

## The effects of temporal continuity of grasslands on plant- and butterfly- communities

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Approximately half grasslands in the world have been converted to farmlands. Temperate grasslands are biodiversity-rich ecosystems that are rapidly decreasing over the world and Japan. For effective biodiversity conservation, it is urgent to identify grasslands that have high biodiversity and thus conservation-priority. Recently, increasing number of studies have shown that the permanence of grassland affects biological communities, suggesting that the past vegetation history can be an effective biodiversity indicator. To establish a identifying method of grasslands with high conservation priority, this study addressed the effects of temporal continuity of grassland, which means that grasslands continue without becoming forests, on biodiversity. We investigated the effects of grassland on species richness and community composition in plants and butterflies, which they are closely related to plants and many endangered species live in grassland.

We traced the change in grassland distribution from the 1910s to the present in three regions in central Japan, i.e. Sugadaira, Hakuba and Kirigamine, using topographic maps and aerial photos. Study sites were "old grassland" that had lasted for more than 100 to 1000 years, "new grassland" generated by deforestation 44 to 73 years ago, and "forest", in the above three regions (total 58 sites). We investigated plant communities at 5–8 sites in each of three types of vegetation. We also studied butterfly communities in the 19 sites in Sugadaira. We sat a 1 × 20 m transect in each study site at least 20 m borders between grasslands and forests. In each transect, we recorded the presence of vascular plant species in July and September. We classified them into grassland-dependent native species and endangered species according to habitat information in guides and appearances in Red lists in each prefecture. For butterfly survey, we sat a 5 × 20 m plot including the plant plot in each study site, and the number of species and individuals was recorded seven times between June and September by one round trip in 12 minutes. We found that old grasslands had higher numbers of grassland-dependent native plant species and that of grassland-dependent endangered plant species, than the other vegetation in the whole three regions. Plant species compositions were different between old and new grasslands, consistently in the three regions. The plant species compositions of the new grasslands tended to be intermediate between the old grasslands and the forests, suggesting that the influences of forest history still remained on the species composition in the new grasslands. Old grasslands tended to have more indicator plant species. As old grassland indicators, *Cirsium* sp. was common in the three regions, and *Adenophora triphylla* was common in Sugadaira and Kirigamine, on the other hand, no indicator species was common in new grassland. We found that grassland had higher number of butterfly species, and the old grasslands tended to have more species than the new ones. Whilst plant community was affected by the vegetation history of the very study sites, butterfly community was affected by the area of old grassland within 300 m of the study sites, suggesting that the historical butterfly communities depend on large old grasslands. This difference between plant and butterfly may be caused by (1) the difference of required resource and (2) mobility. Butterflies (1) require multiple plant individuals for food throughout the larval and adult stages, and (2) are generally more mobile than plants. Thus, butterflies may be more affected by area of grassland than plants that can maintain a species even if only one individual remains. We propose that grasslands that have long temporal continuity have high conservation value with rich and unique biological communities. because almost all grasslands in this study are managed as ski runs, it is re-recognized that

ski runs are important in grassland conservation.

Keywords: semi-natural grassland, land use history, sky run, indicator species, conservation