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Original article

Diversity and Spatial Distribution of the Fagaceae Tree Species in the Doi Suthep-Pui National Park, Chiang Mai Province

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ABSTRACT

This study aimed to explore species diversity, spatial distribution, and habitat suitability of mountain tree species in the family Fagaceae. The data were collected during the years 2016-2018 from the two sources; 1) primary data such as species diversity and topographic factors, elevation and slope, soil factors, soil texture (% sand and clay), and soil pH, were measured from a total of 60 temporary plots of size 30 m x 30 m. 2) The diversity data, which was collected from selected nature trails. All the specimens of Fagaceae species (leave, flowers, and fruits) were collected identified, while the unidentified species were compared with the identified specimens at the Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation. The Generalized Linear Model (GLM) was used to determine the spatial distribution of some dominant species. The geographic information system (GIS) was then used to detect suitable habitats for some species.

Total of 31 Fagaceae species in 3 genera were found, including genus *Lithocarpus* (12 species), *Quercus* (10 species), and *Castanopsis* (9 species). Different sapwood characteristics and acorn morphology can be used for the identification of genus. The temporary plots contained a higher number of species (26 species) compared to the nature trails (21 species). The spatial distribution, based on the GLM analysis, demonstrated that the distribution varied among species and environments. Topographic factors, particularly high elevation (above 1,000 m above sea level, asl.) and sandy clay soil texture, were the most important factors for the evergreen Fagaceae species (*Castanopsis acuminatissima*, *C. diversifolia*, and *C. armata*). In contrast, the low elevation (below 1,000 m asl.) and sandy soils determined the distribution of deciduous Fagaceae species (*Quercus kerrii* and *Lithocarpus polystachyus*, *C. psudo-hystrix,* and *Q. kingiana*). Suitable habitats for all species were also classified as high and medium potential areas. Our results indicate that the variations in species niches and environmental factors had a high influence on the species abundance.

Keywords: ecological niche, Fagaceae, montane forest, spatial distribution, species diversity

INTRODUCTION

Mountain ecosystems are defined based on the altitude above sea level (asl.), which ranges from a minimum of 300 meters to 1,000 meters at equator and cover about 27% of Earth's surface (Kapos *et al*. 2000). In Thailand, the montane forests (MF) are mostly distributed in the high-lands in the northern parts, 1,000 m asl., and serve as an important source of fresh water for the country (Sungpalee, 2002; Bunyavejchewin *et al*. 2011). In addition, MF host a large number of wild plants and animals, especially endemic and rare species. They are characterized by unique topographic factors (elevation, slope, and aspect) which can influence other environments, particularly climatic factors. A relatively high humidity and low temperatures lead to relatively low temperatures all year round (Kutintara, 1999). Such conditions lead to the establishment of temperate plant species such as *Acer laurinum, Betula alnoides, Carpinus viminea* and *Podocarpus neriifolius*. These are found to coexist with the montane species such as plants in a family of Fagaceae, Lauraceae and Theaceae (Santisuk, 2007; Marod and Kutintara, 2009; Rueangruea, 2009; Jingjai, 2014). The establishment of tree species follows different ecological niches, which is defined as the total requirement of a species in terms of resources and physical conditions, to determine their relative survival and abundance at a given place within range (Hutchinson, 1958). In the recent years, MF has become highly vulnerable due to habitat loss caused by anthropogenic disturbances, in particular, the conversion of forest land into agricultural area. This alone has led to a rapid decrease in the forest patches in northern Thailand (Pattanvibool and Dearden, 2002; Fukushima *et al*. 2008). If such disturbances persist at their current rate, which is faster than the natural recovery rate, the original environment conditions will be severely altered causing a loss of biodiversity (Chamnongpakdee, 2018) and will interfere with the natural reproduction of the native vegetation communities (Hermhuk, 2014).

Recently, the Geographic Information System (GIS) has been employed successfully for sustainable forest resource management. The survey results of GIS can be used to assist the decision-makers by indicating the potential development and conservation planning alternatives that can be undertaken and also in modeling the desired outcomes from a series of scenarios. In addition, the spatial distribution analysis model, which is an analytical process conducted in conjunction with GIS, can be used detect habitats suitable for both wildlife and plants (Jirakajornkul, 2012). This model was created based on the spatial distribution analysis and includes any formal techniques which study entities using topological, geometric, or geographic properties. In addition, the habitat suitability is very helpful for devising a restoration program. It can help in determining appropriate species, particularly in unique ecosystem such as MF, which induced high successful on forest recovery. In mountain ecosystems, native plants from the Fagaceae and Lauraceae families can be used in a restoration program. These families are not only widely established but are also a source of food for the frugivores (Nishimura *et al*. 2008; Rueangket *et al*. 2016), which helps in the dispersal seed of their seed into vacant areas, minimizing the recovery to natural forest conditions. Thus, selecting appropriate species in specific areas for restoration may help accelerate the natural regeneration and increase the chances of a successful establishment (Asanok *et al*. 2012)

Doi Suthep-Pui National Park located in the Chiang Mai Province, is a montane ecosystem, where a high diversity of Fagaceae was observed and at the same time, several species were endangered (Marod *et al*. 2015b). Very less documentation has been done till date, in particular of species diversity and spatial distribution, based on the ecological niche. Thus, this study aimed to determine the species diversity of the Fagaceae family and to detect the habitat suitability of some species based on their spatial distribution.

MATERIALS AND METHODS

Study Area

Doi Suthep-Pui National Park is located in Muang, Mae Rim, and Hangdong districts of the Chiang Mai Province, with a total area of 163,162.5 rai or 261 km^2 approximately. The elevation of the area ranges between 330-1,685 m asl., and Doi Pui is the highest peak. The National Park serves as an important source of water which flows into the streams and the Ping river of Chiang Mai Province. The average temperatures range between 2-23 °C, while annual rainfall ranges between 1,350-2,500 mm (Department of National Parks, Wildlife and Plant Conservation, 2009). The existing forests are include a deciduous dipterocarp forest (DDF), mixed deciduous forest (MDF), mountain forest (MF), pine forest (PF), and DDF with pine sub-type (Marod *et al*. 2014).

Data Collection

• Species diversity

1) The primary data was collected using two methods:

1.1) Sixty temporary sample plots of size 30m x 30 m were established. These included DDF (4 plots), DDF with pine sub-type (3 plots), MDF (5 plots), MF (44 plots), and PF (4 plots) and within these plots, a 10 m x 10 m subplot was established. In each sub-plot, all tree species with a diameter at breast height (DBH) larger than 4.5 cm were measured and identified. For this study, we only report the tree species belonging to the Fagaceae family.

1.2) Line transect: Three line transects, based on nature trail lines in the National Park, were selected. These were chosen based on two criteria, that they covered mostly all the whole forest types (MF, PF, DDF with pine sub-type, DDF, and MDF) and that their stretch was at least 1.5 km. All the species belonging to the Fagaceae family were identified.

2) Secondary data: All the recorded tree species of the Fagaceae family from a 16-ha permanent plot, which was established in the Huai Kog Ma watershed area (Marod *et al*. 2015b), were used for the analysis of species diversity.

3) Photographs of all the tree species in the Fagaceae family were taken and leaf and fruit samples were collected for identifying the species. The unidentified species were compared with the identified specimens at the Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation using the nomenclature recommended by Smitinand (2014). In addition, the information on morphological characteristics of the sapwood and acorn was used for genus identification in the field based on the work of Phengklai *et al*. (2005).

• Spatial distribution

1) Some selected dominant species from the Fagaceae family were found in the temporary plots in the MF and DDF forest types, based on the abundance of basal area. Three species from MF, *Castanopsis acuminatissima*, *C. armata* and *C. diversifolia*, and two from DDF, *Quercus kerrii* and *Lithocarpus polystachyus,* were selected. In addition, two rare species, *Quercus kingiana* and *Castanopsis pseudo-hystrix*, were also included (Chamchumroon *et al*. 2017).

2) Topographical and soil factors

2.1) Topographical factors (elevation and slope), of each temporary plot, were characterized using a digital elevation model (DEM) as a raster surface at a resolution of 30 m.

2.2) Soil samples were collected from each temporary plot. The samples were collected from the surface at depths between 0-15 cm. For the analysis of soil properties, five soil samples were collected from different places in each subplot, and combined into a single sample (at least 500 g in weight), In each subplot, for a total of 60 samples. The physical properties like soil texture (%sand, %silt and %clay), and chemical properties like soil pH, nutrients such as Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg), and organic matter, were analyzed at the Laboratory of Soil Science, Faculty of Agriculture, Kasetsart University.

Data Analysis

• Spatial distribution

1) The spatial distribution of the selected dominant species was analyzed. A generalized linear model (GLM) was used to determine the relationship between environmental factors and tree species distribution (negative or positive correlation). In the GLM technique, the dependent variable is usually the total number of individual tree species. However, in this study, the total basal area of each species was used as a dependent variable. This selection was done as we wanted to focus on the tree establishment and the role of adult trees, which have a relatively higher seed production than poling trees .For each plot, the independent variables were the environmental factors. In order to select the independent variables, the cross-correlation between all the variables was analyzed using Pearson's correlation coefficient ($r \geq 0.80$ or $r \leq -0.80$) (Dormann *et al*. 2013; Chakraborty *et al*. 2016). Finally, environmental factors, including elevation,

slope, soil texture (% of sand and clay), soil pH, and distance from the stream, were selected for modeling the tree spatial distribution. The model with the lowest Akaike's information criterion (AIC) was chosen, using a step AIC from the MASS package (Ripley *et al*. 2017) distributed for the R program version 3.3.1, according to the equation:

Equation: Y = <-glm (total BA I ~ x1 + x2 + … x6, family = gaussian (link = identity)) ……….(1),

where, x1 = elevation, x2 = slope, x3 = sand, x4 = clay, x5 = pH,
and x6 = distance_stream

2) Topographic and soil factors

2.1) Kriging interpolation in the ArcMap version 10.1, of the GIS technique, was used to derive the topographic factors in the study area (Jirakajornkul, 2012).

2.2) To analyze the soil properties, soil textures were used to determine the tree spatial distribution. The soil texture (%sand, %silt, and %clay) and soil pH was defined using the Bouyoucos hydrometer (Jones, 2002). The soil pH was determined using a soil: water ratio of 1:1 and measured with a pH meter (Jackson, 1958). The organic matter was determined using the wet oxidation (Walkley and Black). The soil nutrients (P, K, Ca and Mg) such as P was measured using the Bray's II (modified), K, Ca, and, Mg were measured using an extraction with 1 N NH_4OAc and an atomic absorption spectrophotometer.All the results were used in the GIS analysis, based on Thiessen-polygon method. The ArcMap version 10.1 (Jirakajornkul, 2012) was used to determine the soil properties in the study area.

2.3 Euclidean distance method, in the ArcMap version 10.1, was used to measure the distance of the temporary plots from the stream.

• Habitat suitability

Using the suitable model equations (1) and (2), the habitat suitability of selected species was determined. In addition, three categories of habitat suitability was classified in terms of high, middle, and low potential (Kamyo, 2007)

RESULTS AND DISCUSSION

1. Species Diversity of the Fagaceae Family

The results showed that a total of 31 species, in 3 genera were found for Fagaceae family in Doi Suthep-Pui National Park (Table 1). The most abundant genus was *Lithocarpus* (12 species) followed by *Quercus* (10 species) and *Castanopsis* (9 species), respectively. The morphological characteristics of sapwood and acorn can be used for the identification of genus. First, the *Castanopsis* is characterized by an inner bark, without any ridges, penetrating the surface of sapwood and the cupule surface having hard spines and completely covering the nut. Second, the *Quercus* has an inner bark with ridges that penetrate the surface, shortened shallow furrow in the sapwood's surface and cupule party covering the nut surface with a lamellae. Third, *Lithocarpus* has an inner bark with ridges penetrating the surface, a deep long furrow on the sapwood's surface, and cupule partly covering the nut, with surface having scales (Figure 1).

Regarding the species diversity, about 22-50 species in the Fagaceae family found in the MF, have been recorded in the previous studies in northern Thailand (Chokchaichamnankit, 2005; Rueangruea, 2009; Marod *et al*. 2015). In this study, previous records were used to determine the intermediate species diversity, which had 31 species.

Table 1 Species diversity of the Fagaceae family found in the Doi Suthep Pui National Park.

No.	Botanical name	Temporary plots	Natural trails
1	*Castanopsis acuminatissima*	+	+
2	*Castanopsis crassifolia*	+	+
3	*Castanopsis indica*	+	+
4	*Castanopsis armata*	+	+
5	*Castanopsis diversifolia*	+	+
6	*Castanopsis argyrophylla*	+	-
7	*Castanopsis tribuloides*	+	+
8	*Castanopsis pseudo-hystrix*	+	-
9	*Castanopsis* sp.	+	-
10	*Lithocarpus elegans*	-	+
11	*Lithocarpus truncatus*	+	+
12	*Lithocarpus mekongensis*	+	+
13	*Lithocarpus thomsonii*	+	-
14	*Lithocarpus magneinii*	+	+
15	*Lithocarpus polystachyus*	+	+
16	*Lithocarpus dealbatus*	+	+
17	*Lithocarpus lindleyanus*	+	+
18	*Lithocarpus craibianus*	+	+
19	*Lithocarpus auriculatus*	+	+
20	*Lithocarpus garrettianus*	+	+
21	*Lithocarpus ceriferus*	+	+
22	*Quercus kerrii*	+	+
23	*Quercus kingiana*	+	+
24	*Quercus mespilifolius*	+	-
25	*Quercus lineatus*	+	-
26	*Quercus helferiana*	+	-
27	*Quercus brandisiana*	+	-
28	*Quercus ramsbottomii*	-	+
29	*Quercus auricoma*	-	+
30	*Quercus poilanei*	+	-
31	*Quercus oidocarpa*	+	+

Remark: + and – indicate the presence and absence of a species, respectively.

The species diversity varied among the various sites, both in temporary plots and natural trails. The results indicated that the species diversity in temporary plots was higher than in the nature trails. This may be due to extensive observation locations, as a result of which the samples taken from the temporary plots could cover all the habitats from lowland to the Doi Pui summit. Expanding the size of a sampling area may increase the observed diversity of the Fagaceae species, particularly the rare and endemic species, which need a very specific habitat to survive (Marod *et al*. 2015a).

Figure 1 Morphological characteristics of the various genera of sapwood (A) and acorn (B) of the Fagaceae family.

2. Spatial distribution

Topographic factors indicated that the Doi Suthep-Pui National Park is located between 330-1,685 m asl. (Figure 2A), with slope between 4.47-63.76 % and an aspect between 0.63-355.12 degrees. The soil texture gradient varied between lowland to upland and ranged from sandy to clay soil (Figure 2C). Sandy soil and sandy clay loam was mostly distributed in the DDF, MF, and PF, respectively, while, clay loam and loam were found only in the MDF (Santisuk, 2007).

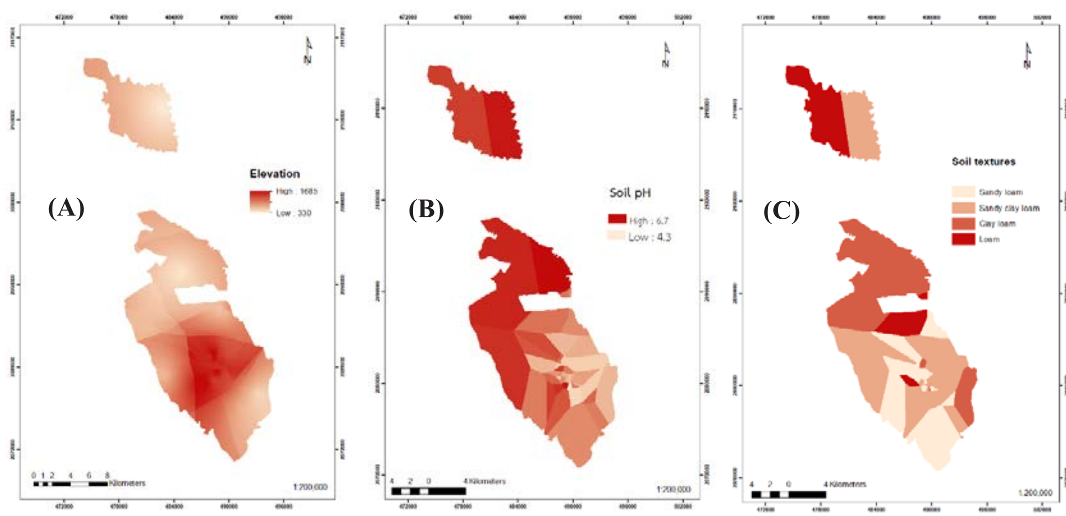

Figure 2 Map demonstrating the environmental variables in Doi Suthep-Pui National Park; (A) elevation, (B) soil pH, and (C) soil textures.

In addition, the soil pH ranged from 4.3-6.7, i.e., moderately acidic to neutral (Figure 2B). This finding was also observed by other researchers, The reported that the soil property gradients are characterized in a tropical MF (Teejuntuk, 2003; Jingjai, 2014).

The GLM analysis showed that the spatial distribution of selected species varied between the species and their environments (Table 2). The elevation had a strong influence on the presence of *Castanopsis acuminatissima*, *C. diversifolia*, *C. pseudo-hytrix*, *Lithocarpus polystachyus,* and *Quercus kingiana* (Table 2), but at different levels of correlation. The *Castanopsis acuminatissima* and *C. diversifolia* species were positively correlated with the elevation, and mostly distributed in the uplands (above 1,000 m asl.). Previously, Jingjai (2014) reported that this species preferred and grew to maximum size at the higher elevations of mountain ridges. On the other hand, the species *Lithocarpus polystachyus*, *Quercus kingiana,* and *Castanopsis pseudo-hytrix* were negatively correlated with elevation, and were found at relatively lower elevations (between 400-700 m asl.) and frequently found in the DDF (Phengklai *et al*. 2005; Chokchaichamnankit *et al*. 2008; Hermhuk, 2014;).

Table 2 Results of a GLM analysis indicating the relationship between species distribution and the environmental factors. The values represent the model regression coefficients, selected on the basis of the lowest AIC.

Species	Environmental factors						
	Elevation	Slope	%Sand	%Clay	pH	Distance stream	AIC
C. acuminatissima	0.0004*		-0.0163***				33.508
C. diversifolia	1.1320*				-6.7200**	1.0850***	-110.16
L. polystachyus	-3.6320*				1.2800	1.8040	-227.55
C. pseudo-hytrix	-1.4170*						-338.35
Q. kingiana	-3.1830*	3.8710		-7.0560		-1.0160	-268.31
C. armata	1.5560		-3.6950*	0			-41.284
Q. kerrii				.0047**	-0.0856***		-114.06

Remarks: * $p < 0.05$, ** $p < 0.01$, *** $p<0.001$.

In addition, the soil texture indicated that the percentage of sand also played an important in the distribution of *Castanopsis acuminatissima* and *C. armata,* which was negatively correlated with the percentage of sand. The two plant species were distributed in areas with sandy soil, such as ridges. The percentage of clay affected the species distribution and that the distribution of *Quercus kerrii* species was positively correlated and it that distributed well in the high DDF. Soil pH and distance from stream also affected the species distribution. The distribution of *Castanopsis diversifolia* was positively correlated with the distance from stream, which indicated that this species was distributed mostly far away from the stream. This finding is in contrast with that of Marod *et al*. (2015a), who that found

Castanopsis diversifolia preferred a high soil moisture and was mostly distributed near a stream. However, high soil moisture content is the main characteristics of high altitudinal montane ecosystems (Bohiman *et al*. 1995; Berryman *et al*. 2015; Marod *et al*. 2015a, b), and so it can be established and distributed far from a stream. Although the distance from the stream played a minor role on the distribution of Fagaceae species in the MF compared to other factors, it can have a strong influence on other tree species, particularly the fig tree species (Jansuwan, 2007). Only two species, *Castanopsis diversifolia* and *Quercus kerrii*, were negatively correlated with soil pH, indicating that, these species preferred a high soil pH or an alkaline soil.

3. Habitat suitability for some species from the Fagaceae family

The habitat suitability varied among species, based on the environmental factors. The most important factors were selected based on the lowest AIC and were used for in the overlay technique to detect the species distribution in the study area. The various factors for the dominant species are listed below.

1. *Castanopsis acuminatissima*: The equation resulting in the lowest AIC was Y = 0.5674 + 0.0004 elevation - 0.0163(Sand). This indicates that the important factors for its distribution were the elevation and the percentage of sand in the soil. The species was mostly found in the MF, which was found above 1,000 m asl. and on the ridges. For habitat suitability, the middle potential area was the largest in size, 83,363.57 rai, followed by low and high potential areas, 53,131.44 and 39,488.01 rai, respectively (Figure 3A).

2. *Castanopsis armata*: The equation resulting in the lowest AIC was Y = 5.5480 - 3.6950 (Sand). This indicates that the most important factor for its distribution was the percentage of sand in soil. It most frequently found in MF, especially on the ridges. For habitat suitability, the high potential area was the largest in size, 113,855.57 rai, followed by middle and low potential area, 62,417.64 and 64.97 rai, respectively (Figure 3B).

3. *Castanopsis diversifolia*: The equation resulting in the lowest AIC was Y = 1.9570 + 1.1320 (elevation) -6.7200 (pH) +1.0850(distance_stream). This indicates that the important factors for the distribution of this species were elevation, soil pH, and the distance from the stream. It was mostly found in MF, in an alkaline soil, and far away from stream, mostly on ridges. For habitat suitability, he middle potential area had the largest area at, 82,323.05 rai, followed by low and high potential area, 79,235.88 and 14,518.39 rai, respectively (Figure 3C).

4. *Quercus kerrii*: The equation resulting in the lowest AIC was Y = -0.5288 + 0.0047 (Clay) -0.0856 (pH). The important factors for the species distribution were the percentage of clay in the soil and soil pH. It was mostly found in the DDF and DDF with pine subtype. Additionally, the habitat suitability was the highest in the middle potential area, as indicated by the largest area of 86,183.21 rai, followed by low and high potential area, 68,477.06 and 20,850.64 rai, respectively (Figure 4A).

5. *Lithocarpus polystachyus*: The equation resulting in the lowest AIC was Y = -1.8180 - 3.6320 (elevation). The most important factor for its distribution was the elevation. It was found in areas with an elevation ranging between 500-900 m asl., mostly distributed in the DDF and MDF. In addition, areas of habitat suitability were in the high potential category, as indicated by the largest area (101,905.65 rai), and followed by middle and low potential area, 47,916.62 and 26,455.28 rai, respectively (Figure 4B).

6. *Quercus kingiana*: The equation resulting in the lowest AIC was Y = 5.6930 - 3.1830 (elevation). Elevation was the the most important factor for the distribution of this species and it was found in areas with elevation ranging between 700-900 m asl., and was frequently found in the DDF to DDF with pine subtype. In addition, the high potential area had the largest area at approx., 101,773.31 rai for habitat suitability, followed by middle and low potential areas, 47,854.39 and 26,420.92 rai, respectively (Figure 5A).

7. *Castanopsis pseudo-hystrix*: The equation resulting in the lowest AIC was Y = 1.9640 - 1.4170 (elevation). The most important factor for its distribution was the elevation and it was found in areas with an elevation between 500-900 m asl., and mostly distributed in the DDF and MDF. In addition, the high potential area was a suitable habitat as indicated by the largest area of 101,905.65 rai, followed by middle and low potential areas, 47,916.62 and 26,455.28 rai, respectively (Figure 5B).

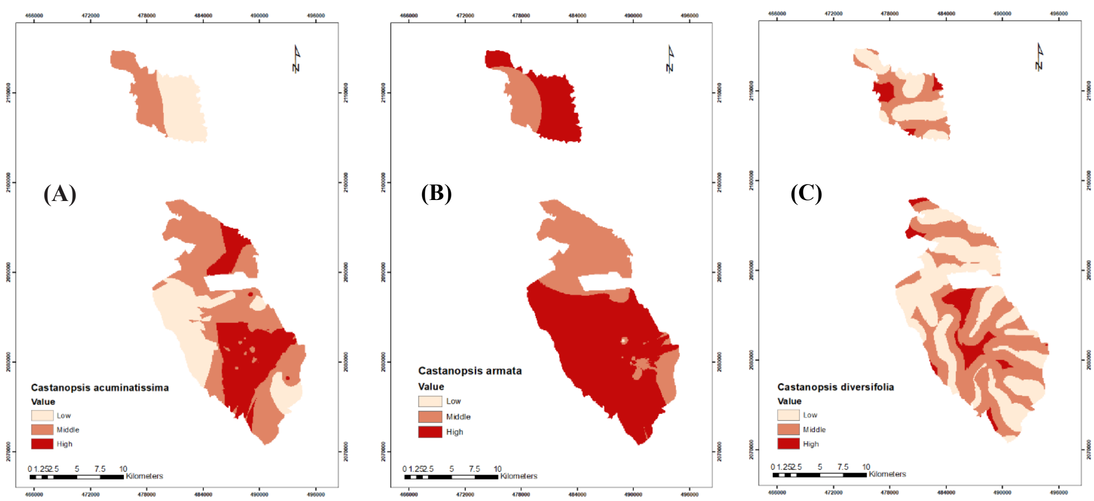

Figure 3 Habitat suitability maps for the evergreen species; (A) *Castanopsis acuminatissima*, (B) *C. armata*, and (C) *C. diversifolia.*

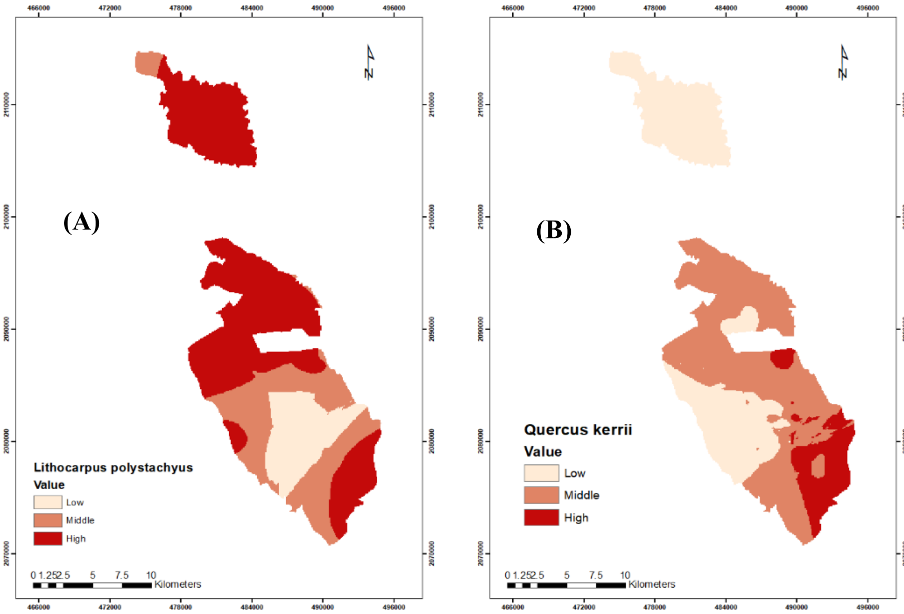

Figure 4 Habitat suitability maps for the deciduous species; (A) *Lithocarpus polystachyus* and (B) *Quercus kerrii.*

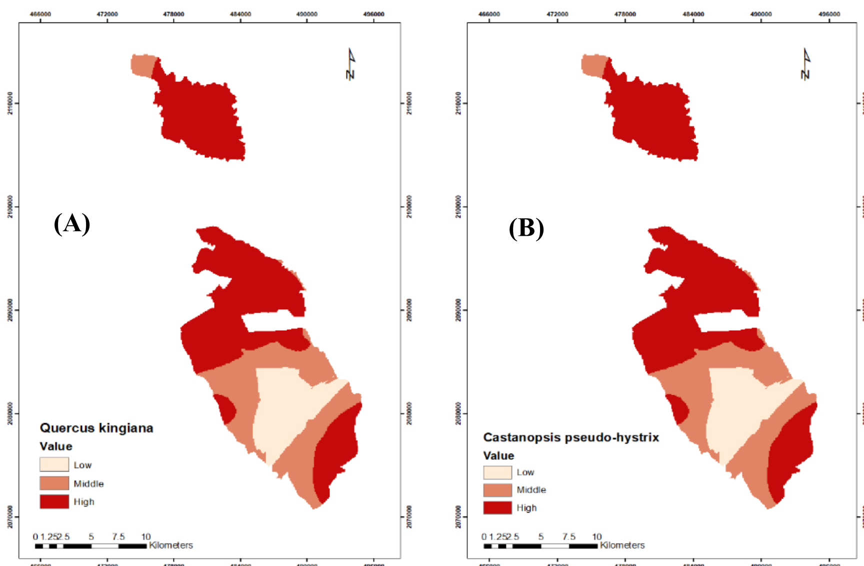

Figure 5 Habitat suitability maps for the deciduous species; (A) *Quercus kingiana* and (B) *Castanopsis pseudo-hystrix.*

Considering the habitat suitability, high potential areas were observed for *Castanopsis armata, Quercus kingiana*, *Castanopsis pseudo-hystrix,* and *Lithocarpus polystachyus*, while the middle potential areas were found for the rest of the species, *Castanopsis acuminatissima*, *C.*

diversifolia, and *Quercus kerrii*. Considering the previous reports (Marod *et al*., 2014, 2015a, b; Hermhuk *et al*., 2014), the *Castanopsis acuminatissima* species was the dominant species, largely distributed in the MF, while, *Lithocarpus polystachyus* and *Quercus kerrii* were mostly found in the DDF. In contrast, even though a high habitat suitability was observed for the *Quercus kingiana* and *Castanopsis pseudo-hystrix* species, a narrow distribution and low population was found in the specific areas, implying that these were to be considered as rare species (Chamchumroon *et al*. 2017). Variations in species niches and environment factors had a high influenced on their abundance. Anthropogenic disturbances strongly effected the environmental changes may have led to a narrow distribution and to the local loss or species extinction, particularly of the rare and endemic species (Fukushima *et al*. 2008; Hermhuk, 2014; Hermhuk *et al*. 2016; Chamnongpakdee, 2018). The overexploited seed collection for some specific species based on their delectable and marketable objectives, such as *Castanopsis diversifolia* and *C. armata* (Yarnvudhi *et al*., 2016) may reduce their seedling establishment. In addition, the seedling population of the Fagaceae family may be reduced based on the seed predators, in particular, the mammals that could reduce the chances of seed germination (Rueangket *et al*. 2016). Thus, to maintain a species diversity, both the suitable habitats or conservation areas have to be protected and overexploitation should be reduced or stopped.

CONCLUSION

Total of 31 species in 3 genera, in the Fagaceae family, were recorded in the Doi Suthep-Pui National Park. Genus *Lithocarpus* was the most abundant (12 species) followed by *Quercus* (10 species) and *Castanopsis* (9 species). The spatial distribution varied among species depending on the environmental factors, particularly the species niche. High elevation (above 1,000 m asl.) and soil texture, in particular sandy clay texture, were the most important factors for the evergreen Fagaceae species (*Castanopsis acuminatissima*, *C. diversifolia*, and *C. armata*), and mostly distributed in the MF. In contrast, low elevation (below 1,000 m asl.) and sandy soil determined the distribution of deciduous Fagaceaec species (*Quercus kerrii* and *Lithocarpus polystachyus*, *Castanopsis psudo-hystrix* and *Quercus kingiana*) and were mostly distributed in the DDF and MDF. With regards to the habitat suitability, high potential areas were reported for *Castanopsis armata*, *C. pseudo-hystrix*, *Quercus kingiana,* and *Lithocarpus polystachyus*, while middle potential areas were found for the rest of the species, *Castanopsis acuminatissima*, *C. diversifolia*, and *Quercus kerrii*. Variations in species niches and environment factors had a strong influence on their abundance. Anthropogenic disturbances, which strongly effected the environmental conditions, may have led to a narrow distribution and to the local loss or species extinction, particularly of the rare and endemics species. The overexploited seed collection for some specific species based on their delectable and marketable objectives such as *Castanopsis diversifolia* and *C. armata* may reduce their seedling establishment. In addition, the seedling population of Fagaceae may reduce based on the seed predators, in particular the mammals, which could reduce the chances of seed germination.Thus, the establishment of a species based on their ecological niche, derived from this study can be applied to select suitable Fagaceae species for a restoration program, particularly in the MF.

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