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Human influence, regeneration, and conservation of the Gotjawal forests in Jeju Island, Korea

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Abstract Gotjawal, a uniquely formed forest vegetation on the lava terrain located at eastern and western parts of Jeju Island, covers 6% of the island's land surface. The Gotjawal forests play important roles in establishing the biological and cultural diversity while maintaining ecosystem services. Recently, with the recognition of the diverse ecological and cultural values of the Gotjawal forests, efforts to conserve the forests were conducted by adopting the resolutions of the Jeju World Conservation Congress of the IUCN held in 2012. Despite its precious values, the Gotjawal forest is being threatened by the developmental activities of large scale constructions projects. To understand the recent regeneration of the Gotjawal forests, ecological studies have been conducted at the Hankyeong-Andeok Gotjawal Terrain, which is located in the western part and occupies the largest area of the Gotjawal Terrain of Jeju Island. Major vegetation in the area includes the deciduous broad-leaved forests (*Acer palmatum–Styrax japonicus* community), mixed deciduous and evergreen broad-leaved forests (*Neolitsea aciculata–Styrax japonicus* community), and evergreen broad-leaved forests (*Quercus glauca* community). In addition, the Gotjawal forests are evaluated as secondary forests mainly developed from sprouts. Tree-ring studies have revealed that the Gotjawal forests were regenerated from mid- to late-1960s after the cessation of human activities for using woods for various resources.

Introduction

Jeju Island, located in the southernmost area of Korea, was formed by four volcanic activities that have occurred over the past 1.2 million years. During the process, in the hilly and mountainous area of Jeju Island (200–500 m above sea level), small parasitic volcanic craters called "Oreum" were formed (Jeju Special Self-Governing Province and National Folk Museum of Korea, 2007; National Geographic Information Institute, 2011). Highly viscose Aa lava flowed down from the Oreum, forming block type of rocky terrains (Song, 2000).

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People in Jeju Island gave various names to the forests formed in those areas, such as Goji, Golbat, Got, Gotsan, Jawal, Jawil, and Gotjawal (Jeju Development Center of History and Culture, 2010).

The Gotjawal areas were regarded as worthless lands, not suitable for farmlands because soils were poorly developed on predominantly rocky blocks. Recently, attempts have been made to systematically reassess the values and redefine the concept of the area, however. To explain the concept of the word "Gotjawal," "Got" means the place where thorny bushes and trees coexist and "Jawal" means the wasteland where soils are shallow in development (Bukjeju County, 2000). A social corporate in Jeju Island, (Gotjawal peoples' Association, 2005) could rediscover the uniqueness of the forests of the areas where highly viscose lava emerged from volcanic eruptions was later broken into large and small rocky blocks resulting in convexo-concave-shaped terrains. Here, the recharging of groundwater and the occurrence of warming and moistening allowed plant species of subtropical group and boreal group to coexist.

In Jeju, there are four Gotjawal terrains: the Hankyeong-Andeok Gotjawal terrain and Aewol Gotjawal terrain in west and the Jocheon-Hamdeok Gotjawal terrain and Gujwa-Seongsan Gotjawal terrain in east (Fig. 1). The area occupied by the terrains is about 110 km^2, accounting for 6% of the land area of Jeju Island (Jeju Special Self-Governing Province, 2007).

Gotjawal forests have played important roles in the maintenance of ecosystem services among the natural ecosystems of Jeju Island. With increasing awareness of this value, conservation efforts have been expanded as well. The Jeju Special Self-Governing Province designated Gotjawal Terrains as a conservation area and the Daejung-Eup area in Seogwipo City of including Boseong, Gueok, and Sinpyeong-Ri areas encompassing about 155 ha has been identified as a Provincial Park (Jeju Daily News, 2011b). In addition, since 2009, the Jeju Special Self-Governing Province and the Korea Forest Service purchased private forests adjacent to national forests and conducted research after the designation of experimental forests (Jeju Daily News, 2011a). At the World Conservation Congress held in Jeju Island in September 2012, the motion entitled "Support for Conservation and Sustainable Use of Gotjawal Forests in Jeju" was adopted as a resolution (Jeju Daily News, 2012).

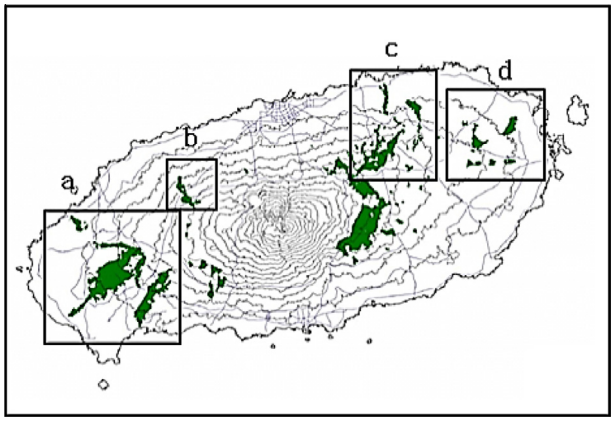

Fig. 1 Distribution of Jeju Gotjawal Forest terrains. (a) Hankyeong-Andeok Gotjawal terrain, (b) Aewol Gotjawal terrain, (c) Jocheon-Hamdeok Gotjawal terrain, (d) Gujwa-Seongsan Gotjawal terrain (Jeju Special Self-Governing Province, 2007).

Despite these efforts in conservation, approximately 14% of entire Gotjawal area has already been destroyed by the development of golf courses, quarries, and amusement parks (SBS, 2012). Further, the Regulations for the Preservation and Administration of Gotjawal proposed by the Jeju Special Self-Governing Province in 2011 could not pass the deliberations of the Provincial Assembly because of objections raised from environmental NGOs and public opinions due to confusions in the definitions and concepts of Gotjawal, the absence of limits in the acts and regulations of penalties, insufficient discussion on designating Gotjawal as conservation areas, and the limitations in the provision of related preservation plans (Newsis, 2011). Although a variety of discussions have been conducted and consensus has been reached on the values and the needs for the conservation of the Gotjawal areas, the general consensus and effective institutional management measures have not been made based on the systematic and academic research.

This study was carried out to understand the ecology of the Gotjawal forests in vegetation, developmental processes of the forests, and the current status of the structure of the forests, which will be related to the discussion on potential conservation schemes of the Gotjawal terrains. Due to the lack of previous studies, the results of this study is expected to provide the baseline information for further studies on the Gotjawal terrains in Jeju Island, Korea.

Materials and methods

Ecological study: research area overview

To understand the formation of the Gotjawal forests and to describe its structure of them, research on the Hankyeong-Andeok Gotjawal terrain (33°15′23″–33°22′51″N, 126°15′28″–126°22′29″E) located in west area encompassing the four Gotjawal terrains of Jeju Island was carried out (Fig. 2).

The Han Kyung-Andeok Gotjawal terrain is located within the range of 50–492 m above sea level in elevation, and its area is about 50.5 km^2, occupying almost a half of the land area of Gotjawal terrains (total area: 110 km^2) (Jeju Special Self-Governing Province, 2007). The topography of the Gotjawal terrain is rather flat on gentle slopes and, but due to its rocky block structure, the unevenness and the dentation of the surface are distinctive and small tumuli of dome-type are observed. The Han Kyung-Andeok Gotjawal terrain is distributed across the Daejung-Eup and Andeok-Myun in Seogwipo City; it is divided into two areas: the Wollim-Sinpyung lava flow area erupted from Doneori Oreum (329.6 m above sea level), whereas the Sangchang-Hwasoon lava flow area erupted from Daebyungak (492 m above sea level). The rock of the Wollim-Sinpyung lava is gray to dark gray augite-olivine basalt, whereas that of Sangchang-Hwasoon lava is grey porous feldspar–augite–olivine basalt (Song, 2000). Because of the geological characteristics of the land consisting of rocky blocks, soil development is very poor where organic layer and A layer are mixed. Generally, the depth of soil is very shallow with the depth of 10–15 cm. Soil is developed in the space among the rocky blocks where unevenness is observed.