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Population Ecology of Some Important Palm Species in Phetchabun Province

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ABSTRACT

Thailand is located in a tropical rain forest, enriched with natural resources. Phetchabun Province is in the lower northern part of Thailand. This area has complicated and diversed forest ecosystems, and this diversity provides both economical and social benefits for local people. Many species of plants found in the locality are traded. The particularly important species are members of the palm family. In the past, Phetchabun had an abundance of diversed palms. As a result of partial destruction by human activities, a large area of Phetchabun forest became highly degraded land. At present, diversity palm species is lower than in the past. The objectives of this research were to investigate the population, abundance and species composition within three conservation areas of Phetchabun mountain land including Thung Salaeng Luang National Park (TS), Khao Kho non-hunting area (KK) and Wang Pong-Chondaen non-hunting area (WP). A systematic random sampling was utilized in this study with circular temporal plots, 20 meters in diameter. Plots were laid out along the baselines, at 20 m intervals, alternating between the left and the right of the central line. For vegetation inventory, palms were classified into three categories; seedlings, juveniles and adults. Quantitative data included the number of species and density were compared. The results show that there were difference in species composition between the three study sites. *Daemonorops jenkinsiana* and *Areca triandra* are dominant species in KK and TS where as *Arenga pinnata* is a dominant palm in WP. Considering species density of *Calamus* cf. *khasianus* in KK (area 2) was significantly different from KK (area 1), TS and WP ($p<0.05$). Meanwhile, density of both *C.* cf. *khasianus* and *L. jenkinsiana* was lower than the other palms at all studied sites. Besides, *C.* cf. *khasianus* and *L. jenkinsiana* were observed only in KK and TS. This suggests that they are endemic species and are threatened to extinction.

Key words: palm, population, ecology

INITRODUCTION

Forest area of Thailand is decreasing at an alarming rate during 1961-1991, more than 0.46 million hectares were deforested annually (RFD, 2003). These rapid and profound changes endangered both genetic resources and plant species diversity. An efficient forest ecosystem provides economic and social benefits. Many species of plants are used commercially, especially

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the palm species (Family Arecaceae). Palms are an abundant, diverse and ecologically important group of tropical plants. In Ecuador on a 0.1 hectare plot in moist forest land, 36 different species of non-epiphytic climbers which include rattan were recorded. These comprised 9% of the total floristic diversity. In Malaysia, an average of 384 and 164 woody lianas, climbing palm a diameters of more than 2 cm per hectare, were recorded in valley and hillslope forest, respectively (Putz and Chai, 1987).

Palm species are common in a primary forest ecosystem, especially an evergreen forest. Climbing palms are also of ecological important, as a source of food and habitat for a variety of forest wildlife (Siebert, 1993). These species of palms are widely used in the furniture industry and the shoots of these species are edible. Rattans include 14 genera and about 600 species around the world. A great biological diversity of rattan palm is spread across Southeast Asia (Dransfield, 1981). IUCN reported that many rattan species are endangered. The stems of this plant have become an increasingly popular raw material for industry. It is used to make furniture, baskets and also as a binding material. Through the increasing demand for non-timber products, palm species in areas of forest land have also decreased. Many species are endemic and are threatened with extinction.

In the northern region, a few studies are focusing on palm species diversity, population and regeneration. The need is to select palm species that will be protected and conserved. It is essential to understand the ecological and biological requirements of such species. Gomez-Pompa and Burley (1991) suggested that the lack of understanding of the requirement of individual species has been considered as the greatest gap in our knowledge, and that management of the threatened species requires ecological quantitative data produced from field monitoring programs. The size and number of populations and area of occupancy are the basis for measurable criteria for further conservation action (IUCN, 1994). Therefore, the objectives of this research were to investigate the population, abundance and species composition of palms on Phetchabun mountain land. The results of this study are significantly important to the conservation and restoration of endangered and endemic species in natural forest ecosystems and are useful in sivilculture application.

MATERIALS AND METHODS

Site description

The research was conducted in three areas at the Thung Salaeng Luang National Park (TS), Khao Kho non-hunting area (KK) and Wang Pong non-hunting area (WP) in Phetchabun Province, lower northern Thailand (Figure 1). The characterization and location of the three study sites are shown in Table 1. Meteorological data gathered over the period 1985-2001, from Pasak watershed research station reveals that annual rainfall normally exceeded 1,800 mm per year and raining period is mostly between May and September. The mean maximum temperature was about 34.97 °C in the hot-dry season (April) and a mean minimum of 15.86 °C in the cool-dry season (December) (data unpublished). Phetchabun mountain land contains many types of forest ecosystems. The dominant forest ecosystems are pine forest, deciduous forest, savanna grassland and hill evergreen forest.

Floristic inventory

In each forest ecosystem, circular temporal plots (10 m in diameter) were systematically laid out along the baseline at 20 m intervals, alternating between the left and the right of the central line. In this study palm plants were classified into three categories, i.e. seedling, juvenile and adult. All individual plants in the seedling group were less than 1.3 m tall. All individual palms with at least one fan-shaped, no trunk and higher than 1.3 m tall were classified as juvenile. Individual plants with trunks and more than 1.3 m tall were classified to the adult group. In all categories, the palm species were counted and identified to species level. The following values were calculated; total and species densities (individual plants per unit area) and number of species. The values were analysed using one-way analysis of variance (ANOVA) through the use of SPSS/PC version 11.5. LSD tests were used for comparisons among means.

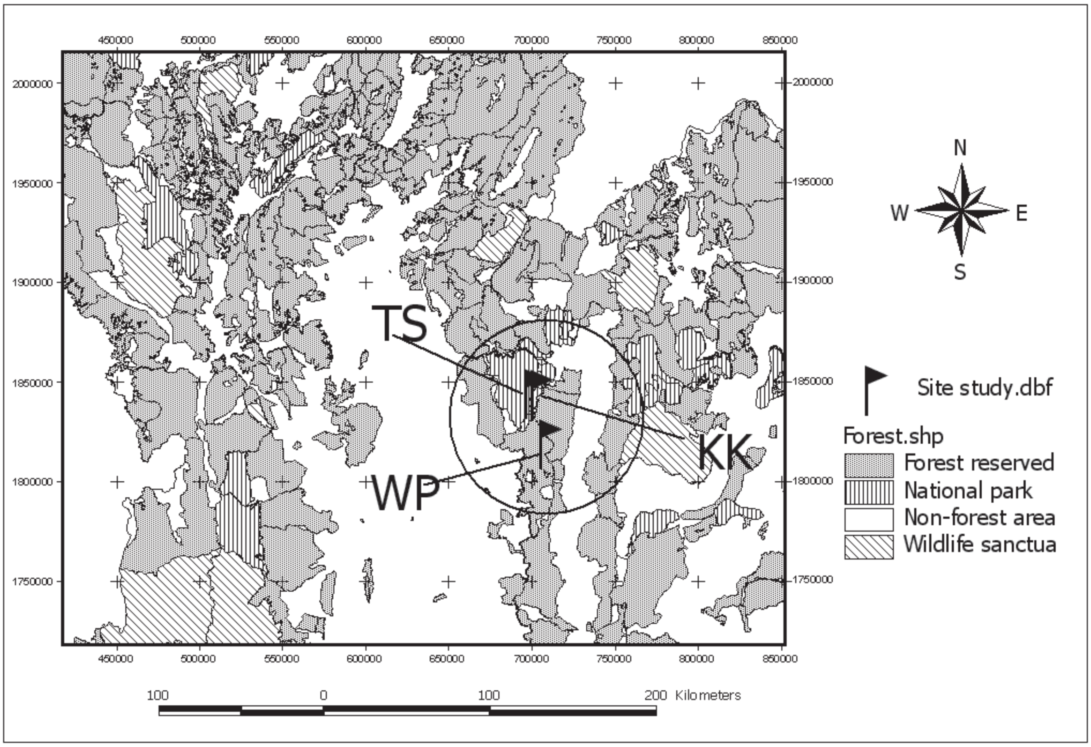

Figure 1 Map of the three studied sites in Phetchabun province, lower northern Thailand.

Table 1 Characterization and location of studied site in Phetchabun Province, lower northern Thailand.

Locality / Characters	KK		TS		WP	
	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2
Latitude	16° 37' 53''N	16° 37' 23''N	16° 36' 29''N	16° 37' 38''N	16° 25' 50''N	16° 21' 07''N
Longitude	100° 56' 30''W	100° 56' 07''W	100° 50' 24''W	100° 53' 46''W	100° 53' 30''W	100° 58' 51''W
Elevation	660 m asl	600 m asl	738 m asl	706 m asl	831 m asl	250 m asl
Forest type	Hill evergreen	Hill evergreen	Hill evergreen	Hill evergreen	Hill evergreen	Hill evergreen
Geomorphology	Mountain, lowland	Mountain, lowland	lowland	lowland	Mountain ridge, waterfall	Mountain ridge, waterfall

RESULTS AND DISCUSSION

For the KK site study, there were 5-6 species (Table 2), *Livistona jenkinsiana* (fan palm), *Calamus palustris* (rattan), *Calamus* cf. *khasianus* (rattan), *Daemonorops jenkinsiana* (rattan) and *Areca triandra* (palm). Species composition in KK was similar to TS area. However, the number of palm species in WP was lower than KK and TS. Three species of palms, i.e. *Arenga pinnata* (sugar palm), *Caryota* sp. (jaggery palm). and *Calamus* sp. (rattan) were found in this site. Species composition in WP was different from both KK and TS. The difference in species composition between KK, TS and WP may be related to physical factors e.g. altitude and moisture.

The highest density of adult palm was 537-590 trees per ha^{-1} in TS, followed by KK (446-529 trees per ha^{-1}) and WP (145-234 trees per ha^{-1}), respectively (Table 2). The high density in KK and TS was due to the amount of *D. jenkinsiana* and *A. triandra*. These species may have more potential to flourish in a natural forest ecosystem than other species, because both *D. jenkinsiana* and *A. triandra* produce clusters of stems and propagate vegetatively.

In Table 3, the results showed that density of seedling palms were high, but there were relatively few adults. This suggests that palm plants have a high rate of seedling mortality. This coincides with the research data on *Livistona* seedling survival which reported that the number of individual plants generally decreases with increasing size class. Therefore, its survival rate is low in the seedling stage (Weiner and Corlett, 1987). In addition, lipstick palm (*Cyrtostachys renda*) showed a low survival rate in the seedling stage. Higher mortality among the early stages of the life cycle (suckers and seedlings) was probably caused by thick cover from falling palm and pandan leaves preventing sunlight exposure, severe competition for space, and frequent and prolonged flooding/waterlogging. The evolvement of abundant suckers may be a palm strategy to maintain a successful population recruitment. Moreover, The influence of slope on soil texture and water holding capacity partly determines the levels of available mineral nutrients and consequently the establishment and spatial distribution of vegetable species (Widyatmoko *et al*., 2005). High mortality rate is a major problem for plants to regenerate in a natural forest ecosystem.

Table 2 Total number of adult, juvenile and seedling of palm species at the three studied sites.

Number of species	KK		TS		WP	
(Palm growth stage)	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2
Adults	5	4	4	5	1	2
Juveniles	6	4	4	5	2	2
Seedlings	6	2	4	5	2	2
Total	6	5	5	5	3	3

Table 3 Total density (individual/ha) of adult, juvenile and seedling palms at the three studied sites.

Density	KK		TS		WP	
(individual/ha)	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2
Adults	446	529	590	537	234	145
Juvenile	380	924	581	426	971	273
Seedlings	1,079	885	989	1,449	4,190	1,310
Total	1,905	2,338	2,160	2,412	5,395	1,728

Regarding species density, it was found that the highest density of *A. triandra* and *D. jenkinsiana* were found at TS, followed by KK, but both species were not found at WP. Both *A. triandra* and *D. jenkinsiana* propagate vegetatively. Thus, these species regenerate quickly in a natural forest ecosystem. These species occupied a niche space and flourish in this area better than other species. *L. jenkinsiana* and *C.* cf. *khasianus* were found only in KK and TS. The density of *L. jenkinsiana* in KK ranged from 0-26 individual/ha, while species density in TS was 8-22 individual/ha. Density of *C.* cf. *khasianus* in KK (area 2) was significantly different from KK (area 1), TS and WP ($p<0.05$). Average density of *C.* cf. *khasianus* in KK ranged from 26 to 96 individual/ha. The density of this species in TS was 0 to 20 individual/ha (Table 4). The density of these species was very low when compared to other palm plants established in this area. *L. jenkinsiana* and *C.* cf. *khasianus* species are solitary palm plants which reproduce by seeds. Thus, these traits are relatively easy to eliminate in a natural forest ecosystem. In an ecological perspective, the low density of some species is due to the species competition. Inter-specific competition, especially through shoot competition, is the process that most decisively prevents the development of palm tree species. This coincide with the scientific reported that competition was thought to be the main factor that decreased the probability of *Virola surinamensis* and *Euterpe delis* seedling survival and growth rate (Howe and Richter, 1982, Pizo and Simao, 2001).

Many palms are known to establish and grow rapidly in large spaces (Appanah and Nor, 1991). However, not all palms exhibit strong shade-intolerance and space growth regenerating preferences. Such as the widely different light intensities tolerated by *Calamus exilis* and *C. zolingeri* that reveal a range of shade tolerance similar to that observed in tree species (Siebert, 1993). The large-diameter and furniture quality rattan, *C. cf. khasianus,* exhibit light-demanding traits. This characteristic is similar to *L. jenkisaina*. These palms grow upwards through the forest canopy. If they grow as an understorey layer, growth and survival rate may be decreased. *L. jenkinsiana* is a slow-growing species and usually grows at an altitude above 600 m asl. Therefore, this is the one reason that this species are only found in KK and TS. This suggests that these species are endemic especially *C.* cf. *khasianus*. The result determined by Weiner and Corlett (1987) concluded that *Livistona* can grow and flourish on plateau-like sites where poor, shallow soil prevents a closed tree canopy. *Livistona* and rattan can germinate and establish itself in forest gaps. These species are positively related to high light intensities (Appanah and Nor, 1991). So it is a problem for these palm species to regenerate in a natural evergreen forest ecosystem, where there is low light intensity in the understory layer. However the low density of the palm population may be due to the predators. The report showed that the palm seeds were attacked by rodents, insects and other predators (Wilson and Janzen, 1972, Notman *et al*., 1996).

Table 4 Average density of some important adult palms at the three studied sites.

Density	KK		TS		WP	
(individual/ha)	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2
L. jenkinsiana	26±15.30 a	0±0.00 a	22±10.72 a	8±5.23 a	0±0.00 a	0±0.00 a
C. cf. khasianus	26±9.24 a	96±80.56 b	0±0.00 a	20±15.81 a	0±0.00 a	0±0.00 a
D. jenkinsiana	99±39.45 ae	331±113.36 bc	273±81.14 bd	173±26.85 acd	0±0.00 ae	0±0.00 e
A. triandra	297±50.62 a	83±34.40 b	363±58.76 a	338±79.99 a	0±0.00 b	0±0.00 b
A. pinnata	0±0.00 a	0±0.00 a	0±0.00 a	0±0.00 a	234±35.46 b	138±46.83 c

Different letters indicate significant differences at $p < 0.05$.

At the WP site, *A. pinnata* was clearly the dominant species and was widely spread out in two areas. This species was not found in the KK and TS forest ecosystems which are adjacent areas. This may be due to geomorphology, as these sites have waterfalls and creeks. Thus, the local conditions are favorable establishment and persistence of the species. This result was supported by Widyatmoko *et al*. (2005) who revealed that the palm species i.e. *Crytostachys renda* was sensitive to changes in the water table. The abundance of this palm in seasonally flooded sites was very low. Well-drained forests were preferable and supported the largest populations with a complete age-structure. Suckers and seedlings growth was very low. This agree with Kahn and Mejia (1990) who also found that palm density and diversity was very low in the Peruvian Amazonia forests which were periodically flooded by blackwater streams. In addition, limitation of dispersal mechanisms should be related to palm dispersion. Therefore, spatially limited seed dispersal could cause floristic dissimilarity between adjacent conservation lands. Several studies revealed strong evidence of dispersal limitation for palm plants at both fine and broad scales in tropical forest (Svenning, 1999, Charles-Dominique *et al*., 2003).

C. cf. *khasianus* produces a large rattan cane which is used in the furniture industry. This species may be at risk of extinction through human interference, if there is no plan to conserve this palm. Similar situation was reported by Dransfield (1987) that habitat destruction and excessive rattan cane harvesting has depleted the wild rattan population. Several economically important rattan species, particularly large-diameter canes are threatened with extinction. Light-demanding trait information is useful for management strategy, if this palm is introduced to cultivation.

CONCLUSION

This study demonstrated that there were differences species composition in density between the KK and TS sites, which are northern mountainous areas, and WP which is located in the south. *D. jenkinsiana* and *A. triandra* were the dominant species in KK and TS. *A. pinnata* was a dominant palm in WP. Different species composition between KK, TS and WP was due to the different physical factors such as geomorphology and altitude. In addition to the biological factor which is dispersal limitation, the low density of *L. jenkinsiana* and *C.* cf. *khasianus* in KK and TS, this may be due to their reproductive capability. Therefore, these species are threatened with extinction. Moreover, *C.* cf. *khasianus* is the large diameter cane endemic species which was found only at KK and TS. This information indicates that a strategy to conserve *C.* cf. *khasianus* must be promptly initiated. Moreover, this rattan represents an excellent opportunity to develop a sustainable supply of cane for the rattan furniture industry.

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