

Background

Mt. Merapi is one of the major active volcanos of the Island of Java which known with its "Merapi-type *nuées ardentes*". The objective of this study was to describe the patterns of plant succession and detect the possibilities of alternative states that may occur.



Figure 1. Mt. Merapi *nuées ardentes* (Left). Location of Mt. Merapi in Central Java, Indonesia (Right).

Method

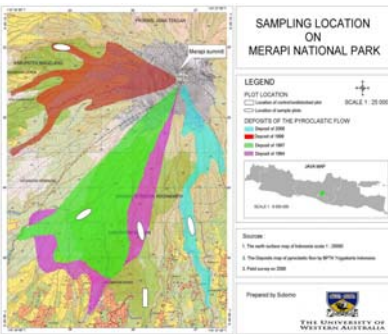


Figure 2. Map showing position of sampling sites

Four *nuées ardentes* affected areas and one unaffected sites were sampled in 2008. These affected sites are of different age (time since eruption). The youngest was 2 years old and the oldest was 14 years old. Multivariate analysis using PRIMER (Clarke, 1993) was used for data analysis.

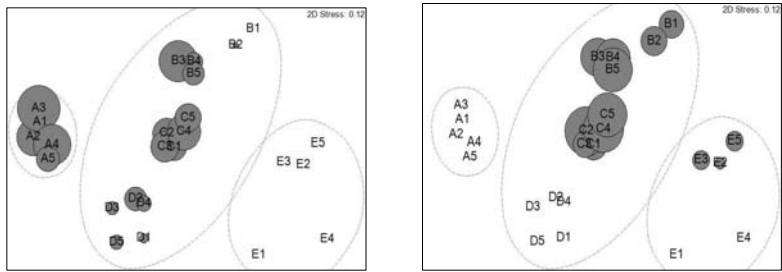


Figure 4. Pattern of native (*Imperata*-left) and exotic (*Eupatorium*-right) colonizer in Mt. Merapi secondary succession

Results

Table 1. Variation in species richness in primary and secondary succession sites on Mt. Merapi

ANOVA Group	Primary succession	Secondary succession
Site 2006	4.0 (± 1.49) ^a	9.20 (± 1.48) ^a
Site 1998	6.7 (± 1.41) ^b	14.0 (± 3.39) ^b
Site 1997	7.4 (± 1.07) ^{bc}	15.4 (± 1.51) ^b
Site 1994	8.4 (± 2.11) ^c	19.4 (± 2.96) ^c
Un-affected site		10.6 (± 1.67) ^a



Figure 3. Resilience of Merapi volcanic ecosystem. Kaliadem *nuées ardentes* deposit areas 3 months after May 2006 eruption (left) Kaliadem *nuées ardentes* deposit areas, two years since eruption (right).

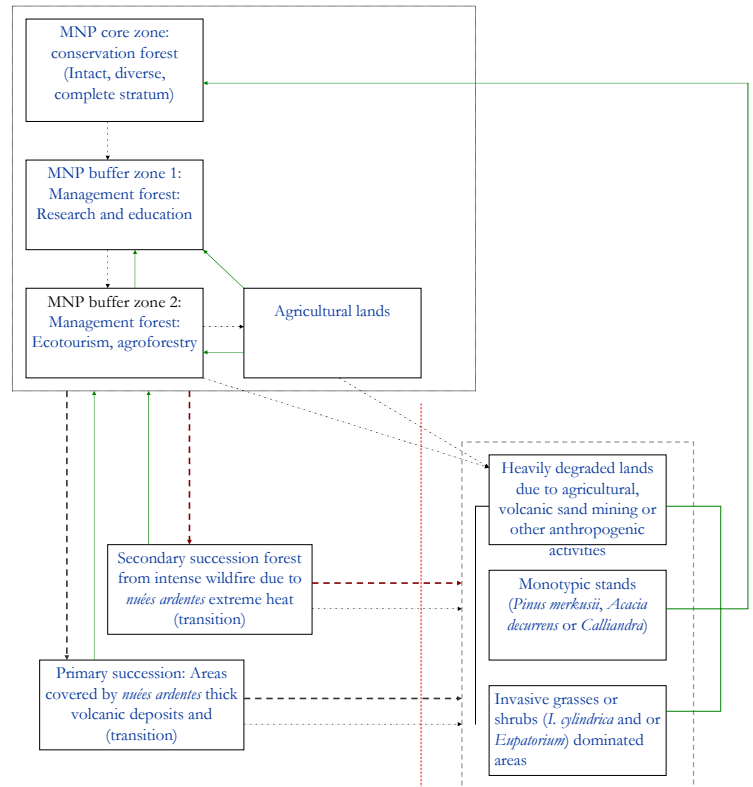


Figure 5. Conceptual alternative stable states model to incorporate vegetation succession and dynamics into management and restoration practice in Mt. Merapi National Park (MNP). Grey box represent transitions that can occur as a part of active management. Individual boxes are transition that can occur due to volcanic disturbances. Dashed grey box represents alternative undesirable stable states that can occur after the threshold (dashed red line) is crossed. Thick dashed red arrows are *nuées ardentes* wildfire whereas black dashed arrows is *nuées ardentes* deposits. Thin dashed black arrows represents anthropogenic disturbance while green arrows indicates where restoration is needed.

Conclusion

In Mt. Merapi primary succession, disturbance, and invasive species are an important features. Despite this swift vegetation establishment, domination of invasive species and subsequent periodic eruption of the volcano may alter the successional trajectory.