The ecological response of lianas to habitat fragmentation of the tropical rainforest

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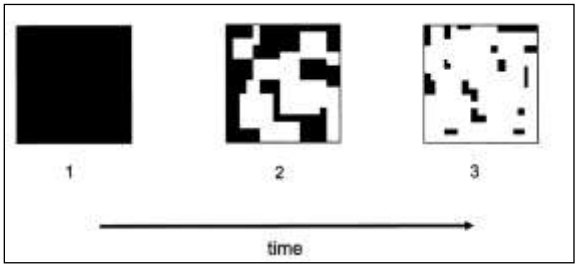
Habitat fragmentation



(Figure from Fahrig, 2003)

"The fragmented landscape is becoming one of the most widespread features of the modern world" (Laurance, 2004)

Fragmentation of forests can result in many negative conservation outcomes including:

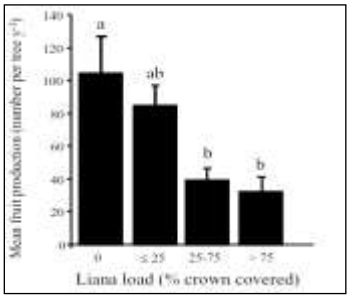
- Biodiversity decline
- Forest biomass loss and decreased carbon storage capacity
- Altered nutrient cycling and microclimate
- Enhanced "edge effects"
- Increased weed and pest animal incursions
- Hyper-dynamism of fragment processes e.g. increased tree turnover rates
- Population isolation and genetic health decline/inbreeding
- and many more

Lianas (woody vines)

1. Lianas impact upon individual trees through:
   - Structural stresses and competition
     - Light
     - Soil nutrients
     - Soil moisture

This can lead to
- Reduced fecundity
- Reduced growth
- Increased stem damage, limb breakage and tree falls
- Increased tree mortality

Reduced fruit production



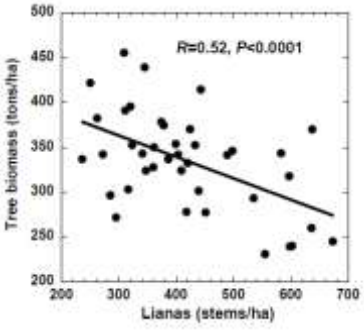
(Kainer et al, 2008)

Lianas (continued)

2. Lianas impact upon tree communities through:
   - Alter forest/treefall gap succession
   - Alter forest tree species composition
   - Reduced forest biomass

3. Lianas are increasing in abundance over time
   - CO_2 fertilization
   - Storm disturbance
   - Rainfall seasonality

Reduced forest biomass



(Laurance et al, 2001)

Research Questions

1. How do lianas respond to the habitat fragmentation of their threatened rainforest ecosystem?
    a. How do lianas respond between fragments of different sizes and non-fragmented rainforest?
    b. How do lianas respond within individual forest fragments?
2. How do we best manage lianas within a fragmented landscape for maximal tree and liana species conservation?

Study area

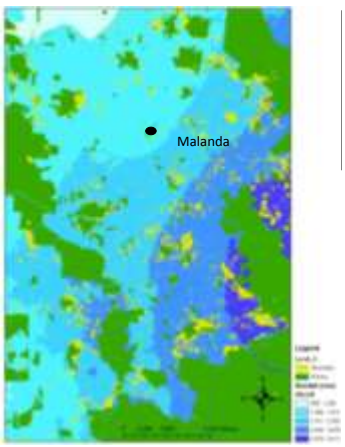
Far North Queensland
- Wet tropics bioregion

Atherton tablelands
- Near the town of Malanda

Cleared early 1900's
- Timber getting
- Dairying
- Agriculture

>76, 000 ha lost by 1983 (Winter et al. 1987)

(Map produced by the Wet Tropics Management Authority (WTMA))



(Figure A. Magrach, data courtesy WTMA)

Study design

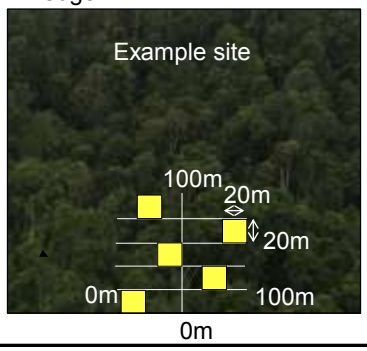
Entire study

24 Sites

- Fragments of varying area
- Non-fragmented forest (controls)

5 Plots per site

- Stratified by distance to forest edge



Pilot study

- 4 fragments (18-917 Ha)
- 1 non-fragmented site (9500 Ha)

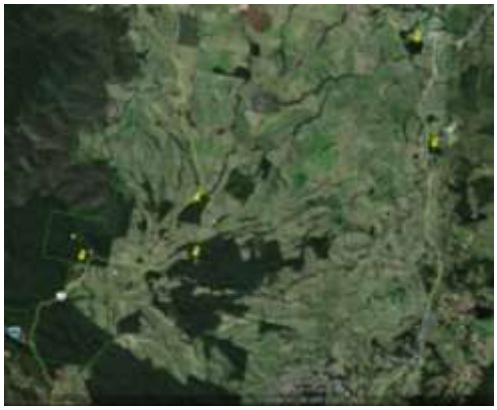


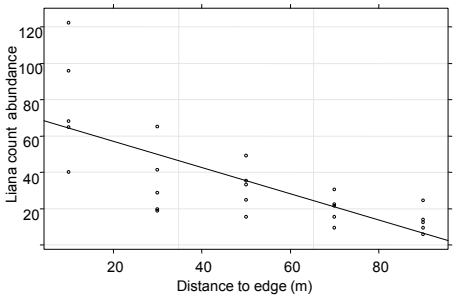
Image courtesy Google earth

Data collected

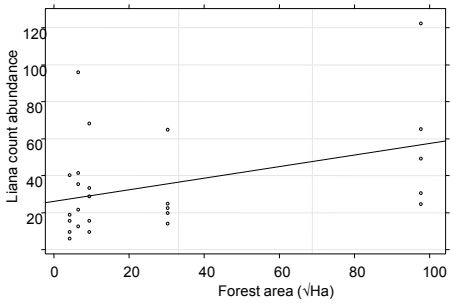
- GIS data collection
  - Environmental variables
    - Rainfall
    - Parent material and soil type
    - Elevation
    - Vegetation type
  - Forest traits
    - Fragment area
    - Fragment isolation
    - Fragment shape
    - Fragment orientation
    - Surrounding matrix type

- On site data collection
  - Environmental and forest variables
    - Canopy cover %
    - Estimated number of forest strata
    - Number of fallen logs
    - Plot incline and direction of slope
    - Forest edge aspect
    - Weed species presence and abundance
  - Liana and tree variables
    - Abundance
    - Diameter Breast Height (DBH) - Biomass
    - Spatial location within plot
    - Species identification
    - Liana climbing guild type
    - Presence/type of any liana defence traits utilized by trees

Pilot study findings



There are significantly more lianas on forest edges than in forest interiors at any given forest size

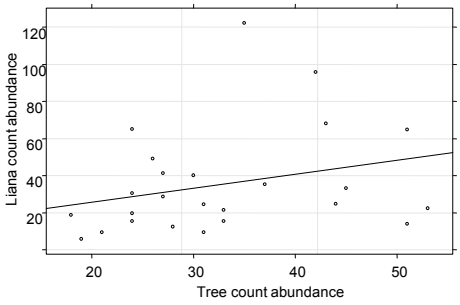


Lianas abundance significantly increases with increasing forest area

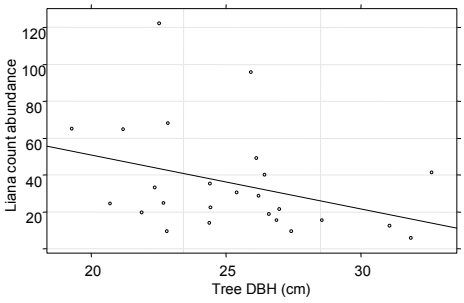
Count of liana abundance against explanatory variables: x,y,z; fitted using poisson GLMM

- Poisson error distribution
- Partial regression equations

Pilot study findings (continued)



Liana abundance significantly increases in concert with tree abundance



There are generally fewer lianas in plots with large trees

Discussion

1. Lianas are more commonly found on forest edges and thus heavily impact forest fragments with a large edge: interior ratio
2. Lianas contribute to the loss/decline of large trees especially within small forest fragments
3. Liana abundance appears to be limited by the number of trees within a forest
4. Liana abundance appears to be limited by the size of the trees they can climb

Confounding location specific issues

- Fragments on the Atherton tablelands are quite old and may have already lost many of their large trees
- Regular cyclonic activity is likely to exacerbate fragmentation impact through enhanced disturbance

Management implications

- Buffer small and irregular fragments
- Re- introduce “climax/old growth” tree species into small fragments
- Control liana abundance in forest fragments after major disturbances
  - i.e. Cyclones
- When conserving lianas within small fragments structural resources may need to be provided

Future Research

- Examine liana and tree species composition/proportions within fragments
- Increased site replication and the number of variables examined
- Compare findings to recently fragmented sites (temporal comparison) and other locations (geographic comparison)

Questions?