DETERMINATION OF ECOLOGICAL CONTINUITY OF HORTON PLAINS NATIONAL PARK USING MACROLICHENS AS INDICATORS

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Introduction

Ecological continuity (EC) means the time span a forest habitat requires to reach the successional stage of dynamic equilibrium (Wu and Loucks, 1995). In the tropics, lichens have been used as bioindicators to predict the environmental changes in forests of Thailand (Wolseley and Aguirre-Hudson, 1997a, 1997b). Rose (1974) reported that presence of some vascular plants and lichens in recent woods were different from those present in ancient woods, which were continuously wooded since 1600 A.D. It is considered that the growth of forest in Horton Plains National Park (HPNP) fluctuated from 3,600 cal yr BP onward (Premathilake and Risberg, 2003). Furthermore, the forest of HPNP was influenced by other factors like forest fires and Sambar grazing (DWC project report, 2007). The objective of this study was to determine the areas where EC is most preserved and to find out the ecological continuity indicator (ECI) species of macrolichens in HPNP.

Materials and Methods

Six transects (each 10 m × 100 m) each in continuous forest and in forest islands were selected from a remote sensing map of HPNP. The bark pH, tree height up to canopy and tree diameter at the 1.5 m above the ground level of the host trees, and light intensity of the continuous forest and forest islands were recorded and compared using Minitab 14 software.

The macrolichen genera such as 1) *Bunodophoron* sp., 2) *Collema* sp., 3) *Heterodermia* sp., 4) *Leptogium* sp., 5) *Lobaria* sp., 6) *Menegazzia* sp., 7) *Nephroma* sp., 8) *Pannaria* sp., 9) *Parmeliella* sp., 10) *Phyllopsora* sp., 11) *Pseudocyphellaria* sp., 12) *Sticta* sp., 13) *Teloschistes* sp., 14) *Usnea* sp. were documented as ECI genera in the available literature. The respective frequencies and cover values of these macrolichens in the transects in both continuous forest and forest islands were recorded. A two-way indicator species analysis (using PCORD statistical software) was performed to find out the indicator species of macrolichens among the macrolichen genera present in our study.

Results

Total frequency of ECI genera in continuous forest and forest islands are shown in Figure 1A. All ECI genera occurred at a higher total frequency in the forest islands (Figure 1A), especially *Heterodermia*, *Lobaria*, *Pseudocyphellaria* and *Sticta* which were significantly higher, compared to the corresponding values in the continuous forest.

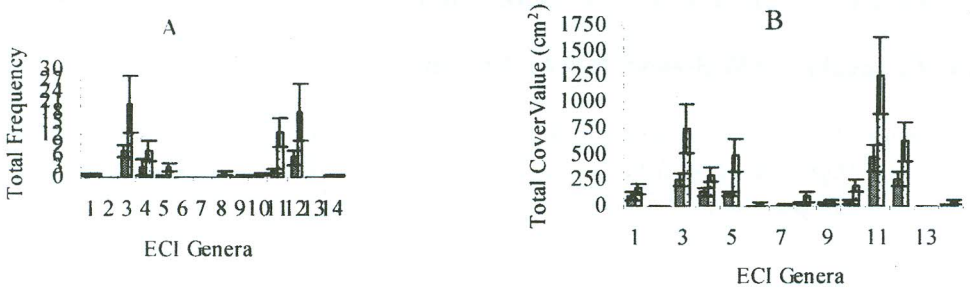

Figure 1. A) Total frequency and B) total cover value of Ecological Continuity Indicator (ECI) genera in continuous forest (grey bars) and forest islands (dotted bars) in HPNP.

Total cover value of ECI genera in continuous forest and forest islands were shown in figure 1B. The cover values of all the ECI genera in forest islands were higher than that of the continuous forest, where more than 50 % of ECI genera showing significantly higher values (Figure 1B). The genus *Pseudocyphellaria* showed the highest total cover value in both forest types (Figure 1B).

Parameters such as average host tree height, average host tree diameter and average light intensities were not significantly different between the two forest types. However, host bark pH was significantly different ($p \leq 0.05$) between the two forest types. According to the statistical analysis (correlation analysis, MNITAB 14.0, $p=0.05$), a positive correlation was observed between host tree diameter and the bark pH.

Macrolichen species, *Parmeliella* sp.1, *Parmeliella papillata*, *Phyllopsora buettneri*, *Leptogium* sp 4 and *Pseudocyphellaria beccarii* were found as possible ECI species in HPNP.

Discussion

Continuous forest supports fewer macrolichen genera at lower frequency and cover than forest islands. The higher values of such parameters indicated that, ecological continuity is better preserved in forest islands than the continuous forest. According to the Wolseley and Aguirre-Hudson (1997a), use of lichen taxa frequency allows them to assess rates of change when occurring environmental continuity and deterioration in tropical forests. They also found species rich, fire tolerant lichen communities associated with ancient Dry Dipterocarp Forest (DDF) in Northern Thailand. Considering the hosts bark pH, a temporary increase from 6.3 to 6.7 within one year has been reported due to the severe burning in DDF in Thailand. However, the increased pH may be reversed during the rainy season (Wolseley and Aguirre-Hudson (1997b). This phenomenon is not be applicable for the host plants present in forest islands in HPNP due to the

lack of forest fires during last few decades. This may be a result of less amount of leaching experienced by trees with large diameter having larger crowns. When the crown is large, it facilitates draining the rainwater away from the main trunk (Kermit and Gauslaa, 2001).

The ECI lichen species determined in this study will be useful in predicting the ecological continuity of forest in HPNP. Considering all the above facts, we can conclude that the ecological continuity is highly preserved in forest islands of the HPNP and five macrolichen species were identified from the above ECI genera as ECI species in the area studied.

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References

Department of Wildlife Conservation (DWC), (2007). Follow up study of forest die-back in Horton Plains National Park. Protected area management and wildlife conservation project. 1-26.

Kermit, T. and Gauslaa, Y. (2001). The vertical gradient of bark pH of twigs and macrolichens in a *Picea abies* canopy not affected by acid rain. Lichenologist 33: 353-359.

Premathilake, R. and Risberg, J. (2003). Late quaternary climate history of the Horton Plains, central Sri Lanka. Quaternary Science Reviews, 22: 1525-1541.

Rose, F. (1974). The epiphytes of oak. In The British oak: its history and natural history, ed. M. G. Morris and F. H. Perring, Classey, Faringdon, Berkshire, United Kingdom. 250–273.

Wolseley, P. A. and Aguirre-Hudson, B. (1997a). The ecology and distribution of lichens in tropical deciduous and evergreen forests of northern Thailand. Journal of Biogeography, 24: 327-343.

Wolseley, P. A. and Aguirre-Hudson, B. (1997b). Fire in tropical dry forests: corticolous lichens as indicators of recent ecological changers of Thailand. Journal of Biogeography, 24: 345-362.

Wu, J. and Loucks, O.L. (1995). From balance of nature to hierarchical patch dynamics: a paradigm shift in ecology. Q Rev Biol., 70: 439–466.