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The Effects of Anthropogenic Disturbances on The Butterfly Assemblage in An Urban Green Area: Monitoring The Decrease and Recovery from 1990 to 2005 in Kanazawa Castle Park, Japan

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Urban green areas are important habitats for native organisms (Niemela 1999; Miller and Hobbs 2002). However, these green areas are often affected by harmful human disturbances for biodiversity conservation (deforestation, vegetation removal, paving, undue mowing etc). Kanazawa Castle Park (KCP, ca 30 ha) is an isolated urban green area at the center of Kanazawa City, Japan (Figure 1b). KCP had a mature forest (ca. 5 ha) and grassland patches. However, that forest was deforested by thirty percent during 1996-1999, and grasslands were destructed during 2000-2002. In this study, we examined the effects of these anthropogenic disturbances on butterfly assemblage and subsequent recovery in KCP, using the two previous papers studying butterflies in early 1990s and our monitoring data during 1999-2005. Furthermore, we discussed the characteristics of the butterfly assemblage in KCP by comparing with that of Tawara in satoyama area 6 km away from KCP.

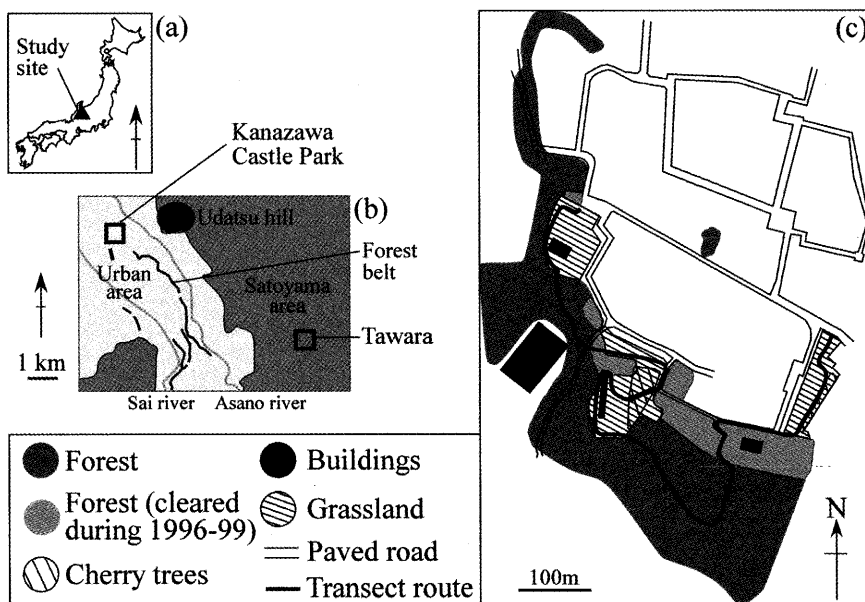


Figure 1 Schematic map of the study site, Kanazawa Castle Park, in national (a), regional (b), and local (c) scales.

From the previous papers, 35 species are judged to colonize in KCP in early 1990s. The number of generalist species (multivoltine and polyphagous species) was similar both in KCP and in Tawara, but the number of specialist species (univoltine and oligophagous species) was much lower in KCP than in Tawara. The butterfly assemblage in KCP was a subset of that in Tawara. Eight species have disappeared from KCP due to deforestation and not recolonized yet until now, even if some of disappeared species extravagated once or twice after deforestation (2000-2005) probably from the

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nearest satoyama area or forest belts near KCP (Figure 1b). They are bamboo grass feeders, mantle feeders and uni-bivoltine herb/grass feeders. Interestingly, no tree feeders disappeared after deforestation. Grassland destruction also made huge negative impacts on herb/grass-feeding butterflies, but they are recovering quickly following the partial grassland recovery since 2003 (Figure 2).

Our results reveal several important points: (1) KCP was already negatively affected by urbanization because many specialist butterflies were lost from KCP even before human disturbances. (2) Species living around forest edge and forest floor (bamboo and mantle feeders) were locally extinct due to deforestation, but tree feeders living in canopy were not. This indicates that sensitivity to deforestation may depend on butterflies' mobility and their habitats that adults occupy. (3) Herb/grass feeders living in urban areas are rather tolerant of human disturbance (even to habitat destruction). They recovered soon (Figure 2). (4) Some disappeared species after deforestation extravagated once or twice during 1999-2005 probably from satoyama area 2 km away from KCP or forest belts (Figure 1b). Although they have not recolonized yet, this is encouraging because improvement of habitats for these species (forest interior and edge) would enhance recolonization of some disappeared species and recover butterfly diversity in KCP. Accordingly, recovery of vegetation in forest floor and forest edge, which are the main habitat for disappeared butterfly species feeding on bamboo grasses and mantle plants, is strongly required.

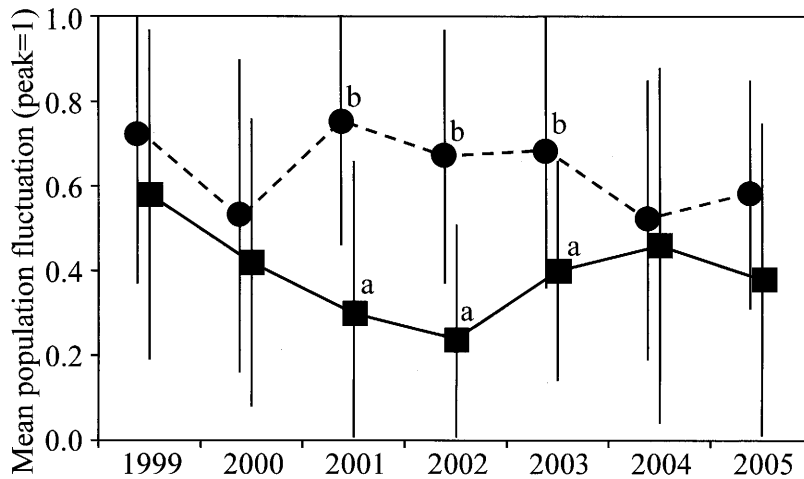


Figure 2 Annual change in relative abundance per species for herb/grass feeders (solid line) and tree feeders (broken line) during 1999-2005 in Kanazawa Castle Park. For each species, the peak abundance across seven years is expressed as one. Different letters in certain years indicate significant differences in relative abundance between herb/grass feeders and tree feeders.