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Three *Cassida* species new to South Korea, with additional faunistic data and key to all Korean species (Coleoptera: Chrysomelidae: Cassidinae)

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ABSTRACT. *Cassida ferruginea* GOEZE and *C. mongolica* BOHEMAN are reported for the first time in South Korea and occurrence of *C. japana* BALY is confirmed based on a critical examination of male genitalia. Key to all known species and additional material of Korean *Cassida* are provided.

Key words: entomology, new records, Chrysomelidae, Cassidinae, *Cassida ferruginea*, *Cassida japana*, *Cassida mongolica*, Korea.

INTRODUCTION

The genus *Cassida* LINNAEUS, 1758 with 457 described species is the most speciose genus within the subfamily Cassidinae (BOROWIEC 1999, BOROWIEC & ŚWIĘTOJAŃSKA 2014). The genus is distributed throughout the Old World with two native species in North America (SPAETH 1927, MAJKA & LeSAGE 2008). HEYDEN (1887) reported *Cassida viridis* LINNAEUS for the first time in Korea. Since then, GRESSIT & KIMOTO (1963) provided the first comprehensive review of Korean *Cassida* and listed 13 species with a key to species. AN et al. (1985) reported 18 species including 4 newly recorded species. Recently, BOROWIEC & CHO (2011) described a new species, *C. koreana*, which was the only endemic species to Korea. In total, 19 species have been recorded from Korea to date.

Here we report newly recorded species, *Cassida ferruginea* GOEZE, 1777 and *C. mongolica* BOHEMAN, 1854, from South Korea. *Cassida ferruginea* shows disjunct distribution in Western and Eastern Palearctic region while *C. mongolica* is widely

distributed in Northeast Asia. The occurrence of *C. japana* BALY, 1874 is confirmed based on recent materials and examination of male genitalia. *Cassida juglans* GRESSITT, 1942 is excluded from the Korean fauna. Keys to 21 known species, photographs and additional material of Korean *Cassida* are provided. The specimens are deposited in the Department of Biodiversity and Evolutionary Taxonomy, University of Wrocław, Poland. Photographs were taken by a Nikon D5200 digital camera attached to a Nikon SMZ1500 microscope, and were edited by Helicon Focus 5.3.12 and Adobe Photoshop CS5 software.

RESULTS

Cassida ferruginea GOEZE, 1777

(Figs. 5-6)

MATERIAL EXAMINED

1 ex., Buryeon Valley, Seo-myeon, Uljin-gun, Gyeongsangbuk Prov., South Korea, 10.V.1991, S.M. Jang.

DISTRIBUTION

Europe (excluding Iberian Peninsula), Algeria, Turkey, Japan (Honshu, Kyushu). New to South Korea.

REMARKS

Cassida ferruginea is similar to *C. panzeri* WEISE in the colouration and triangular spot at elytral base, but can be distinguished by the obtusely angulate sides of pronotum, narrow and moderately declivous explanate margin of elytra and black femora on basal 2/3. This species had been regarded as a European species before *C. ferruginea*, previously misidentified as *C. panzeri*, was recorded from Japan by SUENAGA (2013). The cause of this disjunct distribution still unknown.

Cassida japana BALY, 1874

(Figs. 9-10, 43-44)

MATERIAL EXAMINED

1 ex., Mt. Soemisan, Oncheon-dong, Dongnae-gu, Busan, South Korea, 3.VI.2004, H.W. Cho; 1 ex., Seodun-dong, Gwonseon-gu, Suwon-si, Gyeonggi Prov., South Korea, 26.V.2011, H.W. Cho.

DISTRIBUTION

Laos, Vietnam, China (Jiangsu, Zhejiang, Anhui, Hubei, Sichuan, Fujian, Jiangxi, Guangdong, Guangxi), Taiwan, Japan. First certain record to South Korea.

REMARKS

Cassida japana has long been confused with unspotted specimen of *C. piperata* since DOI (1927) reported this species under name of *C. japonica* for the first time in

Korea. The male genitalia, the only reliable diagnostic character, has not been studied in any specimens from Korea. In the study, we confirmed the occurrence of *C. japana* based on recent materials and study of male genitalia (Figs. 43-44).

***Cassida mongolica* BOHEMAN, 1854**

(Figs. 17-18)

MATERIAL EXAMINED

1 ex., Mt. Sangwolsan, Imgye-myeon, Jeongseon-gun, Gangwon Prov., South Korea, 17.VI.1997, H.C. Park.

DISTRIBUTION

China (Hebei, Jiangsu, Shaanxi, Shandong), Mongolia, Russian Far East, Japan. New to South Korea.

REMARKS

The black coloured specimen of *C. mongolica* is similar to *C. atrata* FABRICIUS in the black body with two yellowish brown triangular spots on the anterior margin of pronotum, but can be distinguished by the narrowly rounded pronotal sides and elevated relief of elytra. This species is widely distributed in Northeast Asia.

***Cassida juglans* GRESSITT, 1942**

REMARKS

AN et al. (1985) recorded *C. juglans* from South Korea based on two specimens and placed it in a key to Korean species. In our opinion the taxon was misinterpreted in this paper because original description of *C. juglans* is superficial and does not offer good diagnostic characters distinguishing *C. juglans* from *C. concha* and with great probability both taxa are conspecific. We unsuccessfully tried to find vouchers from the publication by AN et al. (1985) and it is difficult to say which species the authors of this work examined. Until the revision of the type of *Cassida juglans* we recognize its presence in Korea as doubtful.

NEW FAUNISTIC DATA

***Cassida amurensis* (KRAATZ, 1879).** 1 ex., Corea sept. 1987, Pukde-chon [Bukdaecheon Stream, Tanchon-si, Hamgyongnam Prov., North Korea], Exped. ISEZ Cr.

***Cassida concha* SOLSKY, 1872.** 3 exx., Mt. Irwolsan, Irwol-myeon, Yeongyang-gun, Gyeongsangbuk Prov., South Korea, 12.VI.2011, H.W. Cho.

***Cassida fusciorufa* MOTSCHULSKY, 1866.** 1 ex., Mt. Gunyeosan, Bugi-myeon, Cheongwon-gun, Chungcheongbuk Prov., South Korea, 3.VIII.1997, J.W. Lee; 1 ex., Heungcheon-myeon, Yeosu-gun, Gyeonggi Prov., South Korea, 28.V.1999, Y.B. Lee; 1 ex., Songcheon-dong, Andong-si, Gyeongsangbuk Prov., South Korea, 5.V.2003, H.W.

Cho; 1 ex., same data as preceding one except 19.VI.2003, H.Y. Kwon; 1 ex., same data except 31.VI.2003; 1 ex., same data except 23.V.2006, J.E. Lee.

***Cassida koreana* BOROWIEC & CHO, 2011.** 1 ex., Naeji-ri, Yongmun-myeon, Yecheon-gun, Gyeongsangbuk Prov., South Korea, 11.V.2009, M.J. Lee; 1 ex., Songwol-ri, Hari-myeon, Yecheon-gun, Gyeongsangbuk Prov., South Korea, 11.V.2009, K.S. Sim; 1 ex., Mt. Baekunsan, Gwangyang-si, Jeollanam Prov., South Korea, 14.VI.2009, S.S. Kim; 1 ex., Dochon-ri, Sangni-myeon, Yecheon-gun, Gyeongsangbuk Prov., South Korea, 7.IX.2009, M.J. Lee.

***Cassida lineola* CREUTZER, 1799.** 1 ex., Songcheon-dong, Andong-si, Gyeongsangbuk Prov., South Korea, 1.VI.2004, H.W. Cho; 1 ex., same data as preceding one except 2.VII.2004.

***Cassida mandli* SPAETH, 1921.** 1 ex., Dutaeyeon, Yanggu-gun, Gangwon Prov., South Korea, 30.V.1992, H.C. Park; 1 ex., Mt. Gwangdeoksan, Cheonan-si, Chungcheongnam Prov., South Korea, 16-18.VI.1994, H.S. Choi; 1 ex., Mt. Bangtaesan, Inje-gun, Gangwon Prov., South Korea, 25.VI.1996; 1 ex., Oknyeobong, Nonsan-si, Chungcheongnam Prov., South Korea, 23.V.1997, S.Y. Kim; 2 ex., Seodun-dong, Gwonseon-gu, Suwon-si, Gyeonggi Prov., South Korea, 20.VI.2000, S.J. Jang; 1 ex., Mt. Gyemyeongsan, Chungju-si, Chungcheongbuk Prov., South Korea, 17.VI.2003, K.D. Han & T.W. Kim; 1 ex., Mt. Jeombongsan, Girin-myeon, Inje-gun, Gangwon Prov., South Korea, 22.VI.2006, S.H. Kim.

***Cassida pallidicollis* BOHEMAN, 1856.** 2 ex., Songcheon-dong, Andong-si, Gyeongsangbuk Prov., South Korea, 23.V.2004, H.W. Cho; 1 ex., same data as preceding one except 2.VII.2004; 1 ex., same data except 25.VII.2006, S.E. Noh.

***Cassida piperata* HOPE, 1842.** 1 ex., Yeongdeok-gun, Gyeongsangbuk Prov., South Korea, 18.VI.1994, J.J. Park; 1 ex., Daemun-ri, Gunoe-myeon, Wando-gun, Jeollanam Prov., South Korea, 8.V.1998, I.S. Kim; 1 ex., Songcheon-dong, Andong-si, Gyeongsangbuk Prov., South Korea, 8.VI.2006, H.W. Cho; 1 ex., Dosan-myeon, Andong-si, Gyeongsangbuk Prov., South Korea, 18.VI.2006, H.W. Cho; 1 ex., Yeongjang-ri, Gwangtan-myeon, Paju-si, Gyeonggi Prov., South Korea, 30.V.2008, H.W. Cho.

***Cassida rubiginosa* MÜLLER, 1776.** 1 ex., Mt. Daeamsan, Dong-myeon, Yanggu-gun, Gangwon Prov., South Korea, 7.VII.1995, J.I. Kim; 1 ex., same data as preceding one except 23.V.2003, T.W. Kim; 1 ex., same data except 7-8.VII.2003, J.K. Kim & T.W. Kim.

***Cassida sigillata* (GORHAM, 1885).** 5 ex., Namcheon Valley, Danyang-gun, Chungcheongbuk Prov., South Korea, 7.VI.2008 H.W. Cho.

***Cassida velaris* WEISE, 1896.** 1 ex., Nakdong River, Gangseo-gu, Busan, South Korea, 1.IV.2002, S.G. Kim.

Cassida versicolor (BOHEMAN, 1855). 1 ex., Mt. Naejangsan, Jeongeup-si, Jeollabuk Prov., South Korea, 26.V.1994, J.M. Park.

Cassida viridis LINNAEUS, 1758. 1 ex., Songnim-ri, Yeongok-myeon, Gangneung-si, Gangwon Prov., South Korea, 27.VI.1993, D.S. Ku; 1 ex., Mt. Palgongsan, Jangsu-gun, Jeollabuk Prov., South Korea, 24.V.2005, H.W. Cho.

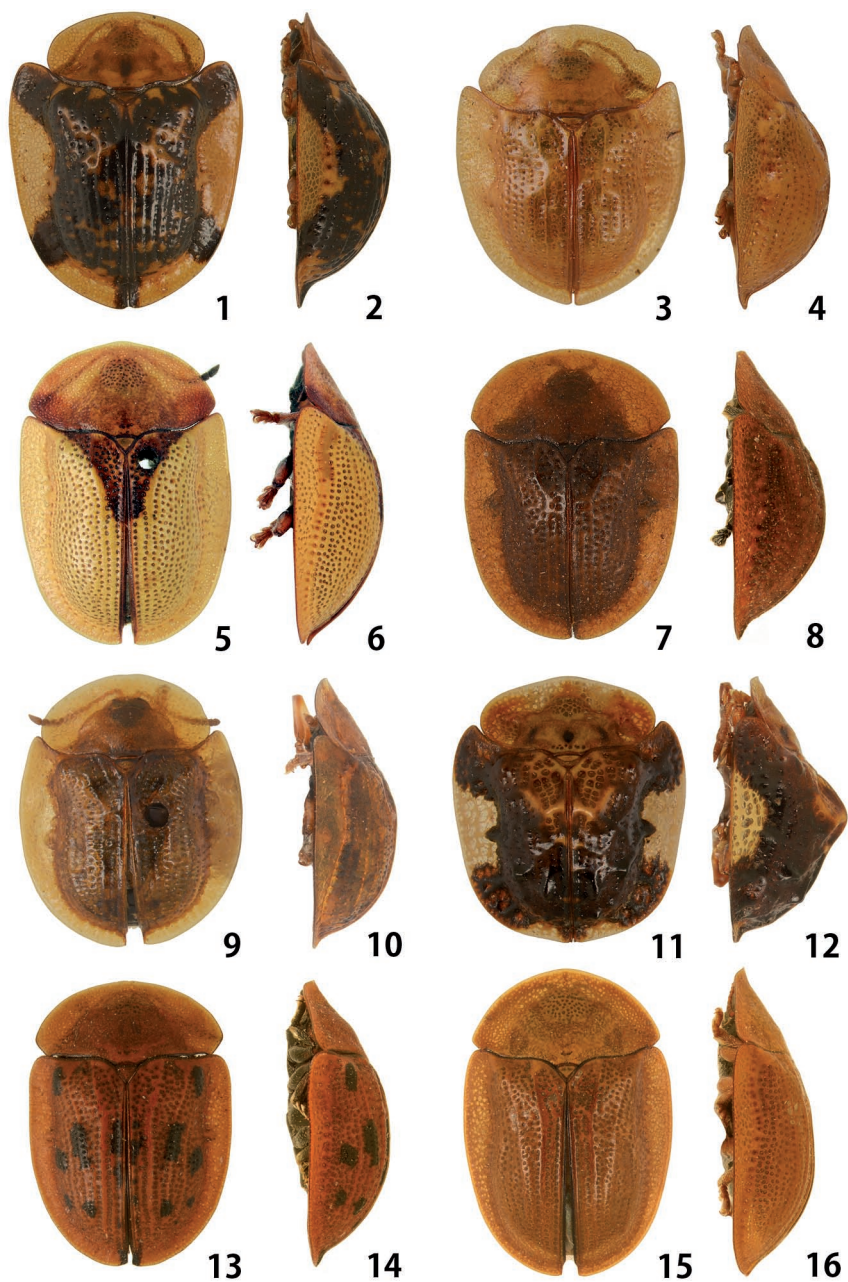
KEY TO SPECIES

1. Body pentagonal. Elytral disc with large postscutellar tubercle. Explanate margin of elytra with both humeral and posterolateral spots 2.
- Body oval or oblong or elongate. Elytral disc regularly convex or with more or less elevated postscutellar tubercle. Explanate margin of elytra with or without spots 3.
2. Pronotum with small oval or v-shaped brown spot of distinct borders. Postscutellar area pale red (Figs. 11-12) *koreana* BOROWIEC & CHO
- Pronotum immaculate or only occasionally with small brown spot of diffused borders. Postscutellar area dark brown to black (Figs. 37-38) *vespertina* (BOHEMAN)
3. Punctuation of elytra at least partly regular 4.
- Punctuation of elytra completely irregular (Figs. 39-40) *viridis* LINNAEUS
4. Claws simple 5.
- Claws appendiculate 19.
5. Claws strongly divergent, not hidden by hairs of the last tarsal segment 6.
- Claws narrowly divergent, hidden by hairs of the last tarsal segment (Figs. 3-4) *concha* SOLSKY
6. Body elongate. Explanate margin of elytra steeply declivous 7.
- Body oval or oblong or slightly elongate. Explanate margin of elytra moderately declivous 9.
7. Femora black on basal half or more 8.
- Femora almost completely yellowish brown (Figs. 41-42) *vittata* VILLERS
8. Punctuation of pronotum shallow and sparse. Femora black except for apical half (Figs. 21-22) *nobilis* LINNAEUS
- Punctuation of pronotum coarse and dense. Femora black except for apical base (Figs. 33-34) *velaris* WEISE
9. Punctuation of elytra mostly regular, without any punctures between third and fourth rows 10.
- Punctuation of elytra partly regular, with some extra punctures between third and fourth rows 12.
10. Smaller, length 4.0-5.5 mm. Elytra with or without dark patterns and posterolateral spots. Outer margin of elytra not swollen 11.
- Larger, length 6.3-7.2 mm. Elytra with numerous spots, without posterolateral spots. Outer margin of elytra swollen in basal third (Figs. 19-20) *nebulosa* LINNAEUS

11. Elytra without posterolateral spots (Figs. 9-10). Median lobe of aedeagus feebly curved in lateral view, apex oblong in dorsal view (Figs. 43-44) *japana* BALY
- Elytra with or without posterolateral spots (Figs. 25-26). Median lobe of aedeagus distinctly curved in lateral view, apex more or less trapezoid in dorsal view (Figs. 45-46) *piperata* HOPE
12. Elytra without longitudinal stripes 13.
- Elytra with many longitudinal stripes (Figs. 13-14) *lineola* CREUTZER
13. Legs entirely black 14.
- Legs entirely or partly yellow to brown 15.
14. Dorsum deep brownish red or rusty red, rarely yellowish brown. Pronotal sides angulate. Elytral disc with weak elevations. Dorsum with minute setae (Figs. 7-8) *fuscorufa* MOTSCHULSKY
- Dorsum largely black or rusty brown. Pronotal sides rounded. Elytral disc with distinct elevations. Dorsum with thick setae (Figs. 17-18) *mongolica* BOHEMAN
15. Pronotum without red basal band. Elytra generally without triangular spot at base 16.
- Pronotum with red basal band. Elytra always with triangular spot at base (Figs. 5-6) *ferruginea* GOEZE
16. Head black. Elytra without well marked H-shaped elevation 17.
- Head reddish brown. Elytra with well marked H-shaped elevation (Figs. 23-24) *pallidicollis* BOHEMAN
17. Femora entirely yellow to brown 18.
- Femora black on basal half (Figs. 27-28) *rubiginosa* MÜLLER
18. Elytral interstriae with minute setae (Figs. 15-16) *mandli* SPAETH
- Elytral interstriae without minute setae (Figs. 31-32) *spaethi* WEISE
19. Elytra without well marked X-shaped elevation 20.
- Elytra with well marked X-shaped elevation (Figs. 35-36) *versicolor* (BOHEMAN)
20. Explanate margin of elytra with both humeral and posterolateral spots (Figs. 1-2) *amurensis* (KRAATZ)
- Explanate margin of elytra with only humeral spots (Figs. 29-30) *sigillata* (GORHAM)

AUXILIARY KEY TO SPECIES

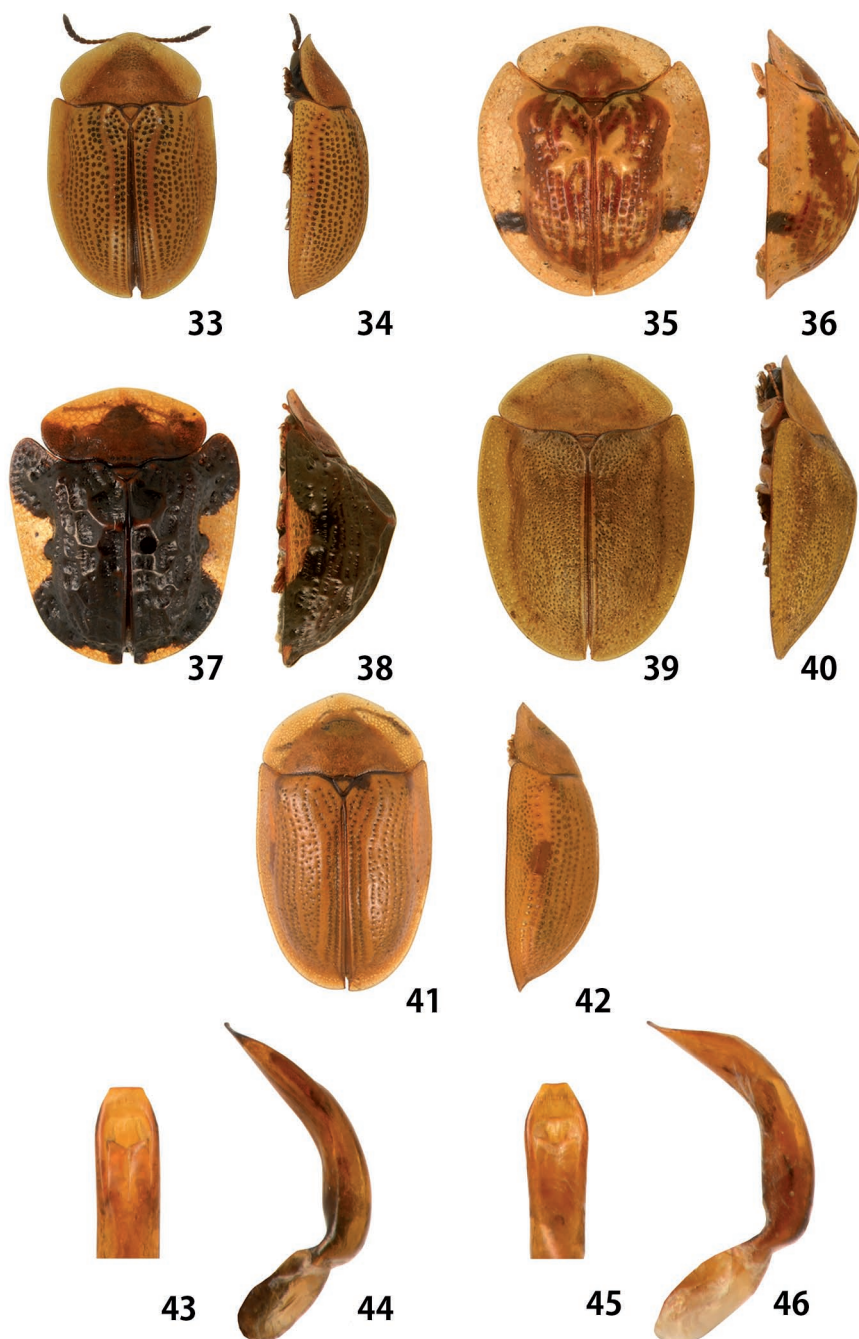
1. Explanate margin of elytra with distinct dark spots: humeral, posterolateral or both humeral and posterolateral (Figs. 1, 11, 25, 29, 35, 37) 2.
- Explanate margin of elytra without distinct dark spots: uniformly yellow (Figs. 3, 5, 15, 21), green (Figs. 27, 39), brown or black (Figs. 7, 17), or with indistinct mottled pattern (Fig. 23), or few dark spots in posterior length (Fig. 19) 7.
2. Explanate margin of elytra with only humeral (Fig. 29) or posterolateral spots (Figs. 25, 35) 3.



1-2. *Cassida amurensis*; 3-4. *C. concha*; 5-6. *C. ferruginea*; 7-8. *C. fusciorufa*; 9-10. *C. japana*; 11-12. *C. koreana*; 13-14. *C. lineola*; 15-16. *Cassida mandli*



17-18. *Cassida mongolica*; 19-20. *C. nebulosa*; 21-22. *C. nobilis*; 23-24. *C. pallidicollis*; 25-26. *C. piperata*;
27-28. *C. rubiginosa*; 29-30. *C. sigillata*; 31-32. *C. spaethi*



33-34. *Cassida velaris*; 35-36. *C. versicolor*; 37-38. *C. vespertina*; 39-40. *C. viridis*; 41-42. *C. vittata*; 43-44. Aedeagus of *C. japana*: 43 – apex dorsal, 44 – aedeagus lateral; 45-46. Aedeagus of *C. piperata*: 45 – apex dorsal, 46 – aedeagus lateral

- . Explanate margin of elytra with both humeral and posterolateral spots (Figs. 1, 11, 37) 5.
- 3. Explanate margin of elytra with broad humeral spot. Pronotal and elytral disc dark coloured, reddish-brown, brown or black (Figs. 29-30) *sigillata* (GORHAM)
- . Explanate margin of elytra with narrow posterolateral spot 4.
- 4. Body regularly circular. Pronotal and elytral disc with reddish to brownish pattern on pale yellow background and yellow relief, with high, X-shaped postscutellar elevation (Figs. 35-36) *versicolor* (BOHEMAN)
- . Body oval. Pronotum unicolours, elytral disc with brownish pattern on yellowish-brown background, with low X-shaped postscutellar elevation. Typical form with posterolateral spots on explanate margin of elytra (Figs. 25-26) *piperata* HOPE
- 5. Elytral disc with distinct hump in profile (Figs. 12, 38) and strong sculpture behind the hump (Figs. 11, 37) 6.
- . Elytral disc regularly rounded in profile (Fig. 2) and indistinct sculpture behind the hump (Fig. 1) *amurensis* (KRAATZ)
- 6. Pronotal disc immaculate or only occasionally with small brown spot of diffused borders. Postscutellar area dark brown to black (Figs. 37-38) *vespertina* (BOHEMAN)
- . Pronotal disc with small oval or v-shaped brown spot of distinct borders. Postscutellar area pale red (Figs. 11-12) *koreana* BOROWIEC & CHO
- 7. Punctuation of elytra at least partly regular, dorsal colour from uniformly yellow to black, or spotted. Claws simple or appendiculate 8.
- . Punctuation of elytra completely irregular, dorsum uniformly yellow or green (Figs. 39-40). Claws with small basal tooth *viridis* LINNAEUS
- 8. Both pronotum and elytra mostly or completely yellow, brown or with pattern but never black 9.
- . Pronotum and elytra mostly black (Figs. 17-18) *mongolica* BOHEMAN
- 9. Legs entirely black 10.
- . Legs entirely or partly yellow to brown 11.
- 10. Pronotal sides angulate (Fig. 7). Elytral disc with weak elevations. Dorsum with minute setae *fusciorufa* MOTSCHULSKY
- . Pronotal sides rounded (Fig. 17). Elytral disc with distinct elevations. Dorsum with thick setae. Pale form with mostly brown dorsum *mongolica* BOHEMAN
- 11. Elytra with well defined small black spots on yellow or reddish background (Figs. 13-14, 19-20) 12.
- . Elytra uniformly yellow or brown, or with mottled pattern (Figs. 23, 25, 35), or basal spot (Fig. 5) but never with well defined small black spots on yellow or reddish 13.
- 12. Pronotum with rounded sides, without basal corners. Explanate margin of elytra in posterior half usually with black spots (Fig. 19). Punctuation of elytra completely regular. Sexual dimorphism indistinct *nebulosa* LINNAEUS
- . Pronotum widest close to base, with basal corners. Explanate margin of elytra in posterior half always without black spots (Fig. 13). Punctuation of elytra at base

- of elytra with additional punctures between rows. Sexual dimorphism distinct *lineola* CREUTZER
13. Claws simple. Elytra without well marked X-shaped elevation 14.
- Claws appendiculate. Elytra with well marked X-shaped elevation (Figs. 35-36) *versicolor* (BOHEMAN)
14. Body elongate, subcylindrical with narrow, steeply declivous explanate margin of elytra (Figs. 21, 33, 41) 15.
- Body oval to circular usually with broad, moderately declivous explanate margin of elytra (Figs. 3, 15, 23, 25, 27, 31) 17.
15. Femora black on basal half or more 16.
- Femora almost completely yellowish brown (Figs. 41-42) *vittata* VILLERS
16. Punctuation of pronotum coarse and dense (Figs. 33-34) *velaris* WEISE
- Punctuation of pronotum shallow and sparse (Figs. 21-22) *nobilis* LINNAEUS
17. Claws strongly divergent, not hidden by hairs of the last tarsal segment. Body shape variable (Figs. 15, 23, 25, 27, 31) 18.
- Claws narrowly divergent, hidden by hairs of the last tarsal segment. Body almost hemispherical (Figs. 3-4) *concha* SOLSKY
18. Punctuation of elytra completely regular, without any punctures between third and fourth rows. Form without posterolateral spots on explanate margin of elytra (Figs. 9-10) 19.
- Punctuation of elytra with some additional punctures between third and fourth rows 20.
19. Median lobe of aedeagus feebly curved in lateral view, apex oblong in dorsal view (Figs. 43-44) *japana* BALY
- Median lobe of aedeagus distinctly curved in lateral view, apex more or less trapezoid in dorsal view (Figs. 45-46) *piperata* HOPE
20. Femora black on basal half 21.
- Femora entirely yellow to brown 22.
21. Pronotum with red basal band, elytra with brown, triangular basal spot (Fig. 5) *ferruginea* GOEZE
- Pronotum uniformly yellow, elytra unicolours, or with small brown spot at post-scutellar point, occasionally with few brown basal spots in postscutellar impression (Fig. 27) *rubiginosa* MÜLLER
22. Elytral interstriae with minute setae. Base of elytra as wide as base of pronotum (Figs. 15-16) *mandli* SPAETH
- Elytral interstriae without minute setae. Base of elytra slightly wider than base of pronotum (Figs. 31-32) *spaethi* WEISE

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