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Research Article

Genetic Considerations for Selecting the Seedlings to Restore a Small Population of *Abies koreana*, an Endangered Fir Species that is Endemic to Korea

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ABSTRACT

Korean fir (*Abies koreana* E.H. Wilson), which is a Korean endemic species that has been designated as an endangered species by the International Union for Conservation of Nature, has been declining by approximately 33% in its natural habitat. There are three large and six small populations with a relatively large and small number of individuals, respectively. The Korean fir population in Mt. Geumwonsan is known to have only 20 adult trees and approximately 23 seedlings. It was also observed that the seed production was extremely poor, while the genetic diversity (*He*=0.612) is lower than that of other large populations in Korea, with a very high fixation index of the seedlings (*F*=0.318). Therefore, there is a high risk of local extinction due to the inbreeding effect with the limited number of trees and a great need to implement restoration projects immediately to reduce the risk. Selecting the restoration materials for the small population needs to consider the genetic diversity and uniqueness of the natural population while enhancing their adaptability and resilience against environmental change. Hence, to restock the Korean firs into the Geumwonsan population, we evaluated the genetic similarity between the populations in Korea and suggested a guideline to select the appropriate materials for restoration.

Keywords: Korean fir; Endangered species; Small population; Restoration; Genetic considerations

INTRODUCTION

A decline in the natural habitats due to climate change is a global issue. Especially, *Abies* species in sub-alpine regions are reported to be vulnerable to global warming, with the recent worldwide decline. The causes of the decline in *Abies* species in sub-alpine regions are reported due to increased winter temperatures and competition with broadleaf tree species [1-3]. Simply regarding the decline of natural habitats as a decrease in population size, in terms of number of individuals or total area in a given area or region, can lead to worse results with regards to successful sexual reproduction. This would be required for the sustainable regeneration of the population as well as for the maintenance of the genetic diversity to adapt to environmental change [4,5]. In order to mitigate habitat loss, restoration in the form of augmentation or the reestablishment of the population is needed and has been particularly emphasized in the "Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources", which was developed by the Commission on Genetic Resources for Food and Agriculture [6].

Recently a renewed restoration method, i.e., the "genetic restoration", has received great attention, mainly because it re-establishes the declined population with careful consideration of the genetic concerns arising from previous restoration efforts, which include whether the population has a distinct genetic structure from other local populations and how much would the introduction of new genes and genotypes out of the local origin affect the genetic structure of the existing one [7]. A few thematic studies have suggested a guideline for the genetic restoration of declined forest ecosystems [8]. In Korea, a recent demographic research reported that approximately 25% of the natural habitats of the sub-alpine coniferous forests have declined during the past 20 years [9]. Moreover, the Korea Forest Service have established an integrated action plan in 2016to manage the decline in the natural habitats, which was called "A Countermeasure on Conservation and Restoration of Endangered Sub-Alpine Conifer species"

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