The molecular phylogenetic structure and biogeographic history of a alpine gravel environment specific plant *Dicentra peregrina* (Papaveraceae) in Japan

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In determining the distribution area of an organism, meteorology, climate, geography, topography and geology are important factors. In particular plants are more susceptible to climate change by limitations on dispersion compared with animals, thus the relationship between climate change and geographical distributional history in the glacial-interglacial cycles have been discussed a lot. For example, a hypotheses and a pattern have been proposed about the distribution history of alpine plants in the Japanese Archipelago. During the glacial periods, their distribution area was expanded (to the more southern region), on the other hand, the distribution area shrank (to the more northern region) during the interglacial periods and survived only in the alpine areas. Regarding the geological conditions, soil nutrition, size and stability of gravels influence species composition and population dynamics. Not only environmental factors but also biological interactions play an important role. If the weather, geography and geological conditions are severe, it will be a major barrier to plants' lives. However, few cases have established the effects of habitats' environments on their distributional histories. *Dicentra peregrina* inhabiting the alpine gravel lands and represent the alpine desert plants' community. In Japan, *D. peregrina* is also called "queen of alpine plants". Such alpine gravel lands distribute scattered around the volcanoes, and also around the ridgeline areas of high altitude mountains with strong disturbances: harsh weathering and/or unstable lands' surface. Therefore, migration is strongly restricted and highly influenced by weather, geography, topography and geology, compared with other alpine plants. Thus, *D. peregrina* is a suitable targeted alpine plant to investigate the relationship between the habitat environments and the distributional history. In order to estimate their distributional history, we have conducted phylogenetic analyses of *D. peregrina* in the Japanese Archipelago. Additionally, we have also conducted the "Ecological niche modeling" to estimate distributional changes by climate changes. As a result of our phylogenetic analyses, we observed two major genetic lineages within *D. peregrina*: one is endemic to Hokkaido (Group 1), and the other was observed from wide-areas in the Japanese Archipelago (Group 2). The boundary between the two lineages was recognized within the Daisetsu Mountain Range at Central Hokkaido. In Hokkaido, Group 2 was only observed in Mt. Kaundake and Mt. Furanodake. According to some geological studies, both Mt. Kaundake and Mt. Furanodake having comparatively old origin, it is considered that they were formed before 700,000 years ago. In contrast, regarding mountains where observed the Group 1, it is considered that they were formed around 150,000 years ago. Such differences of the mountain formation ages might be affected the population dynamics of *D. peregrina* in the glacial-interglacial climate changes. The Group 2 of *D. peregrina* is highly likely migrated to the Japanese Archipelago during the last glacial period. On the other hand, the Group 1 was dispersed to the Japanese Archipelago in older period and it is considered that their distribution spread more widely in the last glacial period. Thus, these old originated mountains served as refugia during inter-glacial periods. In addition, the genetic structure of *D. peregrina* was largely different from other alpine plants, and such difference suggests the distributional history of *D. peregrina* is strongly related to geological history rather than other alpine plants.

Keywords: phylogeography, alpine Plant, alpine desert, glacial-interglacial cycles

