

The genus *Cryptocercus* in East Asia: distribution and new species (Insecta, Dictyoptera, Blattaria, Polyphagidae)

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ABSTRACT

Three new species of *Cryptocercus* Scudder, 1862 are described: *C. hirtus* Grandcolas & Bellés n. sp., *C. meridianus* Grandcolas & Legendre n. sp. and *C. parvus* Grandcolas & Park n. sp. They extend the distribution of the genus to the South and to the North in China. As expected, these new data show that the genus is distributed in varied regions with classical distributional trade-offs between altitude and latitude. These new species together with *C. relictus* Bey-Bienko, 1935, *C. primarius* Bey-Bienko, 1938, *C. matilei* Grandcolas 2000, and *C. kyebangensis* Grandcolas, 2001, bring the number of East Asian species in the genus to seven. Morphological features of these species, including spine numbers on femora, pronotum shape, and genitalia structure, show a wide range of variation among species, larger indeed than among North American species.

KEY WORDS

Insecta,
Dictyoptera,
Polyphagidae,
Cryptocercus,
China,
Korea,
Russia,
new species.

RÉSUMÉ

Le genre Cryptocercus en Asie de l'Est : distribution et nouvelles espèces (Insecta, Dictyoptera, Blattaria, Polyphagidae).

Trois nouvelles espèces sont décrites dans le genre *Cryptocercus* Scudder, 1862 : *C. hirtus* Grandcolas & Bellés n. sp., *C. meridianus* Grandcolas & Legendre n. sp. et *C. parvus* Grandcolas & Park n. sp. Ces espèces étendent significativement la distribution du genre au Sud et au Nord de la Chine. Ainsi qu'on pouvait le prévoir, ces nouvelles données montrent que le genre est distribué dans des régions très diverses avec une compensation classique entre altitude et latitude. Avec ces nouvelles espèces et en addition à *C. relictus* Bey-Bienko, 1935, *C. primarius* Bey-Bienko, 1938, *C. matilei* Grandcolas, 2000 et *C. keyebangensis* Grandcolas, 2001, le nombre d'espèces est-asiatiques dans le genre s'élève maintenant à sept. Les caractéristiques morphologiques de ces espèces, notamment les éperons sur les fémurs, la forme du pronotum et la structure des genitalia, montrent une large gamme de variation, plus large que chez les espèces nord-américaines.

MOTS CLÉS

Insecta,
Dictyoptera,
Polyphagidae,
Cryptocercus,
Chine,
Corée,
Russie,
nouvelles espèces.

INTRODUCTION

The genus *Cryptocercus* Scudder, 1862 is considered as a model to understand the first stages of social evolution in termites because it shows wood-feeding, subsocial behavior, and intestinal flagellates, all traits supposedly shared with the ancestor of termites (e.g., Wilson 1971). Using *Cryptocercus* as a model for evolutionary studies together with some other recently discovered taxa (Pellens *et al.* 2002; Brugerolle *et al.* 2003) makes however necessary to determine the phylogenetic position of *Cryptocercus*. This position permits to distinguish the traits of *Cryptocercus* which are really homologous with termites' ones from those which are only analogous (Grandcolas 1994, 1997; Grandcolas & Deleporte 1996; Gäde *et al.* 1997; Grandcolas & D'Haese 2004).

Even if it is a famous model, the genus *Cryptocercus* is not evenly well known throughout its whole distribution area. Its distribution is amphiberingian, with species both in East Asia and North America (Bey-Bienko 1950; Grandcolas 1999). The genus has been mostly studied in North America until now, except for a recently described Korean species (Grandcolas *et al.* 2001) whose behavior and phylogenetic posi-

tion have been studied (Park *et al.* 2002, 2004; Park & Choe 2003a, b).

In East Asia, two species, *C. primarius* Bey-Bienko, 1938 and *C. relictus* Bey-Bienko, 1935, were described long ago from China and Russia, respectively (Bey-Bienko 1935, 1938), the names of which have been used for any Chinese or Russian specimen collected in the vast and extremely diverse East-Asian region (e.g., Asahina 1991; Clark *et al.* 2001; Nalepa *et al.* 2001; Kambhampati *et al.* 2002; Nalepa 2003). According to our previous statements (Grandcolas 2000; Grandcolas *et al.* 2001), a high diversity of species is in need of study and description in this region, and any generalization in terms of ecological or taxonomic range is premature. East Asian species need to be carefully named and Bey-Bienko's names should not be applied in a blind or conservative taxonomic way but restricted to the taxa that they represent after careful comparison of type specimens. This paper is aimed at providing new information on East Asian *Cryptocercus* species, establishing the distribution of the genus according to carefully identified specimens and with the description of several new species which bring substantial new geographical information.

ABBREVIATIONS

MNHN Muséum national d'Histoire naturelle,
Paris;
NMNHK National Museum of Natural History,
Seoul.

MATERIAL AND METHODS

The genitalia have been dissected as indicated by Grandcolas (1996, 2000) and then studied after clearing in cold KOH. They are conserved in tubes with glycerine, pinned beneath the specimens. Pictures have been obtained with a binocular stereomicroscope Leica MZ12 with a numerical camera Leica DC200. Nomenclature of male sclerites (L1, L2d, L2v, R3d, R3v) follows that of Grandcolas (1996, modified from McKittrick 1964).

SYSTEMATICS

The following descriptions of new species take into account the previous results from Grandcolas *et al.* (2001) and thus do not reiterate the comparisons with *C. primarius* and *C. relictus*, the external morphology and genitalia of which have been fully described and commented before. At this early stage of taxonomic knowledge, a determination key is not provided in order to avoid the misleading perception that such a key would serve to assign a name to every recently collected specimen from China or Russia, as occurred previously with the names *C. primarius* and *C. relictus* in the literature.

Family POLYPHAGIDAE Walker, 1868
Subfamily POLYPHAGINAE Walker, 1868
Genus *Cryptocercus* Scudder, 1862

Cryptocercus hirtus Grandcolas & Bellés, n. sp.
(Figs 1C, K-M; 2A)

TYPE MATERIAL. — Holotype ♀, China, Gansu, Cheumen (= Shimen), 8.V.1919, P. Licent coll. (MNHN).

TYPE LOCALITY. — Shimen, Gansu, China.

ETYMOLOGY. — The species is named according to the ornamented pronotum.

MEASUREMENTS. — Body length: ♀, 23.5 mm. Pronotum length: ♀, 5.8 mm.

DESCRIPTION

Large species with mesonotum, metanotum and tergites slightly punctuated. Pronotum with a very peculiar shape (Fig. 2A) comprising two pairs of very well delimited protuberances, the hind ones at the summit of the usual hind protuberances, the fore ones very sharp, and a protruding fore margin.

Fore femora (Fig. 1C) with ventro-anterior margin with five spines, the larger ones in the middle of the row.

Subgenital plate with posterior margin not strongly sinuous.

Female genitalia (Fig. 1K-M)

Basivalvulae (Fig. 1L) with anterior and posterior margins clearly delimited and convex, with a distinctive sclerotized appendix following the median membranous groove. Laterosternite IX (Fig. 1M) small, with a sharp and short ventral part. Spermatheca large (Fig. 1K) with long and locally widened ducts, the apical ampulla oval-elongated, the basal ampulla also elongated and with a long and twisted apex.

Cryptocercus meridianus

Grandcolas & Legendre, n. sp.
(Figs 1A, E-G; 2B)

TYPE MATERIAL. — Holotype ♂, China, Yunnan, Lijiang, cloud conifera forest, 3100 m, 23.VII.1993 (MNHN).

TYPE LOCALITY. — Lijiang, Yunnan, China.

ETYMOLOGY. — The species is named according to its very southern locality in China, near the border with Vietnam.

MEASUREMENTS. — Body length: ♂, 24 mm. Pronotum length: ♂, 5.3 mm.

DESCRIPTION

Medium-sized species with a slender body. Body except pronotum smooth, not punctuated. Pronotum (Fig. 2B) with few and weak protuberances, except a protruding fore margin. Fore

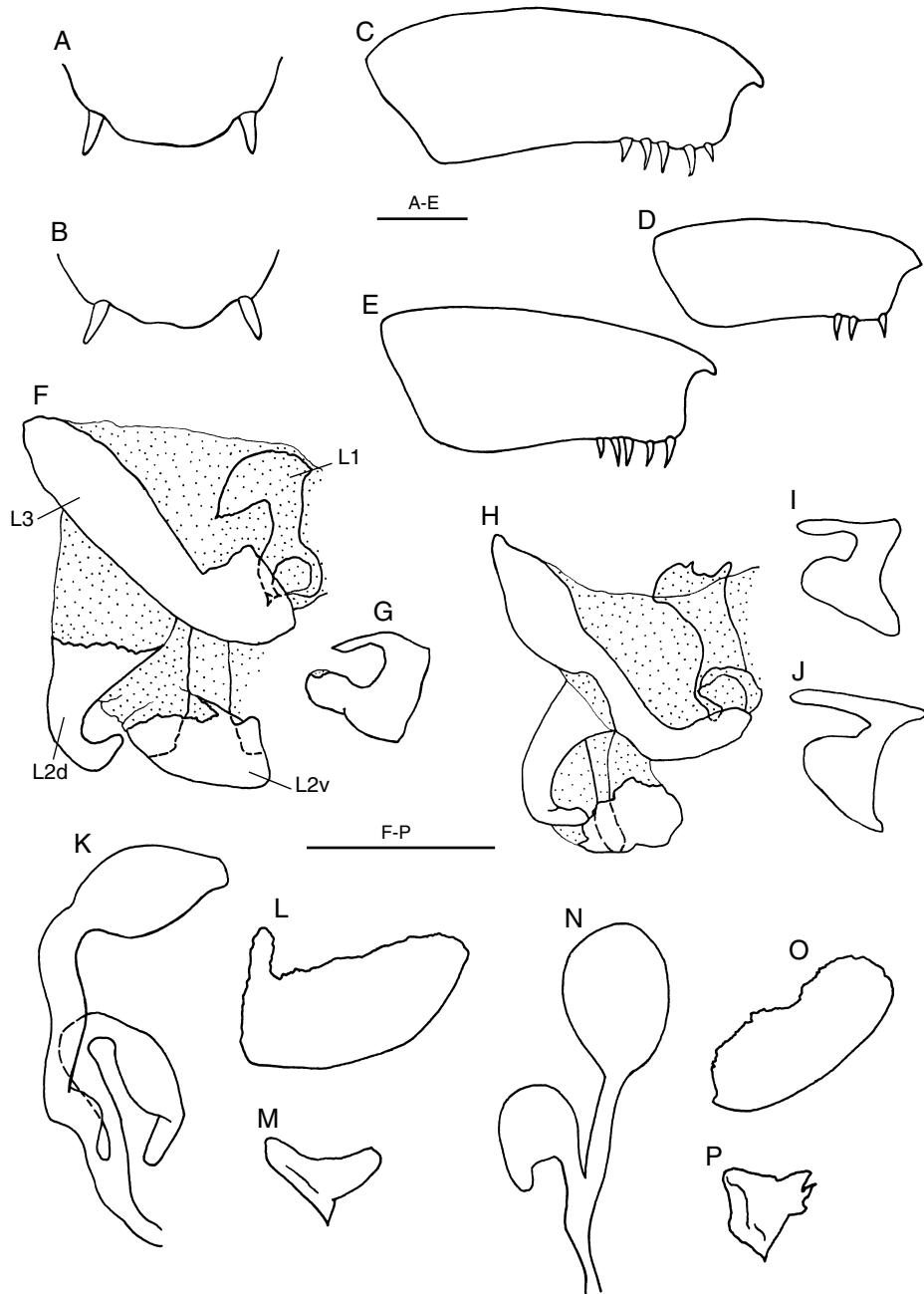


FIG. 1. — **A, E-G**, *Cryptocercus meridianus* Grandcolas & Legendre, n. sp.; **A**, subgenital plate; **E**, fore femora; **F**, left phallomere of male genitalia; **G**, sclerite R3d of male genitalia; **B, D, H-J, N-P**, *C. parvus* Grandcolas & Park, n. sp.; **B**, subgenital plate; **D**, fore femora; **H**, left phallomere of male genitalia; **I, J**, sclerite R3d of male genitalia; **N**, spermatheca; **O**, right basalvalvula in female genitalia; **P**, laterosternite IX in female genitalia; **C, K-M**, *C. hirtus* Grandcolas & Bellés, n. sp., **C**, fore femora; **K**, spermatheca; **L**, right basalvalvula in female genitalia; **M**, laterosternite IX in female genitalia. Abbreviations: sclerites L3, L2d, L2v, L1 of male genitalia (nomenclature from Grandcolas [1996], modified after McKittrick [1964]). Scale bars: 1 mm.

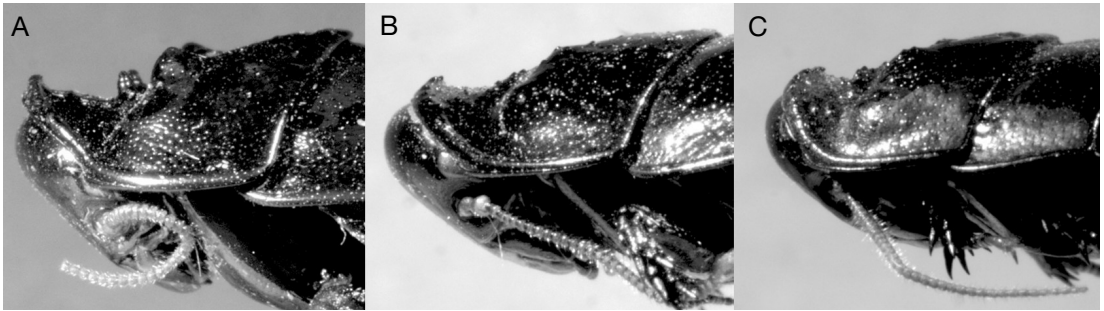


FIG. 2. — Pronotums of *Cryptocercus* species; **A**, *C. hirtus* Grandcolas & Bellés, n. sp., pronotum length: 5.8 mm; **B**, *C. meridianus* Grandcolas & Legendre, n. sp., pronotum length: 5.3 mm; **C**, *C. parvus* Grandcolas & Park, n. sp., pronotum length: 5.0 mm.

femora (Fig. 1E) with ventro-anterior margin with five spines not equally spaced and of roughly increasing size toward the apex. Male subgenital plate (Fig. 1A) with a wide and gently rounded margin between styli.

Male genitalia (Fig. 1F, G)

Sclerite L2d with an angular apex. Dorsal part of L2v also angular with a tooth protruding dorso-innerly. Ventral part of L2v wide and strong. L1 with a rounded apex bearing one spine on the left and an expanded basis. R3d bulbous and slightly unsclerotized innerly, with the basal part sharp.

DNA sequences

The mitochondrial genes 12S and 16S have been partly sequenced for that species and are available on line in the EMBL database under the accession numbers AJ519679 and AJ519678 respectively.

Cryptocercus parvus Grandcolas & Park, n. sp. (Figs 1B, D, H-J, N-P; 2C)

TYPE MATERIAL. — Holotype ♂, allotype ♀, China, Heilongjiang, Laoheidingzi (1349 m) near Xingnong Linchang, 64 km WSW Hailin, SW Mudanjiang, X.1998, Yung Chul Park coll. (MNHN). Paratypes: same locality, 7 ♂♂, 4 ♀♀ (MNHN); China, Heilongjiang, Laoheidingzi (1349 m) near Xingnong Linchang, 64 km WSW Hailin, SW Mudanjiang, X.1998, Yung Chul Park coll., 3 ♂♂, 3 ♀♀ (in alcohol, NMNHK).

TYPE LOCALITY. — Mudanjiang, China.

OTHER MATERIAL EXAMINED. — **China.** Laotudingzi near Shuangfeng Linchang, 100 km WSW Hailin,

4 ♂♂, 6 ♀♀. — Tian-shan (= Tian Ling, or Mudanfeung), 1115 m, 32 km W Ning'an, SW Mudanjiang, Yung Chul Park coll., 3 ♂♂, 2 ♀♀ (MNHN).

ETYMOLOGY. — The species is named according to its small size in the genus.

MEASUREMENTS. — Body length: ♂, 16-18 mm; ♀, 15.5-17.5. Pronotum length: ♂, 5-5.2 mm; ♀, 4.2-5.1 mm.

DESCRIPTION

Small species, short and wide, with punctations on the dorsal surface. Pronotum (Fig. 2C) with low but well delimited protuberances. Fore femora (Fig. 1D) with ventro-anterior margin with three to five spines, of roughly the same size, the more apical one generally farther from others especially in males. Male subgenital plate (Fig. 1B) with a medium space between styli, angularly curved.

Male genitalia (Fig. 1H-J)

Sclerite L2d strong with a long and thin apex. L2v heavy, with a large sclerotized dorsal area and with an apical inner rounded part, and a ventral elongated and narrow part. L3 with a long and narrow apex. R3d with a blunt process and an elongated basis with a rounded apex. R2 heavy but not wide.

Female genitalia (Fig. 1N-P)

Basivalvulae (Fig. 1O) rounded with an inner margin irregularly sclerotized. Laterosternite IX (Fig. 1P) short, polygonal rather than triangular, with a short ventral apex. Spermatheca (Fig. 1N)

with a large and rounded apical ampulla, and a curved basal ampulla on a short duct.

DNA sequences

The mitochondrial genes 12S and 16S have been partly sequenced for that species and are available on line in the EMBL database under the accession numbers AJ519680 and AJ519681 respectively.

DISCUSSION

The genus *Cryptocercus* was previously known in East Asia from a very large area (Bey-Bienko 1935, 1938, 1950; Park 2002, 2004; Grandcolas 2000; Grandcolas *et al.* 2001). The present study further increases this area, setting its presently

known limits in the South to the North of the Annamitic chain in Yunnan (Lijiang) and to the North of China to Gansu (Fig. 3). This area actually corresponds to very different climatic regions with diverse dominant kinds of vegetation (Wang 1961; Ying 1983). As far as it is known from collected specimens, *Cryptocercus* species are always found in temperate forests, even if they are nested within other kinds of vegetation or at very different elevations. To the East and South East, the known distribution does not extend further than South Korea and Sikhote Alin, as previously known (Fig. 3). This distribution invalidates the results brought forward by Kambhampati *et al.* (2002), which suggested a change from high elevation in East Asian to low elevation in some North American species. The diversity of East Asian taxa showed that the eleva-

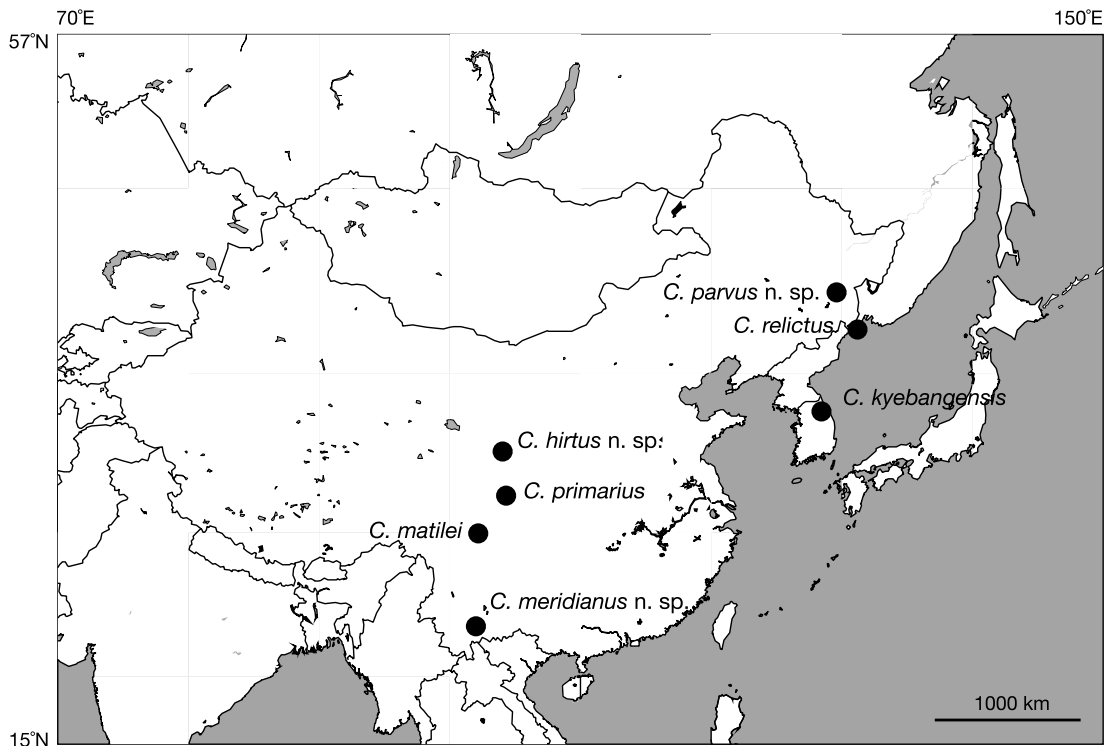


FIG. 3. — Distribution map of the East-Asian *Cryptocercus* species including *C. hirtus* Grandcolas & Bellés, n. sp., *C. kyebangensis* Grandcolas, 2001, *C. matilei* Grandcolas, 2000, *C. meridianus* Grandcolas & Legendre, n. sp., *C. parvus* Grandcolas & Park, n. sp., *C. primarius* Bey-Bienko, 1938, *C. relictus* Bey-Bienko, 1935. Only the specimens compared with the types of every species are placed on the map.

tion of locations clearly varies according to other geographical parameters and especially with latitude: the southerly distributed *C. meridianus* n. sp. is found in a forest at 3000 m of elevation while other and more northern species can be found at less than 1000 m high. In any case, some species are distributed at low elevation in East Asia.

The wide geographical distribution of the genus in East Asia results from the addition of many well differentiated species whose definition has been until now underestimated or questioned (see for example Nalepa 2003). The whole distribution area of the genus *Cryptocercus* in East Asia coincides with the distribution of the forests, which are absent in northwestern temperate deserts, western high tablelands, and northeastern temperate steppes (Wang 1961; Ying 1983).

The present study shows that the morphological diversity of *Cryptocercus* species is more pronounced in East Asia than among North American species, in terms of pronotum shape, leg spines, size, and genitalia morphology. The study of significant samples in several species, particularly in East Asia, with *C. kyebangensis* and *C. parvus* n. sp., showed that several characters are well differentiated among populations and show little variation within local populations, mainly in genital parts, such as the male sclerites L2v and R3d and the basivalvulae, laterosternites IX and spermatheca in females. This was already very clear according to the study of the Korean populations whose morphology, tergal glands products, and mitochondrial DNA showed a very significant divergence by comparison with any other species described (Grandcolas *et al.* 2001; Park *et al.* 2004).

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