

Changes of the land use and decline of the endangered butterfly, *Shijimiaeoides divinus barine* in Azumino

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The large shijimi blue, *Shijimiaeoides divinus barine* is distributed in limited areas of Nagano Prefecture in Japan at present. It has been designated an Endangered Species (CR+EN) by the Ministry of the Environment. In Azumino City, Nagano Prefecture, the volunteer organization has been in active to recover the natural population of this butterfly by the method of releasing pupae from 1999. However, *Trichogramma chilonis* is a severe mortality factor of the egg stage of *S. divinus barine*. Therefore, the natural population was not recovered.

S. divinus barine eggs were sampled and *T. chilonis* adults were collected by sticky trap in Azumino City and Tomi City where the natural population of *S. divinus barine* has survived in Nagano Prefecture. The percentage of parasitism was 50% or more in Azumino City. On the other hand, in Tomi City, the range of percentage of parasitism was from 30% to 40%. The number of *T. chilonis* captured by sticky trap in Azumino City was higher than that in Tomi City.

The difference in the habitats of *S. divinus barine* between two areas was the management method of the grassland. The farmer performs environmental management of ridges in the field, such as mowing and bush burning, in Tomi every year. On the other hand, in Azumino City, since the habitat of *S. divinus barine* was in Alps Azumino Natural Government Park, bush burning was forbidden. The relationship between egg parasitism of *T. chilonis* and the management methods (mowing, bush burning) of inhabitant area of *S. divinus barine* was suggested.

When did bush burning begin in Japan? The andosol which was formed by the bush burning in the Jomon period is widely distributed in Nagano Prefecture. It is known that the distribution areas of *S. divinus barine* overlapped the andosol and imperial pastures. The semi-natural grassland which is suited to *S. divinus barine* has been maintained from the Jomon period by pasturage or bush burning in Nagano Prefecture. However, after the Edo period, the paddy field was reclaimed in Azumino, and the pastures were lost. Was *S. divinus barine* exterminated? The answer is NO. In order to use *Sophora flavescens* as a herb etc., it planted in ridges of a rice field, the bank of the irrigation canal, etc. Mowing and bush burning were performed periodically. Thus, the habitat of *S. divinus barine* has been maintained. However, the major land improvement enterprise was undertaken around from 1962. Semi-natural grassland vegetation including *Sophora flavescens* was lost and bush burning was stopped. Therefore, the environment where *S. divinus barine* can live has disappeared.

An experiment of the bush burning was carried out in Azumino City, Nagano Prefecture on March 29, 2009, in order to verify the effect of bush burning on parasitism and the survival of *S. divinus barine*. Immediately after bush burning, the cages were set up in the burned area and the control area respectively.

Afterward, *S. divinus barine* eggs were taken for observation, and *T. chilonis* adults were collected by sticky trap inside and outside the cages. The percentage of parasitism on June 9 inside the cage was 2.3% in the burned area and 30.3% in the control area. The number of *T. chilonis* captured by sticky trap inside the cage in the control area was a total of 21 individuals from May 5 to June 9. However no individual was captured in the burned area. It was given as a conclusion that the bush burning had an effect on parasitism of *T. chilonis* on *S. divinus barine* eggs.

In Alps Azumino Natural Government Park, bush burning has become to be performed by the results of our researches every year. As a result, *S. divinus barine* adults were observed in 2011 for the first time in about 15 years.

Keywords: *Shijimiaeoides divinus barine*, *Trichogramma chilonis*, *Sophora flavescens*, bush burning, imperial pastures, semi-natural grasslands