

Identification guide to grasshoppers (Orthoptera: Acrididae) in Central Otago and Mackenzie Country

DOC SCIENCE INTERNAL SERIES 26

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Published by
Department of Conservation
P.O. Box 10-420
Wellington, New Zealand

DOC Science Internal Series is a published record of scientific research carried out, or advice given, by Department of Conservation staff, or external contractors funded by DOC. It comprises progress reports and short communications that are generally peer-reviewed within DOC, but not always externally refereed. Fully refereed contract reports funded from the Conservation Services Levy are also included.

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© January 2002, New Zealand Department of Conservation

ISSN 1175-6519

ISBN 0-478-22190-8

This is a client report commissioned by Otago Conservancy and funded from the Unprogrammed Science Advice fund. It was prepared for publication by DOC Science Publishing, Science & Research Unit; editing and layout by Geoff Gregory. Publication was approved by the Manager, Science & Research Unit, Science Technology and Information Services, Department of Conservation, Wellington.

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ABSTRACT

This report examines the distribution of a new species of short-horned grasshopper, *Sigauss* species A, first proposed by C. Jamieson. It is based on material and data collected from the Alexandra region. The taxon is related to, but a separate species from, *Sigauss childi*. Included is a description of the morphological characteristics of *Sigauss* species A that separate it from *S. childi*, and a key suitable for field use to distinguish the grasshoppers present in Central Otago and Mackenzie Country. Evidence of hybridisation between *S. childi* and the *S. australis* complex is also presented.

Keywords: grasshoppers, *Sigauss* spp., Acrididae, identification key, Central Otago, Mackenzie Country, New Zealand.

© January 2002, New Zealand Department of Conservation. This paper may be cited as:
Morris, S.J. 2002. Identification guide to grasshoppers (Orthoptera: Acrididae) in Central Otago
and Mackenzie Country. *DOC Science Internal Series 26*. Department of Conservation,
Wellington. 17 p.

1. Introduction

C. Jamieson (unpubl. report 1999) collected what appeared to be a new species of Acridid grasshopper, *Sigaus* species A, from gold tailings near Alexandra and Muttontown, Central Otago. Jamieson based the presence of this new species on personal observations, stating that it was easily recognisable in the field compared with the other grasshoppers that are established on the tailings, *Pboulacridium marginale* (Walker 1870), *Pboulacridium otagoense* (Ritchie & Westerman 1984) and *Sigaus childi* (Jamieson 1999a). Jamieson (unpubl. report 1999) also believed that *Sigaus* species A was part of the unresolved *Sigaus australis* (Hutton 1897) complex.

Jamieson described *S. childi* from the Alexandra area of Central Otago and mapped its distribution (Jamieson 1999b). *S. childi* is illustrated in a book by Peat & Patrick (1999), who also discussed the presence of an unnamed species (species A) that is confined to the Earnsclough Tailings.

Of the 24 endemic New Zealand grasshoppers (Orthoptera: Acrididae), eight are unnamed. Twelve of these grasshopper species belong in the *Sigaus* genus, and five of these species are undescribed. The genus *Sigaus* is easily distinguished from other genera within this family by the distinctive structures of the male genitalia. The epiphallus lophi are saddle-like in shape with the mesal protuberance of the lophus having a smooth, rounded outline. The epiphallus is a key internal structure of the male genitalia. The lophus originate in a lateral and posterior position on the epiphallus and the mesal protuberance is anterior and sublateral from the epiphallus lophus.

A review of New Zealand grasshoppers, based on male internal genitalia, was started in 1997 by the author, and is the first time that the internal genitalia have been examined in detail. The first group studied was the *S. australis* complex, as some specimens collected did not match the known distribution, size or colouring of either *S. australis* or *S. obelisci* Bigelow 1967 (Morris unpubl. data). The internal genitalia seem to be the only stable feature useful enough for taxonomic purposes for determining species within the *S. australis* complex. Five new species have been identified to date (Morris unpubl. data), and all but one of these unnamed species are confined to small mountainous regions (<http://homepages.cyberxpress.co.nz/visualmap/grasshopper.htm>). The other unnamed species (*Sigaus* species A) is widely distributed throughout the Mackenzie Country and Alexandra region.

This paper aims to accomplish research goals set out by the Department of Conservation: to determine the taxonomic status of *Sigaus* species A; to review of evidence provided by Jamieson (1999b) in considering *Sigaus* species A to be a separate species from *S. childi*; to provide a list of the morphological characteristics of *Sigaus* species A; and provide a key suitable for field use to distinguish between grasshoppers at Galloway and on the Earnsclough Tailings sites.

2. Methods

The 31 specimens collected by Jamieson from the Alexandra, Muttontown and Earnsclough Tailings were examined (Otago Museum collection). In addition, three male and two female *Sigauss* species A were collected on 28 February 2001 from 213 m a.s.l. on the Alexandra tailings (G42 246447 [45°15.00'S, 169°21.90'E]). The specimens collected by the author were stored frozen until examination. Male genitalia were easily extracted upon thawing by lifting the epiproct using forceps. The epiphallus, epiphallic sclerites, cingulum and phallic complex structures were extracted using two pairs of forceps. All specimens were then pinned, dried and stored in the author's private collection in Darfield. The genitalia are stored in the genitalia collection at the Canterbury Museum.

The male genitalia were sketched using a stereomicroscope with a grid eyepiece. Sketches were digitised using a Genius NewSketch 1212HRIII plotting tablet, then edited using CorelDraw 7. The South Island maps were prepared using VisualMap 5.

Distribution maps were created using data from the author's private collection and database (S.J. Morris in prep.). Table 1 includes information from S.J. Morris (unpubl. reports 2000); Jamieson 1999a, 1999b; and S. Elkington (pers. comm.).

3. Results and discussion

The genus *Sigauss* is split into two groups by external morphology, which are easily distinguished by examining the caudal margin of the pronotum. Specimens with a wavy caudal margin belong to the *Sigauss campestris* (Hutton 1897) complex, while those with a smooth margin belong to the *S. australis* complex (Fig. 1). The *S. australis* complex is made up of two described species (*S. australis* and *S. obelisci*) and five undescribed species (S.J. Morris unpubl. data), all of which are found in the southern half of the South Island (<http://homepages.cyberxpress.co.nz/visualmap/grasshopper.htm>). In comparison, the *S. campestris* complex comprises three described species (*S. childi*, *S. campestris*, and *S. minutus*)

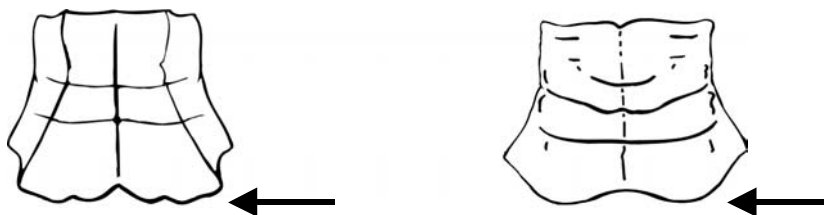


Figure 1. Caudal margin of the pronotum, left *Sigauss campestris* complex, right *Sigauss australis* complex.

Sigauss species A is placed in *Sigauss* due to the epiphallus lophus being saddle-like in shape and the antenna apical are flattened and broadened. As the caudal margin of the pronotum is smooth, *Sigauss* species A is considered part of the *S. australis* complex. The internal genitalia of *Sigauss* species A was compared with *S. australis*, *S. obelisci* and the five undescribed species, confirming that it is indeed a separate species from *S. childi* (Fig. 2).



Figure 2. Male *Sigauss* species A epiphallus, left Anterior view of epiphallus, right Dorsal view of epiphallus. Arrows indicate key features on the epiphallus.

The morphological characteristics of *Sigauss* species A were compared with that of *S. childi*. Many consistent features for distinguishing them were found (Table 1), with two of the principal external characteristics being the length of the tegmina and the caudal margin of the pronotum.

Sigauss species A is an average-sized grasshopper, with females approximately 20–25 mm and males roughly 12–15 mm in length. The forewings are never greater than 15 mm, and the hindwings are shorter and tucked under the forewings (S.J. Morris in prep). The hind tibiae are reddish in colour, with the hind femur usually having two black bands on the inside of the leg. *Sigauss* species A has only been collected at lower altitudes compared with the other grasshoppers in the *S. australis* complex; however, there is overlap in altitude with other species (see Fig. 3). All the specimens observed on 28 February from the Alexandra tailings were grey in colour. This contrasts with specimens of *Sigauss* species A collected from 26 sites throughout the Mackenzie Country, where the body colour of *Sigauss* species A is an overall forest green and the forewings are a darker green in colour. The grey coloration is a local adaptation, and probably assists in camouflage against the grey/white substrate of the Alexandra tailings.

TABLE 1. PRINCIPAL MORPHOLOGICAL CHARACTERISTICS THAT SEPARATE *Sigauss* species A AND *S. childi*.

<i>Sigauss</i> species A	<i>S. childi</i>
Adult male body length 12–15 mm long. Adult female body length 20–25 mm long.	Adult male body length 11–13 mm long Adult female body length 21–22 mm long.
Tegmina small and extends further than half way down the second abdominal segment.	Tegmina very small and extends no further than half way down the second abdominal segment.
A smooth caudal margin of the pronotum.	A wavy caudal margin of the pronotum.
Lateral lobe of lophus of male genitalia with a small ridge on the outline.	Lateral lobe of lophus of male genitalia with smooth outline.

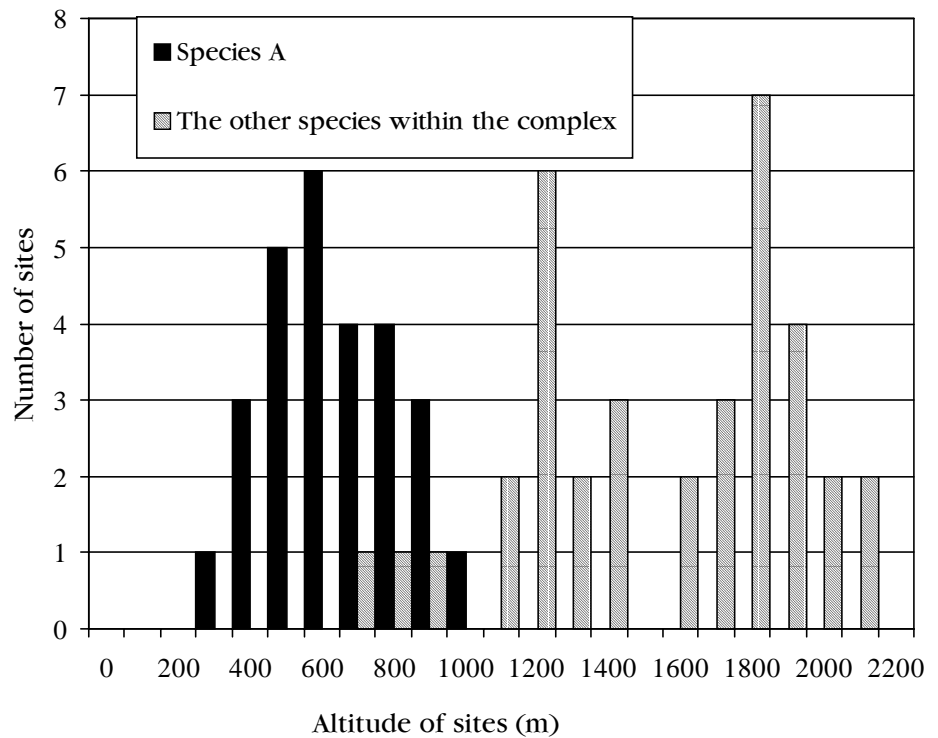


Figure 3. The altitude of collecting sites for *Sigaus* species A and the remaining species in the *S. australis* complex (*Sigaus* species A, $n = 27$; *S. australis* complex, $n = 37$).

Four species of grasshoppers can be found around Alexandra, *P. marginale*, *P. otagoense*, *Sigaus* species A and *S. childi*. All species were found at the four sites surveyed: Galloway Station, and the Alexandra, Earnsclough and Muttontown tailings sites. The exception to this is the lack of *P. marginale* at the Galloway Station site. The population of *Sigaus* species A from the Alexandra tailings is the most southern recorded, some 16 km further south of the previous record (S.J. Morris in prep). Distribution maps for each of the grasshopper species found in the Earnsclough and Alexandra tailings areas have been produced as Figs 4-8.

4. Conclusions

Appendix 1 contains a key to the montane/lowland grasshopper species of Central Otago and the Mackenzie Country. This key will allow reliable separation of these species.

Examination of the 31 specimens collected by Jamieson found several specimens with external characteristics of both *S. childi* and *Sigaus* species A. This is interpreted as evidence of hybridisation between the two species and has probably resulted from the two populations being sympatric. Trewick & Wallis (unpubl. report 1999) also mention that they observed hybridisation between *S. childi* and *S. australis*.



Figure 4. Distribution of *Phaulacridium marginale* in the South Island, New Zealand.



Figure 5. Distribution of *Phaulacridium otagoense* in New Zealand.



Figure 6. Distribution of *Sigauss* sp. A in New Zealand.



Figure 7. Distribution of *Sigauss childi* in New Zealand.



Figure 8. Distribution of *Sigaus minutus* in New Zealand.

Note. The southernmost location is Green Spur (south of the Upper Taieri Plains)

The Alexandra tailings are relatively small, and only about half a dozen adults were seen. However, this would not be the first time that a grasshopper species would be restricted to such a very small area. The Australian grasshopper *Phaulacridium howeanum* Key 1992 is restricted to a site no larger than 40 m² on Mount Gower, Lord Howe Island (Key 1992).

Additionally, I report the first instance of a colour morph of a short-horned grasshopper confined to a small area in New Zealand. Several grasshopper species in New Zealand exhibit up to six colour morphs (photographic data collected by the author), but these are usually spread throughout the South Island. The grey colour morph of *Sigaus* species A is very unusual for a New Zealand short-horned grasshopper.

Eventually DNA testing may distinguish between the Earnscleugh tailings and Mackenzie Country populations and show them as distinct species. Nuclear DNA has been used to confirm separation between *P. otagoense* and *P. marginale* (Ritchie & Westerman 1984), and mitochondrial DNA has been used to confirm separation between *S. childi* and *S. minutus* (Trewick & Wallis unpubl. report 1999).

5. Acknowledgements

I would like to thank Peter Johns, Mike Tubbs, and Bruce McKinlay for helping me collect specimens from the Alexandra tailings and Crawford Hills Road.

I thank: Mark Walker and Brian Patrick (both Otago Museum) for reviewing this manuscript; the Otago Museum for use of their resources with their help with this manuscript; and especially Mark Walker who kindly provided the Jamieson specimens for examination.

I gratefully acknowledge the added support of the Canterbury Museum, Mason Foundation Research Grant, for funding me to collect the other specimens useful for this report.

6. References

- Bigelow, R.S. 1967: The Grasshoppers (Acrididae) of New Zealand, Their Taxonomy and Distribution. University of Canterbury Publications. 110 p.
- Hutton, F.W. 1897: The grasshoppers and locusts of New Zealand and the Kermadec Islands. *Proceedings and Transactions of the New Zealand Institute* 30: 135-50.
- Jamieson, C.D. 1999a: A new species of *Sigauss* from Alexandra, New Zealand (Orthoptera: Acrididae). *New Zealand Journal of Zoology* 26: 43-48.
- Jamieson, C.D. 1999b: Distribution and abundance of *Sigauss childi* Jamieson (Orthoptera: Acrididae), a Central Otago endemic. *Science for Conservation* 110. Department of Conservation, Wellington.
- Key, K.H.L. 1992: Taxonomy of the genus *Pbaulacridium* and a related new genus (Orthoptera: Acrididae). *Invertebrate Taxonomy* 6.
- Peat, N.; Patrick, B.H. 1999: Wild Central. University of Otago Press, Dunedin.
- Ritchie, J.M.; Westerman, M. 1984: The taxonomy, distribution and origins of two species of *Pbaulacridium* (Orthoptera: Acrididae) in the South Island of New Zealand. *Biological Journal of the Linnean Society* 21: 283-298.
- Walker, F. 1870: Catalogue of the Dermaptera-Saltatoria in the British Museum. Part IV. p. 710.

Appendix 1

GLOSSARY

Anterior, in front; before.

Apical, at, near or pertaining to the apex of any structure.

Caudal, to the anal end of the insect body.

Carina (pl. **carinae**), an elevated ridge or keel.

Lateral, relating, pertaining, or attached, to the side.

Posterior, hinder or hindmost; opposed to anterior.

Pronotum, the upper or dorsal surface of the prothorax.

Prothorax, the first of the three primary subdivisions of the thorax.

Sinuate, (of edges and margins) wavy.

Sulcus, a furrow or groove.

Tegmen, a covering; the hardened leathery or horny forewing in Orthoptera.

Tibia (pl. **tibiae**; adj. **tibial**) the fourth segment of a leg, between the femur and the tarsus.

Transverse, broader than long, running across; cutting the longitudinal axis at right angles.

Appendix 2

FIELD GUIDE TO SPECIES OF GRASSHOPPER IN CENTRAL OTAGO AND MACKENZIE COUNTRY

To use this field guide, simply match the statement on the left-hand side of the key with the specimen. If the statement matches, the answer is provided on the right-hand side of the key.

A small hand lens may be required to answer some questions. All colours are for live or fresh specimens only.

This is a field guide and should not be used for formal identification.

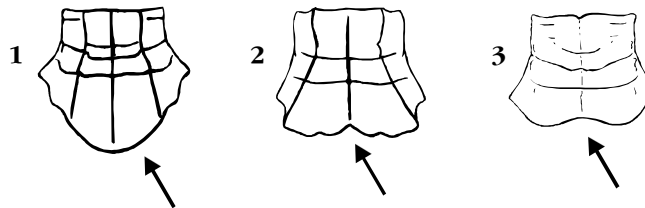
The layout of the field guide was designed so that it could be photocopied and used in the field.

Identification of genus

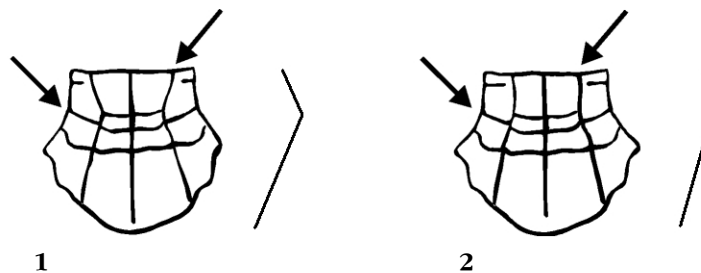
The caudal margin of the pronotum arches backward – 1 ... *Phaulacridium* Q1

The caudal margin of the pronotum is wavy – 2 *Sigaüs* Q2

The caudal margin of the pronotum is notched – 3 Q3



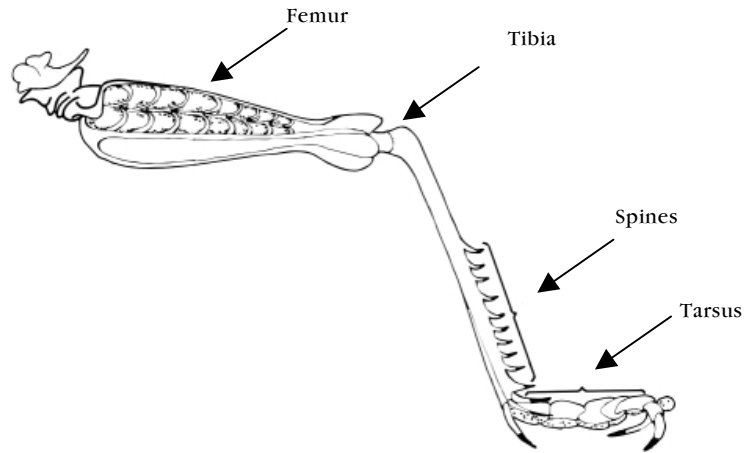
Q1 What species of *Phaulacridium* is it?



The lateral carinae of pronotum forms a larger angle at the second transverse sulcus – 1 *otagoense*

The lateral carinae of pronotum forms a straighter line at the second transverse sulcus – 2 *marginale*

Pbaulacridium species (continued)



The hind tibiae always greyish in colour, never red..... *otagoense*

The hind tibiae reddish, light green, grey or light to dark brown in colour *marginale*

The adult male body length less than 8 mm *otagoense*

The adult male body length greater than 10 mm *marginale*

The specimen was collected on **very dry** and open country *otagoense*

The specimen was collected in tall native grassland *marginale*

Q2 What species of *Siga*us is it?

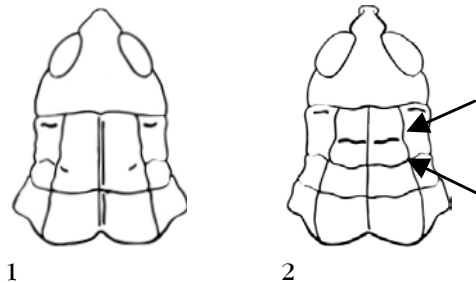
Adult male body length greater than 11 mm

Adult female body length greater than 18 mm *cbildi*

Adult male body length less than 10 mm

Adult female body length less than 17 mm *minutus*

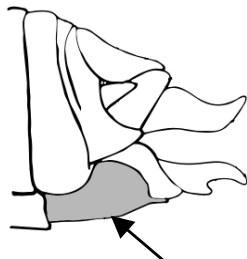
Q3 What genus is it?



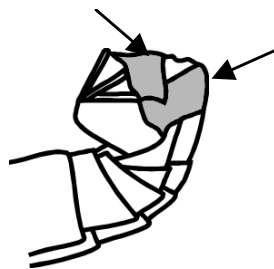
First and second transverse pronotal sulci absent - 1 **Q4**

First and second transverse pronotal sulci present - 2 *Siga*us **Q5**

Q4 What species is it?



Female, subgenital - lateral



Male, subgenital - lateral

Subgenital plate on both male and female is orange*Alpinacris tumidicauda*

Subgenital plate on both male and female is not orange*Paprides dugdali*

Q5 What species of *Siga* *australis* complex is it?

The specimen was collected below 1000 m species A

The specimen was collected above 1400 m *australis* complex ¹

¹It is recommended that male specimens collected be sent to the author for formal identification.