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Distribution of the longhorned beetle *Callipogon relictus* (Coleoptera: Cerambycidae) in Northeast Asia

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Abstract

The distribution of the longhorned beetle *Callipogon* (*Eoxenus*) *relictus* Semenov, 1899 (Coleoptera: Cerambycidae) in Northeast Asia was summarized for the first time, based on the examination of comprehensive material. *Callipogon relictus* is the only representative of the genus *Callipogon* in the Palearctic region. Its distribution ranges from Shanxi province (China) in the south, northward through the Korean Peninsula to Amur Oblast (Russia), and from Inner Mongolia (China) in the west to the coastal area of the Russian Far East.

Key words: *Callipogon relictus*, Cerambycidae, Coleoptera, longhorned beetle, distribution, Northeast Asia

Introduction

Presently, the longhorned beetle genus *Callipogon* Audinet-Serville, 1832, is divided into five subgenera that include nine species, eight of which are distributed from Mexico in Central America to Peru in South America (Monné 2017). Representatives of this genus are large beetles ranging from 6–11 cm in length. They have an elongated and slightly convex body. The lateral margins of the pronotum have many spines, with the spines on the anterior and posterior corners being larger and retrorse. Metepisterna are narrowed posteriorly. The first segment of the antennae is slightly elongated. This genus exhibits strong sexual dimorphism; the males have extremely well-developed mandibles (Du Pont 1832; Nonfried 1892; Semenov 1899; Lameere 1904).

Callipogon relictus is the only representative of the genus that inhabits Northeast Asia. The species abundance throughout the major part of its distributional range is rapidly declining. In some regions, this species is either endangered or extinct (Kuprin & Bezborodov 2012). The large-scale cutting of over-mature broad-leaved forests is the main reason underlying the reduction in *C. relictus* populations. This beetle species has been added to the IUCN Red List of threatened species, and it is legally protected in the Russian Federation (Russian Federation 2001). In South Korea, it is listed in the Red Data Book (Ministry of Environment of Korea 2013) as a Class I Endangered Species. Currently, this species is known to inhabit only the Gwangneung forest, Pocheon-si, Gyeonggi-do in South Korea. Only a few individuals of this species have been observed in this area recently.

The purpose of the present work was to study the distribution of *C. relictus* in Northeast Asia with the ultimate aim of developing measures for an integrated protection system, and to re-establish its local population in parts of the distributional area from which it has become extinct.

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Materials and methods

We sampled the beetles used in the present study from different areas in East Asia (Russia, Northeast China, and the Korean Peninsula), and included the following museum collections: Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZIN RAS), Zoological Museum of M. V. Lomonosov State University, Moscow, Russia (ZMMU), Institute of Animal Systematics and Ecology, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia (IASE SB RAS), Institute of Biology and Soil Science, Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia (IBSS FEB RAS), Ussuri Nature Reserve, Far East Branch of the Russian Academy of Sciences, Ussuriysk, Russia (UNR FEB RAS), Korea University, Seoul, South Korea (KU), Center for the Study of Insect Ecology, Yeongwol Insect Museum, Yeongwol-gun, Gangwon-do, South Korea (CSIE), Yangpyeong Insect Museum, Yangpyeong-gun, Gyeonggi-do, South Korea (YIM), Paichai High School, Seoul, South Korea (PHS), Hampyeong Research Center of Insects, Hampyeong-gun, Jeollanam-do, South Korea (HRCI), and Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZAS).

Results

We examined 256 specimens of *C. relictus*, collected between 1898 and 2016 from the study region. The analyzed material, including locations and collection dates, is presented below, in chronological order. After analyzing the collection notations and data from the literature, we generated the distributional map and specified the relevant populations of the species in Northeast Asia.

Family Cerambycidae Latreille, 1802

Genus *Callipogon* Audinet-Serville, 1832

Callipogon (*Eoxenus*) *relictus* Semenov, 1899

(Fig. 1–3)

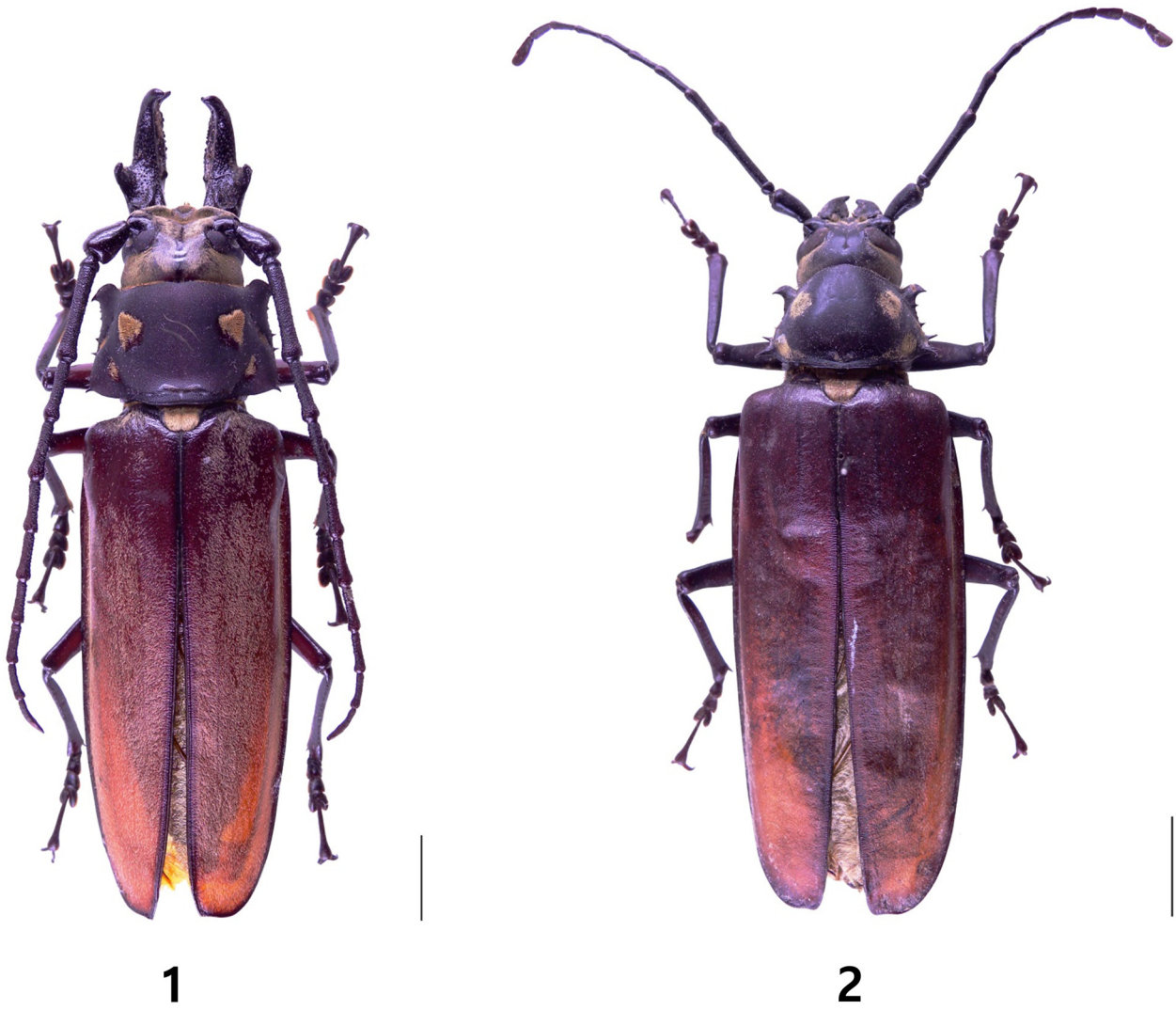
Callipogon (*Eoxenus*) *relictus* Semenov, 1899: 563 (original description). Type locality: Vladivostok, Amur. Type depository: ZIN RAS.

Callipogon (*Eoxenus*) *relictus*: Semenov 1903: 372; Lameere 1904: 48; Li *et al.* 2012: 52; Li *et al.* 2014: 73.

Callipogon (*s. str.*) *relictus*: Gressitt 1951: 17.

Callipogon relictus: Cho 1936: 41; Ohbayashi & Niisato 2007: 339; Kuprin & Bezborodov 2012: 459; Wang 2014: 268; Kuprin *et al.* 2014: 387.

***Russian Federation* (*Russia*). ZIN RAS:** Holotype, Russia, [Vladivostok, Amur], December 1898, 1♀, Semenov; Ussuri region: Anuchino village, December 1898, 1♀, Semenov; Vladivostok, December 1899, 1♀, Semenov; Khabarovsk Kray: Sredne-Sedjmaya River Valley, between Vayzemck station and Glenovsk village, 1902, 1♂, Zolotovsky; Ussuri region (Primorsky Krai): Anuchino village, Mt. Sikhote-Alin, July 1908, 1♀, no coll.; Evsnyavka village, 2–8 July 1910, 1♂, 6♀, Shingarev; 27 km from Evgenjevka village, Odarovsky manufactory, 16 August 1910, 1♂, Chersky and Gerger; Imansky village, Daubikhe River Valley, 4 June 1911, 1♀, Shingarev; Daubikhe River Valley, 7 July 1911, 1♀, Shingarev; Mt. Sikhote-Alin, 18–22 July 1911, 3♀, Shingarev; Anuchino village, June 1912, 1♀, no coll.; Chernigovka village, August 1912, 2♀, Emeljanov; Chernigovka village, 20 July 1912, 1♀, Emeljanov; Evsnyavka village, 2 July 1916, 1♀, Shingarev; Yakovlevka village, Daubikhe River Valley, 3–8 August 1926, 2♂,4♀, Filipjev; ibid., Yakovlevka village, 22–28 August 1926, 2♂, 3♀, Filipjev; Yakovlevka village, July 1927, 2♀, Kvashuk; 100 km East to Nickolsk-Ussuriysk, Mt. Sikhote-Alin, 23 May 1929, 1♀, Filippov; Merkulovka village, 5 August 1930, 1♂, Abdulovsky; Shkotovsky district, Lamazin village, 28 August 1947, 1♀, Lubarsky; Suputinka River Valley, 2 August 1972, 1♂, Tsherepanov (ex coll. A.I. Tsherepanov donation to ZIN RAS St. Petersburg, Russia); Suputinsky (Ussuri) Nature Reserve, on logged timber of *Ulmus japonica*, 14 October 1968, 1♂, Tsherepanov (ex coll. A.I. Tsherepanov donation to ZIN RAS St. Petersburg, Russia); Anuchino village, no date, 1♀, Kalugin; Anuchino village, no date, 1♀, Moltrecht; 2♀, no label.



FIGURES 1–2. *Callipogon relictus*. 1—Male and 2—female.

IBSS FEB RAS: Anisimovka village, no date, 1♀, no coll.; 1♀, no label; 1♂, no label, ex coll. Maslov; Suputinsky (Ussuri) Nature Reserve, 18 August 1934, 1♂, Kurentzov; ibid., Camp-2, 1 August 1978, 1♀, Khalchenko; Kamenuska village, 7 August 1979, 1♀, no coll.; Dalnerecheksky district, 17 July 2002, 1♀, Shabalin; Ussuri Nature Reserve, 14 July 2008, 2♀, Kuprin; Verkhnij Pereval village, 15 July 2013, 1♀, Shabalin.

IASE SB RAS: L. Khanka, 6 June 1911, 1♀, no coll.; ibid., 1935, 1♂, Berman; ibid., no date, 2♀, Plaviltshikov; 1♀, no label; Cydzykhinsky (Lasovsky) Nature Reserve, 1964, 1♀, no coll. (new record); Kamenuska village, 7 July 1979, 1 ♂, Nikitsky; Suputinsky (Ussuri) Nature Reserve, 10 August 1973, 1♂, Arefin; Kamenuska village, 25 July 1982, 1 ♂, Nikitsky, ibid., 11 August 1983, 1 ♂, Antropov, ibid., 13–16 August 1985, 2 ♀, Antropov (ZMMU); Shkotovsky district, Mikhajlovsky forest, 4 August 1937, 2♀, no coll; Suputinsky (Ussuri) Nature Reserve, 3 August 1968, 1♀, Konovalova, ibid., on logged timber of *Populus maximowiczii*, 22 June 1971, 1♀, Tsherepanov, ibid., 24 August 1971, 1♀, Tsherepanov, ibid., 1 August 1971–1973, 1♂, 1♀, Tsherepanov, ibid., 1–2 August 1972–1973, 1♂, 2♀, Tsherepanov; Thernyshevka village, 4 August 1986, 1♂, Danilevich; Anuchinsky district, 10–15 km North of Thernyshevka village, 6 August 1993, 1♀, Zinchenko and Dubatolov; 2 ♀, no label.

UNR FEB RAS: Ussuri Nature Reserve, Komarovsky forest, 8 July 2008, 2♀, Sasova, ibid., 2–4 August 2009, 2♀, Kuprin, ibid., Suvorovsky forest, 10 August 2010, 1♀, Melnichenko, ibid., Komarovsky forest, 26 July 2013, 1♂, 4♀, Kotliar, ibid., Suvorovsky forest, 22 July 2014, 1♀, Kuprin; Khasansky district, Kamishovaya River, Kamishovij village, 6 August 2016, 1♀, Kuprin (new record).

FIGURE 3. Distribution of *Callipogon relictus* in Northeast Asia. The sites where this species is distributed are highlighted in red, and the provinces and administrative districts are indicated with numbers. China: 1—Shanxi, 2—Hebei, 3—Inner Mongolia, 4—Liaoning, 5—Jilin, and 6—Heilongjiang; South Korea: 7—Gangwon-do and 8—Gyeonggi-do; North Korea: 9—Pyeonganbuk-do, 10—Jagang-do, 11—Hamgyeongnam-do, and 12—Yanggang-do; Russian Federation: Primorsky Kray—13—Khasansky district, 14—Ussuriysky district, 15—Shkotovsky district, 16—Lazovsky district, 17—Anuchinsky district, 18—Chernigovsky district, 19—Yakovlevsky district, 20—Chuguevsky district, 21—Dalnerechensky district, and 22—Pozharsky district; Khabarovsky Kray—23—Bikinsky district and 24—South Lazo region; Jewish Autonomous Oblast—25—Oktyabrsky district; Amur Oblast—26—Arkharinsky district, 27—Bureysky district, 28—Mazanovsky district, and 29—Selemdzhynsky district.

CSIE: Spasskii district, near Kalinovka, Sinii ridge, July 2007, 1♂, 1♀; ibid., 24 August 2011, 2♀, Osipov; Ussuri Nature Reserve, Komarovsky forest, 29 August 2012, 1♀, Kuprin.

***Democratic People's Republic of Korea* (*North Korea*). CSIE:** Pyeonganbuk-do, Mt. Myohyangsan, July–August 2010, 8♂, 12♀, ibid., 30 July 2011, 2♂, 1♀, ibid., 1–7 August 2016, 7♀; Pyeonganbuk-do, Mt. Chunmasan, 28 July–7 August 2015, 8♂, 4♀; Pyeonganbuk-do, Mt. Baekamsan, 12 August 2009, 1♀; Jagang-do, Mt. Nanglimsan, 30 July 2009, 1♂; Yanggang-do, Mt. Bukpotaesan, 7 July 2011, 7♂, 24♀; Hamgyeongnam-do, Bulgaemibong, 5 July 2012, 5♂, 26♀; Hamgyeongnam-do, Mt. Duryusan, no label, 1♂,1♀.

***Republic of Korea* (*South Korea*). YIM:** Gyeonggi-do, Gwangneung, 22 July 1959, 1♂, ibid., 25 July 1959, 1♂, 3♀, Y.H. Shin.

PHS: Gyeonggi-do, Gwangneung, 29 July 1967, 1♂; Gangwon-do, Gangreung-si, Sogeumgang, 28 July 1971, 1♀.

KU: Gangwon-do, Chunchun-si, Buksan-myun, Chungpyeong-ri, 17 September 1937, 1♀, J.S. Choi; Gyeonggi-do, Gwangneung, 25 August 1961, 1♂; no label, 1♂, 2 ♀.

CSIE: Gyeonggi-do, Gwangneung, 27 July 1970, 1♂, H.C. Kim.

HRCI: Gyeonggi-do, Gwangneung, 3 August 1967, 2♂, ibid., 14 August 1972, 2♂, 1♀, S.M. Lee.

***People's Republic of China* (*China*). KU:** Harbin, Nachalosvsky, in the forest, 1 September 1926, 1♀, Klementjev.

CSIE: Liaoning, Fushun, Mt. Morihongshan, 3–11 August 2015, 2♂, 7♀; Jilin, Mt. Dajingjishan, July 2011, 4♂, 8♀; Liaoning, Mt. Qianshan, 28 July 2010, 2♂.

Remarks. In March 2016, during the survey on the collection of Zoological Museum of M.V. Lomonosov State University, we discovered one female specimen collected from Sudzuhinsky (Lazovsky) Reserve, which had not been included in the faunistic list of this reserve previously (Sundukov 1998; Russian Academy of Sciences 2009). The collection site is located on the foothills along the Kamishovaya River (Khasansky district) that flows from the East Manchurian Range into the Posyet Bay in the coastal area of the Russian Far East near the border with China and North Korea.

Discussion

Presently, the distributional area of *C. relictus* encompassed the territories that are parts of four countries—the Russian Federation, the People's Republic of China, the Democratic People's Republic of Korea (North Korea) and the Republic of Korea (South Korea) (Fig. 3). The presence of *C. relictus* in the fauna of the Northeast Asian subregion of the Palearctic region is attributable to the contact of the Old World fauna with the New World fauna during repeated occurrences of the Bering land bridge in the Paleogene and the Neogene periods, when a quasi-tropical climate prevailed in the high-latitude regions of Eurasia and North America (Yasamanov 1985; Zubakov 1990; Kuprin & Bezborodov 2012).

Distribution of *C. relictus* in Russia was described in detail by Kuprin and Bezborodov (2012). This species was reported from Primorsky Kray (Khasansky, Shkotovsky, Ussuriysky, Chernigovsky, Anuchinsky, Yakovlevsky, Chuguevsky, Dalnerechensky, Pozharsky, and Lazovsky administrative districts), Khabarovsky Kray (near the city of Khabaronsk, Bikinsky administrative district, and South Lazo region), Amur Oblast (Arkharinsky, Bureysky, Mazanovsky, and Selemdzhynsky administrative districts), and the Jewish Autonomous Oblast (Obluchensky and Oktyabrsky administrative districts). Primorsky Kray contains the largest population of this species in Russia, which is among the biggest populations throughout the entire distributional area. This region stretches from the city of Ussuriysk in the south to Dalnerechensk in the north, and from the town of Spassk-Dalny in the west to the coastal areas of the Russian Far East (Lazovsky Nature Reserve). The size and stability of this population is associated with the presence of over-mature nemoral forests of the western macro-slope and foothills of the Sikhote-Alin mountain range. The second-largest population is located in the north of Primorsky Kray and in the south of Khabarovsky Kray in the basins of Bikin and Khor rivers. Both areas have several smaller populations of this species, from which isolated finds were made. The northernmost populations are located in the southeast of Amur Oblast and in the northwest of the Jewish Autonomous Oblast. The northernmost boundary of the distribution of *C. relictus* is located in Mazanovsky and Selemdzhynsky districts of Amur Oblast (Kuprin & Bezborodov 2012).

FIGURES 4–6. Habitats of *Callipogon relictus* in the Ussuri Nature Reserve (Russia).

Outside Russia, the largest and most stable populations of *C. relictus* are localized in Manchurian-Korean mountains, including the area of Baekdu-Changbai on the border of North Korea with China, within the North Korean provinces of Jagang-do, Hamgyeongbuk-do, Hamgyeongnam-do, Pyeonganbuk-do, and Yanggang-do province, and the eastern Chinese province Jilin (Hua *et al.* 2009). The stability and reproduction of the populations in these areas are attributable to its inaccessibility and the presence of a small human population within the region, which might have facilitated the persistence of vast areas of over-mature mixed coniferous and broad-leaved forests. In the south of the Korean Peninsula within the territory of the Republic of Korea, the focal species was recorded in Gyeonggi-do and Gangwon-do provinces (Kim 1978). However, no stable populations are known at present, and the declining populations are on the brink of extinction, owing to severe anthropogenic pressure on the biotopes (Kim *et al.* 1976; Byun 2006; Byun *et al.* 2007).

Historically, the major part of the distributional area of *C. relictus* was in China. Presently, owing to utilization of vast areas in this country, the distributional range of *C. relictus* has undergone greater fragmentation than that in the other countries. The natural distribution of this species in China includes eastern Manchuria within the Amur River Basin, spanning across Heilongjiang, Jilin, and further to the south over the preserved mountain forest ecosystems of Liaoning, Hebei, Shanxi, and Shaanxi provinces (Li *et al.* 2014). Localization of this species in Shaanxi, the southernmost point of the distributional area, is of interest to the Chinese sector of the distributional area. However, data on the distribution in Shaanxi were not confirmed by the material studied (Li *et al.* 2012), indicating that this data might be controversial.

The largest population of *C. relictus* in China is localized in the foothills of the Baekdu-Changbaishan Plateau and valleys of the Tumen, Mudan, and Hunchun rivers. The second-largest population is located on the south-eastern spurs of the Lesser Hinggan Mountains along the middle reaches of the Hulanhe River in the east of Heilongjiang province. Both these large populations are associated with preserved over-mature nemoral forests. The third population, which is significantly isolated from the others, is located on the northern spurs of the Taihang Mountains in Hebei province. The other populations of this species are distributed over a very limited area and are

often localized on separate mountains, such as Mt. Qianshan and Mt. Morihongshan in Liaoning, and Mt. Zhongtiaoshan in Shanxi (Li *et al.* 2012).

The distribution of *C. relictus* has characteristics similar to that of a rare species. The species range is not continuous, because the beetles are confined to over-mature mixed coniferous and broad-leaved forests that do not form a continuous cover over large areas (Fig. 4–6; Kuprin 2016). Kinds of the host plants of *C. relictus* in Russia, and in the adjacent areas of China and North Korea, are interesting. The main host plants of the larvae are *U. japonica*, *Fraxinus mandshurica*, *Tilia amurensis*, *P. maximowiczii*, *Quercus mongolica*, *Betula costata*, and *Acer mandshuricum* (Kuprin *et al.* 2014). A clear correlation in the host plant preferences of the species was found in several populations within Russia. Thus, the central population inhabits mostly in areas covered with *U. japonica* and *T. amurensis* and the northern population inhabits forests of *B. costata*, *Chosenia arbutifolia*, *Salix caprea*, and *P. suaveolens*. In the southern parts of the distributional area within China, this species inhabits forests of *F. rhynchophylla*, *Anacardiaceae mono*, *U. laciniata*, and *Q. liaodungensis* (Li *et al.* 2012). In South Korea, *Carpinus laxiflora* is the main host plant of *C. relictus* (Kim *et al.* 1976; Yi 2014).

Further investigations on this species in Northeast Asia, especially North Korea might provide interesting insights into the mechanisms underlying the distribution of this species.

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