-2 (NZAC). **TO**: 1♂, Karori, 22.i.1947, J. T. Salmon (MONZ); 1♀, Whakapapaiti, Mt. Ruapehu, 1.iii.1959, J. E. Watt (AMNZ); 1♀, Mt. Mangatipua, 25.xii.1952, E. Fairburn (WMNZ); 1♂, Ohakune, T. R. Harris (AMNZ); 1♀, Chateau, Ruapehu, 18.ii.1965, G. Kuschel (NZAC); 1♀, Pureora SF, 400m, 12.x.1979, J, S. Dugdale (NZAC); 1♀, Raurimu, 14,xii.1940 (AMNZ). **TK**: 1♀, Pouakai Ra, Tatangi Peak, 10.i.1978, K. J. Fox, sweeping (NZAC); 1♀, Pouakai, 24.viii.1977, R. M. J. Mackenzie (FRNZ); 1♀, Mt.

Egmont, 1961, G. Kuschel (NZAC). **WN**: 1♀, Wellington, 20.xi.1955, R. G. Ordish (MONZ); 2♀, Paiaka, 11-30.xi.1949, R. A. Cumber, *Phormium* survey (NZAC); 4♂, Ohakune, 3.i.1952, E. Fairburn (WMNZ); 2♀, 2♂, Hutt Valley, 2.i.1928, E. Fairburn (WMNZ); 1♀, Tinakori Hill, 23.xii.1991, J. Nunn (JNNZ); 1♂, as above but on native *Rubus*, 7.x.1991, J. Nunn (JNNZ); 1♀, Korokoro, 13.x.1923, T. Cockcroft (AMNZ); 2♀, Hutt Valley, 2.i.1928, E. Fairburn (AMNZ); 1♀, Ngaio, in wood of peach tree, 20.xii.1959; C. C. Newman (FRNZ). **NN**: 1♂, Botanical Hill, Nelson, 5.X.1972, J. S. Dugdale (NZAC); 1♂, Nelson City, viii.1973, G. Kuschel, terminalia slide No. *Coptomma* m-970508-3 (NZAC); 1♀, Karori Reservoir, 29.x.1994, J. Nunn (JNNZ); 1♂ Aniseed Valley, 7.xii.1965, C. Lackner (CMNZ). **SD**: 1♀, Ship Cove, 15.ii.1973, A. C. Eyles (NZAC); 1♂, Stephens Island (CMNZ); 1♀, Okiwi Bay, ix.1984, T. Jones (NZAC); 1♀, Ohinetahi Bay, 10m to Mahau, 12.i.1994, J. W. Early (AMNZ); 1♂, Queen Charlotte Sound, Bay of Many Coves, beaten at dead vegetation *Nothofagus truncata* forest, 25.x.1993, J. W. M. Marris (LUNZ); 1♀, Te Iro Bay, Queen Charlotte Sound, on *Arum lily* flower, 22.xii.1985, J. W. M. Marris (LUNZ). **BR**: 1♀, L Waikaremoana, 1.xii.1929, J. S. Armstrong (NZAC); 1♀, L. Rotoiti, 0.5 km North of Otaramarae, sweeping in forest, 7.vii.1977, J. S. Dugdale (NZAC); 1♀, Crooked R, 3.xi.1978, R.M. Emberson (LUNZ). **MC**: 1♀, 1♂, Governors Bay, Banks Peninsula, 12.ix.1922, J. F. Tapley (CMNZ); 1♀, as above but 1.ii.1923; 1♀, Hinewai Reserve, Banks Peninsula, 29.xii.1893, J. B. Ward (LUNZ); 1♀, Coopers Knobs, 15.xi.1924, S. Lindsay (CMNZ); 1♀, as above but 10.xi.1934; 1♂, Riccarton, 30.ix.1973, Wakefield (CMNZ); 1♀, Hilltop, 22.i.1958, E. S. Gourlay (NZAC); 1♀, Banks Pen, Hinewai Res, Sheward Boundary, 9-29.xii.1893, J. B. Ward (LUNZ); 1♂, as above but Malaise trap, 1-4.ii.1894 (LUNZ); 1♂, as above but Quiet Stream, 17.xi.1893 (NZAC). **SC**: 1♂, Mills' Bush, Peel Forest, 12.xii.1973, A. C. Harris (OMNZ). **CO**: 1♀, Otago, ii.1984 (OMNZM). **DN**: 1♂, Dunedin, Town Belt (45°53'S, 170°30'E), bred *Astelia* flower, 12.ix.1994, B. H. Patrick (OMNZ); 1♂, Broad Bay, 23.xi.1913, S. Lindsay, terminalia slide No. *Coptomma* m-970819-3 (CMNZ); 1♂, Trotters Gorge, Palmerston, 15.xi.1960, A. C. Harris (OMNZ); 1♀, Dunedin, N. E. V., 17 Buccleugh St., 25.xi.1990, A. C. Harris (OMNZ); 1♂, Dunedin, 23.x.1896, H. Patrick (OMNZ); 1♀, Dunedin, 19.xi.1921, N. Dunedin (AMNZ); 1♂, Broad Bay, 23.xi.1913 (AMNZ). **SI**: 1♀, Big South Cape Is., SW Stewart Is., 14.xi.1968, J. C. Watt, terminalia No. *Coptomma* f-970427-3 (NZAC); 1♂, Stewart

Is., Lec Bay, 22.v.1976, A. C. Harris (CMNZ); 1♂, Big South Cape Is. SW Stewart Is., xi.1968, G. Kuschel (NZAC). **NL**: 2♂, 2♀, no locality (CMNZ); 1♀, as above but no head (CMNZ); 3♂, 1♀, no locality, Wakefield (CMNZ); 1♀, no locality, 1920-1930, J. F. Tapley (CMNZ); 1♀, no locality (AMNZ); 1♀, as above but 1930 (AMNZ).

Description

Male

Body length: 7.2 - 14.7 mm.

Colour (Fig. 2.50). Antennae, head and pronotum reddish-brown, legs yellowish- to dark reddish-brown, elytra dark reddish-brown to greenish-brown, remaining parts reddish-brown to black. Yellowish-white hairs on sides of vertex-frontal region and pronotum. Each elytron with four longitudinal stripes of yellowish-white hairs in grooves: suture one extending from apex to basal 1/9–1/7 and pointing towards scutellum; second one extending from base to apical 1/9 and pointing towards apex;

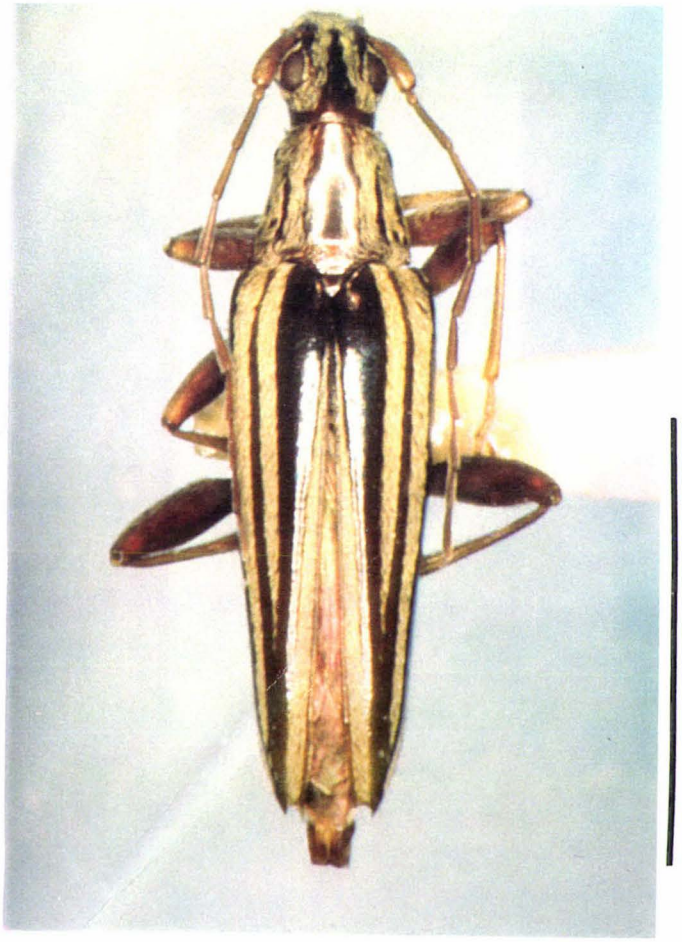


Fig. 2.50. Dorsal view of *C. sulcata*. Scale line: 5mm.

third one longer than second one and also pointing towards apex; marginal one extending from base to apex. Sides of sterna and sternites with yellowish white hairs (Fig. 2.22). Legs with white hairs.

Head. Slightly narrower than prothorax, sparsely punctured; frons short, more than 100^0 angle with vertex (Fig. 2.5); width of frons 1.9-2.1 times height; distance between lower lobes of eyes 3-4 times distance between antennal socket and lateral angle of postclypeus, and about 1.2-1.4 times distance between upper lobes of eyes. Antennae smooth, slender, two thirds length of elytra; scape moderate, about as long as segment 3; segment 4 distinctly shorter than segment 3 and slightly shorter than segment 5, but about as long as segment 6.

Thorax and abdomen. Prothorax slightly longer than wide; pronotum smooth, nitid and hardly punctate on disc, with a small rounded process at each side near anterior 1/5-1/7 and with large areas of coarse punctures on lateral sides; posterior-lateral angles produced. Prosternal process distinctly produced backward. Mesosternal process distinctly produced forward and overhanging and covering prosternal process; scutellum equilaterally triangular (Fig. 2.16), rarely hairy. Metasternum nitid and hardly punctate. Elytra moderately long and nitid; apices sharply spined at margin (Fig. 2.21). Sparse hairs on legs but absent on inner side of hind femora. Abdomen nitid and hardly punctured.

Male terminalia. Apex of median lobe pointed (Fig. 2.27). Spined region of internal sac more than 3 times as long as unspined region; spined region divided into 2 sections: first section distinctly wider than third section, with fairly dense small and short spines; second section absent; third section about 2/3 as long as first section, with dense simple small and long spines on basal half of the section near unspined gap; an unspined gap between first and third sections as long as first section; third section with two chitinous structures: a V-shaped structure occupying 1/2 of third section and a "⊓"-shaped one as long as third section; a pair of chitinous rods near basal internal sac (Fig. 2.51). Eighth sternite Y-shaped subparallel at lateral sides and apex deeply emarginate, with dense setae; dense multi-branched microspines in central area on ventral surface (Fig. 2.36). Apex of eighth tergite heavily emarginate (Fig. 2.40).

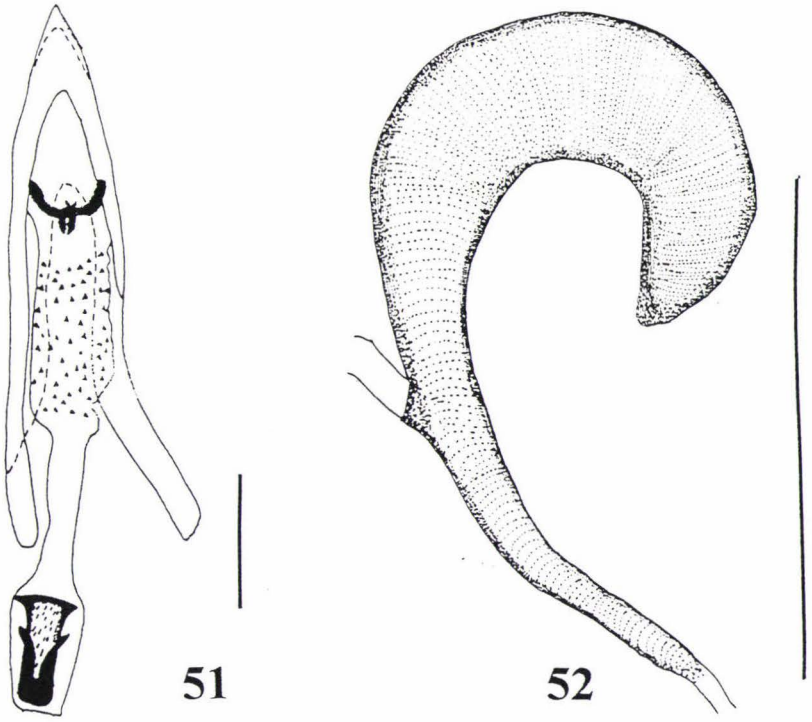
Female

Body length: 8.1-15.0mm.

Lateral side of prothorax smooth, clothing with fairly dense hairs, without punctured areas on sides.

Ovipositor. Each baculi of paraproct extending from about basal 3/7 to apical 1/10; length of proctiger baculi 1-1.3 times length of dorsal baculi (Fig. 2.42).

Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.52).



Figs 2.51-52. Median lobe and internal sac of male genitalia and spermatheca of *C. sulcata*. Scale lines: 0.5mm.

Variation

In some specimens, the femur may be green. The third hairy stripe on the elytron may be split into two.

Biology

Host plants are Montery Pine (*Pinus radiata* Don) (Rawlings, 1953), *Aristotelia serrata* Forster (Hudson, 1934), *Pyrus malus* L., *Malus sylvestris* (L.) Miller, *Prunus amygdalus* Batsch (Miller, 1922; Dale and Maddison, 1982), *Muehlenbeckia australis*

(Forster) Meissner, *Olearia furfuracea* (Richard) Hook, and *Phyllocladus trichomanoides* **Don (Kuschel, 1990),** and may also possibly be *Prunus persica* (L.) (peach tree), *Rubus* L., *Phebalium nudum* Hook and *Phormium* Forster. Dumbleton (1937) recognised that larvae probably bored only in dead wood. Eggs were deposited in the bark of twigs and branches (Duffy, 1963). Larvae were taken from dead branches of the host and pupae were present in May (Duffy, 1963). The larval galleries extended under the bark and also in the wood (Dumbleton, 1957). Adults emerged between August and January (Miller, 1922; Hudson, 1934), and were collected at night or in midday by malaise trap, *Dacrydium cupressinum* Solander branch trap, on *Lilium* L. flowers, on *Rubus australis* Forster flowers (Thomson, 1927), on *Muehlenbeckia australis* (Forster) Meissner flowers (Kuschel, 1990), beating at dead vegetation *Nothofagus truncata* (Colenso) Cookayne, and sweeping forest margin during all months of a year except April, June and July.

Distribution (Fig. 2.53)

Widely distributed in the North, South and Stewart Islands in the areas of ND, AK,

Fig. 2.53. Distribution of *C. sulcata*.

CL, WO, BP, GB, TO, TK, WN, NN, SD, BR, MC, SC, CO, DN and SI, but absent in south-western part of the South Island.

Comments

This species resembles *C. lineata* (Fig. 2.54) but differs in having body size smaller; width of frons 1.9-2.1 times height; segment 4 distinctly shorter than segment 3; apices of elytra sharply spined at margin.

Coptomma lineata (Fabricius)

(Figs 2.54, 2.55, 2.35, 2,38, 2.56, 2.45, 2.57)

Callidium lineatum Fabricius, 1775:189. – Olivier, 1790:252; 1795:26, t. 4, fig. 50; Fabricius, 1801:340.

Coptomma textorium Newman 1840:18. – Lacordaire, 1869:223; McKeown, 1948:107. **syn. nov.**

Coptomma lineatum. – Dieffenbach, 1843:279; White, 1846:20, t. 4, fig. 5.

Navomorpha textoria. - Aurivillius, 1912:489.

Navomorpha lineatum. – Redtenbacher, 1868:178; Lacordaire, 1869:224; Bates, 1874:24; Broun, 1880:590; Hudson, 1934:116; Blair, 1937:266; Dumbleton, 1957:620.

Navomorpha lineata – White, 1855:334; Thomson, 1860:356; 1864:360; Hutton, 1873:164; Aurivillius, 1912:488; Duffy, 1963:154; Bain, 1976:1; Grehan, 1982:1.

Navomorpha philpotti Brookes, 1926. - Hudson, 1934:209; Blair, 1937:266. **syn. nov**.

Material Examined

Callidium lineatum. Holotype, ♂ (BMNH).

Material compared with the Holotype by S. Shute (BMNH). 1♂, Wellington, 6.ii.1870, C. M. Wakefield (BMNH); 1♀, Mt. Ruapehu, Whakapara, National Park, in stream, 13.ii.1938, C. E. Clarke (BMNH); 1♀, Little Barrier Is., 1913, H. Swale (BMNH); 1♀, Ohakune, 15.xii.1919, T. R. Harris (BMNH); 1♂, no locality, 1854, Bolton (BMNH); 1♀, no locality, 1905, Sharp (BMNH); 1♀, no locality, 9.i.1940

(BMNH); 1♀, no locality, 1922, H. E. Andrewes (BMNH); 1♂, Nelson J. M. K. (NZAC); 1♀, Mamaku, 8.ii.1982, J. C. Watt (NZAC).

Navomorpha philpotti. Holotype, ♂, Dun Mountain, Nelson, 8.ii.1924, A. Philpotts (NZAC).

Coptomma textorium. Holotype cannot be located. The type was originally deposited in Children Museum. Part of Children Collection was moved to BMNH. However, as far as I know, the type is not in BMNH.

Other material. 36♂, 43♀. **ND**: 1♂, Lady Alice Island, on *Coprosma* leaf, 21.xi.1979, D. Cunningham (AMNZ); 3♀, Manaia, Whangarei, on bush & scrub, 21.xii.1944, B. B. Given, one ♀ terminalia No. *Coptomma* f-970425–2 (NZAC); 1♂, Whangarei, 21.xii.1944, B. B. Given (NZAC); 1♀, Tawhiti Rahi, 1.i.1956, J. C. Watt (NZAC); 1♂, Mt. Hauto, 12.iii.1927, E. Fairburn (WMNZ); 1♂, as above but 30.i.1928 (WMNZ); 1♂, Mt. Manaia, 28.i.1956, E. Fairburn (WMNZ); 1♂, Parua Bay, Whangarei, 5.i.1927 (AMNZ). **AK**: 1♀, Huia Dam, beating *Coprosma rhamnoides*, iii.1958, J. C. Watt (AMNZ); 1♀, Clevedon, 27.ii.1934 (NZAC); 1♀, as above but ii.1931, A. R. (AMNZ). **CL**: 1♀, Awaroa Ck, Little Barrier I., 18.i.1983, K. A. T. Wise (AMNZ); 1♂, Coromandel, 26.i.1960, J. I. Townsend & R. Zondag (NZAC); 1♂, Little Barrier, on *Astelia*, 7.iv.1984, D. Russell, terminalia slide No. *Coptomma* m–970819–6 (NZAC); 1♀, Summit, Mt. Moehau, 875m, Coromandel Forest Park, flying in sun, 12.ii.1978, R. M. Emberson, C. A. Muie (LUNZ); 1♂, as above but M. R. Butcher (LUNZ). **BP**: 1♂, 1♀, Mt. Ngongotaha, 787m (38°47'S, 176°9'E), 15.ii.1979, J. S. Dugdale, one ♂ terminalia slide No. *Coptomma* m–970508-2 (NZAC); 1♀, Blue L., Rotorua, 23.i.1960, J. I. Townsend, R. Zondag (NZAC); 1♂, 2♀, Mamaku, 8.ii.1982, J. C. Watt (NZAC); 1♂, Mt. Te Aroha 1000m, 14.x.1979, J. S. Dugdale (NZAC); 1♀, Kaiangaroa St., 8.ii.1979, R. M. Emberson (LUNZ); 1♂, Waioeka Gorge, 9.iv.1991, R. F. Gilbert (AMNZ).). **TO**: 1♀, Rangataua, 8.i.1927, H. Hamilton (MONZ); 1♀, Whakapapaiti Hut 3700m, Mt. Ruapehu, 1.iii.1959, J. E. Watt (AMNZ); 1♀, Taupo Lake, 4.iii.1979, T. H. & J. M. Davies, terminalia No. *Coptomma* f–971210–2 (NZAC); 2♀, Taupo, Tauhara, 24.ii.1939, J. T. Salmon (MONZ); 1♂, 1♀, Tongariro NP, Desert Rd. 914m, 19.ii.1974, J. S. Dugdale (NZAC); 1♂, Waikato River 3200m, Turangi, 19.ii.1979, J. S. Dugdale (NZAC); 2♀, Oturere Stream, 19.ii.1979, J. S. Dugdale

(NZAC); 1♂, Mill Rd., Kaimanawa, *Nothofagus* forest, 5.iv.1980, A. Newton, M. Thayer (CSIRO); 1♀, Waimarino R., 22.i.1919 (AMNZ); 1♀, Ohakune, iii.1920, Harris (AMNZ); 1♂, Whakapapaiti Stream, National Park, Mt. Ruapehu, 13.ii.1938 (AMNZ); 1♀, as above but 1.iii.1959, K. A. J. Wise (AMNZ). **HB**: 1♂, Hawkes Bay, Puketitiri, 17.ii.1964, T. H. Davies (NZAC); 1♀, Little Bush, Puketitiri, 10.ii.1984, T. H. & J. M. Davies (NZAC). **WA**: 1♂, Wairarapa, iii.1921 (NZAC); 1♂, Dannevirke, 5.ix.1963, C. Lackner (CMNZ); 1♀, Whakapuni, 4.viii.1959, V. S. D. (LUNZ); **WN**: 1♂, Turakirae Head, Coastline 0–200m, 16.x.1980, N. Elvidge, C. W. Hornabrook, Wellington coast botany survey (MONZ); 1♂, Mt. Hector, 2500ft, 14.ii.1931, E. A. Plank (MONZ); 1♂, Wellington, ii.1975, Wakefield (CMNZ); 1♀, Pakuratahi Forks, 28-30.xii.1893, J. Nunn (JNNZ); 1♀, as above but 22.i.1895 (JNNZ); 1♂, Rimutaka Hill Rd., 21.ii.1893, J. Nunn (JNNZ); 1♂, Ohakune, Wellingnton, 27.xii.1928, E. Fairburn (WN); 1♂, Hutt Valley, Wellington, 2.i.1928, E. Fairburn (WN). **NN**: 1♀, Dun Mountain, Nelson, 8.ii.1924, A. Philpotts (NZAC); 1♀, as above but 4.i.1959, R. M. Bull (NZAC); 1♂, Nelson J. M. K. (NZAC); 1♂, Silverstream, x.1912, A. C. O'Connor (NZAC); 1♀, Upper Matai V., 26.i.1930, L. Buttress, terminalia No. *Coptomma* f–970425–3 (NZAC); 1♀, Canan, 2000m, West Nelson, 17-24.i.1949, Brookes & A. C. O'Connor (NZAC); 1♂, Dun Mt., Nelson, 19.i.1931, E. S. Gourlay (WMNZ); 1♀, Mt., Tiger, North Island, 27.xi.1937, E. Fairburn, terminalia No. *Coptomma* f–970425–1 (WMNZ); 2♂, Mt., Burnett 600m, sweeping *Hebe*, 8.ii.1981, J. W. Early (WMNZ); 1♀, Kakatahi, 22.i.1934 A. R. (AMNZ). **SD**: 1♀, D'Urville Island, 10.xi.1894, R. H. Blank (LUNZ); 2♀, Greville Harbour, D'Urville Island, swept pasture, 24.ii.1964, R. Goldsbrough (LUNZ); 1♀, Mahau Sound, Willowby, on beach, 5.i.1984, R. R. Scott (LUNZ); 1♂, Queen Charlotte Sound, Bay of Many Coves, on unknown flower species, coastal bush, 29.xii.1985, J. W. M. Marris (LUNZ); 1♂, South D'Urville Island, airstrip, 12.ii.1974, R. D. Welch (LUNZ); 1♀, Mahau Sound, Ohinetahi Bay, 28.xii.1989, J. W. Early (LUNZ); **NL**: 3♂, 1♀, no locality, Wakefield (CMNZ); 1♀, as above but Dr. A. Milne (AMNZ); 1♀, as above but M. B. Paterson (AMNZ).

Description

Male

Body length: 13.3 - 18.7 mm.

Colour (Fig. 2.54). Body reddish- to dark reddish-brown but apical 1/5 of femora always darker than remaining parts of body; two longitudinal stripes of yellowish-white hairs starting from frons and extending to posterior margin of pronotum; lateral margins of pronotum nitid, almost without hairs. Scutellum with yellowish-white hairs. Each elytron with four longitudinal stripes of yellowish-white hairs in grooves: first near outer margin from base and extending towards but not reaching apex; two in middle starting from base and jointed together at apical 1/7 - 1/8; fourth near suture from base to apex. Each side of sterna and sternites with dense yellowish-white hairs (Fig. 2.23).

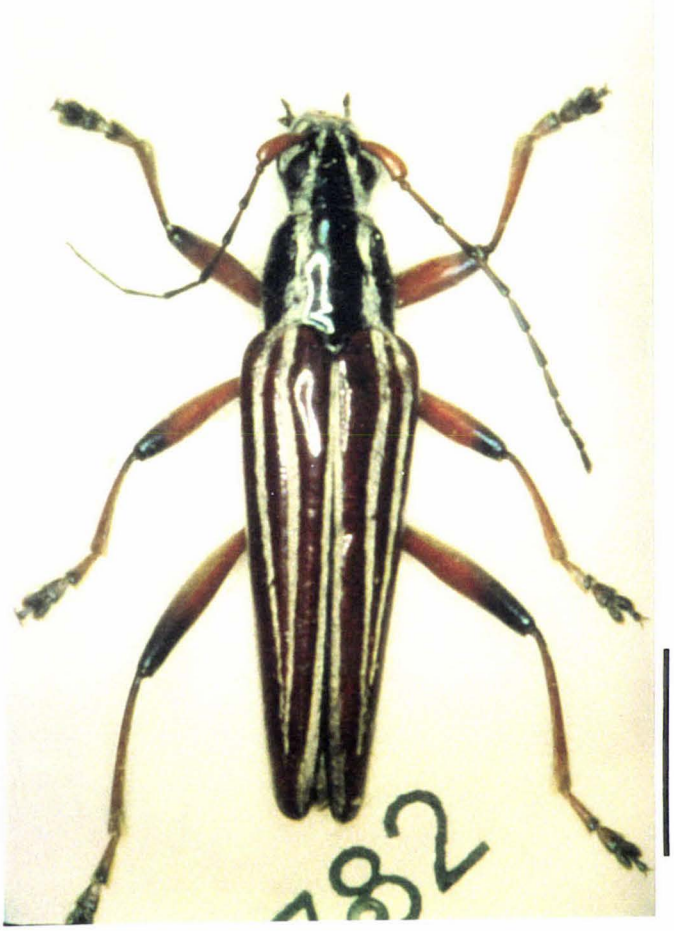


Fig. 2.54. Dorsal view of *C. lineata.* Scale line: 5mm.

Head. Slightly narrower than prothorax, nitid and not punctured; frons more than 100^0 angle with vertex; width of frons 1.6-1.9 times height; distance between lower lobes of eyes 2.3-3.2 times distance between antennal socket and lateral angle of postclypeus,

and 1.3-1.5 times distance between upper lobes of eyes. Antenna smooth, slender, two third length of elytra; scape moderate, longer than segment 3; segment 4 as long as segment 3, longer than segment 6, but shorter than segment 5.

Thorax and abdomen. Prothorax longer than wide with a small, nitid and rounded process at each side near anterior margin; pronotal disc smooth and nitid with two lateral areas of dense and coarse punctures near anterior margin. Prosternal process distinctly produced backward (Figs 2.14-15). Mesosternal process distinctly produced forward and overhanging and covering prosternal process (Figs 2.14-15). Scutellum short, transversely triangular. Elytra moderately long, smooth and nitid; apices rounded. Abdomen nitid and hardly punctured.

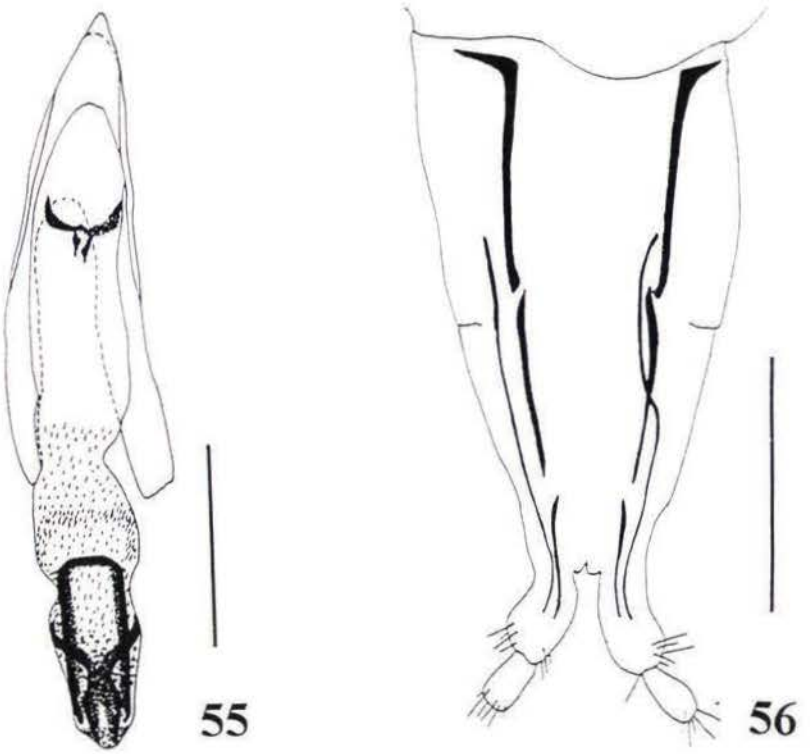
Male terminalia. Apex of median lobe pointed (Fig. 2.27). Spined region of internal sac as long as unspined region; spined region divided into 2 sections: first section absent; second section slightly wider and shorter than third section, with dense simple small and long spines; third section with mixture of dense simple small and short spines and simple small and long spines in area close to second section and with mixture of dense multi-branched spines and simple small and long spines in area distant to second section; third section with 2 chitinous structures: a Y-shaped one occupying more than 1/2 of third section, and a "⊓"-shaped one as long as third section; no unspined gap between sections; a pair of chitinous rods near basal internal sac (Fig. 2.55). Eighth sternite obliquely truncate at lateral sides, parallel at basal and terminal sides; apex slightly emarginate with fairly dense setae; no microspines on ventral surface (Fig. 2.35). Apex of eighth tergite slightly emarginate (Fig. 2.38).

Female

Body length: 14.4-22.1 mm.

Pronotal disc without two lateral areas of dense and coarse punctures near anterior margin.

Ovipositor. Each paraproct baculi extending from basal 2/6-2/7 to apical 1/10; length of proctiger baculi 1.1-1.4 times length of dorsal baculi (Fig. 2.56).



Figs 2.55-56. Median lobe and internal sac of male genitalia and ovipositor of *C. lineata*. Scale lines: 1mm.

Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.45).

Variation

No distinct variation was observed.

Biology

Following plants are recorded as its hosts: *Pseudotsuga taxifolia* (Poiret) Rehder (Duffy,1963); *Pinus radiata* Don (Hudson,1934); *Pseudotsuga menziesii* (Mirbel) Franco (Douglas fir) (Dumbleton, 1957; Bain,1976); *Cryptomeria japonica* (L.) Don (Dumbleton,1957); *Nothofagus* spp. (Blume), *Podocarpus* L'Herit. (Bain,1976); *Cyathodes fasciculata* (Forster), *C. juniperina* (Forster), *Nothofagus solandri* (Hook), *N. truncata* (Col.), (Grehan, 1982). Hosts may also be *Astelia* Banks, *Hebe stricta* (Benth.), and *Coprosma* Thamnoides A. Cunn. Eggs are usually laid under bud scales on twigs (Duffy,1963; Bain,1976) and adjacent to cicada scars on the host *C. fasciculata* (Grehan, 1982). The larvae bore under the bark and cut a downward spiral track before entering the centre of the stem (Bain, 1976). There are four distinct types of tunnelling which is related to different stage of larval development (Grehan, 1982). Pupation takes 2-3 weeks (Bain,

1976). Adults emerged in November, December and January (Duffy, 1963), and were collected at light during all months of a year except May to July. The aspects of biology of this species were studied by Bain (1976), Duffy (1963), Dumbleton (1957), Hudson (1934) and Grehan (1982).

Distribution (Fig. 2.57).

Occurring in ND, AK, CL, BP, TO, HB, WA, WN, NN and SD of both main islands between 35^0s to 42^0s.

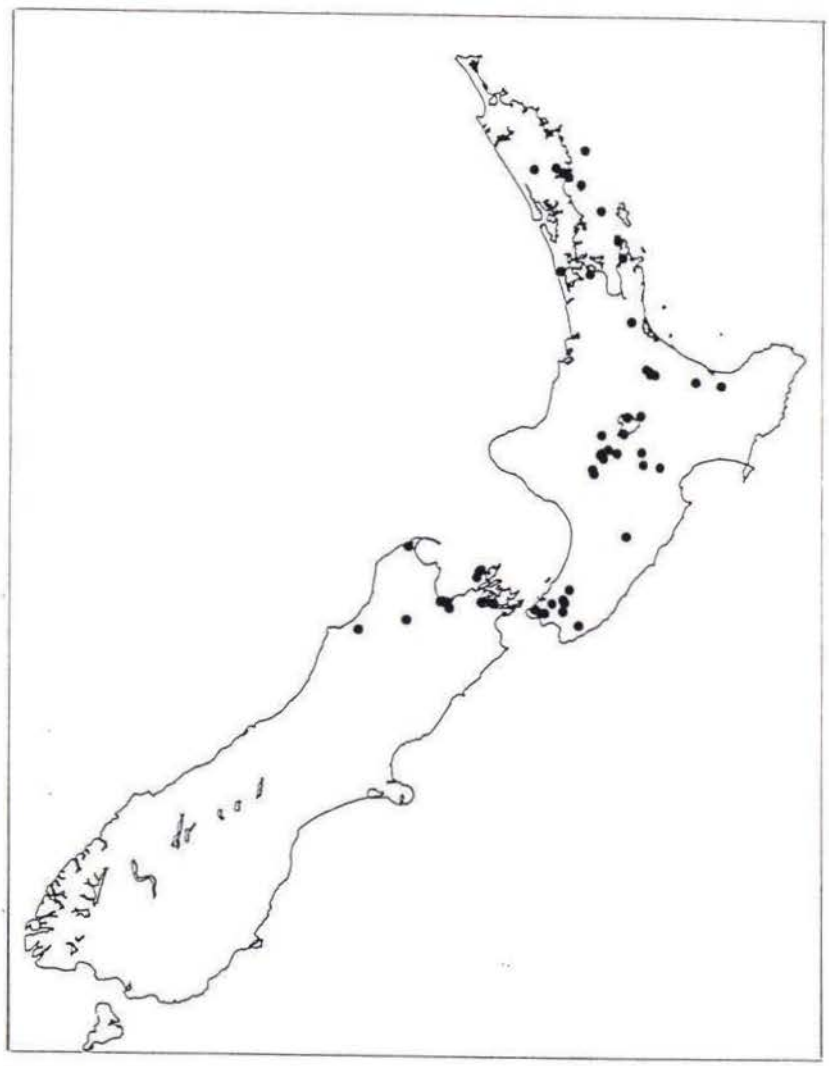


Fig. 2.57. Distribution of *C. lineata*.

Comments

On the basis of Newman's (1840) original description, *C. textoria* is a synonym of *C. lineata*. His original record of *C. textoria* distribution was not correct. The species is not in Australia.

This species resembles *N. sulcata* (Fig. 2.50) but having first antennal segment longer than segment 3; segment 4 about as long as segment 3; elytral apex rounded.

Coptomma stictica (Broun), comb. nov.

(Figs 2.58, 2.59, 2.60, 2.61, 2.62, 2.63. 2.64)

Navomorpha sticticum Broun, 1893:1284 – Hudson, 1934:116; Blair, 1937:266.

Navomorpha stictica – Aurivillius, 1912:488; Duffy, 1963:154.

Material Examined

Holotype. No data (BMNH)

Specimens compared with Holotype by S. Shute (BMNH). 1♂, Rotorua, Ngongotaha, 1913, H. Swale (BMNH); 1♀, Ngongotaha, forest 2550 feet, on *Panax*, 1903 (BMNH); 1♂, no locality, i.1910, Brown (BMNH); 1♂, Mt Egmont, Taranaki, 1932, E. Fairburn (WMNZ); 1♀, Haungatautari Mt., 28.ii.1982, M. S. Buchanan, on trip at summit (NZAC).

Other material. 3♂, 11♀. **ND**: 1♂, Hen Island, 14-20.i.1932, A. E. Brookes, terminalia slide No. *Coptomma* m–970508-1 (NZAC); 1♀, as above but 1927, T. Pycrost (NZAC); 1♂, Taoroa, near Taheke, 25.xii.1944, A. C. O'Cannor (NZAC); 1♀, Hen Is., Whatanui, 14–20.i.1932, A. E. Brookes (NZAC). **CL**: 1♀, Mt. Moehau, 850m, 31.i.1982, R. F. Beecher (NZAC); 1♀, Summit Ridge, Mt. Moehau 875m, Coromandel Forest PK., flying in sun, 12.ii.1978, R. M. Emberson, C. H. Muie (LUNZ). **WO**: 1♀, Maungatautari Mt., 28.ii.1982, M. S. Buchanan, on trip at summit (NZAC). **BP**: 1♀, Mt. Te Aroha, 957m, 6.iii.1985, R. C. Crow, terminalia No. *Coptomma* f–970421–2 (NZAC); 1♀, Mt. Ngongotaha, 850m, 30.xii.1983, J. S. Dugdale (NZAC). **TO**: 1♀, Taupo, Tauhara Mt., near base, 24.ii.1939, J. T. Salmon (MONZ); 1♀, Erua, 1.ii.1917, terminalia No. *Coptomma* f–970421–3 (NZAC) (MONZ); 1♀, Ohakune, 21.iii.1943 (AMNZ). **TK**: 1♂, Mt. Egmont, 1932, E. Fairburn, terminalia slide No. *Coptomma* m–970819–4 (WMNZ); 1♀, Ararata, no head, caught in spider web, 19.i.1957, R. M. Bull (NZAC). **WN**: Wellington, A. C. O'Connor (MONZ).

Description

Male

Body length: 17.2 - 20.8 mm.

Colour (Fig. 2.58). Eyes dark reddish-brown to black; body reddish-brown to blackish-brown; yellowish hairs on lateral sides of vertex-frontal region around eyes and lateral sides of mandibles. A wide, more or less clustered and longitudinal yellowish hair stripe on each side of pronotum. Each elytron with four broad stripes of yellowish clustered hairs: first near margin; two in middle joined together near apex; fourth near suture from basal 1/4 - 1/5 to apex. Each side of sterna and sternites with yellowish-white clustered hairs.

Fig. 2.58. Dorsal view of *C. stictica*. Scale line: 5mm.

Head. Slightly narrower than prothorax, sparsely punctured; frons short, more than 100^0 angle with vertex, with a deep X-shaped depression; width of frons 1.5-1.8 times height; distance between lower lobes of eyes 2.7-3.6 times distance between antennal socket and lateral angle of postclypeus, and 1.2-1.4 times distance between upper lobes of eyes. Antennae smooth, slender, 2/3 as long as elytra; scape moderate, longer than segment 3; segment 4 about as long as segment 3 and segment 6 but shorter than segment 5.

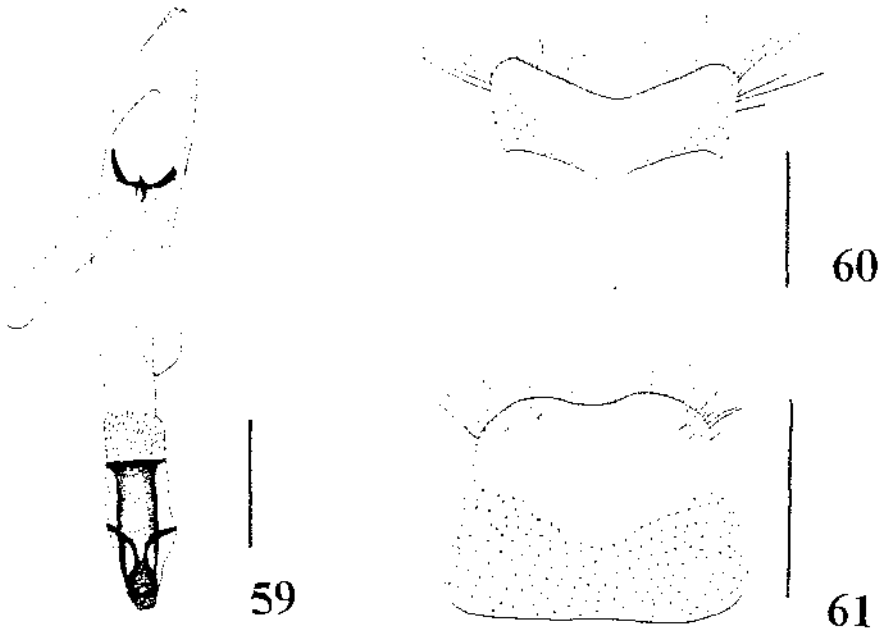
Thorax and abdomen. Prothorax longer than wide with a small, nitid and rounded process at each site near anterior margin; pronotal disc smooth and nitid with two large lateral areas of dense and fine punctures near anterior margin (Fig. 2.7); prosternal process distinctly produced backward. Mesosternal process distinctly produced forward and overhanging and covering prosternal process; scutellum short, transversely triangular. Metasternum nitid and hardly punctured. Elytra moderately long and nitid with irregular and coarse punctures from which clustered hairs arise; apex rounded. Dense hairs on legs but sparse hairs on inner side of hind femora. Abdomen nitid with dense hairs on sides.

Male terminalia. Apex of median lobe pointed (Fig. 2.27). Spined region of internal sac about 0.3 times as long as unspined region; spined region divided into 2 sections: first section absent; second section as wide as third section, with dense simple small and long spines; third section about three times as long as second section, with dense simple small and short spines; no unspined gap between sections; two chitinous structures in internal sac: a Y-shaped structure occupying about 1/2 of third section and a "⊓"-shaped one about as long as third section; a pair of chitinous rods near basal internal sac (Fig. 2.59). Eighth sternite parallel at lateral sides and at basal and apical sides; apex clearly emarginate with fairly dense setae; sparse multi-branched microspines on ventral surface (Fig. 2.60). Apex of eighth tergite slightly emarginate (Fig. 2.61).

Female

Body length: 21.7 – 26.3 mm.

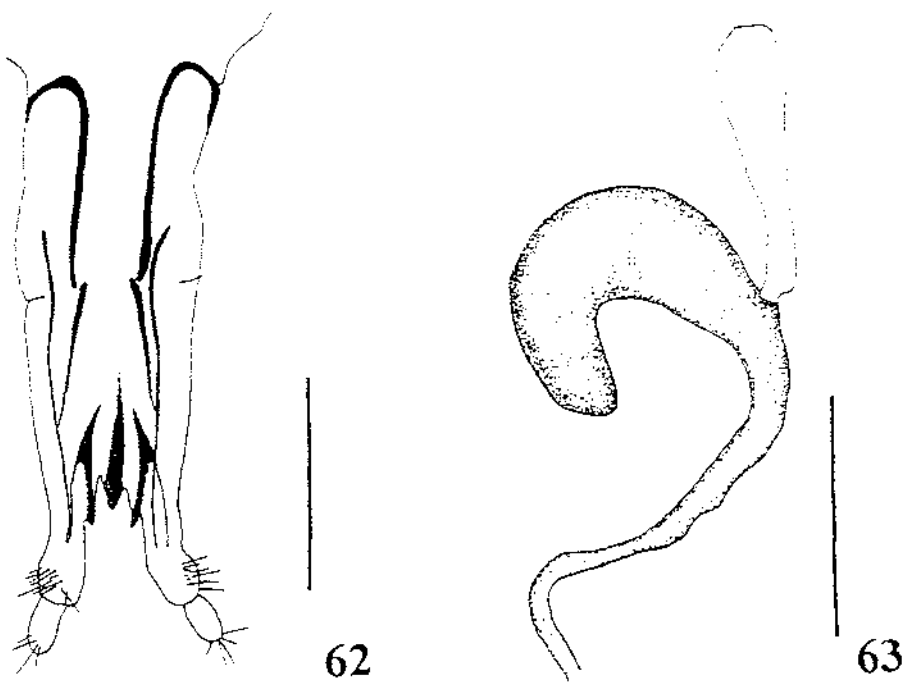
Pronotal disc without two large areas of dense and fine punctures at sides.



Figs 2.59-61. Median lobe and internal sac, eighth sternite and eighth tergite of male terminalia of *C. stictica.* Scale lines: 1mm.

Ovipositor. Each paraproct baculi extending from about basal 2/7 to apical 1/10; length of proctiger baculi 1.3-1.4 times length of dorsal baculi (Fig. 2.62).

Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.63).



Figs 2.62-63. Ovipositor and spermatheca of *C. stictica.* Scale lines: 1mm.

Variation

No distinct variation was observed.

Biology

Host plants are *Plagianthus betulinus* Cunningham (Hudson, 1934) and *Panax* L. Adults emerged between December and February (Hudson, 1934) and were collected at light during January to March and December.

Dstribution (Fig. 2.64)

Restricted to ND, CL, WO, BP, TO, TK and WN in the North Island.

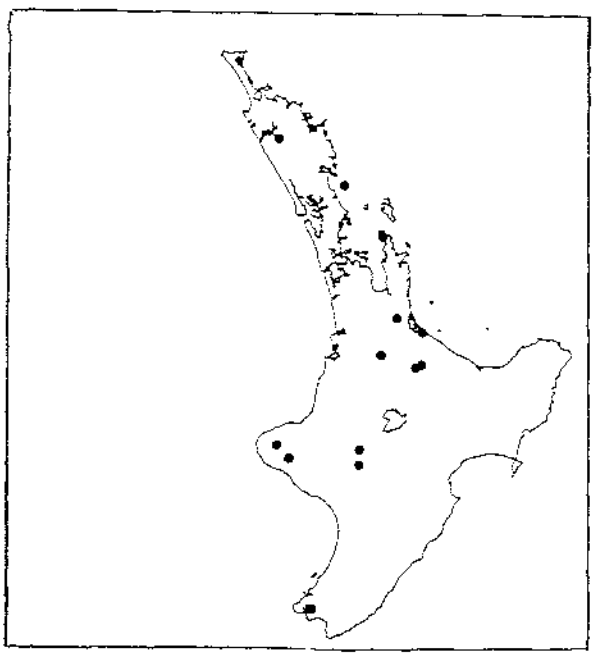


Fig. 2.64. Distribution of *C. stictica*.

Comments

This species resembles *N. lineata* (Fig. 2.54) but differs in having spotted or clustered hairs on pronotal disc and elytra.

Coptomma marrisi, sp. nov.

(Figs 2.65, 2.66, 2.67, 2.68)

Material Examined

Holotype. ♀, Great Island, Lighthouse Bush (34°10'S, 172°8'E), beaten from *Kunzea,* 5.xii.1996, J. W. M. Marris, terminalia No. *Coptomma* f–971210-1 (LUNZ).

Paratype. **TH**: 1♀, Great Island, North West Bay, on Coastal vegetation, 9.xii.1996, J. W. M. Marris, terminalia No. *Coptomma* f–971208–1 (LUNZ).

Description

Female

Body length: 15.1 – 15.5 mm.

Colour (Fig. 2.65). Clypeus, labrum, palps, maxilla, antennae, elytra, tarsi, tibia, basal 1/4 of femora and trochanter reddish-brown, remaining parts dark reddish-brown.

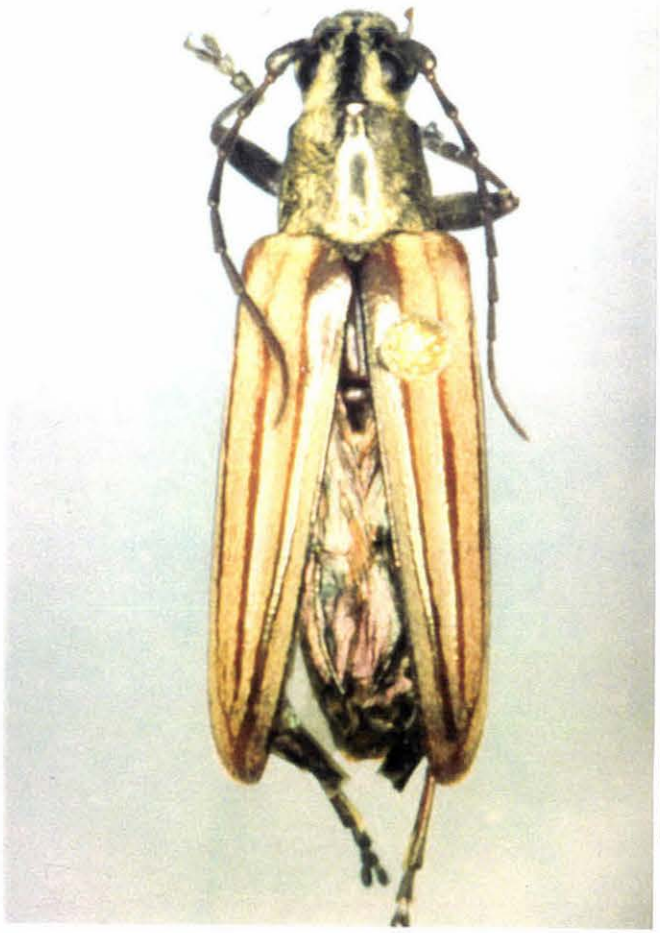


Fig. 2.65. Dorsal view of *C. marrisi.* Scale line: 5mm.

Head and pronotum with dense yellowish white hairs; a hairless and nitid stripe from frons to posterior margin of pronotum. Scutellum with yellowish-white hairs. Each elytron with four longitudinal stripes of yellowish hairs in shallow and wide grooves: first near outer margin from base to apex; two in middle from base and jointed together at apical 1/7 - 1/8; fourth near suture from basal 1/7 - 1/8 to apex; Each side of first 4 visible sternites with 1 yellowish white hairy spot.

Head. Slightly narrower than prothorax, sparsely punctured; frons short, more than 100^0 angle with vertex; width of frons 2.2-2.4 times height; distance between lower lobes of eyes 2.5-2.8 times distance between antenna socket and lateral angle of postclypeus, and about 1.2 - 1.4 times distance between upper lobes of eyes. Antennae smooth, slender, two third length of elytra; scape moderate, longer than segment 3; segment 4 about as long as segment 3 and segment 6 but shorter than segment 5.

Thorax and abdomen. Prothorax longer than wide, sparsely punctured at sides, with a narrow smooth dorsal line on disc and a small, nitid and rounded process at each side near anterior margin. Prosternal process distinctly produced backward. Mesosternal process distinctly produced forward and overhanging and covering prosternal process. Scutellum short, transversely triangular. Elytra moderately long, impunctate; apices rounded. Legs with dense depressed hairs. Abdomen with a triangular, smooth mark in middle of each sternite.

Ovipositor. Each paraproct baculi extending from about basal 2/7 to apical 1/10; length of proctiger baculi 1.1-1.2 times length of dorsal baculi (Fig. 2.66).

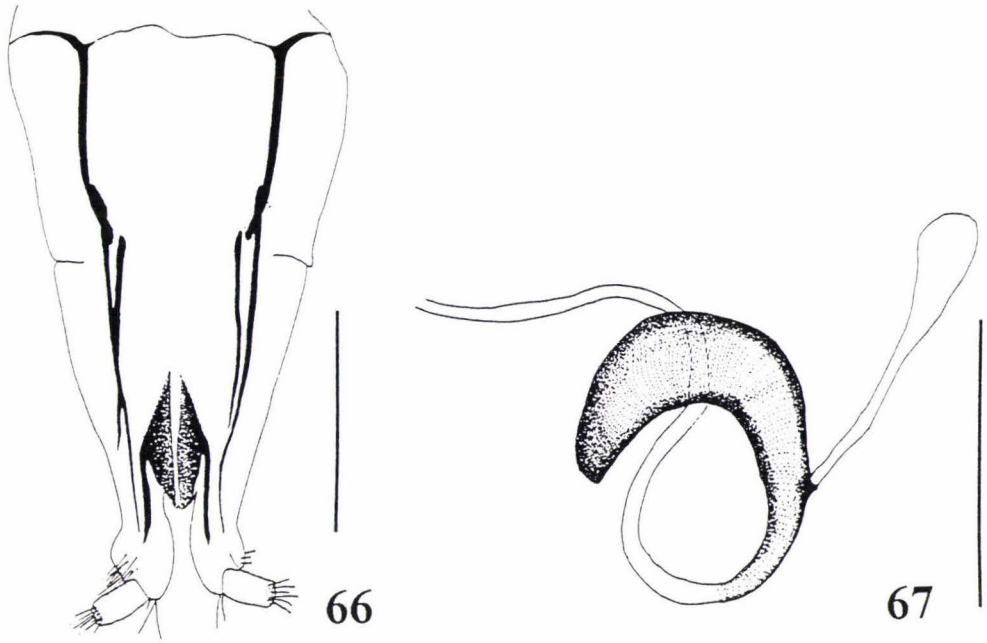
Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.67).

Male

Unknown.

Variation

No distinct variation was observed.



Figs 2.66-67. Ovipositor and spermatheca of *C. marrisi*. Scale lines: 1mm.

Biology

Hosts may be *Kunzea* Reichenbach. Adults were collected on coastal vegetation during December.

Distribution

Known only in Great Island (Fig. 2.68).

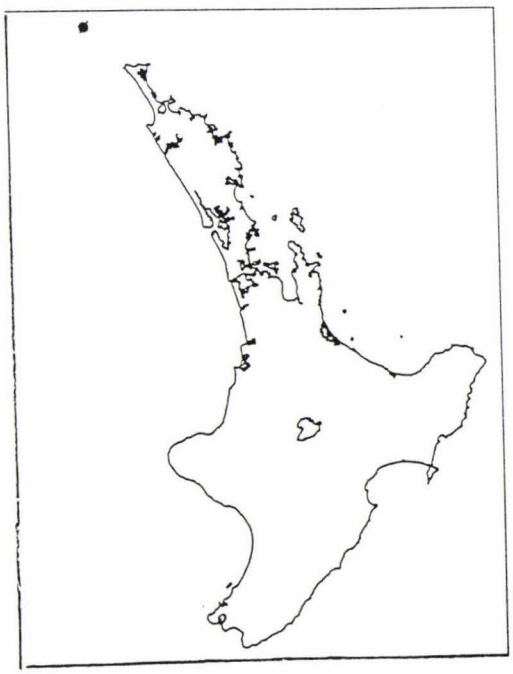


Fig. 2.68. Distribution of *C. marrisi*.

Comments

This new species resembles *C. lineata* (Fig. 2.54) but differs in having width of frons more than 2.2 times height; segment 4 about as long as segment 6; prothorax with a narrow, longitudinal hairless dorsal line on disc; sutural hairy stripe of the elytron extending from basal 1/7-1/8 to apex and marginal stripe extending from base to apex; apical 3/4 of femora dark reddish-brown.

This new species is named in honour of Mr. J. W. M. Marris, who collected the types.

2.4 Taxonomy of the Genus *Calliprason*

Introduction

Since *Calliprason* was erected as a monotypic genus by White (1843), four closely related monotypic genera have been proposed: *Stenepotes, Drotus, Pseudocalliprason, Epheus*. After a detailed study of those genera, and other Cerambycinae in New Zealand, I found that they shared several important characters at generic level; for example, antennal scape distinctly clavated at apex, more than 1.5 times length of segment 3, and front tibia with 1 spur. Therefore, the genetic name *Stenopotes*, *Drotus, Pseudocalliprason* and *Epheus* should not be retained. I propose now to synonymise them with *Calliprason*. The revised *Calliprason* now includes 5 species.

The Genus *Calliprason* White

Calliprason White, 1843:277. – White, 1845:189; 1846:23, t.4, fig. 3; Thomson, 1864:406; Lacordaire, 1869:414; Hutton, 1873:164; Bates, 1874:21; Broun, 1880:582; Aurivillius, 1912:152; Hudson, 1934:114, pl. xii, fig.6; Blair, 1937:264; Duffy, 1963:122. [Type species: *C. sinclairi* White, 1843:277, by monotypy.]

Stenepotes Pascoe, 1875:216, pl. v, fig.7. – Broun, 1880:583; Aurivillius, 1912:150; Hudson, 1934:114; Blair, 1937:264; Rawlings, 1953:1; Dumbleton, 1957:622; Morgan, 1960:26; Duffy, 1963:118; Zondag & Bain, 1976:1; Kuschel, 1990:67. [Type species: *S. pallidus* Pascoe, 1875:216, pl. v, fig.7, by monotypy.] **syn. nov.**

Drotus Sharp, 1877:194. – Broun, 1880:583; Aurivillius, 1912:152; Hudson, 1934:207; Blair, 1937:264. [Type species: *D. elegans* Sharp, 1877:194, by monotypy.] **syn. nov**.

Pseudocalliprason Broun, 1880:573. - Aurivillius, 1912:142; Hudson, 1934:111; Duffy, 1963:121; Blair, 1937:264. [Type species: *Calliprason marginatum* White, 1846:23, t.4, fig.6, by monotypy.] **syn. nov**.

Epheus Broun, 1886:871. – Aurivillius, 1912:142; Hudson, 1934:113; Blair, 1937:264. [Type species: *E. costifer*, Broun, 1886:871, by monotypy.] **syn. nov**.

Diagnosis

Distinguished by vertex-frons region with depressed hairs; distance between lower lobes of eyes shorter than 1.7 times distance between antennal socket and lateral angle of postclypeus; antennal scape distinctly clavated at apex, more than 1.5 times third segment; prothorax longer than wide and constricted in front; front tibia with 1 spur at infero-apical angle; first segment of hind tarsus longer than that of second + third sections.

Description.

Size small to median for Cerambycidae, elongate.

Colour. Body green, reddish-brown, yellowish-brown, to dark brown.

Head. Narrower or slightly wider than prothorax; a finely impressed longitudinal line between antennae; distance between lower lobes of eyes shorter than 1.7 times distance between antennal socket and lateral angle of postclypeus, and about 0.6-1.8 times distance between upper lobes of eyes. Antennal scape slender, clavated at apex, more than 1.5 times third segment; third segment less than 1.1 times fourth segment; third and fourth segments shorter than fifth segment.

Thorax and abdomen. Prothorax longer than wide and constricted in front. Scutellum (Figs 2,16, 2.18-19) equilaterally or curvilinearly triangular, or parabola with dense or fairly dense depressed hairs. Metasternum with sparse hairs and rarely or densely punctured. Elytra elongate with dense punctures and fine granules; apex

rounded. Front tibia with 1 spur at infero-apical angle; first segment of hind tarsus longer than that of second + third sections. Abdomen with fairly dense depressed hairs.

Male terminalia. Apex of median lobe strongly projected (Fig. 2.28). Internal sac divided into 2 regions: basal unspined region and terminal spined region; length of spined region of internal sac about 0.4 times, or about as long as, or more than 1.5 times unspined region; spined region without first section and divided into only 2 sections (except in *C. pallidus* which has 3 sections): all sections with 1 to 2 kinds of spines, including simple spines, multi-branched spines and scale-like spines (Figs 2.29-33); length of unspined region + first spined section shorter than that of second + third spined sections. Eighth sternite (Figs 2,37, 2.71, 2.82, 2.89, 2.95) obliquely truncate at lateral sides and apex emarginate and V-shaped, with setae; ventral surface with 1 to 2 kinds of microspines, including simple, multi-branched microspines, cloud-like processes, or no microspines. Eighth tergite (Figs 2.41, 2.72, 2,83, 2.90, 2.96) with simple or multi-branched microspines on ventral surface, apex rounded, truncate or slightly emarginate.

Ovipositor. Each paraproct baculi extending from about basal 1/3 to apical 1/10; length of proctiger baculi 3.0-6.0 times as long as dorsal baculi (Figs 2.43, 2.73, 2.84, 2.91); spermatheca (Figs 2.46, 2.74, 2.78, 2.85) slightly or clearly curved; spermathecal gland arising near base.

Distribution (Fig. 2.75, 2.79, 2.86, 2.92, 2.97)

Widely distributed in the North Island, and has also been found on Chatham Island and in 4 South Island localities: Nelson, Marlborough Sounds, Mid Canterbury and Fiordland.

Key to the Species of *Calliprason* Newman

1 Each side of prothorax with an acute spine 2

Each side of prothorax without an acute spine.....4

2 Disc of pronotum with two acute spines.....3

Disc of pronotum without spines .....*C. sinclairi* White

3 Elytra green, with a longitudinal orange or brown marginal streak defining disc on each side..... .....*C. marginatum* White

Elytra yellowish- to reddish-brown, with a yellowish margin and a yellowish lateral post-median spot on each side.....*C. costifer* (Broun)

4 Antennal scape more than twice as long as segment 3, disc of pronotum more or less flat.....*C. pallidus* (Pascoe)

Antennal scape less than twice as long as segment 3; disc of pronotum slightly raised just before middle, with a pair of obtuse elevations..... .....*C. elegans* (Sharp)

Calliprason sinclairi White

(Figs 2.69, 2.70, 2.71, 2.72, 2.73, 2.74, 2.75)

Calliprason sinclairi White, 1843:277 – White, 1845:189; 1846:23, t.4, fig. 3; Thomson, 1864:406; Lacordaire, 1869:414; Hutton, 1873:164; Bates, 1874:21; Broun, 1880:582; Aurivillius, 1912:152; Hudson, 1934:114; Blair, 1937:264; Duffy, 1963:122.

Stenoderus sinclairi. – Westwood, 1845:27, t. 56, fig.3; Broun, 1880:582.

Material Examined

Holotype. No data (BMNH).

Material compared with Holotype by S. Shute (BMNH). 1♂, Ohakune, 1.i.1997 (NZAC); 1♀, Swanson, 5.xii.1916 (NZAC).

Other material. 20♂, 20♀. **ND**: 1♂, Hen Island, 14-20.i.1932, A. E. Brookes, terminalia slide No. *Calliprasson* m–970801-6 (NZAC); 1♂, 1♀, as above but (MONZ); 1♂ Mangamuka, 420m, 29.x.1976, J. S. Dugdale (NZAC); 1♂, Mangamuka, Kaitaia, 6.i.1963, E. S. Gourlay (NZAC); 1♂, Mangamuka Gorge, 2.xii.1951, A. E. Brookes (NZAC); 1♂, Mangamuka, 10.i.1927, N. Qucli (AMNZ); 2♂, Maungakaramea, Whangarei, 17.xii.1927, E. Fairburn (AMNZ); 1♂, Whangarei, 17.i.1927 (AMNZ); 1♀,

Kaeo, 14.i.1921, N. Auck (AMNZ). **AK**: 1♂, Papakura, 10.x.1915, E. S. Gourlay (NZAC); 1♀, Swanson, 5.xii.1914, terminalia No. *Calliprason* f–970801-5 (NZAC); 1 ♀, Karekare, Auckland, on *Nikau* flower, 3.i.1965, B. M. May (NZAC); 1♂, Auckland, 27.xii.1951, E. Fairburn (WMNZ); 1♀, as above but 29.xii.1931 (WMNZ); 1♂, Hunua Gorge, near Papakura, 23.i.1927, A. Richardson (AMNZ); **CL**: 1♀, Great Barrier Island, Port Fitzroy, 31.i – 6.ii.1930, A. E. Brookes (MONZ). **BP**: 1♀, White Pine Bush, A. F. Clark (NZAC); 1♂, Orere Forest, Te Puia Hut, beaten from *Myrsine australis* branch trap, 25.i.1993, R. M. Emberson (LUNZ). **TO**: 1♂, Ohakune, 1.i.1917, terminalia slide No. *Calliprason* m–970801–4 (NZAC). **WN**: 3♀, Porirua, Pahia, xi.1906 (MONZ); 1♀, Orongorongo Dist, opposite Jacob's ladder, under bark of dead *Rata*, 24.x.1960, C. & G. Laurie (MONZ); 1♂, 1♀, Tokomaru Gorge, 5.xii.1959, R. M. Bull (NZAC); 1♀, Orongorongo Field Stn., 17.ix.1969, J. C. Watt (NZAC); 1♀, as above but 29.x.1960, C. & G. Laurie (NZAC); 1♂, 1♀, Wellington, 2.i.1928, E. Fairburn (WMNZ); 1♀, Ballance Bridge Res, beaten from climbing rata, 11.i.1957, R. M. Bull, terminalia No. *Calliprason* f–970819–2 (NZAC); 1♀, Bottle Hill Res, Pauatahanui, xii.1992, J. Nunn (JNNZ). **NN**: 1♂, Upper Matai V., Nelson, 19.ii.1965, C. Bull (NZAC). **SD**: 1♀, Queen Charlotte Sound, Bay of Many Coves, malaise trap in *Nothofagus truncata/Podocarpus* mixed broadleaf forest, 24.x-26.xii.1993, J. W. M. Marris (LUNZ). **MC**: 1♀, Kaituna, Collingwood, 6.v.1965, J. I. Townsend (NZAC). **NL**: 1♀, no data (NZAC); 3♂, no locality, Hudson (MONZ);

Description

Male

Body length: 8.5 - 10.4 mm.

Colour (Fig. 2.69). Antennae, clypeus, labrum, palps, maxillae, legs (except basal femora) yellowish- or reddish-brown; tibiae reddish-brown or green, basal femora green, eyes reddish-brown or golden yellow, elytron grass green, with a stripe of silvery scale-like hairs near margin, remaining parts dark green or dark brown; ventral side of body with dense silvery scale-like hairs.

Head. Slightly narrower than prothorax; frons and vertex with dense irregular punctures and fine hairs; ventral side with transverse wrinkles; eyes very prominent; a fine impressed line between antennae; frons subquadrate, less than 100^0 angle with vertex; distance between lower lobes of eyes 0.6-1.0 times distance between antennal

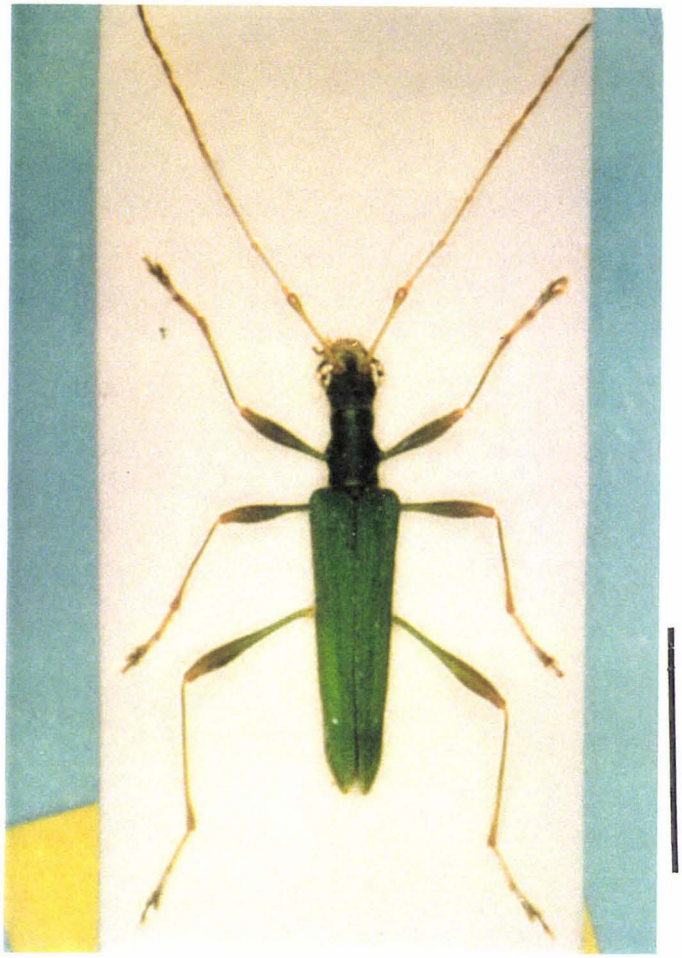
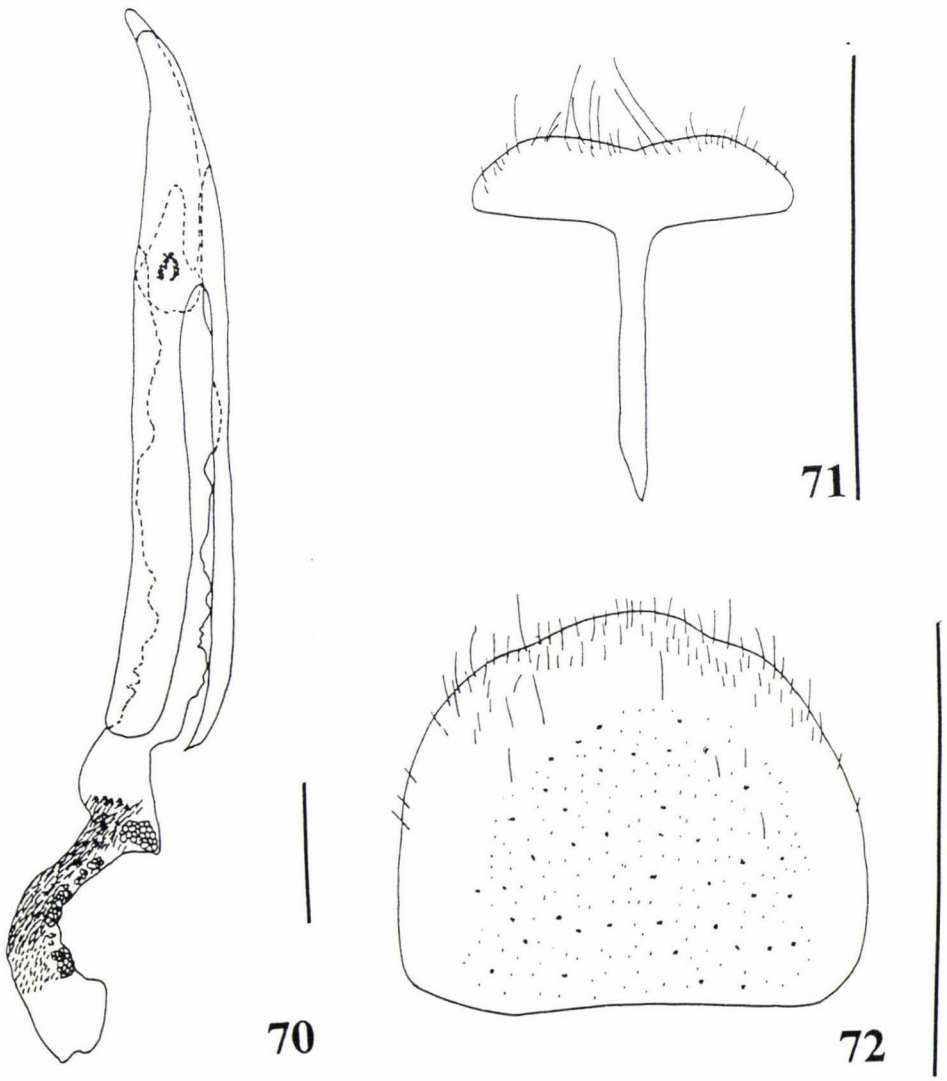


Fig. 2.69. Dorsal view of *C. sinclairi.* Scale line: 5mm.

socket and lateral angle of postclypeus, and 0.7 - 0.8 times distance between upper lobes of eyes. Antennae smooth, with fine hairs, as long as or slightly shorter than body; scape rather slender and distinctly clavated at apex, 1.6-1.8 times length of segment 3; segment 4 about 1-1.1 times length of segment 3 but as long as segment 5.

Thorax and abdomen. Prothorax distinctly longer than wide; constricted near anterior and posterior ends; pronotum impunctured with a pair of slightly raised tubercles just in front of middle on disc and with a short spine at each side (Fig. 2.8). Scutellum equilaterally triangular. Metasternum almost impunctured. Elytra slender, broadest at prominent shoulders, gradually attenuated toward posterior; disc with dense punctures, fine rugose granules and short inconspicuous hairs; each elytron with two weak longitudinal costae; apex rounded. Femur slender, fusiform.

Male terminalia. Apex of median lobe strongly projected (Fig. 2.28). Spined region of internal sac about 0.4 times as long as unspined region; spined region divided into 2 sections: first section absent; second section about 3.7 times as long as third section, with mixture of dense simple large and long spines, fairly dense scale-like spines, and fairly dense multi-branched spines; third section with mixture of fairly dense simple large and short spines and fairly dense scale-like spines; no unspined gap between sections; a pair of chitinous rods near basal internal sac (Fig. 2.70). Eighth sternite obliquely truncate or more or less rounded at lateral sides and apex emarginate and V-shaped, with sparse setae; no microspines on ventral surface (Fig. 2.71). Apex of eighth tergite rounded (Fig. 2.72).



Figs 2.70-72. Median lobe and internal sac, eighth sternite and eighth tergite of male terminalia of *C. sinclairi.* Scale lines: 0.5 mm.

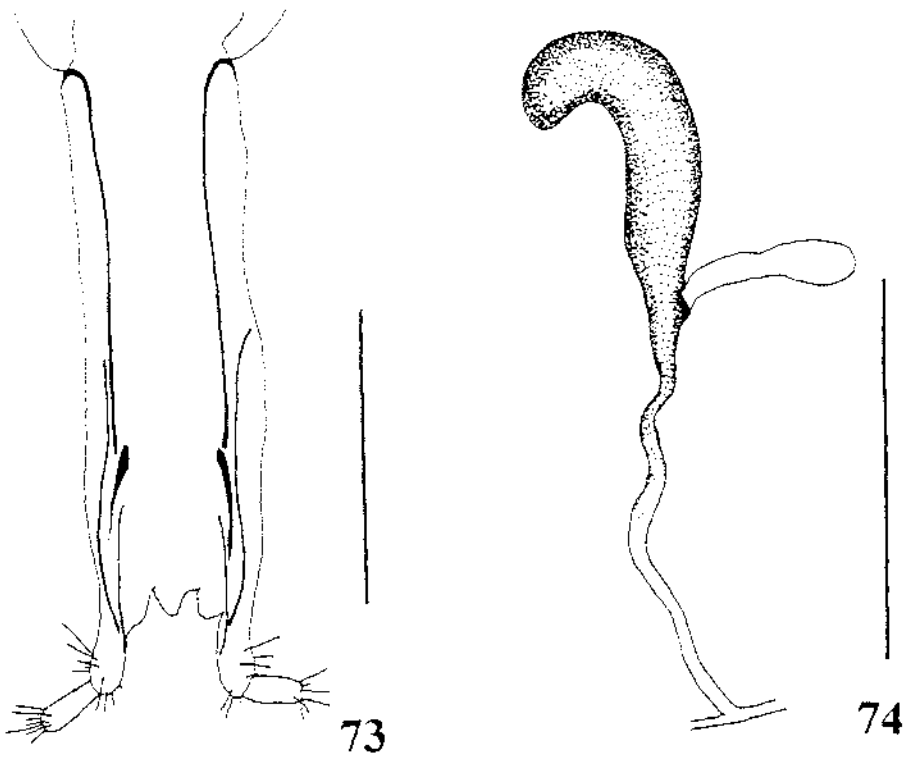
Female

Body length: 9.7 - 12.9 mm.

Antennae distinctly shorter than body.

Ovipositor. Each paraproct baculi extending from about basal 3/7 to apical 1/10; length of proctiger baculi 4-6 times length of dorsal baculi (Fig. 2.73).

Spermatheca. Slightly curved; spermathecal gland arising near base. (Fig. 2.74).



Figs 2.73-74. Ovipositor and spermatheca of *C. sinclairi.* Scale lines: 1mm.

Variation

No variation was found.

Biology

Host plants are *Hedycarya arborea* Forster et Forster (Hudson,1934), and *Podocarpus ferrugineus* Bennett ex Don (Duffy, 1963). Adults were beaten from forest growth from December to February (Hudson, 1934) and were collected by malaise trap,

Myrsine australis L. branch trap, or on climbing rata and *Rhopalostylis sapida* Wendland et Drude (Nikau) flower during September to December, January, February and May.

Distribution (Fig. 2.75)

Widely distributed in WD, AK, CL, BP, TO, WN of the North Island, and in NN, SD, and MC of the South Island.

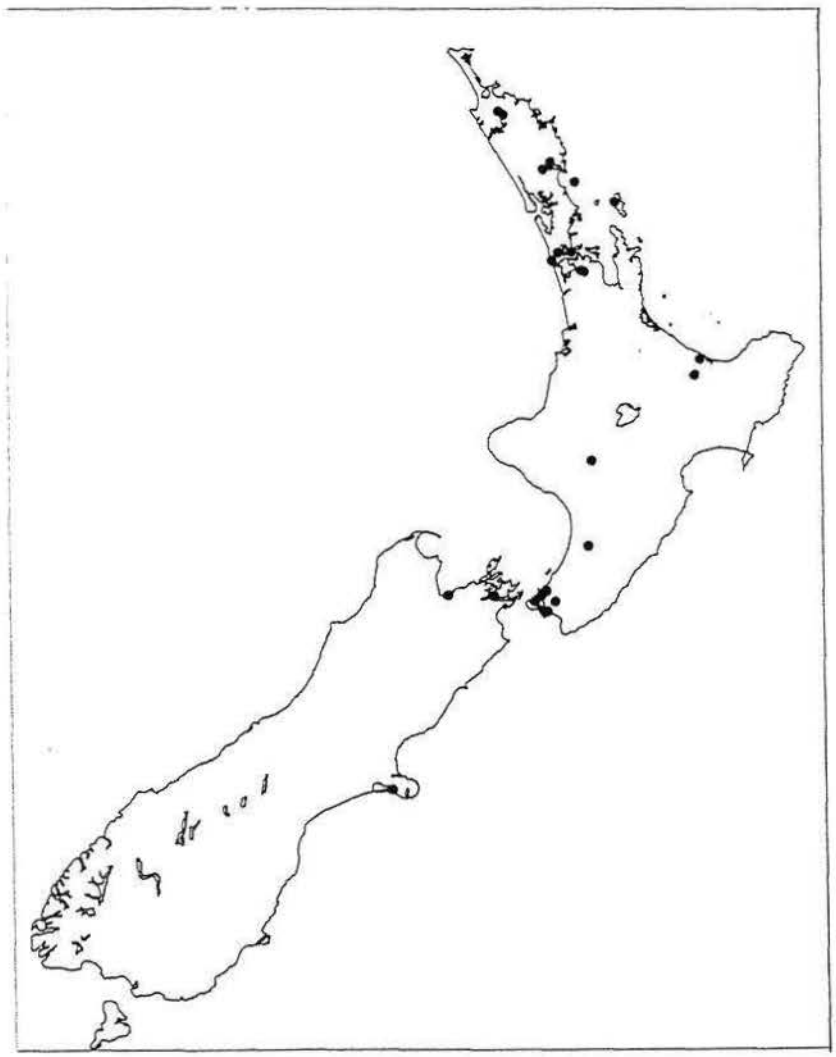


Fig. 2.75. Distribution of *C. sinclairi.*

Comments

This species resembles *C. marginatum* (Fig. 2.87) but differs in having ventral sides body with dense silvery scale-like hairs; elytra without longitudinal yellowish streak defining disc on each side, and disc of pronotum without erect spines.

Calliprason pallidus (Pascoe), comb. nov.

(Figs 2.76, 2.77, 2.37, 2.41, 2.43, 2.78, 2.79)

Stenepotes pallidus Pascoe, 1875:216, pl.v, fig.7. – Broun, 1880:583; Aurivillius, 1912:150; Hudson, 1934:114; Blair, 1937:264; Rawlings, 1953:1; Dumbleton, 1957:622; Morgan, 1960:26; Duffy, 1963:118; Zondag & Bain, 1976:1; Kuschel, 1990:67.

Material Examined

Holotype. No data (BMNH).

Material compared with Holotype by S. Shute (BMNH). 1♂, Nelson, *Pinus radiata*, xii.1946, J. M. K. (NZAC); 1♀, Woodhill SF., 21.i.1987, in Army caravan, B. A. Aolloway (NZAC).

Other material. 33♂, 56♀. **ND**: 1♀, Waipoua S.F., 12.vi.1966, J. C. Watt, in dead *Pinus elliottii* (NZAC); 2♀, Wangarei, in dead branches of *Phyllocladus trichomanoides*, 17.viii.1977, F. S. Dugdale, terminalia No. *Calliprason* f-970728-2 and No. *Calliprason* f–970804–5 (NZAC); 1♀, Parahaka, sweep net, 27.xii.1944, B. Given, (NZAC); 1♀, Puketona, 1.iii.1950, R. A. C. (NZAC); 1♂, Paihia, 16.i.1949 (NZAC); 1♀, as above but 23.i.1949 (NZAC); 2♀, Waipoua S.F, Waipoua River, 31.x.1985, R. C. Craw (NZAC); 1♂, Kaitaia, 11.vii.1989, G. Messenger, terminalia slide No. *Calliprason* m–970804–4 (NZAC); 1♀, Mangamuka Gorge, 2.xii.1951, A. E. Brookes (NZAC); 2♀, Waipoua SF, 17.x.1912, J .S. Dugdale (NZAC); 1♀, Te Paki Station, North Cape, 6-7.ii.1975, D. N. Eerro (LUNZ); 1♂, Waima Forest, 25.iii.1993, J. W. Early, terminalia slide No. *Calliprason* m–970804–3 (AMNZ); 1♀, Paihia, at light, 1.i.1906, K. Wise (AMNZ); 1♂, Kaitaia, in hospital, xi.1959, L. S. Malthus (AMNZ); 1♂, Herekino, i.1930, N. Auck (AMNZ); 1♂, Maungukaramea, Whangarei, 28.i.1928, E. Fairburn (AMNZ); 1♂, as above but 1.i.1927 (WMNZ); 1♂, as above but 17.xii.1927 (CMNZ); 1♀, as above but 28.i.1922 (WMNZ); 1♂, Okaihau, 29.ix.1973, J. Sanderson (AMNZ); 1♀, Tangihua Range, 16.xii.1932, E. Fairburn (WMNZ). **AK**: 1♂, 1♀, East Tamaki, ii.1982, H. M. Randon (NZAC); 1♀, Titirangi, light trap, xi.1952, C. R. Thomas (NZAC); 1♀, as above but xi.1952 (NZAC); 1♀, as above but light trap, i.1953 (NZAC); 1♀, as above but 26.i.1965, B. M. May (NZAC); 1♀, Mangatangi, Hunua Ra, kauri seed

traps, 27.iv.1976, A.R.A. (NZAC); 1♀, Woodhill SF, in Army caravan, 21.i.1987, B. A. Holloway (NZAC); 1♀, Auckland, 27.xi.1950, S. A. Ramsay (NZAC); 1♀, E. Tamaki, ii.1980, H. Raudan (NZAC); 1♀, Auckland, 30.i.1960, J. C. Watt (NZAC); 1♂, Waiheke Is., Goodwood Res., 23.x.1984, P. A. Maddisan (NZAC); 1♂, Mangatarata, South Auckland, rotten *Phyllocladus trichomanoides,* xi.1973, P. K. Walker (NZAC); 1 ♂, Whenuapai, 1.vi.1975, P. T. Lear (NZAC); 1♂, Clevedon, 22.ix.1956, J. C. Watt (NZAC); 1♀, Sunnyvale, Henderson, 16.viii.1959, K. A. J. Wise (NZAC); 1♀, Moumoukai Valley, ii.1955, J. C. Watt (NZAC); 1♀, Glendowie, 10.xi.1895, J. Taylor (NZAC); 1♀, Woodhill S.F., in army caravan, 21.i.1987, B. A. Holloway (NZAC); 1♀, Queen St., Auckland, 17.xii.1954, M. MacGreyor (AMNZ); 1♀, Sunnyvale, Henderson, 26.ii.1966, K.A.J. Wise (AMNZ); 1♂, Mt. Roskill, 1.ii.1895, H. Grenfell (AMNZ); 1♀, Warkworth, 1.i.1939, E. Fairburn (AMNZ); 1♂, Papakura, 8.iii.1934, A. Richardson (LUNZ). **CL**: 2♀, Waiau Falls, 18.vi.1983, J. C. Watt (NZAC); 1♂, Coromandel Range, 19.ii.1934 (AMNZ). **WO**: 1♀, Hamilton, 6.xii.1950, C. R. Thomas (NZAC); 1♂, Kaimai Range, Okauia, 10.ii.1944, R. E. Brookes (NZAC); 1♀, Naike, 19.ii.1989, M. Burnett (LUNZ); 1♂, as above but 4.i.1990, P. Burnett (AMNZ). **BP**: 1♂, Mt Te Aroha 300m, 6.iii.1985, R. C. Craw (NZAC); 1♀, Rotorua, 7-8.ii.1978, F. R. I. (LUNZ); 1♂, Orete Forest, Te Puia Hut, beated form *Phyllocladus trichomanoides* branch trap, upland broadleaf forest, 22.x.1892, J. Marris (LUNZ). **GB**: 1♂, Waikaremoana, 21.x.1958, J. C. Watt, terminalia slide No. *Calliprason* m–970804–6 (NZAC); 1♀, Pohatu, 18.iii.1993, J. W. M. Marris (LUNZ). **TO**: 1♂, Ohakune, 31.xii.1917 (NZAC). **RI**: 1♂, 1♀, Taihape, Hautapu Gorge, at night, 10.xi.1982, J. C. Watt (NZAC). **WN**: 1♂, Tokomaru Gorge (40°29'S, 175°31'E), 5.xii.1959, R. M. Bull (NZAC); 1♀, Orongorongo Valley, 7-9.xi.1978, R. C. Craw, terminalia No. *Calliprason* f–970728–1 (NZAC); 1♂, Akatarawa, Seddle 2000m, 25.iii.1974, A. C. Harris (NZAC); 1♀, Paiaka, 24.xi.1949, R. A. Cumber, *Phormium* survey (NZAC); 1♀, Korokoro, Wellington, 29.xii.1923, T. Cooleroft (AMNZ); 1♀, Karori Reservoir Res., 8.x.1994, J. Nunn (JNNZ); 1♂, Tinakori Hill, 11.i.1992, J. Nunn (JNNZ); 1♀, as above but 24.xii.1991 (JNNZ); 1♀, as above but 8.i.1992 (JNNZ); 1♀, as above but 2.ii.1992 (JNNZ). **NN**: 2♀, Nelson, dead Matai or Rimu branches, 15.x.1965, J. I. Tocvusend (NZAC); 1♀, as above but *Pinus radiata,* xii.1946, J.M.K. (NZAC); 1♂, Nelson, 28.xii.1950, E. Gourlay (AMNZ); 1♂, Mt Tiger, 4.ii.1927, E. Fairburn (WMNZ). **SD**: 1♀, Waikawa Bay, on boat, 5.ii.1995, J. W. M. Marris (LUNZ). **MB**: 1♂, Upper

Maitai, 14.ii.1943, E. S. Gourlay (NZAC). **CH**: 1♀, Maunganui, 25.5.1919, terminalia No. *Calliprason* f–970728–3 (NZAC). **MC**: 1♀, Banks Peninsula, Prices Valley, malaise trap edge of Native bush, xii.1980, R.P. Macfarlane (NZAC); 1♀, Springston, iii.1966 (LUNZ). **FD**: 1♀, Pohatu, reared from rimu (*Dacrydium cupressinum*) branch from felled tree, 18.iii.1993, J. W. M. Marris (LUNZ). **NL**: 1♀, no locality, 20.xi.1949, B. B. Given, D. H. Todd (NZAC); 1♂, as above but xii.1971 (WM); 2♂, 2♀, no locality, Hudson (MONZ).

Description

Male

Body length: 12.5 - 19.3 mm.

Colour (Fig. 2.76). Front legs and apical 2/3 of antennae yellowish-brown, elytra yellowish- or dark-brown, remaining parts reddish- to dark reddish-brown. Head with

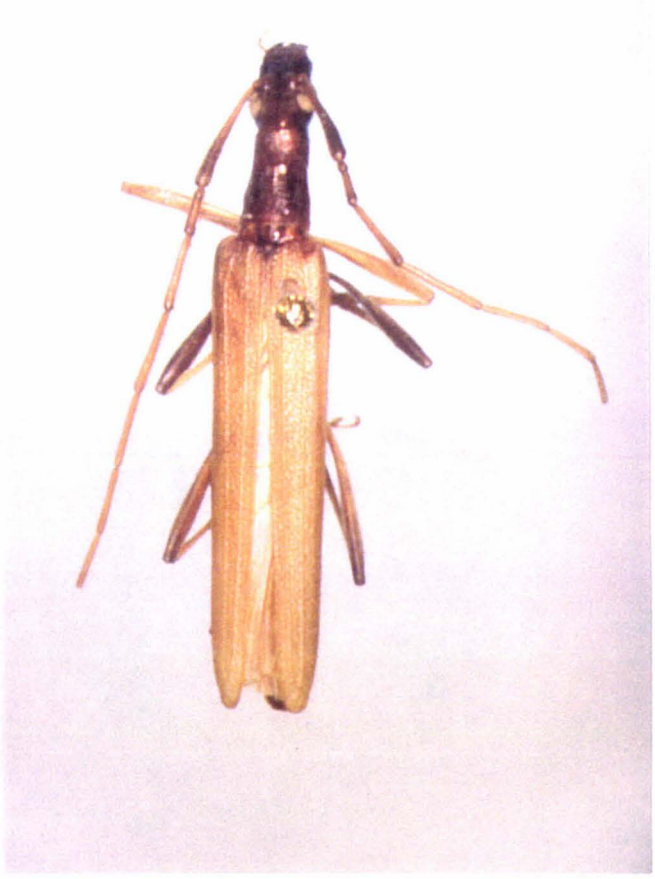


Fig. 2.76. Dorsal view of *C. pallidus*. Scale line: 5mm.

fairly dense yellowish hairs. Prothorax with yellowish depressed hairs on disc, concentrated in form of a narrow line near each side. Metasternum with fine yellow hairs. Femur with short pale white hairs. Abdomen with fine yellow hairs.

Head. Slightly narrower than prothorax, coarsely and closely punctured on frons and transversely wrinkled on ventral side; a longitudinal deeply impressed line between antennae; frons protended forwards, quadrate, more than 100^0 angle with vertex; distance between lower lobes of eyes 1.4-1.7 times distance between antennal socket and lateral angle of postclypeus, and 1.5-1.8 distance between upper lobes of eyes. Antennae smooth, longer than body, with dense short depressed hairs throughout and segments 1-6 or 1-7 with long erect hairs on lower side; scape clavated at apex, 2.4-3.3 times length of segment 3; segment 4 about 1.8-2.2 times length of segment 3 but shorter than segment 5.

Thorax and abdomen. Prothorax longer than wide, elongate-conical, with distinct transverse wrinkles; disc with two small slightly raised tubercles at anterior 2/5 and each side with a vaguely raised tubercle at posterior 1/3. Scutellum curvilinearly triangular, with hairs. Metasternum almost impunctate with dense short hairs. Elytra elongate, with dense punctures and fine granules but almost no hairs on disc; each with two longitudinal costae on disc; apex rounded. Femur slender, fusiform. Abdomen with dense pale depressed hairs.

Male terminalia. Apex of median lobe strongly projected (Fig. 2.28). Spined region of internal sac more than twice as long as unspined region; spined region divided into 3 sections: first section short and wide, with multi-branched spines; second section slightly longer than first section, with mixture of dense simple large and long spines and sparse simple small and long spines; third section narrower and about 3 times as long as second section, with dense simple large and long spines; no distinct unspined gap between sections; a pair of chitinous rods near basal internal sac (Fig. 2.77). Eighth sternite obliquely truncate at lateral sides and apex emarginate and V-shaped, with dense setae; dense simple microspines on ventral surface (Fig. 2.37). Apex of eighth tergite truncate (Fig. 2.41).

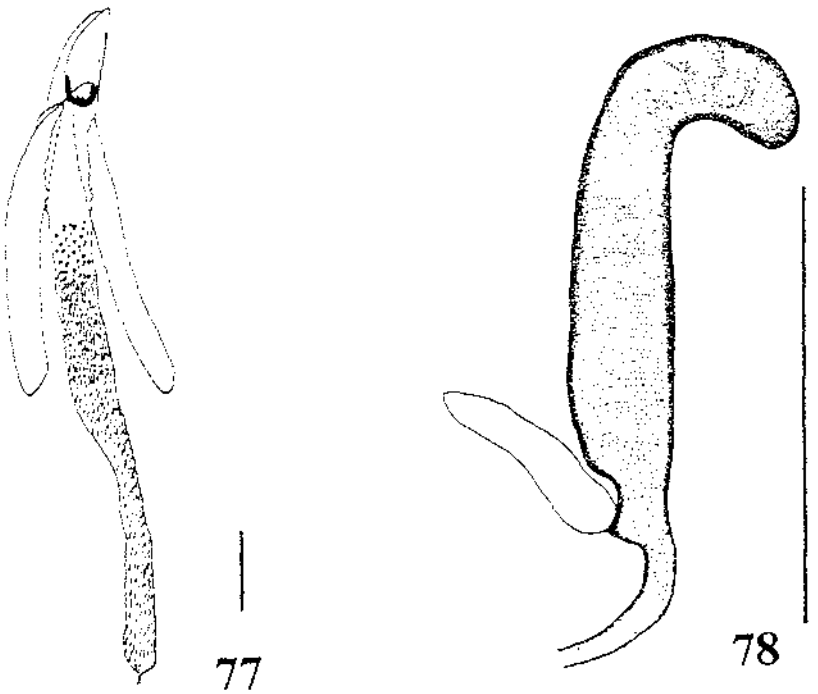
Female

Body length: 15.3 - 19.7 mm.

Antennae as long as or slightly shorter than body. Elytral disc fulvescent to pale-green.

Ovipositor. Each paraproct baculi extending from about basal 1/3 and to apical 1/10; length of proctiger baculi 3.1- 4.2 times length of dorsal baculi (Fig. 2.43).

Spermatheca. Slightly curved; spermathecal gland arising near base (Fig. 2.78).



Figs 2.77-78. Median lobe and internal sac of male genitalia and spermatheca of *C. pallidus*. Scale lines: 0.5mm.

Variation

No distinct variation was observed.

Biology

Host plants are *Pinus radiata* (Don) (Gourlay, 1951), *Podocarpus totara* Bennett ex Don, *P. ferrugineus* Bennett ex Don, *Dacrydium cupressinum* Lambert, and *Larix* spp. (Morgan, 1960), *Pseudotsuga menziesii* (Mirbel) Franco

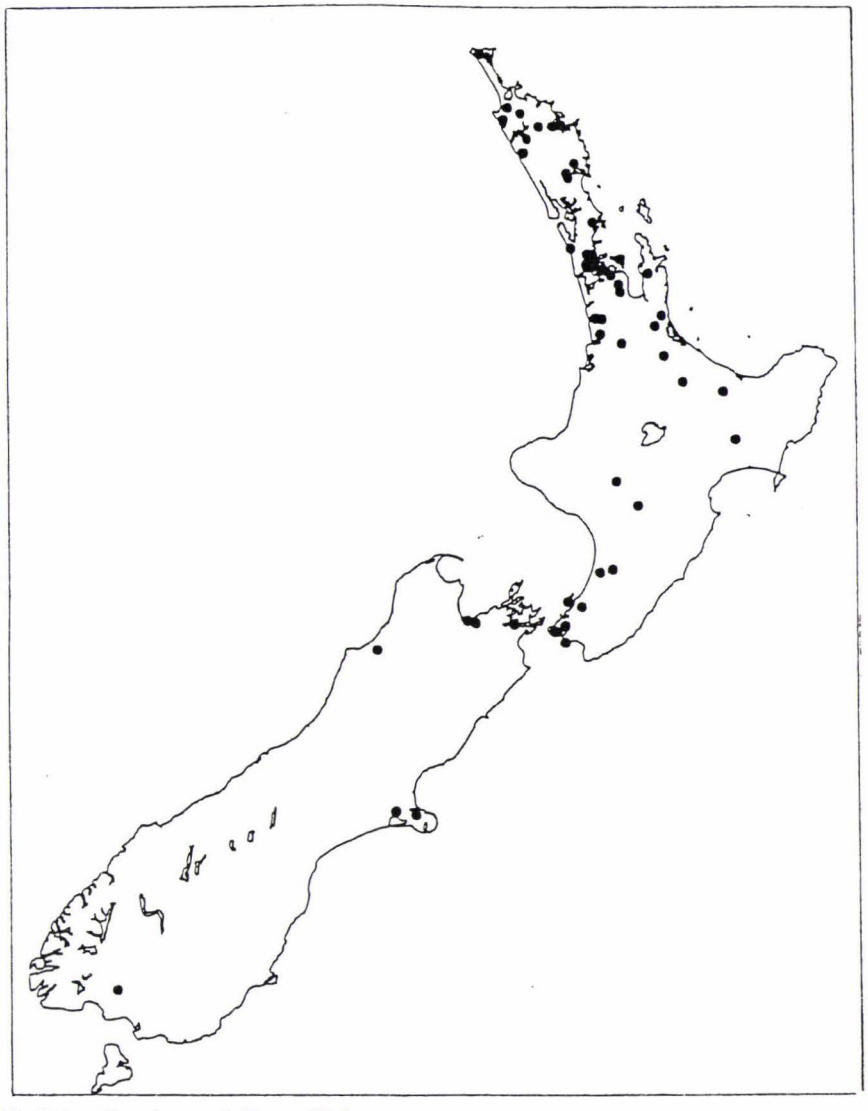


Fig. 2.79. Distribution of *C. pallidus*.

Material Examined

Holotype. No data (BMNH).

Material compared with Holotype by S. Shute (BMNH). 1♂, Ohakune, xi.1921, T. R. Harris (NZAC); 1♀, Matea, on *Pinus radiata*, 4.ii.1958, N. O. S. (FRNZ).

Other material. 4♂, 7♀. **ND**: 1♂, Manaia, Opepe Res., 10.xi.1959, R.H. Millikan (FRNZ); 1♀, Manaia, Opepe Res., 10.xi.1959, R. H. Millikan (FRNZ); 1♀, Whangarei, 7.xii.1946, E. Fairburn (NZAC). **TO**: 1♂, Pokaka, 22.ii.1917, terminalia slide No. *Calliprason* m-970801–2 (NZAC); 1♀, Waikune, 23.xii.1977, J. S. Dugdale, terminalia No. *Calliprason* f–970801–1 (NZAC); 1♀, Matea, 4.ii.1958, N. O. S., terminalia No. *Calliprason* f–970819–1 (FRNZ); 2♀, Oio, 20.i.1936, F. Gardner, terminalia No. *Calliprason* f-971216–1 (NZAC); 1♂, Ohakune, x.1921, J. R. Harris

(NZAC); 1♂, as above but xi.1921, terminalia slide No. *Calliprason* m–971217–2 (NZAC). **NL**: 1♀, no locality, Wakefield (CMNZ).

Description

Male

Body length: 10.3 - 12.1 mm.

Colour (Fig. 2.80). Antennae, mouthparts, elytra and legs reddish-brown, remaining parts reddish- to dark reddish-brown. Body clothed with fairly dense silvery hairs. Each elytron with two yellow discoidal costae on disc, extending from base to just before apex

Fig. 2.80. Dorsal view of *C. elegans*. Scale line: 5mm.

Head. Slightly wider than prothorax, with dense round punctures; a finely impressed longitudinal line between antennae; frons protended forward, quadrate, more than 100^0 angle with vertex; distance between lower lobes of eyes 1.0-1.3 times distance between antennal socket and lateral angle of postclypeus, and 1.0 - 1.1 times distance

between upper lobes of eyes. Antenna smooth, distinctly longer than body; scape slender, clavated at apex, 1.7-2.0 times length of segment 3; segment 4 about 1- 1.1 times length of segment 3 but slightly shorter than segment 5.

Thorax and abdomen. Prothorax distinctly longer than wide, obliquely constricted in middle with coarse punctures of irregular form; a pair of obtuse elevations on anterior 2/5 of disc, and a curved elevation extending from side to side, but becoming obscure on dorsum behind middle of disc. Scutellum curvilinearly triangular. Ventral side impunctuate with fairly dense hairs. Elytra slender, with dense punctures and very fine granules, hairs concentrated at margin, suture and on costae; apex rounded. Femur slender, fusiform.

Male terminalia. Apex of median lobe strongly projected (Fig. 2.28). Spined region of internal sac more than twice as long as unspined region; spined region divided into 2 sections: first section absent; second section with mixture of dense simple large and long spines and sparse multi-branched spines; third section about 3 times as long as second section, with dense simple large and long spines; no unspined gap between sections; a pair of chitinous rods near basal internal sac (Fig. 2.81). Eighth sternite obliquely truncate or more or less rounded at lateral sides and apex emarginate and V-shaped, with fairly dense setae; dense cloud-like processes but few or no simple microspines on ventral surface (Fig. 2.82). Apex of eighth tergite truncate (Fig. 2.83).

Female

Body length: 11.4 - 16.3 mm.

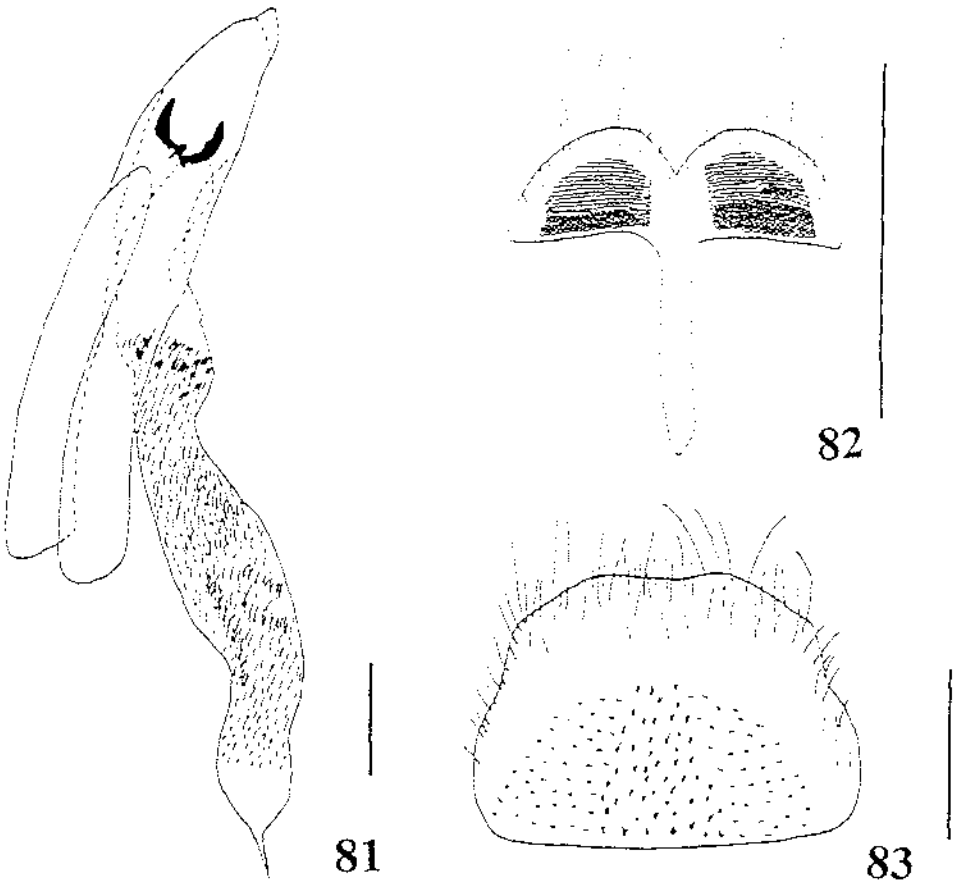
Antennae as long as or slightly shorter than body; femora more slender than those of male.

Ovipositor. Each paraproct baculi extending from about basal 1/3 to apical 1/10; length of proctiger baculi 3-5 times length of dorsal baculi (Fig. 2.84)

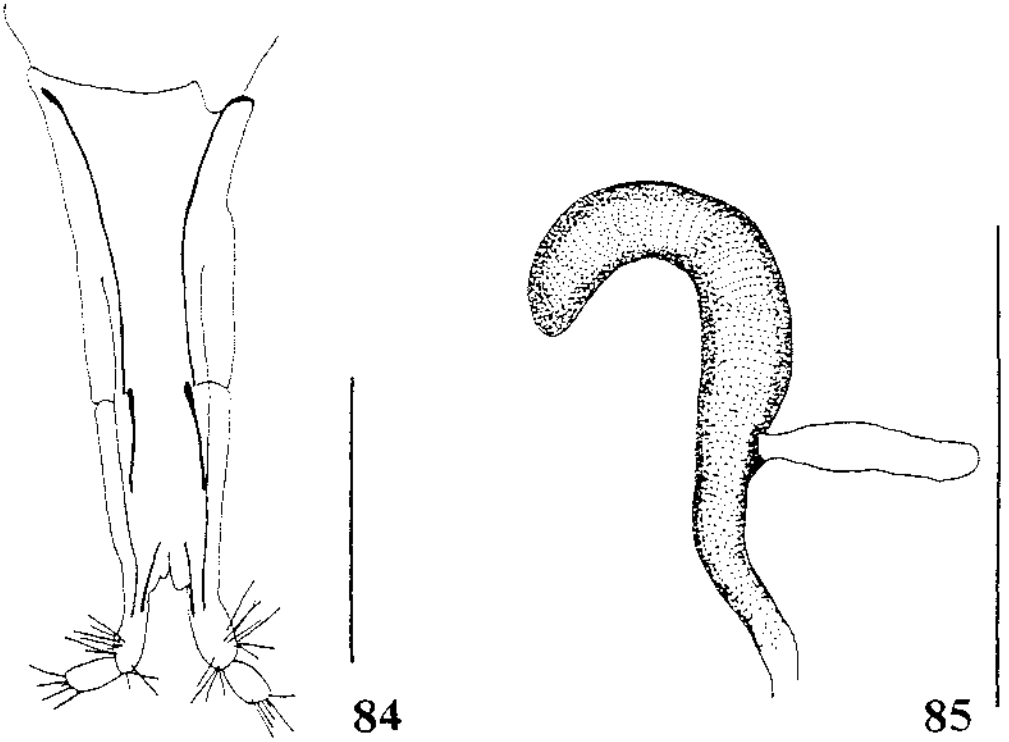
Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.85).

Variation

No distinct variation was observed.



Figs 2.81-83. Median lobe and internal sac, eighth sternite and tergite of male terminalia of *C. elegans*. Scale lines: 0.5 mm.



Figs 2.84-85. Ovipositor and spermatheca of *C. elegans*. Scale lines: 1mm.

Biology

Hosts unknown. Adults were collected during January to February and October to December.

Distribution (Fig. 2.86)

Known only in the North Island, including ND and TO.

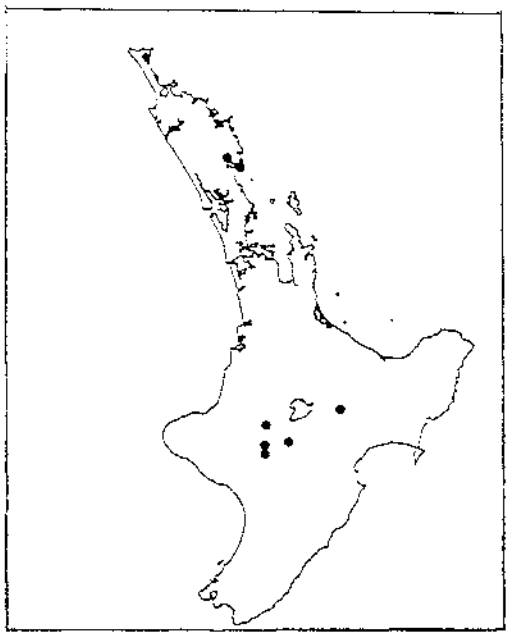


Fig. 2.86. Distribution of *C. elegans*.

Comments

This species resembles *C. pallidus* (Fig. 2.76) but differs in having scape 1.7–2 times length of segment 3; prothorax constricted in the middle with two distinct elevations on anterior 2/5 of disc.

Calliprason marginatum White

(Figs 2.87, 2.88, 2.89, 2.90, 2.91, 2.46, 2.92)

Calliprason marginatum White, 1846:23, t. 4, fig.6.- Bates, 1874:21; Hutton, 1873:164.

Pseudocalliprason marginatum Broun, 1880:573. - Aurivillius, 1912:142; Hudson, 1934:111; Blair, 1937:264; Duffy, 1963:121.

Material Examined

Holotype could not located.

Material compared with BMNH specimens by S. Shute (BMNH): 1♂, Hunua Ranges, 28.ix.1980, B. M. May (NZAC); 1♀, Whakarewarewa, 14.i.1953, G. B. Railings (NZAC).

Other material. 6♂, 18♀. **ND**: 1♀, Parua, O'Connor (MONZ); 1♀, Tauraroa, 31.iii.1928, F. Fairburn (WMNZ); 1♀, Waipoua SF, Te Matua Ngahere, 30.x.1985, R. C. Craw (NZAC). **AK**: 1♂, Hunua Ranges (37°5'S, 175°1'E), 28.xi.1980, B. M. May, terminalia slide No. *Calliprason* m–970804-1 (NZAC); 1♀, Waitakere Ra., 5.iv.1984, J. C. Clearwater, terminalia No. *Calliprason* f–970804–2 (NZAC); 1♀, Titirangi, Auckland, 9.i.1950, H. M. Lewes (NZAC). **WO**: 1♂, Naike, 22.ii.1989, M. & P. Burnett, terminalia slide No. *Calliprason* m–970819–7 (AMNZ); 1♀, Kaimai Saddle 500m, 14.ii.1979, J. S. Dugdale (NZAC). **BP**: 1♂, 1♀, Whakarewarewa, ii.1949, B. B. Railings (NZAC); 1♀, as above but 12.ii.1949 (NZAC); 1♀, as above but 14.i.1953, terminalia No. *Calliprason* f–970730–3 (NZAC); 1♀, as above but 12.v.1949, terminalia No. *Calliprason* f–970730–2 (NZAC); 1♂, Mt. Te Aroha 900m, 13.xi.1983, J. C. Watt (NZAC). **TO**: 1♀, Horopito, 24.iv.1923 (MONZ); 1♀, Ohakune, 1920 (AMNZ). **WN**: 1♀, Upper Hutt, on lancewood, feeding on sap, 1.iii.1988, P. Clarkson (MONZ); 1♀, Gollans Valley, Wellington, 22.x.1921, G. W. Roberts (NZAC); 1♀, as above but 23.xii.1937, G. V. H. (MONZ); 1♀, Gollans Valley, iv.1922 (NZAC); 1♀, Whakarewarewa, 12.ii.1949, J. B. Railings, terminalia No. *Calliprason* f–970730–1 (NZAC). **NL**: 1♂, 1♀, no locality, Hudson (MONZ); 1♂, no data (NZAC).

Description

Male

Body length: 18.2-21.8 mm.

Colour (Fig. 2.87). Palps, labrum, antennae (except scape) and legs reddish-brown, elytra green, remaining parts dark reddish- to blackish-brown. Two longitudinal stripes of yellow hairs starting from vertex and extending to posterior margin of pronotum, forming a "∧"-shaped mark. Elytra with a longitudinal orange or brown marginal streak defining disc on each side.

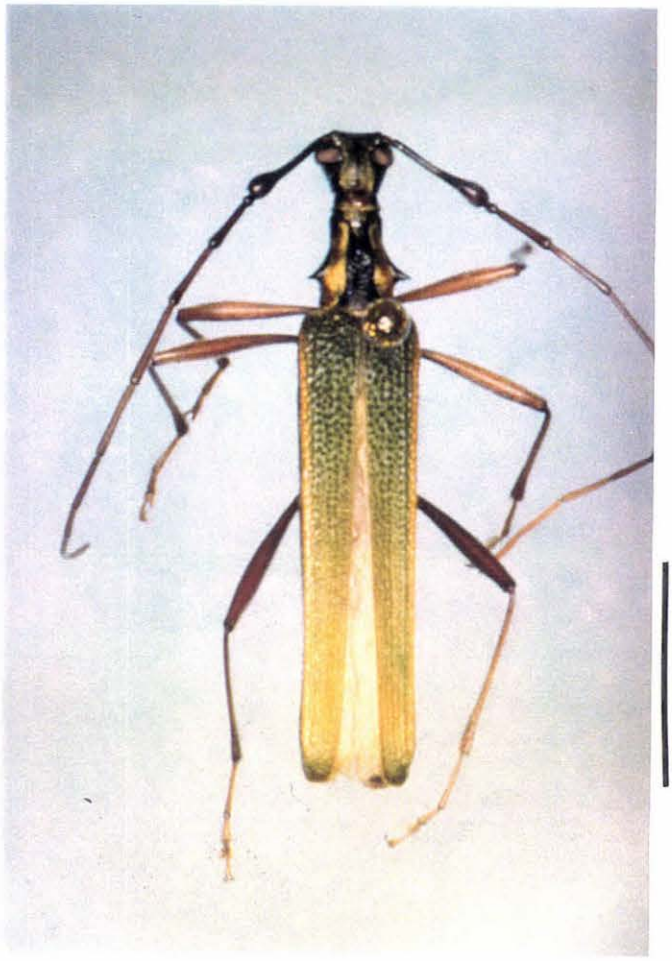


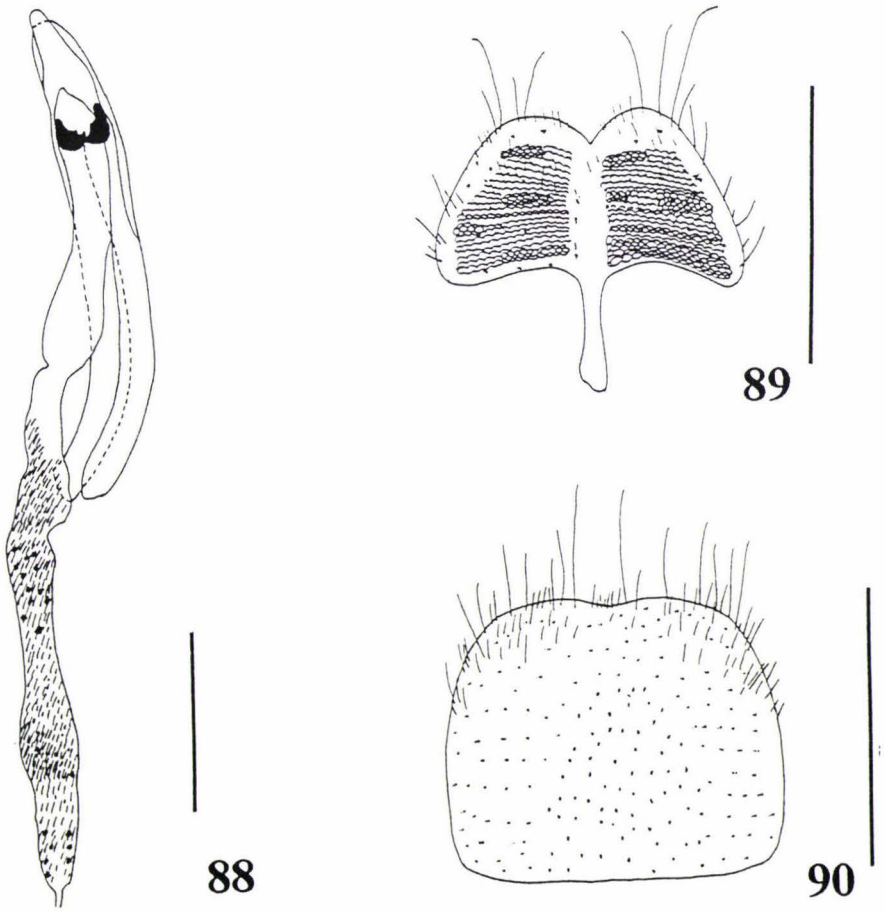
Fig. 2.87. Dorsal view of *C. marginatum*. Scale line: 5mm.

Head. Distinctly narrower than prothorax, constricted behind eyes; ventral and lateral sides with strong, transverse wrinkles; a finely impressed longitudinal line between antennae; frons subquadrate; less than 100^0 angle with vertex, with dense coarse and irregular punctures; distance between lower lobes of eyes 1.3-1.5 times distance between antennal socket and lateral angle of postclypeus, and 1.2-1.5 times distance between upper lobes of eyes. Antenna smooth, with fairly dense short hairs; about as long as body; scape clavated at apex, 1.5-1.9 times length of segment 3; segment 4 about 1-1.3 times length of segment 3 but shorter than segment 5.

Thorax and abdomen. Prothorax distinctly longer than wide, elongate-conical, slightly constricted at anterior 1/3, transversely wrinkled; disc of pronotum with two large erect spines, slightly pointed backwards; each side with an acute spine, pointed up-backwards (Fig. 2.9). Scutellum curvilinearly triangular with sparse yellow hairs. Metasternum and abdomen covered with dense fine hairs alternating with dense large and shallow punctures, a sub-erect hair arising from each puncture. Elytra elongate, with

dense deep punctures and fine granules arranged longitudinally; two indistinct discoidal costae on each; apex rounded. Femur slender, fusiform, with short hairs.

Male terminalia. Median lobe strongly projected and apex fairly rounded (Fig. 2.28). Spined region of internal sac slightly more than 1.5 times as long as unspined region; spined region divided into 2 sections: first section absent; second section with dense simple large and long spines; third section 4 times as long as second section, areas near and most distant to second section with mixture of dense simple small and long spines and fairly dense to sparse multi-branched spines, and remaining with dense simple large and long spines; no unspined gap between sections; two internal chitinous rods near basal internal sac (Fig. 2.88). Eighth sternite obliquely truncate at lateral sides; apex emarginate and "V"-shaped, with fairly dense setae; dense multi-branched microspines and cloud-like processes on ventral surface (Fig. 2.89). Apex of eighth tergite slightly emarginate (Fig. 2.90).



Figs 2.88-90. Median lobe and internal sac, eighth sternite and eighth tergite of male terminalia of *C. marginatum*. Scale lines: 1mm.

Female

Body length: 16.4-26.1 mm.

Ovipositor. Each paraproct baculi extending from about basal 1/3 to apical 1/10; length of proctiger baculi 3.0-4.2 times length of dorsal baculi (Fig. 2.91).

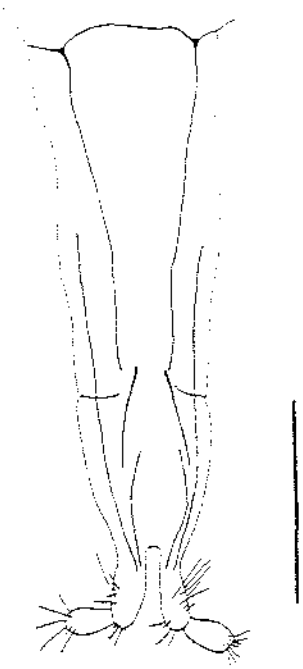


Fig. 2.91. Ovipositor of *C. marginatum*, ventral view. Scale line: 1mm.

Spermatheca. Clearly curved; spermathecal gland arising near base (Fig. 2.46).

Variation

In some specimens, the constriction of head behind eyes may be incomplete.

Biology

Host plant is *Ixerba brexioides* Cunningham (Duffy, 1963). Larvae tunnel under the bark and later in the wood and a crescentic excavation is made in the bark before pupation (Duffy, 1963). Adults were collected during January to May and October to December.

Distribution (Fig. 2.92)

Found only in the North Island, including ND, AK, WO, BP, TO and WN.

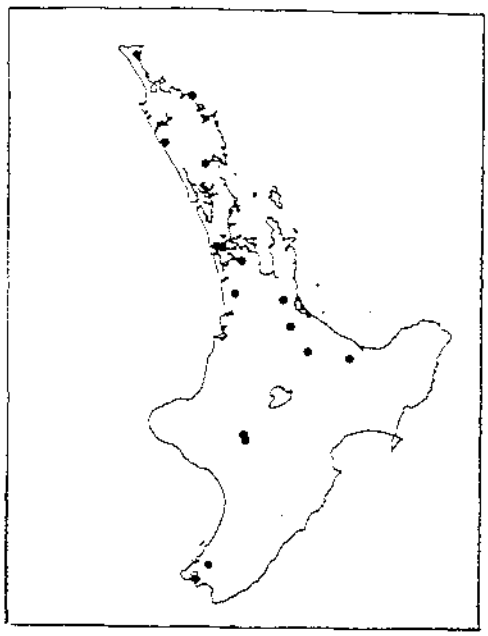


Fig. 2.92. Distribution of *C. marginatum*.

Comments

This species resembles *C. costifer* (Fig. 2.93) but differs in having elytron green with an obvious orange marginal streak defining the disc: lateral sides of head with strong, transverse wrinkles; vertex and pronotum with two longitudinal stripes of yellow hairs.

Calliprason costifer (Broun), comb. nov.

(Figs 2.93, 2.94, 2.95, 2.96, 2.97)

Epheus costifer Broun, 1886:871 – Aurivillius, 1912:142; Hudson, 1934:113; Blair, 1937:264.

Material Examined

Holotype. No data (BMNH).

Material compared with Holotype by S. Shute (BMNH). 1♂, Rona Bay, at night, 8.ii.1941, S. Gibbs (MONZ).

Other material. 17♂. **ND**: 1♂, Waipoua, iii.1923, G. E. Bryant (NZAC); 1♂, Hen Island, Nikau, v.1956, J. C. Watt, terminalia slide No. *Calliprason* m–970731–1 (NZAC); 1♂, Whangarei, 1926, E. Fairburn (WMNZ); 1♂, as above but ii.1931, E. Fairburn (WMNZ). **AK**: 1♂, Auckland, 1.i.1962, E. F. Fairburn (WMNZ). **BP**: 1♂, Rotorua,

ii.1956, R. H. Millikan (NZAC). **TO**: 1♂, Taupo (38°41'S, 176°5'E), ii.1957, R. H. Millikan, terminalia slide No. *Calliprason* m-970731-3 (NZAC); **RI**: 5♂, Mt Wharite Ridge, 14.ii.1966, A. U. Spain, terminalia slide No. *Calliprason* m–970731–2 (NZAC). **NN**: 1♂, Tokomaru Gorge, 10.i.1960, R. M. Bull (NZAC); 1♂, Pakawau, Mangonui, 10.iii.1918 (NZAC). **NL**: 3♂, no data, Hudson (MONZ)

Description

Male

Body length: 16.3 - 24.3 mm.

Colour (Fig. 2.93). Body yellowish- to reddish-brown with head, thorax, abdomen, femora and basal elytra maybe darker. Head (particularly vertex), pronotum and scutellum with dense golden hairs. Elytra with a yellowish margin and a yellowish lateral postmedian spot on each side. Elytra, femora, sterna and abdomen with short yellow hairs.

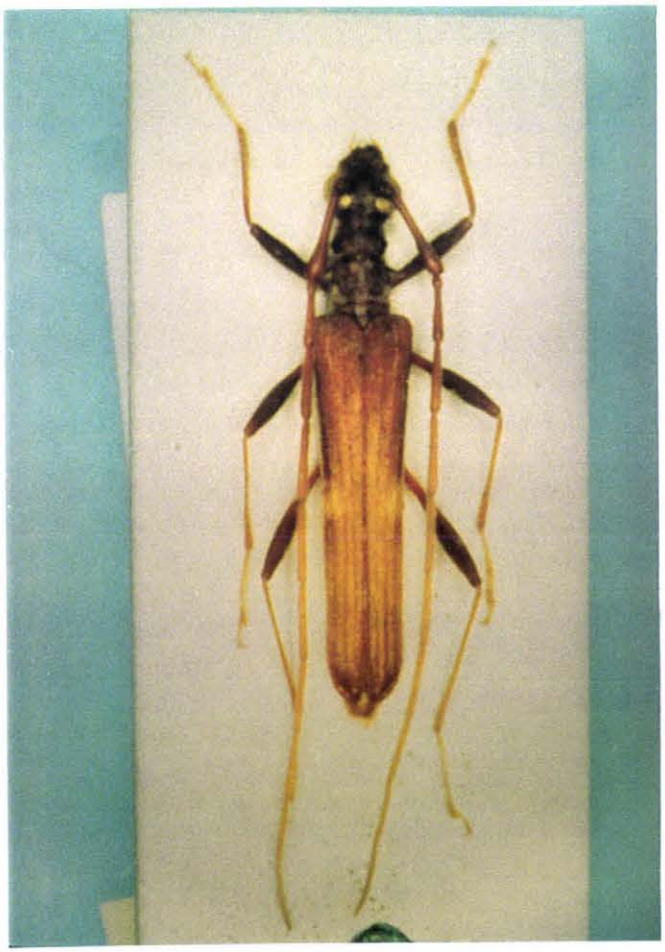


Fig. 2.93. Dorsal view of *C. costifer*. Scale line: 5mm

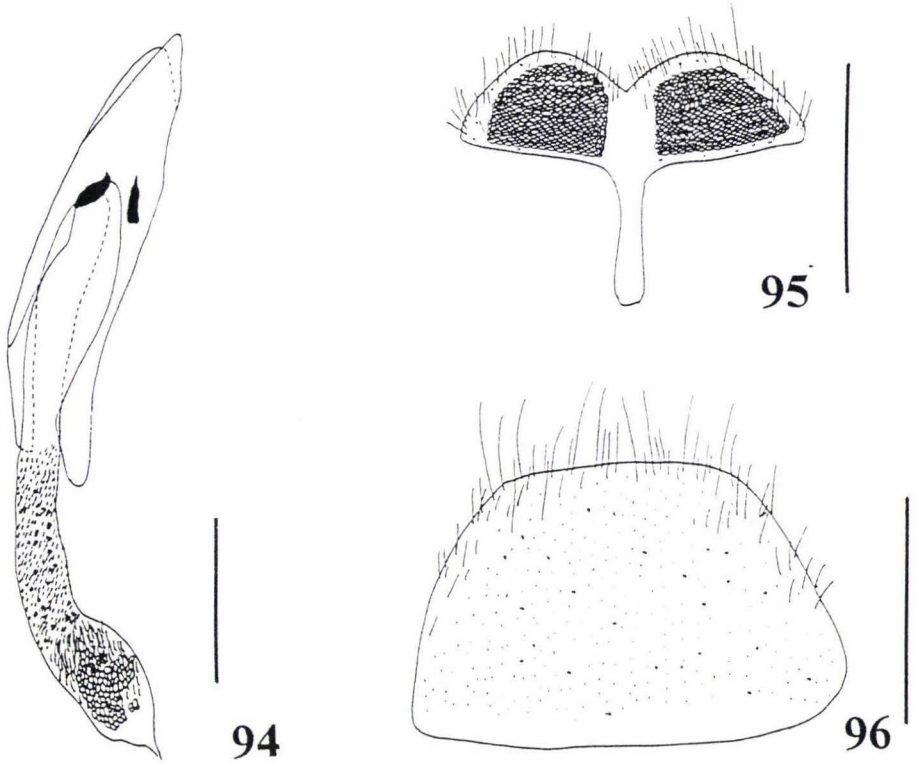
Head. Distinctly narrower than prothorax, constricted behind eyes; transversely wrinkled on ventral side; frons less than 100^0 angle with vertex, with a finely impressed longitudinal line between antennae; distance between lower lobes of eyes 1.1-1.3 times distance between antennal socket and lateral angle of postclypeus, and 1.4-1.8 times distance between upper lobes of eyes. Antennae longer than body, clothed with dense short yellow hairs; scape clavated at apex, 1.8-2.0 times length of segment 3; segment 4 about 1.3-1.5 times length of segment 3 but shorter than segment 5.

Thorax and abdomen. Prothorax longer than wide, deeply constricted at anterior 1 / 4, with vague transverse wrinkles; disc with two large erect spines, slightly pointed backwards; each side with a large acute spine pointed up-backwards. Scutellum parabola (Fig. 2.19). Metasternum convex, almost impunctate, with dense short hairs. Elytra elongate, broadest at shoulders, from behind these gradually incurved to within a short distance of apices, not attenuated posteriorly; disc with dense deep punctures, fine granules and short golden hairs; each with four longitudinal costae, but two lateral ones obsolete at shoulders; apex rounded. Femur slender, fusiform. Abdomen narrow, on a lower plane than sterna.

Male terminalia. Apex of median lobe strongly projected (Fig. 2.28). Spined region of internal sac about as long as unspined region; spined region divided into 2 sections: first section absent; second section as long as or slightly longer than third section, with dense simple small and long spines or mixture of simple small and long species and multi-branched spines; third section with mixture of simple large and long spines and scale-like processes; no distinct unspined gap between second and third sections; a pair of chitinous rods near basal internal sac (Fig. 2.94). Eighth sternite obliquely truncate at lateral side and apex emarginate and V-shaped, with fairly dense setae; dense multi-branched microspines and cloud-like processes on ventral surface (Fig. 2.95). Apex of eighth tergite truncate (Fig. 2.96).

Female

Unknown.



Figs 2.94-96. Median lobe and internal sac, eighth sternite and eighth tergite of male terminalia of *C. costifer*. Scale lines: 1mm.

Variation

No distinct variation observed.

Biology

Hosts unknown. Adults were collected during January to March and May.

Distribution (Fig. 2.97)

Restricted in ND, AK, BP, TO, RI in the North Island and NN in the northwest of the South Island.

Comments

This species resembles *C. pallidus* (Fig. 2.76) but differs in having frons less than 100^0 angle with vertex; prothorax with two erect spines on disc and a spine at each side.

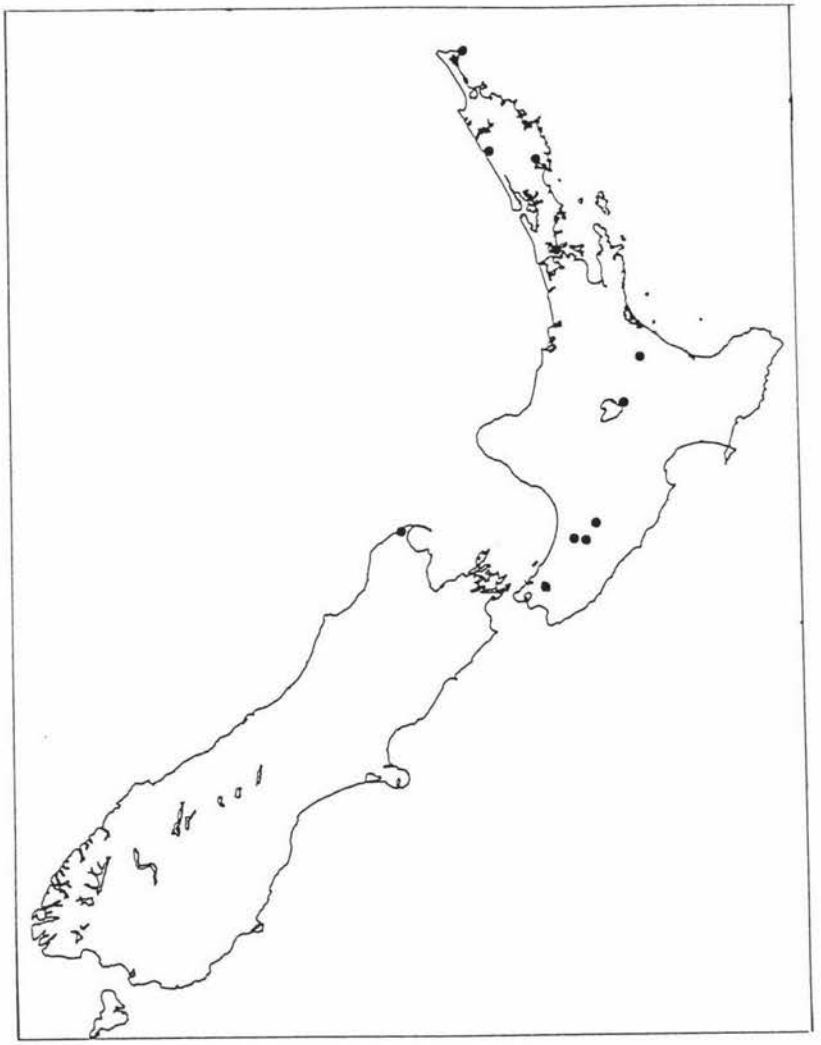


Fig. 2. 97. Distribution of *C. costifer*.

CHAPTER 3
PHYLOGENETIC ANALYSES OF *COPTOMMA* AND *CALLIPRASON*

3.1. Introduction

In the previous chapter I synonymised *Navomorpha* with *Coptomma*, and *Pseudocalliprason*, *Drotus*, *Stenopotes* and *Epheus* with *Calliprason* on the basis of external morphological and terminalia characters. The scope of the revised genera *Coptomma* and *Calliprason* has been redefined.

However, the relationship between species within each genus is not clear although brief discussion on it has been made in *Comments* section of each species description. Because *Coptomma* and *Calliprason* belong to two very different and distantly related tribes, Coptommini and Stenoderini, respectively, and many characters are not comparable between the genera, phylogenetic analyses are conducted separately for each genus.

In this chapter, cladistic analyses are carried out to (1) test monophylies of *Coptomma* and *Calliprason* and (2) determine the phylogenetic relationships between species in each genus.

3.2. Materials and Methods

3.2.1 Ingroup Taxa

An ingroup is all taxa under study. In the phylogenetic analyses the species of the revised genera *Coptomma: C. variegata, C. sulcata, C. lineata, C. stictica* and *C. marrisi,* and those of *Calliprason: C. sinclairi, C. marginatum, C. costifer, C. pallidus* and *C. elegans* were treated as ingroup taxa.

3.2.2 Outgroup Taxa

An outgroup is any group used in the analysis that is not included in the taxon under study.

In the cladistic analysis, outgroups need to be selected for polarising character states (Hennig, 1966). For example, a given character with 2 or more states within a group, the state occurring in related groups or outgroups is assumed to be the plesiomorphic state. If the character contains only 2 states, the alternative state is assumed to be apomorphic, thereby forming a more restricted character (Wiley, 1981).

Maddison *et al.* (1984) indicated that a single outgroup may contain its own apomorphies or reversals and therefore recommended the use of more than one outgroup to maximize global parsimony. Nixon and Carpenter (1993) pointed out that outgroups need not be the sister group of the ingroup, a monophyletic group relative to the ingroup, or a group primitive relative to the ingroup. They also realized that organisms most like those being investigated would be most appropriate outgroups.

Having examined specimens of related tribes, such as Spintheriini, Glaucytini, Callidiopini, Phlyctaenodini, Rhagiomorphini and Stenoderini deposited in museums or collections of New Zealand and Australia, I found that (1) *Glaucytes interrupta* Oliver and *Didymocantha picta* Bates are more closely related to *Coptomma* and (2) *Rhagiomorpha lepturoides* Boisd and *R. exilis* Pasc. to *Calliprason*. Therefore, I chose *G. interrupta* and *D. picta* as outgroups of *Coptomma*, and *R. lepturoides* and *R. exilis* as those of *Calliprason* for character polarizations.

3.2.3 Characters

The taxonomic descriptions of species in the previous chapter were used to evaluate the characters and character states, which are discussed in the following sections.

3.2.4 Cladistic Methods

Cladistic approaches are used for phylogenetic analysis. Cladistic analysis aims at analysing the characters of living things to infer the evolutionary sequence of a group's phylogeny. Cladistic methods have been applied by many authors since Hennig (1950, 1965, 1966) introduced the concepts. In this study, analyses were undertaken using PAUP 3.0s (Swofford, 1991), on a Macintoch computer.

In the PAUP package, there are two approaches to search for optimal trees: exact methods and approximate (heuristic) methods. Exact methods guarantee to find the optimal trees, but need long computing time for medium to large sized data sets. Heuristic methods do not guarantee optimality but suitable for very complex data sets (Swofford, 1991). Because my data sets are relatively small, I employed exact solution algorithms in this study.

In this study, multi-state characters were treated as unordered to avoid *a priori* decision of character state evolution.

3.3. Phylogeny of the Genus *Coptomma*

3.3.1 Characters and Coding

Initially, eighty-one characters were selected for analyses. The data matrix was then checked for the invariant or uninformative (autapomorphic) characters using the 'show character status' option of PAUP. As a result, forty-nine characters were found to be uninformative and thus excluded. This reduced the number of characters used to thirty-two. All informative characters and character states used in the present analysis are shown in Table 3.1 with characters coded as binary or multistate. The numbers (0, 1, or 2) do not imply the polarity of the characters at this stage. The polarity decisions for character states were derived from their change on the most parsimonious tree obtained in the following analyses.

Table 3.1 Characters and character states used in the phylogenetic analysis of *Coptomma* (character states in square brackets)

HEAD

1 Angle of frons with vertex:
<100° [0]; >100° [1].

2 Two longitudinal stripe of yellowish hairs on vertex-frontal region:
Absent [0]; Subparallel [1]; Approaching between antennae [2].

3 W/H of frons (width vs height):
$1.9 \times H < W$ [0]; $W < 1.9 \times H$ [1].

4 Anterior edge of postclypeus:
Not produced forward and not longer than lateral angle of postclypeus [0];
Produced forward and longer than lateral angle of postclypeus [1].

5 Relative length of distance between lower lobes of eyes (L) and distance between upper lobes of eyes (U):
$1.8 \times U < L$ [0]; $L < 1.6 \times U$ [1].

ANTENNAE

6 Relative length of antennal segments 3 and 4:
Segment 3 distinctly longer than segment 4 [0];
Segment 3 as long as segment 4 [1].

7 Relative length of antennal segments 3 and 5:
Segment 3 shorter than segment 5 [0];
Segment 3 as long as segment 5 [1].

8 Relative length of antennal segments 4 and 6:
Segment 4 shorter than segment 6 [0];
Segment 4 as long as or longer than segment 6 [1].

9 Relative length of antennal segments 1 and 3:
Segment 1 shorter than segment 3 [0];
Segment 1 as long as or longer than segment 3 [1].

10 Relative length of antennal segments 3 and 6:
Segment 3 longer than segment 6 [0];
Segment 3 as long as segment 6 [1].

PROTHORAX

11 Base of pronotum partly embraced by elytra:
No [0]; Yes [1].

12 Length/width of pronotum (L/W):
L < W [0]; L > W [1].

13 Prosternal process:
Sloping [0];Vertical or slightly produced backward [1];

MESOTHORAX

14 Hairs on scutellum disc (except the edge)
Dense [0]; Sparse or none [1].

15 Mesosternal process
Sloping [0]; Vertical or produced forward [1].

METASTERNUM

16 Hairs on disc of metasternum:

Sparse [0]; Dense [1].

ELYTRA

17 Arrangement of depressed hairs on elytra:

Evenly arranged [0];

Spots formed, consisting of clustered hairs [1];

Longitudinal lines formed, consisting of dense hairs in grooves [2].

18 Punctures on elytra:

Dense [0]; None or very sparse [1].

ABDOMEN

19 Pattern of depressed hairs on lateral sides of sternites:

Rectangular [0]; Triangular [1].

20 A nitid triangular area in middle of each sternite:

Absent [0]; Present[1].

21 Hairs on sternites:

Fairly dense or sparse [0]; Very dense [1].

LEGS

22 Ratio of tibia length/terminal spur length on tibia (T/S):

$15 \times S < T < 38 \times S$ [0]; $9 \times S < T < 13 \times S$ [1].

INTERNAL SAC OF AEDEAGUS

23 First section:

Present [0]; Absent [1].

24 Unspined region + first section if present / second + third section:

>2.0 [0]; <2.0 [1].

25 Multi-branched spines in third section:
Present [0]; Absent [1].

26 "Y" and "⊓" shaped structures in third section
Absent [0]; Present [1].

MALE EIGHTH STERNITE

27 Shape of the eighth sternite:
Rounded at lateral sides [0];
Truncate at lateral sides [1].

28 Position from which long and sub-long setae rise:
Terminal [0]; Sub-lateral + terminal [1].

29 Microprocesses on ventral surface:
Microspines [0]; Multi-branched [1]; No process [2].

MALE EIGHTH TERGITE

30 Position from which long and sub-long setae rise:
Terminal area [0]; Terminal edge [1].

FEMALE TERMINALIA

31 Length / width of eighth sternite (L/W):
L < = W [0]; L > W [1].

32 Relative length of dorsal baculi (DB) and proctiger baculi (PB) of ovipositor:
DB < 0.5 × PB [0]; DB > 0.7 × PB [1].

The data set of the five species and two outgroups, each scored for each of the thirty-two characters, is shown in Table 3.2. The missing characters were coded as question mark (?) in the data matrix.

Table 3.2 Character state matrix for *Coptomma* and outgroups

Taxa	Characters						
	12345	1 67890	11111 12345	11112 67890	22222 12345	22223 67890	33 12
C. variegata	01000	01011	10111	01110	11011	00011	10
C. sulcata	11011	01110	11111	12100	00000	11101	11
C. lineata	12111	11110	11101	12111	10111	11120	01
C. stictica	12111	10111	11101	11111	10100	11110	01
C. marrisi	12001	11110	11101	02111	10???	?????	01
D. picta	00000	00000	00000	00000	00000	00000	00
G.interrupta	01111	01001	00010	02000	11???	?????	10

3.3.2 Results and Discussion

3.3.2.1 Tree Obtained

Program was run using exact methods to search optimal trees. This resulted in one most parsimonious tree (Length = 53, Consistency Index = 0.660, Retention Index = 0.609) (Fig. 3.1).

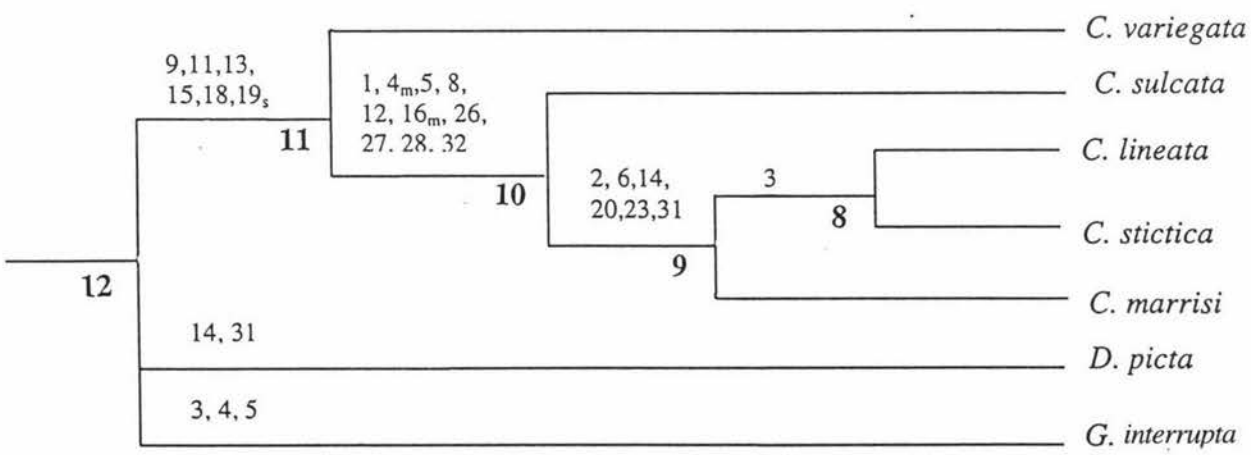


Fig. 3.1. Most parsimonious tree (Length = 53, Consistency Index = 0.660, Retention Index = 0.609) of *Coptomma* showing the distribution of the apomorphic state of characters (numbered as in Table 3.1). Characters that are reversed are subscripted (s: *sulcata*; m: *marrisi*)

3.3.2.2. Determination of Character Polarity

According to outgroup comparison criterion (Watrous and Wheelar, 1981) the determination of character polarity was made based on the states present at outgroup clade (clade 12 in Fig. 3.1).

A review of the characters at the outgroup clade showed that all characters had state 0 at this point on the tree except character 2, 7, 14, 21 and 31, which had state 1, and characters 17, which had state 2 at this point. This indicates that for characters 2, 7, 14, 21 and 31, state 1, and for character 17, state 2 is plesiomorphic and state 0 is apomorphic while for all others state 0 is plesiomorphic and 1 or 2 is apomorphic. Possible character state changes at outgroup and ingroup clades obtained using PAUP's output of 'states for interior clades' command are listed in Table 3.3.

Table 3.3 List of characters of *Coptomma* showing change in state supporting the labelled clades

Clade	Characters					
	1	11111	11112	22222	2222333	
	12345	67890	12345	67890	12345	6789012
8	12111	11110	11101	12111	10100	1111001
9	12011	11110	11101	12111	10100	1111001
10	11011	01110	11111	12110	10000	1111111
11	01000	01010	10111	02110	10000	0001110
12	01000	01000	00010	02000	10000	0000010

3.3.2.3. Monophyly of *Coptomma* and Divisions of Species Groups

Table 3.4 shows the synapomorphies supporting the clades and taxa in Fig. 3.1, obtained from PAUP's output of 'list of apomorphies' command.

Results shown in Fig. 3.1, Tables 3.3 and 3.4 have the following phylogenetic implications (character number given in parentheses).

Table 3.4 Synapomorphies supporting the labelled clades and/or taxa in Fig. 3.1

Clades	No. of synapomorphies	Characters and their state transformation
8	1	3, 0→1.
9	6	2, 1→2; 6, 0→1; 14, 1→0; 20, 0→1; 23, 0→1; 31, 1→0.
10	10	1, 0→1; 4, 0→1; 5, 0→ 1; 8, 0→1; 12, 0→1; 16, 0→1; 26, 0→1; 27, 0→1; 28, 0→1; 32, 0→1.
11	6	9, 0→1; 11, 0→1; 13, 0→1; 15, 0→1, 18, 0→1; 19, 0→1.

Monophyly of the genus Coptomma

The monophyly (clade11 in Fig. 3.1) is supported by six synapomorphies: antennal segment 1 as long as or longer than segment 3 (9); base of pronotum partly embraced by elytra (11); prosternal process vertical or slightly produced backward (13); mesosternal process vertical or produced forward (15); elytra with rare or no punctures (18); abdominal sternites with triangular patterns of depressed hairs on lateral sides (19).

The clade 10 species group

This group is supported by ten synapomorphies (Fig. 3.1): angle of frons with vertex > 100° (1); anterior edge of postclypeus produced forward and not longer than lateral angle of postclypeus (4); length of distance between lower lobes of eyes 1.6 times that between upper lobes of eyes (5); antennal segment 4 as long as or longer than segment 6 (8); pronotum longer than wide (12); metasternum with dense hairs on disc (16); third section of male internal sac with "Y"- and "⊓"- shaped structures (26); lateral sides of eighth sternite of male truncate (27); long and sub-long setae on male eighth sternite rising form sub-lateral and terminal sides (28), and length of dorsal baculi on ovipositor >0.7 times length of proctiger baculi (32).

The clade 9 species group

This group is supported by six synapomorphies (Fig. 3.1): two longitudinal bands of yellowish hairs on vertex-frontal region approaching between the antennae (2); antennal segment 3 about as long as segment 4 (6); disc of scutellum (except the edge) with dense hairs (14); abdomen with a nitid triangular area in middle of each sternite (20); male internal sac without first section (23), and female eighth sternite as long as or shorter than wide (31).

The sister species relationship between *C. lineata* and *C. stictica* is supported by one synapomorphy (Fig. 3.1): frons width < 1.9 times height (3).

3.3.2.4 Character Analysis

Table 3.5 provides diagnostics of each character in terms of its steps, consistency index

Table 3.5 Diagnostics of the contribution of different characters to the most parsimonious tree for *Coptomma* (Fig. 3.1)

Character	Step	CI	RI
1	1	1.000	1.000
2	2	1.000	1.000
3	2	0.500	0.500
4	3	0.333	0.000
5	2	0.500	0.000
6	1	1.000	1.000
7	2	0.500	0.000
8	1	1.000	1.000
9	1	1.000	1.000
10	3	0.333	0.000
11	1	1.000	1.000
12	1	1.000	1.000
13	1	1.000	1.000
14	2	0.500	0.500
15	1	1.000	1.000
16	2	0.500	0.500
17	3	0.667	0.000
18	1	1.000	1.000
19	2	0.500	0.500
20	1	1.000	1.000
21	2	0.500	0.000
22	2	0.500	0.000
23	1	1.000	1.000
24	2	0.500	0.000
25	2	0.500	0.000
26	1	1.000	1.000
27	1	1.000	1.000
28	1	1.000	1.000
29	3	0.667	0.000
30	2	0.500	0.000
31	2	0.500	0.500
32	1	1.000	1.000

(CI) and retention index (RI) on the most parsimonious tree (Fig. 3.1). Characters that support monophylies of clades were analysed on the basis of Fig. 3.1 and Tables 3.1-5.

Binary characters 7, 10, 21, 22, 24, 25 and 30, and multistate character 29 have lowest consistency and retention indices and more steps, suggesting they have highest homoplasy on the tree, with none of states acting as synapomorphies. On the contrary, binary characters 1, 6, 8, 9, 11, 12, 13, 15, 18, 20, 23, 26, 27, 28 and 32, and multistate character 2 have maximum consistency and retention indices and minimum step, indicating that they function as good synapomorphies. The characters between those two extremes may act as synapomorphies but have reversals or convergences.

Further discussion is given to the characters that support monophylies of *Coptomma* and species groups. The distribution of these characters on the most parsimonious tree is shown in Fig. 3.1.

It is indicated that the apomorphic states of characters 9, 11, 13, 15 and 18 act as synapomorphies supporting the monophyly of *Coptomma*. Character 19 may also be a synapomorphy supporting *Coptomma* but the apomorphic state of this character was reversed in *C. sulcata* (Fig. 3.1).

The distribution of the states of the ten characters (1, 4, 5, 8, 12, 16, 26, 27, 28, and 32) supporting the monophyly of the clade 10 species group on the tree (Fig. 3.1) indicates that the apomorphic states of characters 1, 8, 12 and 32 are good synapomorphies but the apomorphic state of character 4 is reversed in *C. marrisi* and converged in *G.interrupta*,character 5 converged in *G.interrupta*and character 16 reversed in *C. marrisi*. Furthermore, because characters 26, 27 and 28 refer to males only and the male of *C. marrisi* is unknown, the synapomorphic status of these three characters may probably be challenged when the male of this species is known in the future.

Among the six characters (2, 6, 14, 20, 23 and 31) supporting the clade 9 species group (Fig. 3.1), apomorphic states of character 2, 6 and 20 are synapomorphies supporting the group. However, characters 14 and 31 are convergent in one of the outgroups, *D. picta*. In addition, because character 23 refers to male only and the male of *C. marrisi* is unknown, this character needs re-evaluating when male of this species is known.

The sister species relationship between *C. lineata* and *C. stictica* is supported by character 3. However, the apomorphic state of this character is convergent in one of the outgroups, *G. interrupta* (Fig. 3.1). Therefore, this needs further investigation when more information is available.

3.4. Phylogeny of the Genus *Calliprason*

3.4.1. Characters and Coding

Originally, forty-nine characters were scored for analysis. The data matrix was then checked for the invariant and uninformative (autapomorphic) characters using the 'show character status' option of PAUP. Sixteen characters were found to be uninformative and were thus excluded. This reduced the number of characters used for analysis to thirty-three, which are listed in Table 3.6. All characters are binary and their states of polarity are made *a posteriori*.

Table 3.6 Characters and character states used in phylogenetic analysis of *Calliprason* (character states in square brackets)

HEAD

1 Hairs arising on vertex-frons region:
Erect hairs only [0]; Depressed hairs [1].

2 Angle of frons with vertex:
$<100^0$ [0]; $>100^0$ [1].

3 Relative length of distance between lower lobes of eyes (F) and distance between antennal socket and lateral angle of postclypeus (G):
$1.7 \times G < F$ [0]; $1.7 \times G > F$ [1].

4 Distinctly constricted behind eyes:
No [0]; Yes [1].

ANTENNAE

5 Relative length of antennal segments 3 and 4:
Segment 3/4 > 1.5 [0]; Segment 3/4 < 1.1 [1].

6 Relative length of antennal segments 3 and 5.

Segment 3/5 > 1.6 [0]; Segment 3/5 < 1.0 [1].

7 Relative length of antennal segments 4 and 5.

Segment 4 >= segment 5 [0]; Segment 4 < segment 5 [1].

8 Relative length of antennal segments 1 and 3.

Segment 1/3 < 1.3 [0]; Segment 1/3 > 1.5 [1].

9 Relative length of antennal segments 3 and 6.

Segment 3 > segment 6 [0]; Segment 3 < segment 6 [1].

10 Erect hairs on segments 1 - 3:

Most long erect hairs on the underside and rarely or no long erect hairs on upper-side except terminal ends [0]; Dense and long erect hairs in all directions [1].

PRONOTUM

11 Two longitudinal bands of depressed hairs on disc:

Absent [0]; Present [1].

12 Longer than wide and constricted in front:

No [0]; Yes [1].

13 Spines on middle of disc:

Absent [0]; Two [1].

14 Lateral sides:

Spined [0]; Rounded or tuberculate [1].

15 Punctures on the disc:

Densely punctuated [0]; Not punctuated or sparsely punctuated [1].

16 Dense and transversal grooves on disc:

Present [0]; Absent [1].

MESOTHORAX

17 Hairs on scutellum (except edge):

Sparse [0]; Dense [1].

METASTERNUM

18 Hairs on disc of metasternum:

Dense [0]; Sparse [1].

ABDOMEN

19 Erect hairs on abdominal sternite:

Present [0]; Absent [1].

LEGS

20 Relative length of 1st segment/2^{nd} +3^{rd} segments of hind tarsus:

First segment < 2^{nd} + 3^{rd} [0]; First segment > 2^{nd} + 3^{rd} [1].

INTERNAL SAC OF AEDEAGUS

21 Unspined region + first section / second + third section (UF/ST):

UF/ST > 1.0 [0]; UF/ST<1.0 [1].

22 Multi-branched spines in second section:

Absent [0]; Present [1].

23 Scale-like spines in third section:

Absent [0]; Present [1].

24 Multi-branched spines in third section:

Absent [0]; Present [1].

MEDIAN LOBE OF AEDEAGUS

25 Shape of apical part of median lobe:

Sharply pointed [0]; Strongly projected [1].

VENTRAL APODEME OF MALE TERMINALIA

26 Relative width of stem and arms.

Widest part of stem = widest part of arms [0];

Widest part of stem > widest part of arms [1].

MALE EIGHTH STERNITE

27 Position from which long and sub-long setae rise:
Sublateral+terminal [0]; Lateral+terminal [1].

28 Micro-processes on ventral surface.
Present [0]; Absent [1].

29 Setae at terminal part.
Absent in middle area [0]; Present in middle area [1].

MALE EIGHTH TERGITE

30 Shape of apex of eighth tergite.
Rounded [0]; Truncate [1].

31 Micro-processes on middle area
Multi-branched spines [0]; Simple small and long spines [1].

FEMALE TERMINALIA

32 Micro-processes on wall of oviduct:
Multi-branched [0]; Simple large and long [1].

33 Relative length of dorsal baculi and proctiger baculi (DB/PB):
$0.24 \times PB < DB$ [0]; $DB < 0.2 \times PB$ [1].

The character matrix of *Calliprason* species and two outgroups, each scored as in Table 3.6 for each of the thirty-three characters, is shown in Table 3.7. The missing characters were coded as question mark (?) in the data matrix.

3.4.2 Results and Discussion

3.4.2.1 Trees Obtained

The same procedure was used as in the analysis of *Coptomma*. The exact solution algorithm generated three equally parsimonious trees for *Calliprason* (Length = 52, Consistency Index = 0.635, Retention Index = 0.558). The difference between the trees is

Table 3.7 Character state matrix for *Calliprason* and outgroups

Taxa	Characters						
	1	11111111112	22222	22223	333		
	12345	67890	12345	67890	12345	67890	123
C. pallidus	11101	11111	11011	01111	10001	11001	100
C. marginatum	10111	11110	11101	01111	10011	10001	010
C. sinclairi	10101	11100	01001	10111	01101	00100	111
C. elegans	11101	11100	01010	11111	11001	00111	101
C. costifer	10111	11111	01101	11111	11101	01011	1??
R. lepturioides	00000	00000	00000	00000	00000	00000	000
R. exilis	00000	00000	00010	00000	00010	01011	000

the position of *C. elegans*, *C. sinclairi* and *C. costifer*. The remaining parts of the topologies are identical. The strict consensus tree of these three trees is shown in Fig. 3.2, which has four implications:

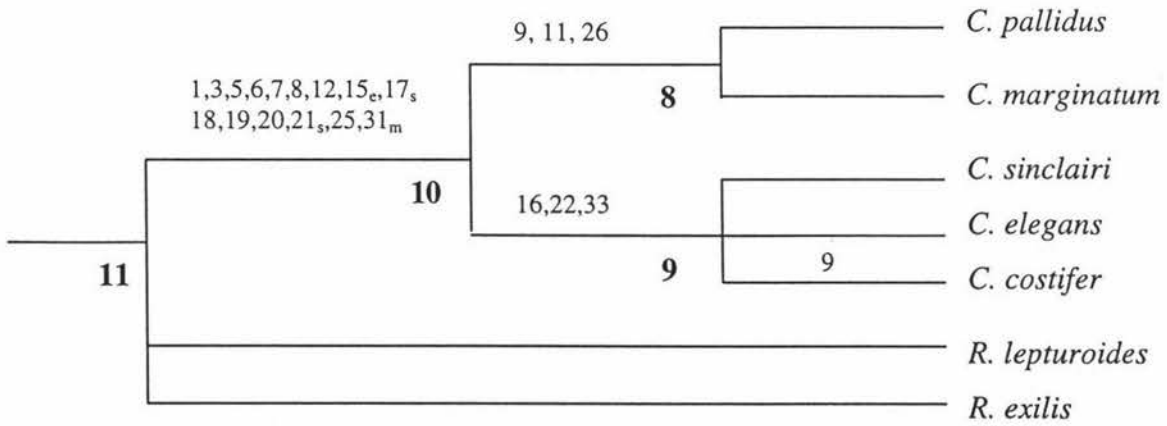


Fig. 3.2. Strict consensus tree from three equally parsimonious trees (Length = 52, Consistency Index = 0.635, Retention Index = 0.558) of *Calliprason*, showing the distribution of the apomorphic states of characters. Reversed characters are subscripted (e: *elegans*; s: *sinclairi*; m: *marginatum;* c: *costifer*)

1. *Calliprason* forms a distinct group arising at clade 10;
2. The species form two groups (clade 8 and 9);
3. *C. pallidus* is the sister species of *C. marginatum*;
4. The polytomy of *C. sinclairi, C. elegans* and *C. costifer* is not resolved.

3.4.2.2. Determination of Character Polarity

Determination of character polarity was made based on the states present at outgroup clade (clade 11 in Fig. 3.2). A review of the characters at outgroup clade showed that state 0 of all characters except character 30, which had state 1, is plesiomorphic. It is thus indicated that for character 30 state 0 while for all other characters state 1 is apomorphic. Character state changes at outgroup and ingroup clades for Fig. 3.2 are listed in Table 3.8.

Table 3.8 List of characters of *Calliprason*, showing changes in states supporting the labelled clades

Clade	Character						
	1	11111	11112	22222	22223	333	
	12345	67890	12345	67890	12345	67890	123
8	10101	11110	11001	01111	10001	10001	100
9	10101	11100	01001	11111	11101	00111	101
10	10101	11100	01001	01111	10001	00001	100
11	00000	00000	00000	00000	00000	00001	000

3.4.2.3. Monophyly of *Calliprason* and Divisions of Species Groups.

Synapomorphies supporting the clades and taxa in Fig. 3.2 are listed in Table 3.9. A review of Tables 3.7-9 has indicated the following (character number given in parentheses).

Monophyly of Calliprason

The monophyly of *Calliprason* is supported by fifteen synapomorphies (Fig. 3.2): depressed hairs on vertex-frons region (1); distance between lower lobes of eyes shorter 1.7 times distance between antennal socket and lateral angle of postclypeus (3); antennal

Table 3.9. Synapomorphies supporting the labelled clades in Fig. 3.2

Clades	No. of synapomorphies	Characters and their state transformation
8	3	9, 0→ 1; 11, 0→ 1; 26, 0→ 1.
9	3	16, 0→ 1; 22, 0→ 1; 33, 0→ 1.
10	15	1, 0→ 1; 3, 0→ 1; 5, 0→ 1; 6, 0→ 1, 7, 0→ 1; 8, 0→ 1; 12, 0→ 1; 15, 0→ 1; 17, 0 → 1; 18, 0→ 1; 19, 0→ 1; 20, 0→ 1; 21, 0→ 1; 25; 0→ 1; 31, 0→ 1.

segment 3 less than 1.1 times segment 4 (5); antennal segments 3 shorter than segment 5 (6); antennal segment 4 shorter than segment 5 (7); antennal scape more than 1.5 times segment 3 (8); pronotum longer than wide and constricted in front (12); pronotum disc not punctured or sparsely punctured (15); scutellum (except the edge) with dense hairs (17); metasternum disc with sparse hairs (18); sternites without erect hairs (19); first segment of hind tarsus longer than 2^{nd} + 3^{rd} segments (20); length of unspined region + first section of internal sac shorter than that of second + third sections (21); apical part of median lobe strongly projected (25); simple small and long micro-processes present in middle area of male eighth tergite (31).

The clade 8 species group

This group is supported by three synapomorphies (Fig. 3.2): antennal segment 3 shorter than segment 6 (9); pronotum disc with two longitudinally stripes of depressed hairs (11); widest part of stem of apodeme wider than widest part of arms (26).

The clade 9 species group

This species group is supported by five synapomorphies (Fig. 3.2): pronotum disc without transversal grooves (16); second section of internal sac with multi-branched spines (22); length of dorsal baculi less than 0.2 times proctiger baculi (33).

3.4.2.4. Character Analysis

The synapomorphies supporting monophylies of *Calliprason* and its subdivisions were analysed in this section. The consistency and retention indices and steps for each character are shown in Table 3.10.

Table 3.10 Diagnostics of the contribution of different characters to the strict consensus tree for *Calliprason* (Fig. 3.2)

Character	Step	CI	RI
1	1	1.000	1.000
2	2	0.500	0.000
3	1	1.000	1.000
4	2	0.500	0.000
5	1	1.000	1.000
6	1	1.000	1.000
7	1	1.000	1.000
8	1	1.000	1.000
9	2	0.500	0.500
10	2	0.500	0.000
11	1	1.000	1.000
12	1	1.000	1.000
13	2	0.500	1.000
14	3	0.333	0.000
15	2	0.500	0.500
16	1	1.000	1.000
17	2	0.500	0.500
18	1	1.000	1.000
19	1	1.000	1.000
20	1	1.000	1.000
21	2	0.500	0.500
22	1	1.000	1.000
23	2	0.500	0.000
24	2	0.500	0.000
25	1	1.000	1.000
26	1	1.000	1.000
27	3	0.333	0.000
28	2	0.500	0.000
29	3	0.333	0.000
30	2	0.500	0.000
31	2	0.500	0.500
32	2	0.500	0.000
33	1	1.000	1.000

Table 3.10 shows that characters 2, 4, 10, 14, 23, 24, 27, 28, 29, 30 and 32 have highest homoplasy on the tree, none of their states acting as synapomorphies, and characters 1, 3, 5-8, 11-13, 16, 18-20, 22, 25, 26, and 33 are synapomorphies. The characters in between may function as synapomorphies but have reversals or convergence. The distribution of these characters on the consensus tree is shown in Fig. 3.2.

Among the fifteen characters supporting the monophyly of *Calliprason* (Table 3.9) the apomorphic states of 11 characters are synapomorphies without reversal or convergence (Table 3.10). However, character 15 is reversed in *C. elegans*, characters 17 and 21 reversed in *C. sinclairi*, and character 31 reversed in *C. marginatum* (Fig. 3.2).

The monophyly of the sister species relationship between *C. pallidus* and *C. marginatum* is supported by characters 9, 11 and 26 (Table 3.9). However, the distribution of their states on the tree suggests that only characters 11 and 26 are synapomorphies without reversal or convergence and that character 9 is convergent in *C. costifer.*

Characters 16, 22 and 33 support the monophyly of the *sinclairi*-species group (clade 9) without reversal or convergence (Table 3.9, Fig. 3.2). However, character 33 refers to female only and the female of *C. costifer* is unknown. Therefore, this character needs re-evaluating when the female of *C. costifer* is known.

3.5 Conclusion

The monophylies of the two revised New Zealand longicorn beetle genera, *Coptomma* and *Calliprason*, and the phylogenetic relationships between species in each genus were analysed cladistically in this chapter. Characters supporting monophylies of the genera and their species groups were discussed. The conclusions drawn from this study are listed below:

1. The revised *Coptomma* is a monophyletic genus including five species: *C. variegata, C. sulcata, C. lineata, C. stictica* and *C. marrisi.* The erection of *Navomorpha* is therefore not justified, and it should be synonymised with *Coptomma. C. variegata* is closer to the root of the tree (Fig. 3.1) than any other members of the genus. The clade 10 containing four species is recognised as a monophyletic group, within which a distinct monophyletic species group, the clade 8, is formed. *C. lineata* and *C. stictica* are confirmed as sister species.

2. Cladistic analysis has confirmed that the proposals for the genera *Pseudocalliprason*, *Drotus*, *Stenopotes* and *Epheus* are not justified. The genus *Calliprason* now includes five species: *C. pallidus*, *C. marginatum, C. sinclairi*, *C. elegans* and *C. costifer*. Two distinct monophyletic species groups are recognised: the clade 8 containing two species, *C. pallidus* and *C. marginatum*, and the clade 9 including the remaining three species. However, the polytomy of the *sinclairi*-species has not been resolved.

CHAPTER 4
GENERAL DISCUSSION AND SUMMARY

4.1 Introduction

The present study includes comprehensive treatment of taxonomy and phylogeny of the genera *Coptomma* and *Calliprason*. The main findings of the study will be summarised and discussed in this chapter.

4.2 Taxonomy

The number of known species of the genera *Coptomma* and *Calliprason* increased to five, respectively, as a result of this study. Table 4.1 compares the previous system and the present taxonomic status of these genera.

Table 4.1 Comparison between previous and present taxonomic systems

Previous			Present		
Genus	No.of sp.	Species	Genus	No.of sp.	Species
Coptomma	1	*variegata* (Fabricius),1775	*Coptomma*	5	*variegata* (Fabricius),1775
Navomorpha	6	*sulcata* (Fabricius),1775			*sulcata* (Fabricius),1775
		lineata (Fabricius),1775			*lineata* (Fabricius),1775
		textoria (Newman),1849			**syn. nov.** with *lineata*
		philpotti Brookes,1926			**syn. nov.** with *lineata*
		stictica Broun,1893			*stictica* (Broun), comb. nov.
		douei Lucas,1863			no specimen seen
					marrisi **sp. nov.**
Calliprason	1	*sinclairi* White,1843	*Calliprason*	5	*sinclairi* White,1843
Pseudicalliprason	1	*marginatum* (White),1846			*marginatum* White, comb. nov
Stenopotes	1	*pallidus* Pascoe,1875			*pallidus* (Pascoe), comb. nov
Drotus	1	*elegans* Sharp,1877			*elegans* (Sharp), comb. nov
Epheus	1	*costifer* Broun,1886			*costifer* (Broun), comb. nov

The genus *Navomorpha* was transferred to *Coptomma.* Its species shared a combination of characteristics: the base of pronotum partly embraced by the elytra; prosternal process vertical or slightly produced backward; mesosternal process vertical or produced forward; abdominal sternites with triangular or rectangular patterns of depressed hairs on lateral sides. *N. philpotti* and *N. textoria* were synonymised with *C. lineata*. One new species, *C. marrisi*, was described.

The genera *Pseudocalliprason, Drotus, Stenopotes* and *Epheus* were synonymised with *Calliprason*, sharing a combination of characteristics: antennal scape distinctly clavated at apex, more than 1.5 times third segment; prothorax longer than wide and constricted in front; first segment of hind tarsus longer than that of second + third segments; front tibia with a spur at infero-apical angle. The last character also occurs in the monotypic genus *Leptachrous* Bates (1874). However, this genus is very different from *Calliprason* in other characters. It is therefore likely that the character, front tibia with a spur, is convergent in *Leptachrous*.

Male and female terminalia of the *Coptomma* and *Calliprason* were studied for the first time. A detailed study of their internal sacs shows that the forms and arrangement of the sclerotised processes or microspines inside the sacs are very useful taxonomic characters at species level. Characters of the 8th sternite of the male, especially its shape, the processes on its ventral surface, position where long and sub-long setae arise are conservative within species. Structures of the 8th tergite of the male are also useful in taxonomy, for example, the shape of its apex, microspines on its middle area, and the position where long and sub-long setae arise. The general shape of the ovipositor and spermatheca is similar in all species but the relative length of proctiger baculi and dorsal baculi, and position where spermathecal gland arises are useful at genus and species level.

The present taxonomic study was based on adults. The immature stages of these two genera are still largely unknown. Dumbleton (1957), Duffy (1963), Bain (1976), Zondag & Bain (1976) and Grehan (1982) described immature stages of twenty species but only five of which belong to *Coptomma* and *Calliprason*: *Coptomma lineata, C. sulcata, Calliprason pallidus, C. marginatum* and *C. sinclairi*. Therefore, further taxonomy study of the

Coptomma and *Calliprason* should be mainly devoted to the description and illustration of the immature stages. More new species may be found in the future.

4.3 Phylogenetic Relationships

Cladistic approaches to a study of phylogenetic relationships within *Coptomma* and *Calliprason* were used for the first time. The monophyly of the *Coptomma* and *Calliprason* is confirmed with the former being supported by 5 good synapomorphies and the latter by 11. *Coptomma* consists of a monophyletic group, Clade 10 group, and a species being closer to the root of the tree (Fig. 3.1). The Clade 10 group includes four species, within which a monophyletic species group, the clade 8, is formed. Two monophyletic groups are recognised in *Calliprason* (Fig. 3.2): clade 8 group and clade 9 group. However, the relationship between three species of clade 9 has not been resolved.

As discussed previously, the phylogenetic analyses in chapter 3 were based on adult morphology. No studies of immature stages, or DNA sequences were made. In their study of cerambycid larvae of the Palaearctic Region, Svácha and Danilevsky (1986) pointed out that adults were usually free-living active animals whose external morphology may be influenced by a variety of environmental pressures while larvae usually lived inside plants, a relatively stable environment. They thus supposed that larval characters would provide more reliable evidence about relationships than adult characters. Further phylogenetic analyses should include characters of larval and pupal morphology and DNA sequences.

4.4 Distribution

According to data from all specimens examined and literature, species' distribution was described in Chapter 2. *C. variegata, C. sulcata, C. pallidium* are widely distributed in both main islands, but *C. lineata, C. sinclairi, C. costifer* occur in the North Island and the northernmost part of the South Island, *C. stictica, C. marginatum* and *C. elegans* found only in the North Island, and *C. marrisi* in the Great Island, north of the North Island.

4.5 Biological Aspects

Little is known of the biology of most species of *Coptomma* and *Calliprason*. However, biological records on some species can be found in the collection notes listed in Chapter 2

and in Dumbleton (1957), Duffy (1963), Bain (1976), Zondag & Bain (1976) and Grehan (1982). Biological aspects were summarised in Chapter 2 for all species except *C. elegans* and *C. costifer*. It is therefore possible to make some comments on the biology of the *Coptomma* and *Calliprason*.

More than 28 species are recorded as host plants of *Coptomma*. Adults lay eggs in the bark of twigs, branches or under bud scales on twigs. The larvae bore under the bark and extending in the centre of the stem. Pupation takes 2-3 weeks. Adults emerge between August and February and were collected at night or light during all months of the year except May to July.

Twelve species are recognised as host plants for *Calliprason*. The eggs are laid in the bark, hatching in 15-26 days, taking at least 14 months to develop to adults. Larvae tunnel under the bark and later in the wood. Pupation occurs up to one inch depth in the wood. Adults may often be found on flowers, some tree or light traps at night or in day-time during all months of a year.

4.6 Conclusion

The main findings and perspectives of the study of *Coptomma* and *Calliprason* are summarised and discussed in this section. This study has included a general introduction to the beetle, historical background, taxonomic revisions, phylogeny, distribution and aspects of biology. This thesis has provided a much wider systematic and biological knowledge of *Coptomma* and *Calliprason* than before.

REFERENCES

Allan, H. H. (1982) 'Flora of New Zealand Volume 1, Indigenous Tracheophyta, Psilopsida, Filicopsida, Gymnospermar, Dicotyledoues'. (DSIR: Wellington) 1085 pp.

Aurivillius, P. O. C. (1912) Cerambycidae: Cerambycinae. In 'Coleopterorum Catalogus, Vol. 22(39)'. (Ed. S. Schenkling.) pp.1-574. (Junk: Berlin.)

Bain, J. (1976) *Navomorpha lineata* (Fabricius) (Coleoptera:Cerambycidae). *Forest and Timber Insects in New Zealand* **2,** 1-3.

Bates, H. W. (1874). On the Longicorn Coleoptera of New Zealand. *The Annals and Magazine of Natural History including Zoology, Botany and Geography. 4th Series* **14,** 23-24.

Blair, G. K. (1937). Synonymy of the cerambycidae of New Zealand (Col.). *The Entomologist's Monthly Magazine* **73**, 261-268.

Blanchard, E. (1853). Description des Insectes. In 'Voyage au Pole Sud et dans l'OCÉANIE sur les Corvettes l'Astrolabe et la Zélée; Exécuté par Ordre du roi Pendant les Années 1837-1838-1839-1840, Sous le Commandement. Zoologie. IV' (Ed. DE M. J. Dumont-D'Urville.) pp.274-275. (J. Baudry: Paris)

Brookes, E (1926). A new genus and eight new species of Coleoptera. *Transactions and Proceedings of the New Zealand Institute* **56**, 440-448.

Broun, T. (1880). 'Manual of the New Zealand Coleoptera, Part I.' (Government Printer: Wellington.) 651pp.

Broun, T. (1886). 'Manual of the New Zealand Coleoptera, Part III and IV.' (Government Printer: Wellington.) pp. 746-973.

Broun, T. (1893). 'Manual of the New Zealand Coleoptera, Part V.' (Government Printer: Wellington.) pp. 975 – 1504.

Crosby, T. K., Dugdale, J. S. and Watt, J. C. (1976). Recording specimen localities in New Zealand: an arbitrary system of areas and codes defined. *New Zealand Journal of Zoology* **3**, 69.

Dale, P. S. and Maddison, P. A. (1982). A catalogue (1860 – 1960) of New Zealand insects and their host plants II --- Alphabetical list of insects and their host plants. *New Zealand Department of Scientific and Industrial Research Bulletin* **231**, 1-260.

Dieffenbach, E. (1843). 'Travels in New Zealand; with Contributions to the Geography, Geology, Botany, and Natural History of That Country, Volume II.' (John Murray: London.) 369pp.

Duffy, E. A. J. (1963). 'A Monograph of the Immature Stages of Australian Timber Beetles (Cerambycidae).' (British Museum (Natural History): London.) 235pp.

Dumbleton, L. J. (1937). Borers in fruit-trees. *New Zealand Journal of Agriculture* **55,** 295-298.

Dumbleton, L. J. (1957). The immature stages of some New Zealand longhorn beetles (Coleoptera:Cerambycidae). *Transactions of the Royal Society of New Zealand* **84,** 611-628.

D'Urville, D. (1835) 'Voyage De D'Couvertes De L'Astrolabe Exécuté Par Ordre Dui Roi, Pendantles Années 1826-1827-1828-1829.' (Tastu: Paris.) 716pp.

Ehara, S. (1954). Comparative anatomy of male genitalia in some cerambycid beetles. *Journal of Faculty of Science, Hokkaido University, Series VI, Zoology* **12**, 61-114.

Fabricius, J. C. (1775). 'Systema Entomologiae.' (Flensburg et Lipsiae: Kortii).

Fabricius, J. C. (1801). 'Systema Elevtheratorvm, Tomus II.' (Kiliae: Novi.)

Gemminger, M., and Harold, B. (1873) 'Catalogus Coleopterorum Hucusque Descriptorum Synonymicus et Systematicus.' (E.H. Gummie, Monachii; E. Deyrolle Fils: Paris.) 2984pp.

Gmelin, J. F. (1790). Insecta. In 'Systema Naturae Per Regina Tri A Naturae Secundlum Classes, Ordines, Genera, Species Cum Chacteribus, Differentis, Synonymis, Locis. Tomus 1.' (Ed. C. Linnaeus.) (Impensis Georg Emanual Beer: Lipsiae.) p.1849.

Gourlay, E. S. (1951). Notes on insects associated with *Pinus radiata* in New Zealand. *Bulletin of Entomological Research* **42,** 21-22.

Gourlay, E. S. (1960). Notes on New Zealand insects and records of introduced species. *New Zealand Entomologist* **2**, 7-9.

Grehan, J. R. (1982). Larval tunnelling and associated features of *Navomorpha lineata* (Fabricius) (Coleoptera:Cerambycidae) in the host *Cyathodes fasciculata*. *Tuatara* **26,** 1-7

Healy, A. J., and Edgar, E. (1980). 'Flora of New Zealand Volume III, adventive cyperaceous, petalous and spathaceous monocotyledous.' (DSIR: Wellington) 220pp.

Hennig, W. (1950). 'Grundzüge einer Theorie der Phylogenetischen Systematik.' (Deutsche Zentraverlag: Berlin). 370pp.

Hennig, W. (1965). Phylogenetic systematics. *Annual Review of Entomology* **10**, 97-116.

Hennig, W. (1966). 'Phylogenetic Systematics' (translated by D.D. Davis and R. Zangerl.) (University of Illinois Press: Urbana.) 263pp.

Hudson, G. V. (1934). 'New Zealand Beetles and Their Larvae.' (Ferguson and Osborn: Wellington.) 236pp.

Hutcheson, J. A. (1980). *Arhopalus ferus* (Coleoptera: Cerambycidae): Structure and function of the female reproductive system. *New Zealand Journal of Zoology* **7**, 417-424.

Hutton, F. W. (1873). List of the insects recorded as having been found in New Zealand previous to the year 1870. *Transactions and proceedings of the New Zealand Institute* **6**, 158-171.

Kelsey, H. P., and Dayton, W. A. (1942). 'Standardized Plant Names (second edition), a Revised and Enlarged Listing of Approved Scientific and Common Names of Plants and Plant Products in American Commerce or Use'. (Pa. J. Horace McFarland Company for American Joint Committee on Horticultural Nomenclature: Harrisburg). 637pp.

Kuschel, G. (1990). Beetles in a suburban environment: a New Zealand case study. *DSIR Pant Protection Report* **3,** 1-120.

Lacordaire, J. T. (1869). 'Histoire Naturelle des Insectes. Genera des Coléoptéres ou Exposé Methodique et Critique de Tous les Genres Proposés Jusqu'ici Dans cet Ordre D'Insectes. VIII. Trictenotomides et Longicornes.' (Pairs.) 552pp.

Lucas, H. (1863). *Navomorpha douel* (sp. nov.). *Annales de la Société Entomologique de France* **3,** 116-117.

Lucy, B. M., and Edgar, E. (1970). 'Flora of New Zealand Volume II, Indigenous Tracheophyta, Monocotyledones except Gramineae'. (DSIR: Wellington.) 354pp.

Maddison, W. P., Donoghue, M. J. and Maddison, D. R. (1984). Outgroup analysis and parsimony. *Systematic Zoology* **33**, 83-103.

McKeown, K. C. (1948). A new name for an Australian Cerambycid. *Proceedings of the Royal Zoological Society of New South Wales* **37**, 107.

Miller, D. (1922). A new apple-tree borer, *Navomorpha sulcatus*. *New Zealand Journal of Agriculture* **25,** 296-298.

Miller, D. (1925). 'Forest and timber insects in New Zealand.' (Government Printer: Wellignton.) 76pp.

Morgan, F. D. (1960). The comparative biologies of certain New Zealand Cerambycidae. *New Zealand Entomologist* **2**, 26-34.

Newman, E. (1840). On Australasian longicorns. *The Annals and Magazine of Natural History including Zoology, Botany and Geology* **5**, 18.

Nixon, K. C., and Carpenter, J. M. (1993). On outgroups. *Cladistics* **9**: 413-426.

Olivier, A. G. (1790). Encyclopédie Méthodique, *Insectes* Tome V. p.252. (Paris.)

Olivier, A. G. (1795). Entomologie, ou histoire naturelle des insectes, avec leurs carastères generiques et spécifiques, leur description, leur synonymie et lent figure enluminee. *Coleopteres*. Tome IV. pp.25-28, 57. (Lanneau, Pairs.)

Pascoe, F. P. (1875). Descriptions of new genera and species of New Zealand Coleoptera, Part I. *The Annals and Magazine of Natural History including Zoology, Botany and Geography. 4th Series*, **16**, 216 – 217.

Rawlings, G. B. (1953). Insects of *Pinus radiata* forests in New Zealand. *New Zealand Forest Service, Forest Research Notes* **1(8),** 1-19.

Redtenbacher, L. (1868). Dr. Ludwig Redtenbacher. In 'Reise Der Österreichischen Fregatte Novara Um Die Erde in Den Jahren 1857, 1858, 1859. Zoologischer Theil. Zweiter Band. I. Abtheilung A.' (Ed. B. Von Wüllerstorf-Urbair.) p. 178. (Aus Der Kaiserlich-Königlichen Hof-und Staatsdrucherei: Wien.)

Serville, T. G. A. (1834). Nouvelle classification de la famille des longicornes. *Annales de la Société Entomologique de France* **3**, 72.

Sharp, D. (1877). Descriptions of a new genus and some new species of New Zealand Coleoptera. *The Entomologist's Monthly Magazine* **13**, 194 –195.

Sharp, D. and Muir, F. (1912). The comparative anatomy of the male genital tube in Coleoptera. *Transactions of the Entomological Society of London* , 477-642.

Svácha, P. and Danilevsky, M. L. (1986). Cerambycoid larvae of Europe and Soviet Union, part I. *Acta Universitatis Carlinae – Biologica* **30**, 1-176.

Swofford, D. L. (1991). 'PAUP: phylogenetic analysis using parsimony program and manual, Version 3.0s' (Illinois Natural History Surver: Illinois). 178pp

Thomson, J. (1860). 'Essai d'une Classification de la Famille des Césambycides, et Matérnux pour servir a une Monographie de cette Fanille. 8vo. (Liége: Paris.) 396pp.

Thomson, J. (1864). 'Systema cerambycidarum ou exposé de tous les genres compris dans la famille des cerambycides et familles limitrophes. 8vo. Livr. 1-4.' (Liége: Paris.) 578pp.

Thomson, J. (1927). The pollination of New Zealand flowers by birds and insects. *Transactions and Proceedings of the New Zealand Institute* **57,** 106-125.

Wang, Q. (1993). A revision of *Atesta* Pascoe (Coleoptera: Cerambycidae, Phoracanthini) from Australia, with descriptions of 18 new species. *Invertebrate Taxonomy* **7**, 961-1024.

Watrous, L. E., and Wheeler, Q. D. (1981). The out-group comparison method of character analysis. *Systematic Zoology* **30**, 1-11.

Webb, C. J., Sykes, W. R. and Garnock, P. J. (1988). 'Flora of New Zealand Volume IV, Naturalisted Pteridophytes, Gymnosperms, Dicotyledous'. (DSIR: Christchurch.) 1365pp.

Westwood, J. O. (1845). On the longicorn coleoptera of New Zealand. *Arcana Entomologica.* **2**, 25 – 28.

White, A (1843). Fauna of New Zealand. In 'Travels in New Zealand; with Contributions to the Geography, Geology, Botany, and Natural History of That Country, Volume II.' (Ed. E. Dieffenbach.) p. 277. (John Murray: London.)

White, A. (1845). *Calliprason sinclairi* sp. nov. *Revue Zoologique* **8**, 189.

White, A. (1846). Insects of New Zealand. In 'The Zoology of the Voyage of H.M.S. Erebus and Terror, Under the Command of Captain Sir James Clark Ross, R.N., F.R.S., during the Years 1830 to 1843. Vol. II.' (Eds. J. Richardson and J. E. Gray.) pp.1-24. (London.)

White, A. (1855). Cerambycidae. In 'Catalogue of Coleopterous Insects in the Collection of the British Museum. Part VIII. Longicornia 2.' (Ed. British Museum.) pp. 334-335. (London.)

Wiley, E. O. (1981). 'Phylogenetics – The Theory and Practice of Phylogenetic Systematics.' (John Wiler & Sons: New York.) 439pp.

Zondag, R. and Bain, J. (1976). *Stenopotes pallidus* Pascoe (Coleoptera:Cerambycidae). Forest Research Institute New Zealand Forest Service, *Forest and Timber Insects in New Zealand* **6,** 1-3.