

Analysis of the Geographical Distribution of an Endangered Butterfly, the Large Shijimi Blue, *Shijimiaeoides divinus*, Using Insect Database

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Abstract Geographical distribution of an endangered butterfly species, *Shijimiaeoides divinus* was analyzed three insect databases, 'Database on Collection Records of *Shijimiaeoides divinus*', 'Database on Literature List of *Shijimiaeoides divinus*' and 'Database on Collection Records of Insect at Nagano Prefecture'. There are five subspecies of this butterfly, *S. divinus barine* and *S. divinus asonis* in Japan, and *S. divinus divinus*, *S. divinus asahii* and *S. divinus shinichiroi* in foreign country. Recent records in 21st century are only at three points in foreign countries. Analyzing the database, subspecies *S. divinus barine* in Nagano Prefecture disappeared rapidly after 1980. Only two populations remained. Natural population of *S. divinus barine* is on the verge of extinction in Japan.

Key word : *Shijimiaeoides divinus*, geographical distribution, Nagano Prefecture, database

Introduction

The large shijimi blue, *Shijimiaeoides divinus* (Fixsen), is a grassland lycaenid butterfly, which is distributed in Japan, the Korean Peninsula, North-eastern China and the Southern Amur region (Fujioka 2007). In Japan this butterfly inhabited the eastern part of Honshu (Muroya 1989 ; Miura 2007) and the Kuju Kogen and Mt. Aso in Kyushu (Fukuda *et al.*, 1984 ; Murakami 2007). However, only small populations in Honshu remain in limited areas of Nagano Prefecture at present (Kobayashi 1989 ; Tashita & Maruyama 2007). A large population is still found around Mt Aso, but habitat change has caused a decline in the butterfly population (Murata & Nohara 1993 ; Murata *et al.*, 2008).

S. divinus was designated an Endangered Species by the Ministry of the Environment (2000) and by Nagano Prefecture (2004). Tomi City of Nagano Prefecture, Shirozu Village and Aso Town of Kumamoto Prefecture identified this butterfly as Natural monument. Moreover, it has been identified as a rare wild animal by Nagano and Kumamoto ordinances.

In this paper, I report the geographical distribution of an endangered butterfly species, *S. divinus barine* by analyzing three insect databases.

Life History

S. divinus belongs to order Lepidoptera and family Lycaenidae. Fig. 1 shows the photos of this insect. Wings size of adult butterfly is 3-4cm. This size is relatively large in lycaenid butterfly. Female wings have several black spots (Fig. 1a). On the other hand, male has no spot (Fig. 1b). This butterfly has one generation and the adult appears from late May to early June in Nagano Prefecture. The adult female lays eggs on the flower buds of the host plant, *Sophora flavescens* (Fig. 1c). Eggs hatch in about one week after oviposition (Fig. 1d). The larvae pass through four feeding instars in June and July (Fig. 1e). The last instar larvae pupate under withered leaves or soil, where they overwinter until the following year (Fig. 1f).

Database

There are three databases about *S. divinus*. The first one is 'Database on Collection Records of *Shijimiaeoides divinus*'. I have made this

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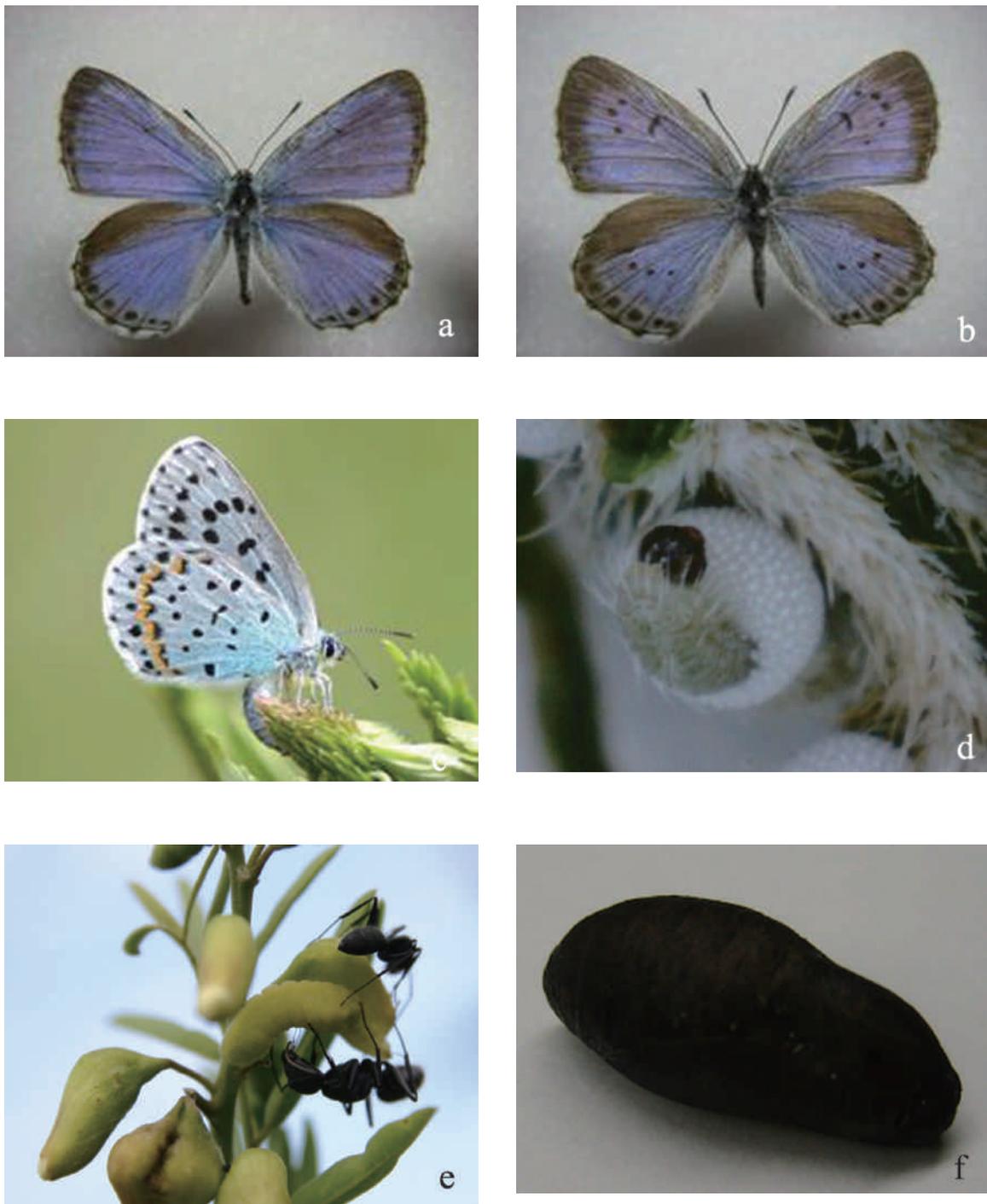


Fig.1 The large shijimi blue *Shijimiaoides divinus barine*.

a. Male upperside.

b. Female upperside.

c. Female oviposit on buds of *Sophora flavescens* at Nagano Prefecture.

d. Hatching.

e. The fourth instar at Azumino, Nagano Prefecture.

f. Pupa.

database from the Literature or specimen label of this butterfly. This database has 206 reliable collection records. The second one is 'Database on Literature List of *Shijimiaoides divinus*'. This database is consisted of about 90 Japanese literatures. There is little information of *S. divinus* in foreign country. The third one is 'Database on Collection Records of Insect at Nagano Prefecture'. This database was made by Nagano Prefecture for making Red Data Book Nagano edition. This database is consisted of total 50949 records of 14 orders of insect and other two invertebrates, shells and spiders. In this database, there are 9092 records of butterfly including 46 records of *S. divinus barine*.

Distribution in the world

According to 'Database on Collection Records of *Shijimiaoides divinus*', there are five sub-species of this butterfly. Japan has two sub-species. One is *S. divinus barine*, which has 151 records. Another one is *S. divinus asonis*, which has 52 records. Other three subspecies are distributed in foreign country. Subspecies *S. divinus divinus* is the original subspecies. Other two subspecies are *S. divinus asahii* and *S. divinus shinichiroi*. Fig. 2 shows the distribution map of five subspecies based on the database. The original subspecies *S. divinus divinus* was recorded in Beijing of China, Korea Peninsula and Old Manchuria. *S. divinus asahii* was recorded at Great Ussuri Island in Ussuri River and the opposite



Fig.2 Area of *S. divinus* distribution.

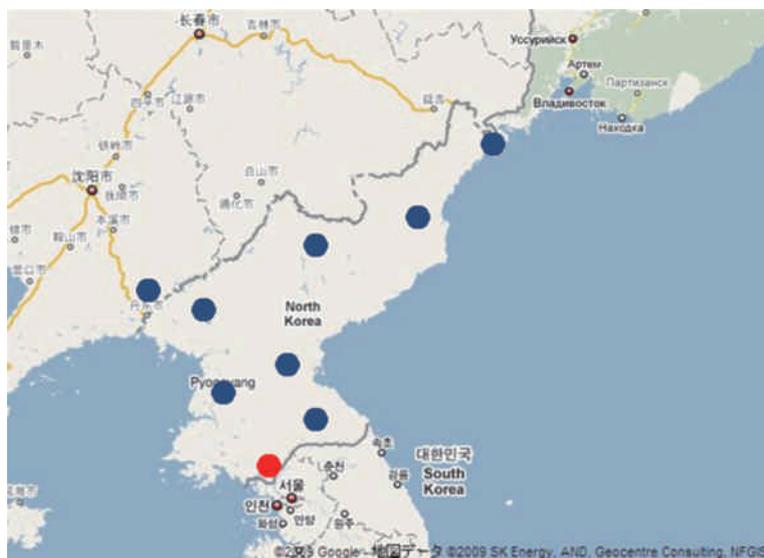


Fig.3 the places collected subspecies *S. divinus divinus* in North Korea

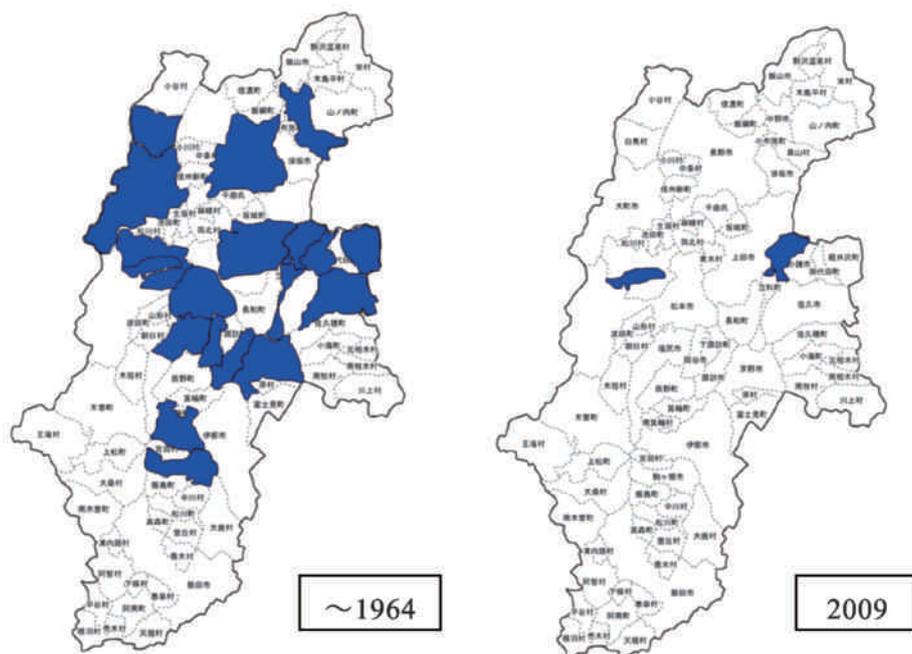


Fig.4 Reduction process of distribution changes of *S. divinus* at Nagano Prefecture.

bank of Russia. *S. divinus shinichiroi* is recorded in Shanxi area. In Japan, *S. divinus barine* is distributed in Honsyu and *S. divinus asonis* is Kyusyu.

Fig. 3 shows the places collected subspecies *S. divinus divinus* in North Korea (Democratic People's Republic of Korea) plotted using 'Database on Literature List of *Shijimiaeoides divinus*'. The original subspecies was collected at Kaesong. These are old records, and now there is no information of this butterfly in North Korea. There are several records of subspecies *S. divinus divinus* in South Korea by Insect Database of Kisti in Korea, but no record in this century. In the distribution map shown Fig. 2 and 3, recent records in 21st century are only at three points in foreign countries. From this result, it may be said that *S. divinus barine* is one of the most threatened species in the world.

Reduction in Japan

This butterfly inhabited grasslands in Aomori, Iwate and Fukushima prefectures, but the populations were exterminated by the 1970s. The populations of Niigata and Gunma prefectures have already been exterminated. Nagano Prefecture

was main habitats in the central part of Honshu, but this butterfly is now on the verge of extinction in Nagano. In Kyushu, this butterfly is found on limited areas of the volcanic slopes of Mt Aso.

Fig. 4 shows the extinction process of *S. divinus* in Nagano Prefecture by 'Database on Collection Records of Insect at Nagano Prefecture' and 'Distribution and Variation of the Butterflies in Nagano, Japan' edited by The Entomological Society of Shinshu (Tashita *et al.*, 1999). Before 1964, the large shijimi blue inhabited in 19 villages or towns by Nagano Prefecture. Thereafter, habitat areas of this butterfly have gradually decreased, and after 1980, this butterfly disappeared rapidly in Nagano. Only two populations are maintained by an organization for the preservation of *S. divinus barine*, which carries out activities to preserve this butterfly. Now, the natural population of *S. divinus barine* is on the verge of extinction in Japan (Fig. 4).

Factors of extinction are considered to be reduction of grass land and host plant by a farm land consolidation, and overhunting of a maniac. In the future, it will be important that the relationship of changes of human lifestyle and extinction process of *S. divinus barine* are analyzed using database. These studies will lead to preservation

and protection of this global endangered species.

References

- Fujioka T (2007) Rare, local, and little known butterflies from Japan (13) —*Shijimiaeoides divinus* (Fixsen, 1887) from Hiraishi-yama, Nagano-ken, Japan, and its geographic variations in the world, including 2 new subspecies—. *Butterflies* 44, 37–46.
- Fukuda H, Hama E, Kuzuya T *et al.* (1984) *The Life Histories of Butterflies in Japan Vol. II* Hoikusya, Osaka.
- Kobayashi Y (1989) Decline of *Shijimiaeoides divinus* Populations in Azumino Prefecture. In: Hama E, Ishii M, Sibatani A (eds) *Decline and Conservation of Butterflies in Japan I*, pp. 97–98. Lepidopterological Society of Japan, Osaka.
- Ministry of the Environment (2000) *Threatened Species*. Japan Integrated Biodiversity Information System. Available from URL : http://www.biodic.go.jp/english/rdb/rdb_f.html.
- Miura H (2007) *Shijimiaeoides divinus* in Miyako-shi, Iwate-ken. *Butterflies* 44, 20–23.
- Murakami T (2007) *Shijimiaeoides divinus* (Fixsen, 1887) in Kyushu District. *Butterflies* 44, 32–36.
- Murata K, Nohara K (1993) Decline and Conservation of *Shijimiaeoides divinus* (Matsumura) in Kumamoto Prefecture. In: Yata O, Ueda K (eds) *Decline and Conservation of Butterflies in Japan IV*, pp. 151–159. Lepidopterological Society of Japan, Osaka.
- Murata K, Okamoto C, Matsuura A, Iwata M (2008) Effect of grazing intensity on the habitat of *Shijimiaeoides divinus asonis* (Matsumura) (Lepidoptera : Lycaenidae). *Transactions of the Lepidopterological Society of Japan* 59, 251–259.
- Muroya Y (1989) Decline of *Shijimiaeoides divinus* Populations in Aomori Prefecture. In: Hama E, Ishii M, Sibatani A (eds) *Decline and Conservation of Butterflies in Japan I*, pp. 90–97. Lepidopterological Society of Japan, Osaka.
- Nagano Prefecture (eds) (2004) *Red data book Nagano edition*. Nagano Prefecture, Nagano.
- Tashita M, Maruyama K (2007) Outline of the Habitat of *Shijimiaeoides divinus barine* in Chubu district, central Japan. *Butterflies* 44, 24–31.
- Tashita M, Nishio N, Maruyama K (1999) *Distribution and Variation of the Butterflies in Nagano, Japan*. Bunitisougousyuppan, Tokyo.