Distribution and conservation status of ground weta, *Hemiandrus* species (Orthoptera: Anostostomatidae)

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A B S T R A C T

A short history of the collection and description of the seven known species of ground weta in New Zealand is presented.

An argument to raise or lower the status of the present names and an indication of the number of undescribed species is given. A few details of the species' biology and maps of the known distributions are presented. Some details of 28 new species are given but the new names are not available (Article 8.3 of the ICZN Code). The species are placed into groups according to conservation status: common and widespread, or common and restricted, very local species, and species that are known from fewer than five records. Conservation recommendations made are based on these details.

Keywords: Orthoptera, Anostostomatidae, weta, *Hemiandrus*, conservation.

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1. Introduction

Weta in the genera *Hemiandrus* Ander, 1938 and *Zealandosandrus* Salmon, 1950 have presented problems to many who have tried to identify species. This is due mainly to some poor descriptions, the confusion over earlier species and names, and the number of undescribed forms now known to exist. In his taxonomic revision, Salmon (1950) misidentified specimens, placing conspecifics under several names in one case, and included within a species description the characters of another taxon. Recent genetic studies suggest that there are two clades within the genus that may require re-examination of their generic status.

Johns (1997), in reviewing the family, gave the basic synonymies and recombinations and the following text expands the arguments for those changes. Although the generic names *Onosandrus* and *Libanasa* (which are based on South African species), and *Ceuthophilus* (a North American genus of the Rhaphidophoridae) have been used in New Zealand, not one has representatives here. The first problem is that of the status of the type species of the genus *Zealandosandrus*: *Libanasa (?) maculifrons* Walker, 1869. The original description is short and most points could be applied to several species. However, those characters, confirmed on re-examination of the holotype, do not include the species *Onosandrus focalis* Hutton 1897, a species given as a synonym of it by Salmon (1950). Size and the described spination of the fore tibia certainly preclude that synonymy. Walker's holotype is in shocking condition: head and five legs missing and the body badly damaged and covered with a deposit that may have arisen after drying from alcoholic preservation. However, the cerci and ovipositor are complete and the weak mottling of the pronotum and abdomen and the notched 7th tergite are compatible with those of *Zealandosandrus gracilis* Salmon, 1950.

Salmon nominated *Libanasa maculifrons* (*nec* Walker, 1869 = *Onosandrus focalis* Hutton 1897) as the type species of *Zealandosandrus*. As a misidentification of the type species is involved article 70(b) of the ICZN Code (1999) should be invoked. The two species involved are considered congeneric and as no nomenclatural instability is likely, *Libanasa maculifrons* may be accepted as the designated type species, regardless of the misidentification. It is also the most widespread and common species, which satisfies some recommendations of the Code.

The basis for separation of *Zealandosandrus* from *Hemiandrus* was the full development of the ovipositor in the former and its complete reduction in the latter. This reduction is presumably associated with the habit of the female of laying eggs within a chamber at the bottom of her burrow where she attends to them and the subsequent larvae for some time during development. An intermediate condition of the ovipositor is seen in three new species, *H.* "evansae", *H.* "okiwi" and *H.* "turgidulus". Another character, found since, is the presence of a pair of lobes and pockets on the posterior (paramedian) surface of the female sternite 6 (S6). This character is seen in most *Hemiandrus* (*sensu* Salmon) species. *Hemiandrus focalis*, the species identified by Salmon as *Zealandosandrus maculifrons,* has paramedian lobes on the female 6th

sternite, although they are very weakly developed. Females of the other species of *Zealandosandrus*, including *H. maculifrons* (Walker), have a median pocket between sternites 6 and 7, a state not seen in any *Hemiandrus* (*sensu* Salmon). On the basis of the distribution of these characters over all the species now considered, *Zealandosandrus maculifrons* (*sensu* Salmon, *nec* Walker = *Onosandrus focalis* Hutton) and *Libanasa maculifrons* Walker should be transferred to *Hemiandrus* Ander, and *Zealandosandrus* is a subjective synonym of *Hemiandrus*.

Libanasa pallitarsis Walker, 1869 must also be excluded from *Onosandrus focalis*. The status of *Libanasa pallitarsis* Walker, 1869 has already been partly resolved by Kirby (in Hutton 1899; Kirby 1906) who had Walker's types available to him. Kirby synonymised *L. pallitarsis* under *Ceuthophilus (?) lanceolatus* Walker, 1869, a species name which Salmon later did not consider, even though Kirby had placed the species in *Onosandrus*, a genus into which the other species had been placed.

Ramsay (1961) reexamined the types and transferred the species to *Hemiandrus*. He considered them to be juveniles, but the holotype of *Ceuthophilus pallitarsis* is, without doubt, a small female with the distinctive bilobate process on the 6th sternite and it must be conspecific with *Hemiandrus furcifer* Ander 1938. The holotype is in very good condition, lacking only its antennae. The holotype of *Libanasa lanceolatus* is, however, a small juvenile and in very poor condition. It is, in essence, a *nomen dubium*. Its extant details are consistent with any one of the species known from the Collingwood area—its type locality—namely *H. maculifrons*, *H.* "alius" or *H.* "disparalis".

2. Collection and preservation

Specific studies were made in areas in or near Waipoua Forest, Coromandel, Lake Rotoiti, Cape Campbell and Alexandra. Other material examined has been collected over many years and is now deposited in National Insect Collection, Landcare Research, Auckland and the Canterbury Museum, Christchurch. Many individuals have made material available, and collections have usually been, or soon will be, deposited in a national institution as required by Department of Conservation permits. My own collecting forms the bulk, and this has been deposited in the Canterbury Museum, though duplicates will be distributed to other institutions. Because I have been based in Christchurch, most information concerns South Island species and this is particularly noticeable in the detail of the distribution patterns.

Most species are active on 'good' nights. Calm, relatively warm and humid conditions coinciding with the lack of moonlight seem best. They are readily pit-trapped (trap size > 3 cm diameter—live traps or with fluid). They are also often taken in malaise traps that touch the ground or surrounding vegetation. The forest species may be caught spot-lighting and one species readily comes to bait trails (1–2 teaspoons of rolled oats set at 1 m intervals). They have not

responded to the otherwise very effective attractant of fermented stale beer and pineapple that works so well for Australian anostostomatids and other insects. They preserve well in 80% alcohol (or 70% if the alcohol is changed within 12 hours) or may be pinned if space is not at a premium, though the loss often of their antennae and palps detracts from this method.

3. The species

Orthoptera: Anostostomatidae: Anostostomatinae

Following Johns (1997) these are the valid names of species and their synonyms.

Hemiandrus maculifrons (Walker, 1869)
Zealandosandrus gracilis Salmon, 1950
Hemiandrus pallitarsis (Walker, 1869)
Hemiandrus furcifer Ander, 1938
Hemiandrus focalis (Hutton, 1897)
Zealandosandrus maculifrons sensu Salmon, 1950
Hemiandrus bilobatus Ander, 1938
Hemiandrus fiordensis (Salmon, 1950)
Hemiandrus subantarcticus (Salmon, 1950)
Hemiandrus lanceolatus (Walker, 1869)

The following are undescribed species and the names used are hereby disclaimed (Article 8.3) and are thus not available (International Code of Zoological Nomenclature 1999). Some names will be used in forthcoming formal descriptions.

Hemiandrus "alius"
Hemiandrus "disparalis"
Hemiandrus "dodsons"
Hemiandrus "elegans"
Hemiandrus "evansae"
Hemiandrus "furoviarius"
Hemiandrus "hapuku"
Hemiandrus "horomaka"
Hemiandrus "kapiti"
Hemiandrus "madisylvestris"
Hemiandrus "mtgeorge"
Hemiandrus "nokomai"
Hemiandrus "okiwi"
Hemiandrus "onokis"
Hemiandrus "otautau"
Hemiandrus "otekauri"
Hemiandrus "porters"
Hemiandrus "promontorius"
Hemiandrus "pureora1"
Hemiandrus "pureora2"
Hemiandrus "redhills"
Hemiandrus "richmond"
Hemiandrus "saxatilis"
Hemiandrus "staveley"
Hemiandrus "timaru"
Hemiandrus "turgidulus"
Hemiandrus "waimakariri"
Hemiandrus "vicinus"

There are several specimens, perhaps representing six species, whose taxon status is too doubtful to be considered here.

3.1 KEY CHARACTERS

In body length the species range from the smallest, *H.* "nokomai", at 12–15 mm, to *H.* "elegans" at 30 mm, but most species are in the 15 to 22 mm range. Females tend to be slightly larger than males. Most species are easily distinguished on a combination of a few characters (Tables 1, 2) applicable to both sexes and most instars. Features are best seen in the penultimate and adult instars. Not all species are included in these tables because of the lack of well preserved, mature specimens. For recognition of species, features may best be checked by following the sequence of the table column headings.

Pilosity—the covering of short fine setae over the surface of the palp segments—is important. Maxillary palpus 4 (MP4) is swollen over its distal half and for most species that swollen portion is also densely pilose, just as is the entire MP5. The distal portion of MP3 may also be pilose, and when it is, so also is all of MP4 (Fig. 1). There is some variation between species as to how much of MP3 and MP4 are pilose and whether the pilosity symmetrically covers the dorsal and ventral surfaces.

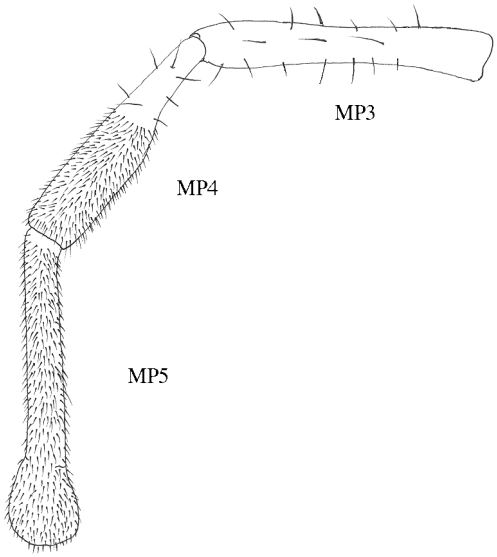

Figure 1. Details of the pilosity and setation of maxillary palps segments 3, 4 and 5.

The number of glabrous (smooth, shining and lacking pilosity) basal segments of the antenna is useful when the antennae are present, but there is considerable variation between individuals.

A set of key features is the number and arrangement of moveable spines on the front and middle tibiae. The front tibia has one moveable spine, usually set about midway, but there is some variation between the species. Three species have two spines set on either side of the midpoint. Very rarely do the two-spined species have only one and occasionally there are three.

The middle tibia has two or three spines on the upper front (prolateral) surface and 3 or 4 on the hind (retrolateral) surface (both numbers include the apical spines). The apical pair is symmetrical (placed on either side equidistant from or at the tibial apex) but the others may be in pairs (symmetrical) or alternate (asymmetrical). Where the hind row is reduced from 4 to 3 it may be through the loss of either the subapical or the proximal spine. There is some minor variation in the loss of spines within a species.

TABLE 1. SPECIES CHARACTERISTICS—GENERAL.

SPECIES AND TAG NAMES	MP3	MP4	ANTENNO-MERES	FORETIBIAL SPINES	PRO-LATERALS	RETRO-LATERALS	MIDTIBIAL SYMMETRY	TARSUS4	STRIDULATORY PEGS
H. bilobatus	bare	55%	12	2	3	4	symmetrical	bare, few erect setae	100-150, T1-3, fewer on T4-6
H. pallitarsis	bare	70%	16-18	1	3	4	slightly asymmetrical	all setose, sparsely pilose	100-150, T1-3
H. "vicinus"	bare	60%	10-15	1	2	4	basal pair symm.	all setose	50-80
H. "onokis"	bare	66%	9-12	1	2	4	symmetrical, proximal missing	all setose, sparsely pilose	100-150
H. "kapiti"				1	2	4			
H. "promontorius"	bare	66%	10	2	2	4	symmetrical	bare, few erect setae	80-100, T1-4
H. fiordensis	33%	100%	10-14	1	3	4	almost paired	f—66%, m—50%, h—20%	
H. "madisylvestris"	33%	100%	10-14	1	3	4	symmetrical	all pilose, appressed	5-10, T1-3
H. maculifrons	33%	100%	12-14	1	3	4	almost paired	all pilose, appressed	10-20, T1-3
H. "evansae"	bare	55%	12-16	1	3	4	asymmetrical	bare, few erect setae	50-70
H. subantarcticus	10%	100%	20-26	1	3	4	almost paired	bare, few erect setae	3-10, T1-2, greatly reduced
H. "disparalis"	bare	55%	20-22	1	3	4	asymmetrical	bare, few erect setae	70-100
H. "saxatilis"	50%	100%	10	1	3	4	asymmetrical	all pilose, appressed	10-20, T1-3
H. "alius"	33%	100%	9-12	1	3	4	strongly asymmetrical	bare, few erect setae	20-30, T1-3
H. focalis	bare	50%		1	2(3 rae)	4		bare, few erect setae	
H. "turgidulus"	bare	50%	10-13	1	3	3	subapical missing	bare, few erect setae	40-60, T1-3
H. "horomaka"	bare	55%	10	1	2	3	asymmetrical	all setose, sparsely pilose	
H. "furoviarius"	bare	55%	10	1	3	3	asymmetrical, subapical missing	bare, few erect setae	50-80, T1-3
H. "nokomai"				1	3	3	asymmetrical, subapical missing	bare, few erect setae	
H. "otekauri"	50%	100%	15	1	3	4	asymmetrical	all pilose, appressed	15-20, T1-3
H. "elegans"	bare	55%	23-25	1	3	4	asymmetrical		50-80
H. "porters"	bare	55%	12-15	1	3	3	asymmetrical, subapical missing		
H. "hapuku"	bare	55%	15-16	2	3	4	asymmetrical		
H. lanceolatus									
H. "timaru"	bare	55%	12-14	1	3	3	asymmetrical, subapical missing		
H. "okiwi"	bare	55%	16-18	1	3	4	asymmetrical		

MP3 and MP4 = percentage cover of fine pilosity on maxillary palps 3 & 4; antennomeres = number of basal glabrous segments; foretibial spines = number of spines close to the midpoint of front tibia; prolaterals = number of prolateral spines on middle tibia; retrolaterals = number of retrolateral spines on middle tibia; midtibial symmetry = whether the prolateral and retrolateral spines are in pairs or asymmetrically placed; tarsus4 = condition of pilosity and setation of the last tarsal segment, f = fore, m = mid, h = hind; stridulatory pegs = number or range of pegs on lateral surface of abdominal tergites 1–6.

TABLE 2. SPECIES CHARACTERISTICS—MALE AND FEMALE.

SPECIES AND TAG NAMES	MALE T8 MARGIN	MALE T9 EDGE	MALE T10 FALCI	MALE CERCI	FEMALE T9	FEMALE 6–7 STERNITE	FEMALE CERCI	OVIPOSITOR
H. bilobatus	Large bilobed		close	blunt, setose	simple	paired	short, pointed, bare tip	short
H. pallitarsis	simple		close		simple	long, narrow, bilobed	long, pointed, bare tip	short
H. "vicinus"	small submedian bilobed	weakly bilobate	wide	blunt, setose	simple	paired	short, pointed, bare tip	short
H. "onokis"	simple	weakly produced, laterally thickened	wide	blunt, setose	simple	large, bilobed	long, pointed, bare tip	short
H. "kapiti"	4 lobes		wide					long
H. "promontorius"	bilobed, triangular	weakly produced, laterally thickened	close	blunt, setose	simple	massive, bilobed	very short bare, sharp	short
H. fiordensis		bilobed	close	blunt, setose	median, simple	long, pointed, bare tip	long	
H. "madisylvestris"	simple	weakly bilobed	close	blunt, setose	simple	median, simple	long, pointed, bare tip	long
H. maculifrons	simple	bilobed, triangulate/spinous	close	blunt, setose	notched	median, simple	long, pointed, bare tip	long
H. "evansae"	median lobe	very weakly bilobate	wide		simple	paired pits	long, pointed, bare tip	moderately short
H. subantarcticus		simple	close	blunt, setose	simple	median, ridged	long, pointed, bare tip	long
H. "disparalis"	weak median triangulate projection	weakly produced, laterally thickened	wide	blunt, setose	simple		long, pointed, bare tip	long
H. "saxatilis"	simple	simple	close	blunt, setose	median	long, pointed, bare tip	long	
H. "alius"	simple	bilobed, triangulate/spinous	close, broad lateral areas	long, pointed, bare tip	simple		long, pointed, bare tip	long
H. focalis	simple	laterally thickened	wide	blunt, setose	simple	paired	blunt	long
H. "turgidulus"	simple	weakly produced, laterally thickened	wide	blunt, setose	simple	wide, paired pits	short, pointed, bare tip	short
H. "horomaka"	simple	weakly produced, laterally thickened	wide	blunt, setose	simple	pair, large lobes		short

Male T8 margin = whether simple, with a median lobe or a pair of triangular lobes; male T9 edge = whether it is lobed, slightly expanded or thickened; male T10 falci = close to median line or widely separated; female S6–7 = state of the sternite's margin and its developments; ovipositor = length (in three categories: long, moderately long, short).

Table 2 *continued*.

SPECIES	MALE T8 MARGIN	MALE T9 EDGE	MALE T10 FALCI	MALE CERCI	FEMALE T9	FEMALE 6–7 STERNITE	FEMALE CERCI	OVIPOSITOR
H. "furoviarius"	simple	weakly produced, laterally thickened	wide	blunt, setose	simple	paired pits	short, pointed, bare tip	moderately short
H. "nokomai"					simple			long
H. "otekauri"	simple	greatly enlarged, bilobed, spinous	close, with lateral triangular, blunt, projections	blunt, setose	simple			long
H. "elegans"	weak median triangulate projection	weakly produced, laterally thickened	wide	blunt, setose	simple			long
H. "porters"	simple	weakly produced, laterally thickened	wide	blunt, setose	simple	paired	long, pointed, bare tip	long
H. "hapuku"	simple	weakly bilobed	wide	blunt setose	simple	paired pits	long, pointed, bare tip	long
H. lanceolatus								
H. "timaru"					simple	paired pits	long, pointed, bare tip	long
H. "okiwi"	simple	weakly bilobed	close, no lateral areas	blunt, setose	simple	wide paired pits	long, pointed, bare tip	moderately short

Male T8 margin = whether simple, with a median lobe or a pair of triangular lobes; male T9 edge = whether it is lobed, slightly expanded or thickened; male T10 falci = close to median line or widely separated; female S6–7 = state of the sternite's margin and its developments; ovipositor = length (in three categories: long, moderately long, short).

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