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# On Some Infraspecific Variation of Chrysomelid Beetles (Coleoptera) Occurring in the Ryukyu Archipelago

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**Synopsis** Consideration is made on the origin of some discontinuous distribution of infraspecific variation observed in some chrysomelid populations distributing in the Ryukyu Archipelago. The origin of these discontinuous distribution is considered as a result of influence of random genetic drift rather than natural selection.

## Introduction

The Ryukyu Archipelago, which stretches from northeast to southwest between the mainland of Kyushu and Taiwan, consists of many islands varying in size, environment and geological history, and constitutes a very interesting series of biological stepping stones (Fig. 1). The Ryukyu Chain has undergone considerable subsidence and emergence at different periods. Thus, there has been a great deal of disturbance and extinction of the fauna, which has taken place at intervals towards the late Pleistocene. As a reflection of the climatic gradient and the different geological history, the living things occurring in the archipelago show extensive geographical variation in certain taxonomic groups and provide good materials for the studies of speciation.

As regards the mechanisms of differentiation of geographical races in allopatric populations, DOBZHANSKY (1951) states that it is caused by the shifting of gene frequencies under the influence of natural selection and random genetic drift. There have been many reports by many workers on the random drift in experimental populations of *Drosophila melanogaster*, such as PROUT (1954), KERR and WRIGHT (1954), BURI (1956), DOBZHANSKY and PAVLOVSKY (1957) and some others. The interaction of random drift and natural selection were diagrammatically clarified by these authors.

It is the purpose of this paper to point out that some geographical variations in certain species of chrysomelid beetles occurring in the Ryukyu Archipelago seem to have been caused by the influence of random drift rather than natural selection.

## Patterns of Geographical Variations in the Ryukyu Archipelago

KIMOTO and GRESSITT (1966) compiled an inclusive revisional work on the Chrysomelidae of the Ryukyu Archipelago. Among the chrysomelid beetles

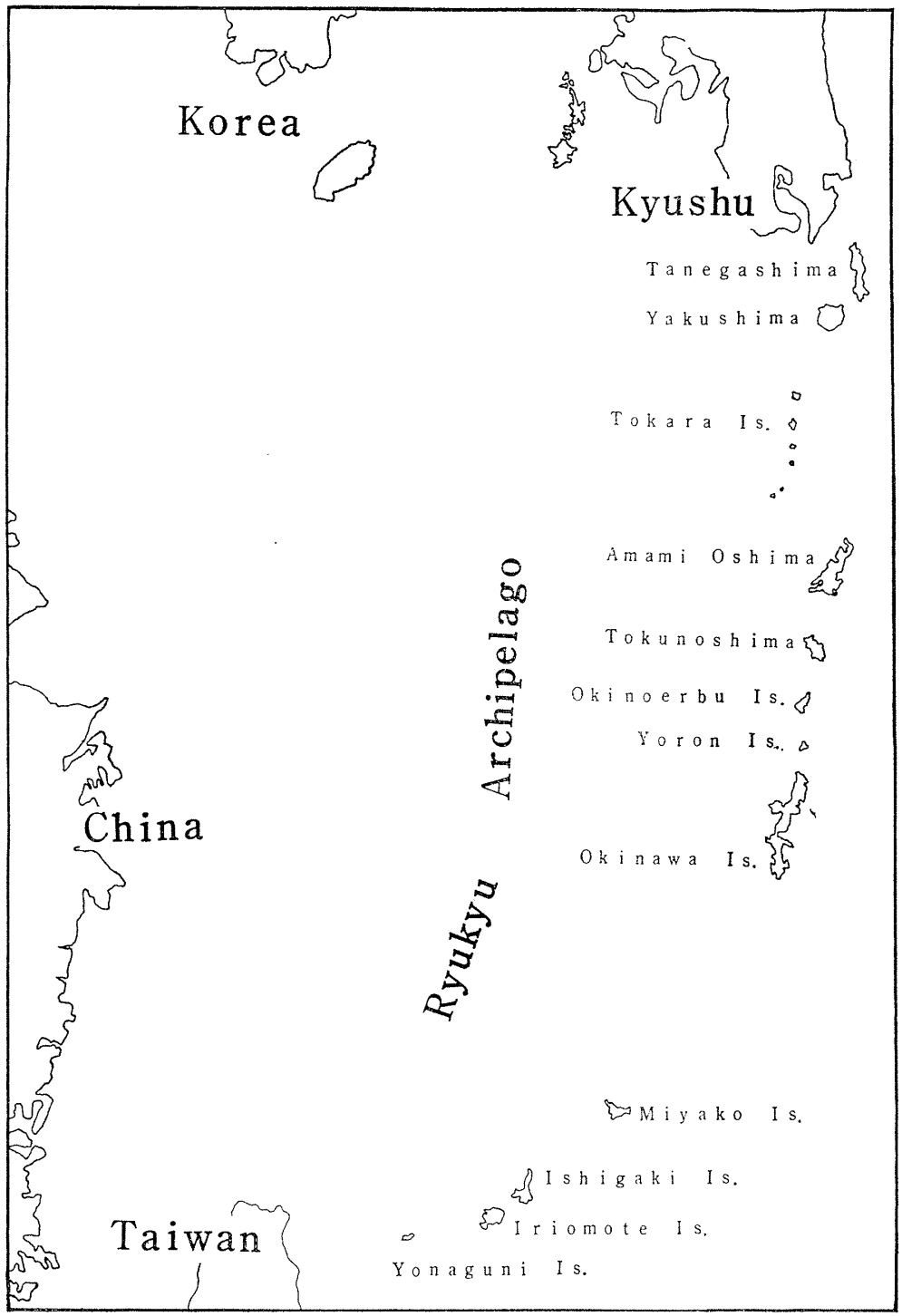


Fig. 1. Map of the Ryukyu Archipelago.

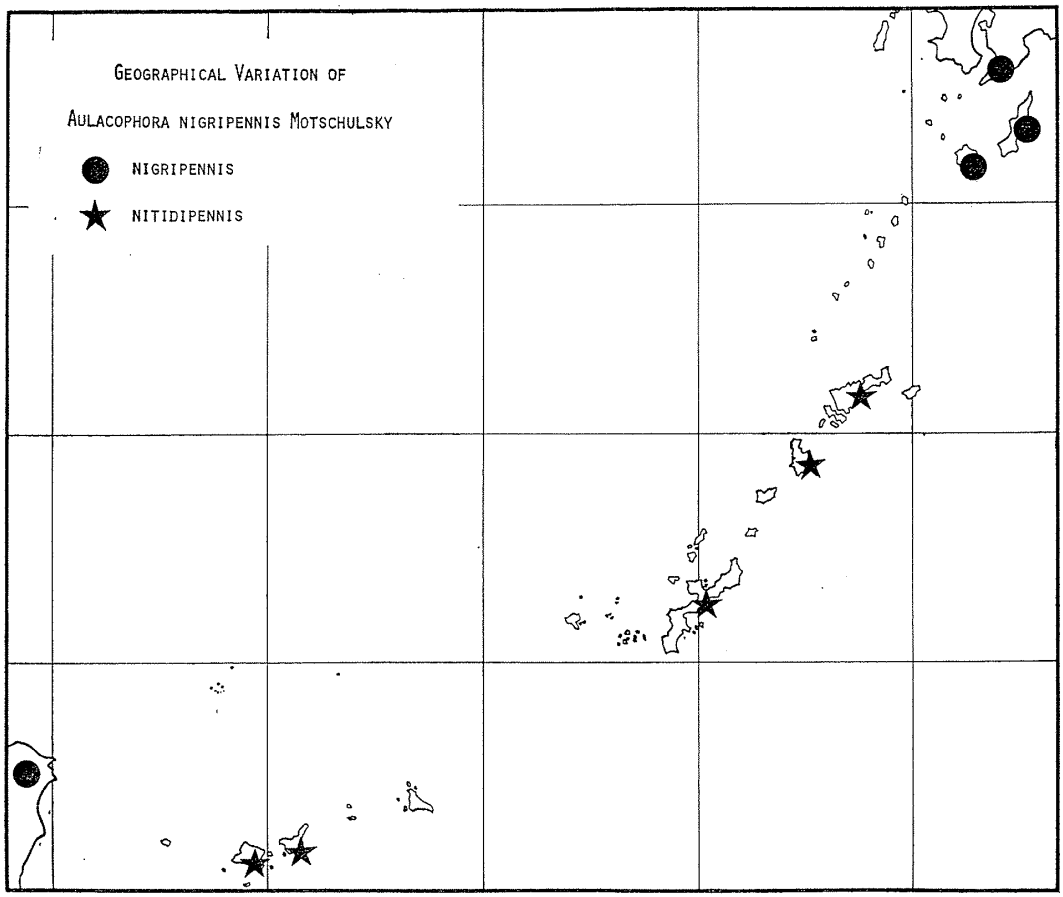


Fig. 2. Geographical variation of *Aulacophora nigripennis* MOTSCHULSKY.

occurring in the archipelago, there are several species showing extensive geographical variations in their coloration and markings of the dorsal surface.

1) *Aulacophora nigripennis* MOTSCHULSKY: This species is now known to occur in Japan, Korea, China, Manchuria, E. Siberia, Taiwan and the Ryukyu Archipelago. The nominate form (*nigripennis*) is characterized by having the elytron entirely black, and *nitidipennis* is separable from it by having the elytron entirely bluish green (KIMOTO & GRESSITT, 1966). The former is now known to occur in Japan proper, including Yakushima, Tanegashima, Korea, E. Siberia, China and Taiwan, and the latter in Amami-Oshima, Tokunoshima, Okinawa, Ishigaki and Iriomote Is. (Fig. 2). The populations distributing in the Ryukyu Archipelago are as a whole differentiated from those of Japan, China, Taiwan and some other territories.

2) *Acrothinium gaschkevitchii* MOTSCHULSKY: This species is now known to occur in Japan, China, E. Siberia, Taiwan and the Ryukyu Archipelago. The nominate form (*gaschkevitchii*) is characterized by having the ground color of elytron deep red with the margins greenish or bluish, *shirakii* by having the ground color of elytron golden or coppery green, with metallic luster on disc,

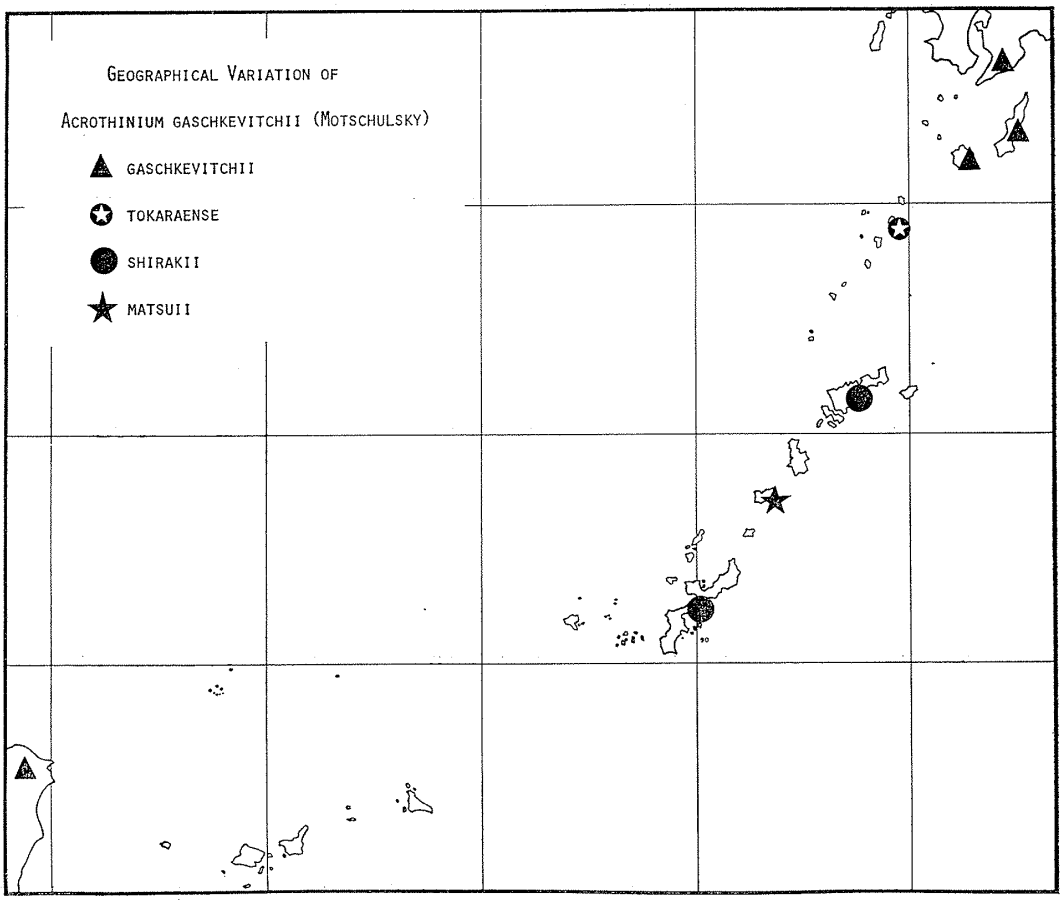


Fig. 3. Geographical variation of *Acrothinium gaschkevitchii* (MOTSCHULSKY).

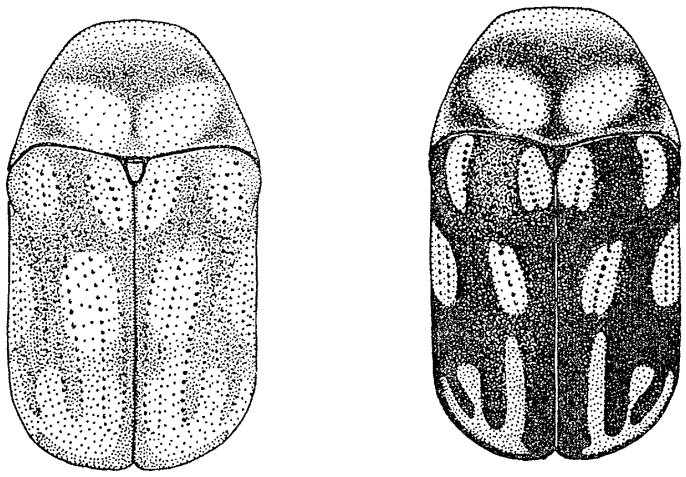


Fig. 4. Infraspecific variation of *Cryptocephalus loochooensis* CHÛJÔ, occurring in the Ryukyu Archipelago: a, *loochooensis*; b, *miyakoensis*.

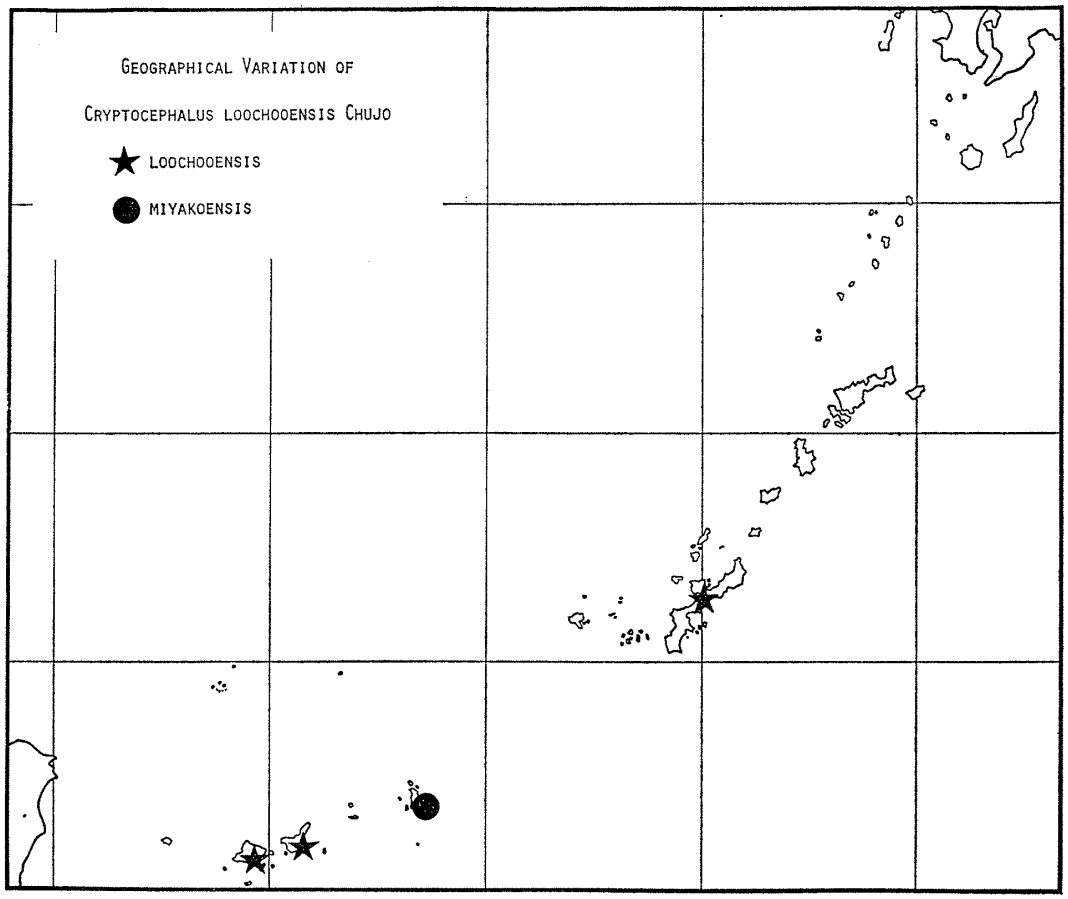


Fig. 5. Geographical variation of *Cryptocephalus loochooensis* CHÛJÔ.

*tokaraense* by having the dorsal surface of elytron entirely greenish violaceous (KIMOTO & GRESSITT, 1966). The nominate form (*gaschkevitchii*) is known to occur in Japan proper, including Yakushima and Tanegashima, China, E. Siberia, China and Taiwan, and *shirakii* in Amami-Oshima and Okinawa. On the other hand, *matsuii* is endemic to the small island, Okinoerabu, which lies between Amami-Oshima and Okinawa Is., and *tokaraense* is endemic to the small island, Nakanoshima of the Tokara group. The geographical distribution of these subspecies in the archipelago shows a complicated geographical discontinuation, viz. *gashkevitchii* in Taiwan, *shirakii* in Okinawa, *matsuii* in Okinoerabu, again *shirakii* in Amami-Oshima, *tokaraense* in Nakanoshima of the Tokara group, and again *gaschkevitchii* in Yakushima, Tanegashima and some more northern territories (Fig. 3). Thus, the populations occurring in the Ryukyu Archipelago are well differentiated from those of Japan, China and Taiwan. Further remarkable differentiation occurs in the population of certain small islands of the archipelago, and the same infraspecific variation occurs discontinuously.

3) *Cryptocephalus loochooensis* CHÛJÔ: This species is now known to be confined in the southern part of the Ryukyu Archipelago. The nominate form

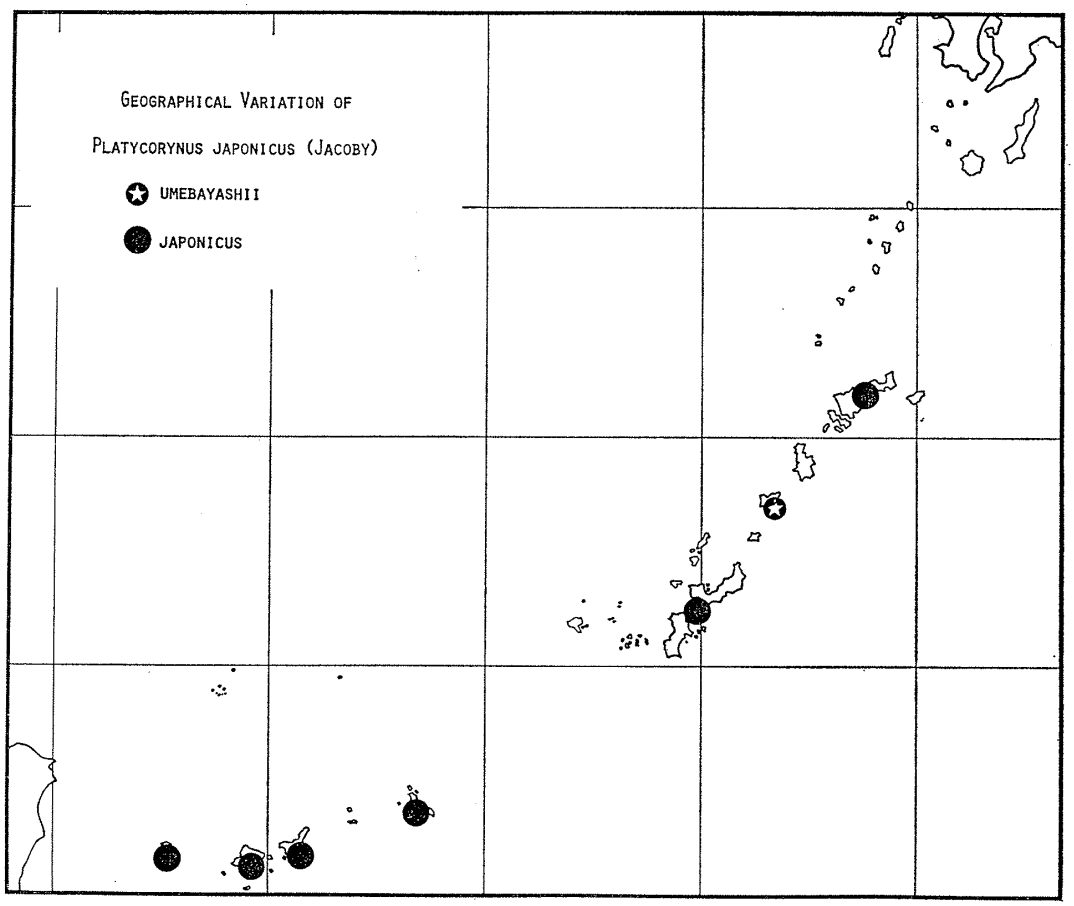


Fig. 6. Geographical variation of *Platycorynus japonicus* (JACOBY).

(*loochooensis*), which is characterized by having the pronotum yellow or yellowish brown, with a large and nearly M-shaped brown or dark brownish marking in the middle, elytron yellowish brown with many ill-defined brown longitudinal and oblique stripes and bands. The Miyako population (*miyakoensis*) is well differentiated from the nominate form (Fig. 4). The nominate form (*loochooensis*) is at present known to occur in Iriomote and Ishigaki Is., and *miyakoensis* in Miyako Is., and again the nominate form in Okinawa Is. (Fig. 5).

4) *Platycorynus japonicus* (JACOBY): This species shows a somewhat similar pattern to that of *Cryptocephalus loochooensis*. Its distribution is restricted to the Ryukyu Archipelago at present. It resembles most closely *P. sauteri* CHÛJÔ from Taiwan, but is clearly separable. The nominate form (*japonicus*) is characteristic in having the dorsal surface bluish green, and the population of Okinoerabu Is. is well differentiated as *umebayashii*. The nominate form (*japonicus*) is known to occur in Yonaguni, Iriomote, Ishigaki, Miyako and Okinawa Is., and *umebayashii* in Okinoerabu Is., and again the nominate form in Amami-Oshima (Fig. 6). Thus, in *Cryptocephalus loochooensis* and *Platycorynus japonicus*, which are known at present to distribute only in the Ryukyu Archipelago, remarkable differentiation

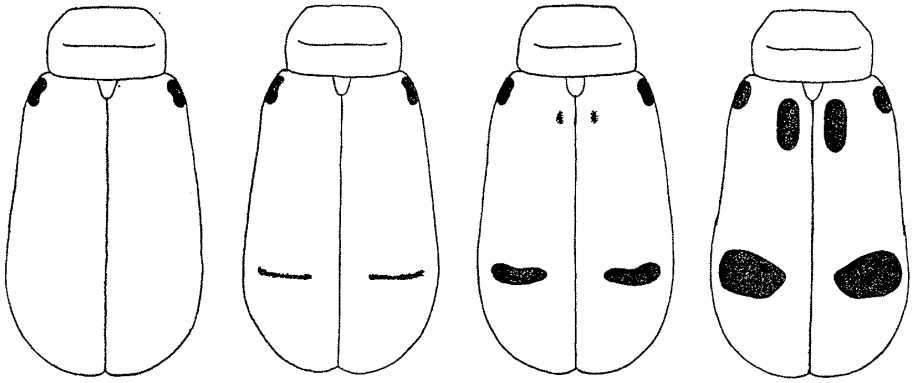

Fig. 7. Infraspefic variation of *Aulacophora bicolor* (WEBER), occurring in the Ryukyu Archipelago: a, *bicolor*; b–c, intermediate forms; d, *sexpunctata*.

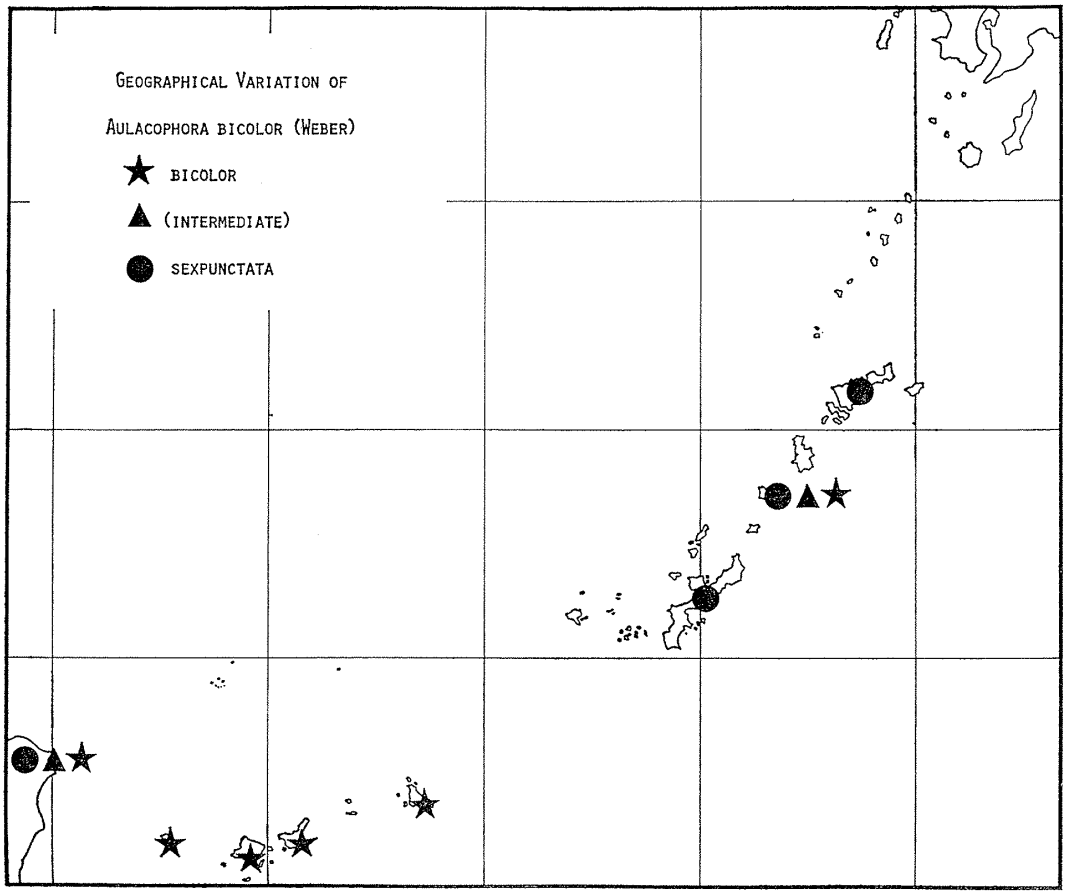


Fig. 8. Geographical variation of *Aulacophora bicolor* (WEBER).

occurs in the population of certain small island and the same form of infraspecific variation occurs discontinuously.

5) *Aulacophora bicolor* WEBER: This species is widely distributed in SE Asia, Taiwan and the Ryukyu Archipelago. The nominate form (*bicolor*) is characteristic in having the ground color of elytron reddish brown with the humerus black, and

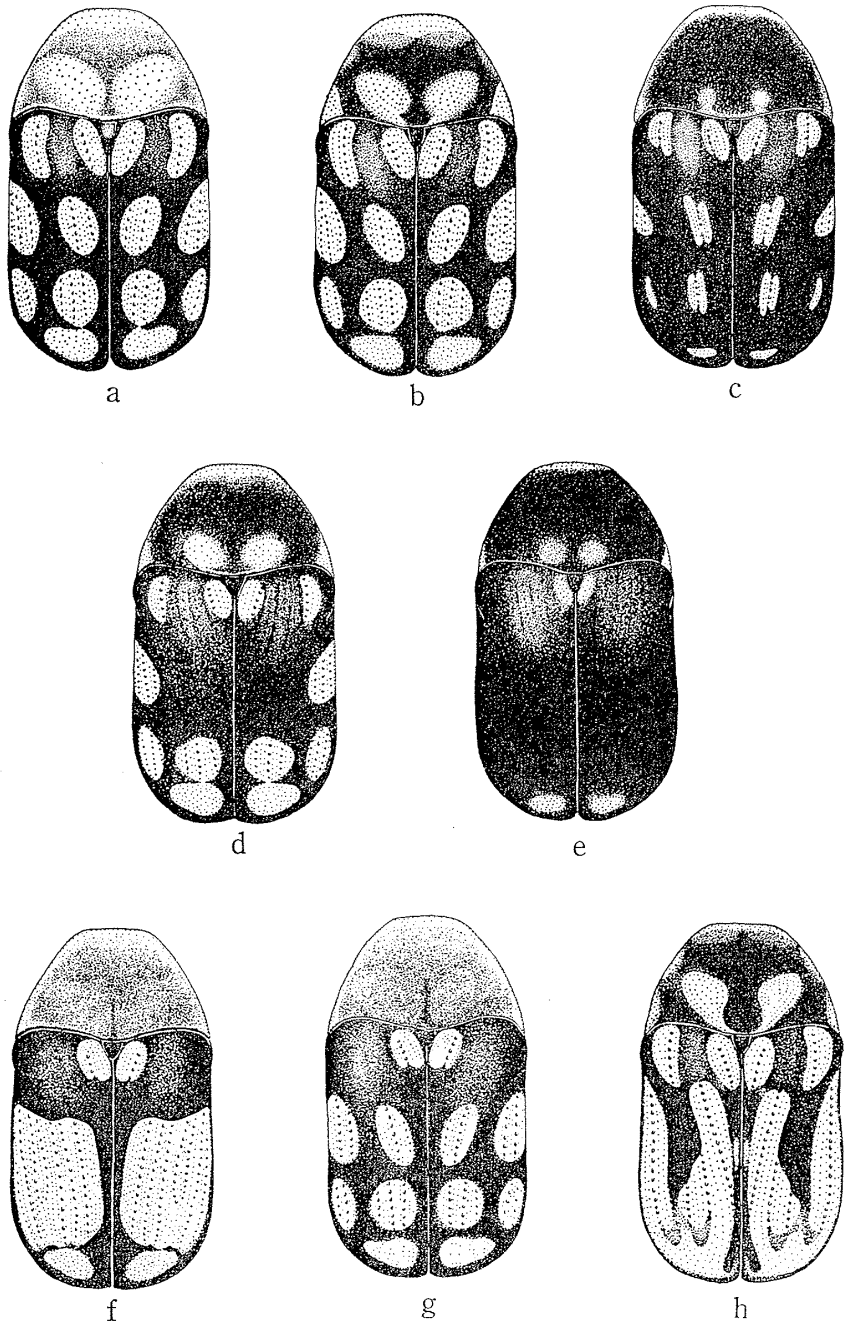


Fig. 9. Infraspecific variation of *Cryptocephalus perelegans* BALY, occurring in the Ryukyu Archipelago: a, *perelegans* (typical); b, *insularis* (typical); c, *insularis* (yellowish markings reduced); d, *insularis* (interio-median marking lacking; Nakanoshima in the Tokara group); e, (*ater*) (darkest form of *insularis*; Nakanoshima in the Tokara group); f, *takahashii* (typical); g, *takahashii* (large post-median marking divided); h, *yonaguniensis*.

*sexmaculata* in having the ground color of elytron reddish brown with three pairs of blackish markings. There are various degrees of intermediate forms between *bicolor* and *sexmaculata* (Fig. 7). The *bicolor* is now known to occur in Yonaguni, Iriomote, Ishigaki and Miyako Is. and *sexmaculata* in Okinawa Is. and Amami-Oshima. It is very interesting that *bicolor, sexmaculata* and many intermediate forms between them are known to occur in Okinoerabu Is., which is situated between Okinawa Is. and Amami-Oshima. Thus, the constitution of the marking forms of this species is remarkably differentiated on the small island, Okinoerabu (Fig. 8).

6) *Cryptocephalus perelegans* BALY: This species is now known to occur in Japan, the Ryukyu Archipelago and Taiwan. Its geographical variation is the most complex and interesting (Figs. 9 & 10). Apparently the populations occurring in Yakushima and north of the island belong to the nominate form (*perelegans*) which is characterized by having pronotum reddish brown with a pair of yellowish markings on the base and elytron black with 8 small spots (3: 2: 2: 1) yellowish. The population occurring in the Tokara Is., especially in Nakanoshima, varies extremely in the pattern of the dorsal surface. Many specimens belong to the

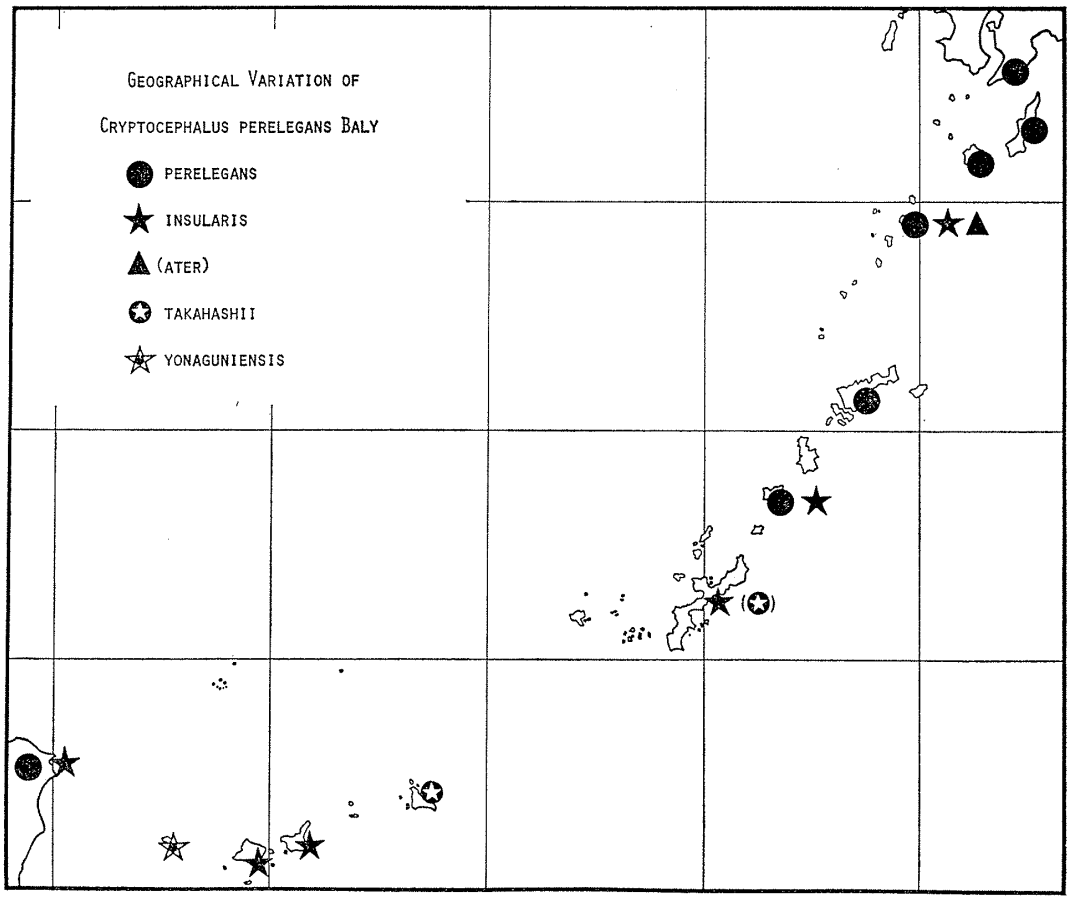


Fig. 10. Geographical variation of *Cryptocephalus perelegans* BALY.

nominate form as described above but some others belong to *insularis* which is characterized by having pronotum yellowish brown with a large M-shaped blackish marking in the middle, and elytron black with 8 small spots (3: 2: 2: 1) yellowish. In some specimens, however, the ground color is more darkened with yellowish patches reduced, and in some others the ground color is paler with yellowish patches enlarged. In the most dark-colored specimens, which are called here *ater*, the dorsal surface is mostly blackish, with the anterior and the lateral borders of pronotum and parts of elytron yellowish.

The Amami-Oshima population belongs to the nominate form and is almost the same as that of Yakushima. The Okinoerabu population[1] is also variable like that of Nakanoshima of the Tokara group and consists of *perelegans*, *insularis* and their intermediates of various degrees. The population of Okinawa Is. comprises mostly *insularis* and very rarely *takahashii*. The Miyako population apparently belongs to *takahashii*, which has the pronotum reddish brown, elytron black with a large subquadrate yellowish markings in the middle, a small yellowish spot near scutellum and another apically, but in some cases the large one is divided into 6 small spots (1: 2: 2: 1). The Ishigaki and Iriomote populations belong to *insularis* and are almost the same as the individuals occurring in Okinawa Is. The Yonaguni population belongs to *yonaguniensis*.

## Consideration of the Origin on Discontinuous Distribution of Infraspecific Variations Occurring in the Ryukyu Archipelago

The pattern of geographical variations of the chrysomelid beetles in the Ryukyu Archipelago discussed in the previous paragraph is summarized in Table 1. From this, it is pointed out that remarkable differentiation of island populations seems to have a tendency to concentrate on Nakanoshima, Okinoerabu, Miyako and Yonaguni Is.

As one of common geological histories, these islands are said to have been submerged by transgressions that occurred in the Ryukyu Period of the Pliocene and the Kunigami Period of the Pleistocene (HANZAWA, 1935). According to the recent work by MACNEIL (1960), HANZAWA's Ryukyu limestone is divided into two parts, viz. the lower unit named as Naha limestone and the upper unit as Yontan limestone, which are referable to the Pliocene and the Pleistocene respectively, and HANZAWA's Kunigami gravel is referred to a part of gravel and residuum of the Yontan limestone. ITIHARA, NARUSE and NAKAGAWA (1965, in MINATO, GORAI and HUNAHASHI ed.; p. 318) referred the upper unit of the Ryukyu limestone to the Shimosueyoshi formation typically developed in the Kantô district. According to GOHARA (1965, in MINATO, GORAI and HUNAHASHI ed.; tables 21–10) the Shimosueyoshi formation is equivalent to the Riss/Würm

1) This species is recorded for the first time from Okinoerabu Is. (3 exs., 3. vi. 1973, 8 exs., 4. vi. 1973, S. KIMOTO leg.).

Some Geographical Variations of the Chrysomelidae occurring in the Ryukyu Archipelago

| | *Aulacophora nigripennis* | *Acrothinium gaschkevitchii* | *Cryptocephalus loochooensis* | *Platycorynus japonicus* | *Aulacophora bicolor* | *Cryptocephalus perelegans* |
|---|---|---|---|---|---|---|
| Kyushu | *nigripennis* | *gaschkevitchii* | — | — | — | *perelegans* |
| Yakushima | *nigripennis* | *gaschkevitchii* | — | — | — | *perelegans* |
| Nakanoshima* (Tokara Is.) | — | ***tokaraense*** | — | — | — | ***perelegans*** / ***insularis*** / ***(ater)*** |
| Amami-Oshima | *nitidipennis* | *shirakii* | — | *japonicus* | *sexmaculata* | *perelegans* |
| Okinoerabu* | — | ***matsuii*** | — | ***umebayashii*** | ***bicolor*** / ***sexmaculata*** | ***perelegans*** / ***insularis*** |
| Okinawa | *nitidipennis* | *shirakii* | *loochooensis* | *japonicus* | *sexmaculata* | *insularis* (+++) / *takahashii* (+) |
| Miyako* | — | — | ***miyakoensis*** | *japonicus* | *bicolor* | ***takahashii*** |
| Ishigaki | *nitidipennis* | — | *loochooensis* | *japonicus* | *bicolor* | *insularis* |
| Iriomote | *nitidipennis* | — | *loochooensis* | *japonicus* | *bicolor* | *insularis* |
| Yonaguni* | — | — | — | *japonicus* | *bicolor* | ***yonaguniensis*** |
| Taiwan | *nigripennis* | *gaschkevitchii* | — | — | *bicolor* / *sexmaculata* | *perelegans* / *insularis* |
| China | *nigripennis* | *gaschkevitchii* | — | — | *bicolor* / *sexmaculata* | — |
| Other localities | Korea, E. Siberia | E. Siberia | | | S. E. Asia | |

The island names with asterisk indicate their complete submergence of the island during the post Ryukyu Period. The scientific names printed in Gothic indicate the occurrence of remarkable differentiation on the island population. { } indicating the presence of various degrees of intermediate forms.

Interglacial Period in the European Alps.

The reconstitution of the populations of these submerged islands is assumed to pregress in accordance with the upheaval of the islands in the Post Ryukyu Period, and the origin of the existing populations can be considered relatively new, comparing with that of the large, nonsubsident islands such as Amami-Oshima, Okinawa, Ishigaki and Iriomote Is. Therefore, the remarkable differentiations observed in these submerged island populations seem to have progressed rapidly by the geographical isolation.

Since the same form of infraspecific variation is observed discontinuously, the origin of these phenomena could be reasonably explained by the random genetic drift rather than natural selection. The number of reconstituted populations in such small, submerged islands is relatively small, especially at the time of the establishment of a new population by a new original founder. The genetic constitution is assumed to have been influenced significantly by the random drift which has negative correlation with the (effective) population number.

## Conclusion

In summary, it could be demonstrated that some discontinuous distributions of infraspecific variations observed in some chrysomelid populations distributing in the Ryukyu Archipelago seem to be originated by the influence of random genetic drift rather than natural selection.

## Descriptions of New Forms

***Cryptocephalus loochooensis miyakoensis*** subsp. nov.
(Fig. 4 b)

This new subspecies is separable from the nominate subspecies in having the large M-shaped marking in the middle of pronotum much darker, and the longitudinal and oblique stripes and bands on elytron much expanded and much darker.

Length: 3.8–4.2 mm.

Holotype: Karimata, Miyako Is. (12. iv. 1964, S. HIGASHIHIRACHI leg.) (Type No. 2028, Kyushu Univ.). Paratopotype: 1 ex., same data as the holotype.

***Cryptocephalus perelegans yonaguniensis*** subsp. nov.
(Fig. 9 h)

This new subspecies is characterized by having the elytron yellowish brown with many irregular longitudinal and transverse stripes and bands blackish.

Length: 3.0–3.8 mm.

Holotype: Sonai, Yonaguni Is., Ryukyu Archipelago (25. v. 1965, S. AZUMA leg.) (Type No. 2030, Kyushu Univ.). Paratopotypes: 13 exs., same data as the holotype. Paratypes: 4 exs., same data as the holotype but 23. v. 1965.

***Platycorynus japonicus umebayashii*** subsp. nov.

This new subspecies is separable from the nominate subspecies in having the dorsal surface entirely violaceous, instead of greenish.

Length: 8.2–10.0 mm.

Holotype: Okinoerabu Is., Ryukyu Archipelago (13. v. 1957, M. UMEBAYASHI leg.) (Type No. 2029, Kyushu Univ.). Paratopotypes: 7 exs., same data as the holotype. Paratypes: Okinoerabu Is. (1 ex., 5. viii. 1958, 3 exs., 8. viii. 1958, S. UÉNO leg.; 3 exs., 4. vi. 1973, S. KIMOTO leg.).

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*Kontyû, Tokyo*, **42**(3): 282. September 25, 1974

# New Names for Two Japanese Species of *Drosophila* FALLÉN (Diptera, Drosophilidae)

Toyohi OKADA

According to personal communications of Dr. Marshall R. WHEELER of the University of Texas and of Dr. Brian H. COGAN of the British Museum (Natural History) through Dr. D. Elmo HARDY of the University of Hawaii about the homonymy of *Drosophila elliptica* and *D. lutea*, respectively, new names are proposed here for the junior homonyms.

***Drosophila* (*Hirtodrosophila*) *elliptosa*** nom. nov.

For *Drosophila* (*Hirtodrosophila*) *elliptica* OKADA, 1973, Kontyû, Tokyo, **41**: 437 (Japan), *junior primary homonym*.

Not *Drosophila* (*Sophophora*) *elliptica* STURTEVANT, 1942, Univ. Texas Publ., (4213): 35 (Mexico), *senior primary homonym, teste* WHEELER.

***Drosophila* (*Sophophora*) *luteola*** nom. nov.

For *Drosophila lutea* KIKKAWA et PENG, 1938, Jap. J. Zool., **7**: 533 (Japan), *junior secondary homonym*.

Not *Drosophila lutea* (WIEDEMANN, 1830), Aussereur. zweiflüg. Ins., **2**: 593 (*Notiphila*; India), *senior secondary homonym, teste* COGAN.