

**University of South Bohemia**  
**Faculty of science**

**Revision of the genus *Caledonica* Chaudoir, 1860**  
**(Coleoptera: Cicindelidae)**

Bachelor thesis

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## **Bachelor thesis**

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## **Anotace**

New Caledonian tiger beetle genus *Caledonica* was revised. Study was based on specimens in museum and author's private collections and also on living specimens directly in their biotopes during three field research trips. Detailed description or redescription of all taxa is given supplemented with data on behaviour observations in their biotopes and all descriptions are fully illustrated.

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Arnošt Kudrna

V Českých Budějovicích dne 12.12.2013



## **Preface**

My original intentions were to produce a thesis upon which a scientific paper will be written supplementing review of *Caledonica* Chaudoir, 1860 by Deuve (1981). However, over the time this review proved to be insufficiently done with numerous things to be corrected or clarified. Therefore I changed my thesis to be a full revision of the genus. Recently, I found several problems which require to go back and forth to the type specimens, I have already studied in the past, to be solved. Most of the type material as well as additional historical specimens are housed in MNHN. Moreover, several types are considered as lost thus neotype designations will be necessary to fix the published names to actual beetle specimens. Unfortunately, it was not possible to obtain the material on loan or do any dissections nor any other manipulations, thus I had to study the specimens *in situ* in MNHN. I am still very grateful I was able to examine these specimens, however, longer time would be needed due recent examinations of new material and detailed studies of the primary descriptions. Therefore, I do not provide here the neotype designations until I have opportunity to see the MNHN material again to chose the best fitting specimens. Nor I include full bibliographic citations to all species because many of subsequent works introduced misidentifications and again additional material housed in MNHN would be required to place them under correct species. In this respect the work is unfinished and will require some more time. However, this might be a "little longer" lasting task because organizing visits to MNHN and loan of material from other institutions is rather slow. Thus, I more focused in the thesis on redescriptions of all taxa including full illustrations of important morphological features.

Once I will be able to complete these "missing" parts the paper will be submitted as a revision to appropriate entomological journal including all relevant information such as neotype designations, full bibliography and other little things missing here.

**This work is not issued for public and permanent scientific record thus all taxonomic acts proposed here must not be considered as validly published in sense of the International Code of Zoological Nomenclature.**

## **Acknowledgements**

I would like to thank Azadeh Taghavian and Thierry Deuve (both MNHN) for kind and friendly cooperation during my visits to the museum and my friend Alain Drumont (IRSNB) for help with original French texts and loan of type material from their collection. I also thank Max Barclay (BMNH) for some language corrections and loan of *Caledonica* specimens under his care. I am very thankful to Lukáš Sekerka for great supervising of my thesis and my father Arnošt Kudrna (Rudolfovo) for his valuable help with excellent quality photographs. I am particularly obliged to Jiří Moravec (Adamov) for his valuable help and advices.

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Last but not least, I would like to gratefully thank all members of Luiggi family. Their hospitality, friendship and all the love they gave us made themselves to become our second family. Big thanks belong in general to all friendly New Caledonian people who were very helpful and made New Caledonia our second home.

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## Introduction

The tiger beetles (Coleoptera: Cicindelidae) is a family with worldwide distribution. It is widespread in all the biotopes, except very cold areas, from humid forests, woods, savannahs to drier semi-deserts and even deserts. The family name tiger beetles refers to their predatory way of life.

Tiger beetle fauna of New Caledonia comprises mostly endemic taxa included into following genera: *Vata* Fauvel, 1903, recently discovered genus *Manautea* Deuve, 2006 and *Caledonica*, Chaudoir, 1860. Except these genera there is only one species, *Myriochila* (*Myriochila*) *semicincta* (Brullé, 1834), which occurs also outside New Caledonia and is widely distributed in the Australo-Asian region.

The most diverse genus with currently recognized 14 species and two subspecies is *Caledonica* Chaudoir, 1860 (Deuve 1981, present paper). Adults are strictly tree trunks dwelling and therefore mostly dependant on forest biotopes. Just like other silvicolous Cicindelidae, members of *Caledonica* are endangered by prospective deforestation and therefore their presence could possibly be a good indicator of nature balance.

Several *Caledonica* species were known only from very few historic specimens collected more than hundred years ago. Nearly nothing was published on their biology, ecology, distribution or behaviour. The genus was briefly reviewed by Deuve (1981), however, this study proved in subsequent decades not to be sufficient source of information if anyone needs to identify *Caledonica* species properly.

Entomological research in New Caledonia, as well as in the other remote areas of the World, is rather difficult, expensive and requires a lot of organising and thorough preparations. Moreover, longer stay is necessary to bring relevant results.

During my long term field research, lasting nine months in total, I have accumulated numerous field observations, photos of specimens in their natural habitats, and collected extensive material which included discovery of an undescribed species and rediscovery of several other species known only from the type specimens. All these findings together with rather poor knowledge of the genus led me to work out this revision which is tended to contain all information on biology and behaviour, detailed redescriptions of all known taxa, description of previously unknown sexes. Additional abundant collected material served as a basis for this

study as it allowed me understanding of species variability and thus enabled proper identification of most species essentially needed for the revision.

However, recent discoveries of a new species right in the garden of my friends or Deuve's (2006) of completely unknown genus and species implies that the Cicindelidae fauna of New Caledonia is still rather poorly explored. Moreover, position of some taxa is still unclear and their biology remains unknown because of insufficient material. Additional studies are necessary and will lead, almost surely, to many new discoveries. Therefore, I will orient my next expedition to New Caledonia with accent to the least explored areas of the archipelago in hope of finding species known currently only from a very limited, mainly historical, material. Furthermore, combination of morphology with molecular studies may also help to resolve the relations of similar species in the genus.

## **Check-list of known *Caledonica* Chaudoir, 1860 species**

*acentra* Chaudoir, 1869

= *wormae* Wiesner, 1991 **syn. nov.**

*affinis* (Montrouzier, 1860)

= *fasciata* Chaudoir, 1860

*arrogans* (Montrouzier, 1860)

= *tuberculata* Fauvel, 1882

*bavayi* Fauvel, 1882 stat. restit.

*fleutiauxi* Deuve, 1981

*longicollis* Fauvel, 1903

*luiggiorum* sp. nov.

*lunigera* Chaudoir, 1860

= *deplanchei* Fauvel, 1862

*mediolineata* (Lucas, 1862)

*mniszechii* (Thomson, 1856)

*myrmidon* Fauvel, 1882

*pulchella* (Montrouzier, 1860)

*rivalieri* Deuve, 1981

*rivalieri laevioricollis* Deuve, 2006



*viridicollis* Deuve, 1987

*viridicollis rubicondosa* Deuve, 2006

## History of the genus

The genus *Caledonica* was erected by Chaudoir (1860) for *Distipsidera mniszechii* Thomson, 1856 in order to separate New Caledonian species included in the genus *Distipsidera* Westwood, 1837 from those occurring outside New Caledonia and possessing different characters. In the same paper Chaudoir described another two species, *Caledonica fasciata* and *C. lunigera*, and argued: “The three known species of this new genus all inhabit New Caledonia, I have given it the name of the country to which this form is devoted”, while on the next page he simultaneously noted that *C. lunigera* probably inhabits Vanuatu (former New Hebrides). Nevertheless, five years later, in his catalogue (Chaudoir 1865), he listed this species as being from New Caledonia and synonymized *C. fasciata* with *C. affinis*.

In the same year in which Chaudoir erected the genus *Caledonica*, three new species of this genus were described by Montrouzier (1860), but placed by him into the genus *Oxycheila* Dejean, 1825: *O. arrogans*, *O. pulchella* and *O. affinis*. Subsequently, three other species were described: *Caledonica mediolineata* (Lucas, 1862), *C. deplanchei* (Fauvel, 1862), and *C. acentra* Chaudoir, 1869.

Later on, Fauvel (1882) treated *C. arrogans* as species *incertae sedis* and described three new species: *C. tuberculata*, *C. myrmidon* and *C. bavayi*. He also presented the first key to *Caledonica* and considered *C. deplanchei* as a synonym of *C. lunigera*. He was apparently not aware of the existence of *C. acentra* as that species was not included in the paper and therefore compared *C. bavayi* to *C. lunigera* and *C. mniszechii*, which he considered to be the closest species.

Fauvel (1903) published a general treatment to New Caledonian geography and summarized the history of the exploration of the insect fauna of the island. In this publication he described *C. longicollis* and also synonymized *C. bavayi* with *C. acentra*.

Horn (1915) designated *Distipsidera mniszechii* Thomson, 1856, the oldest available name originally included in *Caledonica* by Chaudoir (1860), as the type species of the genus.

Recently the genus was revised by Deuve (1981). In his revision he described *C. rivalieri* and *C. fleutiauxi* (based on historical specimens only), restored the specific status of *C. arrogans* and synonymized *C. tuberculata* with it. Later, Deuve (1987) published a description of *C. viridicollis*.

Most recently, Wiesner (1991) described *C. wormae* and Deuve (2006) described two new subspecies: *C. rivalieri laevioricollis* and *C. viridicollis rubicondosa*.

In the present paper *C. wormae* is synonymized with *C. acentra*, *C. bavayi* restored as a good, separate species and *C. luiggiorum* **sp. nov.** is described as a new species for science based on study of respective type specimens and extensive additional material.

## Biology and distribution

The genus name *Caledonica* is very appropriate, since all known species are restricted to the New Caledonian archipelago. With the exception of *C. pulchella*, known only from a single poorly-localized specimen (type locality: “Nouvelle Calédonie”), all other species are known to occur on Grande Terre (the main island of New Caledonia). Three species: *C. affinis* (Montrouzier, 1860), *C. mediolineata* Lucas, 1862 and *C. arrogans* (Montrouzier, 1860) were also collected on the small neighboring island of Ile des Pins (according to the labels of old historical specimens). No species of this genus has been recorded from any of the three atolls of Loyalty Islands.

In addition to the 16 taxa (14 species and two subspecies) of the genus *Caledonica*, three other tiger beetle genera were recorded from New Caledonia. Two of them are also considered to be endemic: *Vata* Fauvel, 1903, with *V. thomsoni* (Perroud, 1864) and *V. gracilipalpis* W.Horn, 1909, and the recently discovered genus *Manautea* Deuve, 2006 with four species described by the same author in the same year: *M. gracilior*, *M. millei*, *M. minimior* and *M. tripotini*. The other tiger beetle occurring here is *Myriochila* (*Myriochila*) *semicineta* (Brullé, 1834), a widespread species in the Pacific area from Australia in the south to some of the Indonesian islands in the north.

The adults of *Caledonica* are predominantly silvicolous, arboreal and of diurnal activity. Nevertheless, there are several exceptions. *Caledonica bavayi* and *C. mniszechii* rather often occur on trees in some distance from forest. In the vicinity of Paita I have even observed one specimen of *C. bavayi* on a tall, wide grass stalk in a shrubby meadow. Furthermore *C. lunigera*

seems to be directly confined to more open biotopes, predominantly along the drier western coast but also inland. I have not found in the literature any records from the eastern coast and I only once observed a population of *C. lunigera* on the eastern windward side of the island. The biotope was a row of trees along a small river surrounded by grassy areas and forest remnants in the vicinity of Kanala. On the western coast, in Paita, I found *C. lunigera* on trunks of trees in a garden and on an avenue of trees along a tarmac road. In the Parc Provincial de la Rivière Bleue, masses of adults were active on tree trunks in a monocultural plantation. On the contrary, *C. rivalieri*, *C. laevioricollis*, *C. longicollis* and *C. myrmidon* are probably strictly silvicolous species.

On tree trunks, adults are found in a head-down position. They are very good flyers, but when disturbed, they hide by running rapidly to the opposite side of the trunk, a maneuver that is repeated if they are disturbed again. They usually hide so fast they are barely noticeable to an observer walking past the trees. Only when disturbed continuously do they fly several meters to another tree. After landing in a head-upwards position they immediately turn head-down. In a garden south of Koumac individuals of *C. luiggiorum* occasionally, when disturbed repeatedly, ran and hid among the grass at the base of the tree instead of flying away.

Rather commonly I found two or three individuals together on one trunk. They are usually found at a height of about one to three meters above the ground, but sometimes I observed them running up to more than eight meters. Adults do not show a preference for particular tree species. Generally they prefer higher and larger dominant trees with some free space around (probably for better sight), but at a distance of only a few meters from other trees. However, close to Sarramea in the lower part of the trail to Plato de Dogny, numerous individuals of *C. bavayi* were seen settled on very narrow trunks of small saplings of *Coffea arabica* that were predominant in that area. They also prefer trunks with a smooth surface or with indistinctly wrinkled bark.

Probably most of their adult life is confined to tree trunks, including feeding, but also mating; however, females oviposit into the soil, mostly after or directly during rain when the soil is moist and soft. Larval holes are rather commonly seen along forest trails and paths. On several occasions adults were observed actively searching for prey, always for small ants running on the trunk.

During the night, adults of *Caledonica* either stay on the trunk or disappear to an unknown place. During several days of camping on the forest edge about three kilometers northwest of Sarramea, I observed a few adults of *C. bavayi* dwelling permanently two trees near my tent. Some of the adults stayed on the trunk during the night, but often ran up the tree, while the others disappeared. Once I found an adult hidden inside a bark fissure. This suggests that the disappearing individuals possibly hide in a safe place for the night.

Adults usually persist on trees during rainy conditions, including heavy rain; for example numerous adults of *C. longicollis* in a forest near Bouirou. The trunks in this case were entirely wet and I observed some adults with raindrops trickling from their bodies and heads.

Adults are not attracted to light, except for when the light source is in immediate proximity to the place where they stay overnight. On one occasion, close to Sarramea, a male of *C. bavayi* came to the sheet of light trap and actively hunted small ants there.

## Materials and Methods

### Acronyms of collections:

AKCB – Collection Arnošt Kudrna, České Budějovice, Czech Republic;

BMNH – British Museum of Natural History, London, United Kingdom;

IRSNB – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium;

MNHN – Muséum national d'Histoire naturelle, Paris, France;

QMBA – Queensland Museum, Brisbane, Queensland, Australia.

Following abbreviations of type status are used in the revision: HT = holotype, PT = paratype, ST = syntype, AT = allotype.

Mandibles of historical and type specimens are usually firmly closed. Unfortunately, it is often impossible to relax them without a high risk of their damage, thus their exact shape remains unknown. Furthermore such manipulations of historical type material are usually strictly forbidden.

Type specimens of *C. mniszechii* and *C. arrogans* are considered as lost (Deuve 1981). Therefore I separate both species here based on previously published information. However, very recently I discovered that *C. arrogans* is most likely synonymous with *C. mniszechii* based on the original descriptions and figure given by Thomson (1856). Thus specimens presently identified

as *C. arrogans* should be conspecific with *C. mniszeczii* in sense of the original description and specimens currently identified as *C. mniszeczii* represent an undescribed species. Unfortunately, I made this discovery too late to be fully incorporated in my thesis thus both species are treated here in the old way and this paragraph merely serves as a clarification of the current situation. However, these changes as well as neotype designations will be included in the final publication.

**Type material labels.** All labels of each type specimen are cited in their original spelling. Individual labels are separated by a semicolon, and additional explanatory notes are placed in square brackets.

**Labels of non-type specimens.** The citation is restricted to locality labels only.

**Measurements.** The body length was measured without the labrum and refers to the distance from the clypeus to the apices of the elytra (excluding sutural spines). The width of the body was measured across the widest part of the elytra. The width of the head was measured across the eyes and includes their lateral margins. Labral length includes median tooth (if present). Pronotal width was measured including spines or ribs of notopleural sutures. Lateral margins of pronotum includes proepisterna when visible from above.

When only limited number of specimens (less than 15) was available per species, all examined specimens were measured. For species available in longer series, always at least 15 specimens were measured and used specimens were selected to cover maximum of the variability.

**Preparation of the aedeagus.** All aedeagi are described and illustrated here in their left lateral position. The aedeagus possesses very important diagnostic characters. Not only its shape, but also the structure of the internal sac is very important for identification of species. The aedeagi of all species treated here were studied thoroughly except for those of *Caledonica mediolineata*, *C. arrogans* and *C. fleutiauxi*, because the aedeagi of these old historical specimens deposited in MNHN were not available for my examination and to make necessary preparations; moreover no other specimens of these three species were available for my study. The aedeagi of *C. pulchella* and *C. viridicollis* were also not studied, because males of these two species are unknown.

In all other species the aedeagus was withdrawn from the abdomen, inserted into a small dish with a solution of potassium hydroxide and kept there 12-48 hours depending on the size of

the aedeagus. Then, the aedeagus was washed in distilled water for about 15-20 minutes. If the inner sac was still not clearly observable, after another washing in distilled water the aedeagus was immersed in clean lactic acid for another 12-24 hours and then washed again for 15-20 minutes in distilled water. Then it was inserted into propyl-alcohol and kept there for at least 10 minutes. During these procedures, the majority of surface impurities were removed and the air bubbles which occasionally occur inside the aedeagus were carefully pushed away. Then the aedeagus in its left lateral position was immersed into a drop of synthetic transparent resin (Solakryl) on a transparent plastic mounting board. During the next 24 hours several additional drops of the resin were added to completely cover the aedeagus for permanent conservation of the sample. The plastic mounting board with the aedeagus is in all cases attached to the pin bearing the corresponding beetle specimen (between the specimen and the first locality label).

**Illustrations.** All photographs were taken using a digital camera. The quality of the photographs reflects the conditions under which they could be taken. The best quality pictures were taken in nearly professional settings, mostly from specimens deposited in the author's collection. Specimens of a few species were photographed under much less ideal conditions, during the author's visits to the MNHN.

## Species descriptions

### *Caledonica pulchella* (Montrouzier, 1860) (Figs 1-2b)

*Oxycheila pulchella* Montrouzier, 1860: 234.

**Type locality:** “Nouvelle Calédonie”.

**Type material.** Holotype ♀ in MNHN, labelled: “Étiquette Baladano?, N<sup>ll</sup> Caledonie” [handwritten]; “Museum Paris, N<sup>elle</sup> Calédonie, Mestro 53-56.” [pink, printed/handwritten]; “Type” [red, printed]; “Cicindela pulchella Montr., Soc. ent. 234 (1860)” [brownish, handwritten]; “Caledonica pulchella” [printed].

**Diagnosis.** Superficially resembling *C. affinis* due to its dark colouration and elytra with enlarged median macula, but clearly distinguished from it by lateral margins of pronotal disc which are rounded, not convex and lacking elevated costae. From *C. luiggorum* **sp. nov.** it is distinguishable by its larger body-size and narrower elytral median band. In contrast to *C. luiggorum*, *C. affinis* and *C. viridicollis*, its elytra possess doubled humeral macula and lacks elevated elytral costae.

**Description of holotype.** Body of female holotype (only existing specimen) medium sized (Fig. 1), length 11.20 mm, width 3.40 mm.

Head with large eyes, slightly narrower than elytra, dorsally black with dark cupreous metallic reflections; frons moderately convex, separated from clypeus by distinct suture, irregularly wavy-rugulose; vertex moderately convex, with shallow posterior impression, longitudinally to irregularly striate; orbital plates distinctly longitudinally parallel-striate with two setae on each side; occipital area irregularly vermicular-rugulose; genae glabrous, metallic green, finely parallel-striate; clypeus cupreous to green with strong metallic reflections, surface coriaceous.

Labrum (Fig. 2) 4-setose, dark testaceous except for much paler entire median area; only very slightly shorter than wide, length 1.40 mm, width 1.50 mm, with acute anterolateral teeth and prominent, tridentate median lobe of acute teeth which are bent downwards, so their acute shape is not obvious in dorsal view.

Mandibles dark testaceous, firmly closed in holotype, therefore only their apical teeth and paler basolateral margins observable.

Labial and maxillary palpi testaceous except for darkened terminal palpomeres and also penultimate palpomere of maxillary palpi.

Antennae. Scape, pedicel and antennomeres 5-6 testaceous, antennomeres 3-4 dark brown with slightly paler apices, remaining antennomeres missing.

Thorax. All thoracic parts glabrous. Pronotum 2.00 mm long, 2.55 mm wide; anterior and posterior sulci well pronounced, median line indistinct; lateral margins of disc rounded, notopleural sutures lacking elevated costae; pronotal surface black with lustre and feeble green and cupreous metallic reflections along posterior sulcus, surface shallowly irregularly wavy to vermicular-rugulose; proepisterna green with cupreous central area and with metallic lustre, meso- and metepisterna shiny green, pro- and mesepisterna nearly smooth, metepisterna only shallowly striate; female mesepisternal coupling sulci unrecognizable, lacking any pit; metepisterna with distinct impression at posterior suture; pro-, meso-, and metasternum dark testaceous with green metallic lustre; metasternum with fovea-like impression placed at dorsolateral corner.

Elytra elongate, length 7.40 mm, slightly narrowing towards rounded anteapical angles, apices rounded, moderately emarginate towards short sutural spine; basodiscal convexity, apical and juxtahumeral impressions indistinct; each elytron with only indicated longitudinal discal costa, sublateral costa absent; elytral surface anteriorly densely and deeply punctate, juxtahumeral impression punctate only sporadically; punctures towards apex becoming smaller and shallower and nearly effaced on apical area, sparse setigerous punctures with white hairlike setae are distributed on anterior area; elytral colouration lustrously black; elytral maculation ochre-white consisting of three maculae: humeral macula doubled (with tightly adjacent additional basal macula) both ochreous coloured, white, rather narrow and long transversal median band not reaching suture, and white reniform anteapical macula.

Abdomen. Ventrites glabrous, dark testaceous with limited green to cupreous, metallic reflections.

Legs. Coxae and trochanters testaceous, femora testaceous with indistinctly darkened apices; tibiae, tarsi and claws testaceous; tarsi dark testaceous.



**Biology & distribution.** Nothing is known about the biology or distribution of *C. pulchella*. The only existing specimen, female holotype, was collected more than 150 years ago and is without precise locality.

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1



2



2b



3

5



4



6

Figs 1–2b. *Caledonica pulchella* (Montrouzier). 1 – habitus, female, Nouvelle Calédonie (no locality), 11.2 mm, MNHN, 2 – labrum, *ibid.*, 2b – labels, *ibid.* Figs. 3–6. *C. longicollis* Fauvel. 3 – habitus, male, Touho, 9 mm, AKCB, 4 – front view, *ibid.*; 5 – habitus, female, N Bourail, 9.5 mm, AKCB, 6 – front view, *ibid.* Scale bars = 1 mm.

