Defaunation and forest degradation: how to measure the impacts of hunting?

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FAO, Rome, 08/09/2009

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Selective logging in Congo Basin

- Major land use in humid forests
  - Logging concessions: 51M ha
  - Protected areas: 23M ha

- Major economic activity
  - Major income earner for countries
  - Main rural employer
- As all other extractive activities, induces damage to the ecosystem

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Typology of logging impacts

Impacts	Directs	Derived
Unavoidable	• Damage to residual stand • Disturbances (noise, light) • Fragmentation • Changes in C stocks	• **Increased human presence** (both temporary and permanent) • **Increased access to remote forests**
Avoidable	• Soil erosion • Water course pollution • Reduced regeneration • …	• Increased deforestation • Increased fire risks • Favor invasive species • **Increased hunting**

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Bushmeat hunting in Congo Basin

- Estimates of the value of the bushmeat trade range from US$42 to US$205 million per year in West-Central Africa.
- Current harvest in Central Africa alone may well be in excess of 2 million tons annually, equivalent of over 1.3 billion chickens or 2.5 million cows!
- 30 t0 80% of the protein intake of many rural populations

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Consequences of hunting

- Direct
  - Depletion of hunted populations
  - Animal-man transmissions
  - …
- Indirect
  - Changes in vegetation structure and regeneration patterns
  - Increase in unhunted species
  - Change in predation and herbivory patterns
  - Food crisis
  - …

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Indicators of defaunation

- Direct:
  - Hunted populations
  - Large mammals (e.g. duikers)

- Indirect:
  - Road network
  - Hunter surveys
    - ✓Hunting profiles
    - ✓Hunting effort
  - Household surveys
    - ✓Meals with meat
    - ✓Sales/consumption
  - Market surveys
    - ✓Fresh/smoked
    - ✓Quantities

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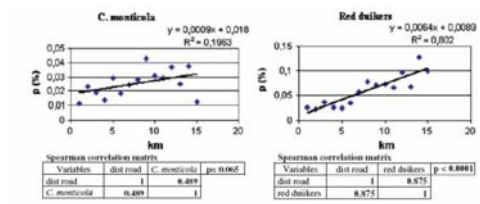
Effect of roads…



Spearman correlation matrix

Variables	dist road	C. monticola	ps 0.065
dist road	1	0.489	
C. monticola	0.489	1	

Spearman correlation matrix

Variables	dist road	red duikers	p < 0.0001
dist road	1	0.875	
red duikers	0.875	1	

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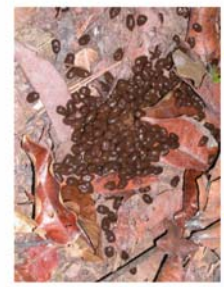
Surveys of mammal populations



- Direct observations
  - Line transects, RECCE
    - Direct sightings (day/night)
    - Dung counts or trails
  - Capture/recapture
  - Net hunts
- Indirect observations
  - Line transects
    - Hunting signs
  - Market, household, hunter surveys

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Classic methods

Line transect with measure of perpendicular distances

❑ **Direct observations during the day or night**

Recent innovations

- ***Call* method** (van Vliet et al., in press)

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Classic methods

Line transect with the measure of perpendicular distance

❑ Direct observations during the day or night

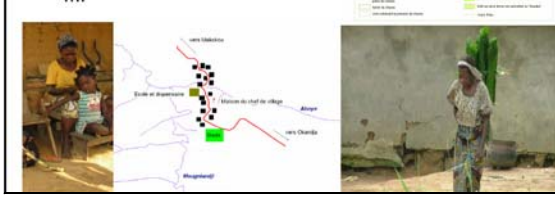
❑ **Dung counts**

Recent innovations

- ***Call* method** (van Vliet et al., in press)
- **Capture recapture methods with non invasive genetic methods**
- **Capture recapture using camera traps**

Surveys of indirect indicators

- Resource mapping
- Sharing hunters' life
- Understanding household economies
- ….



In guise of conclusion

- Lack of basic knowledge of natural ecosystem processes
- No ideal method is available
- Trends matter!
- Comparability matters too! (almost impossible to compare between studies)
- Basic research is still needed
- A good survey must combine several methods (direct, indirect) and approaches (synchronic, diachronic)
- Intelligent use of modelling
- Design and use survey comparable across sites

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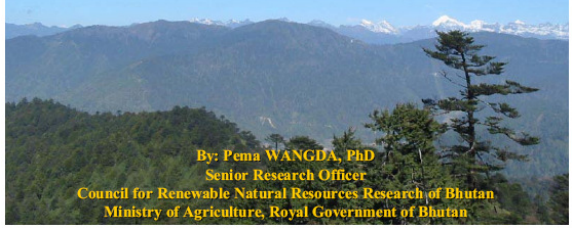
Forest Degradation in Bhutan: A case of Wasabi Pilot Project

(Methods to Assess Forest Degradation)



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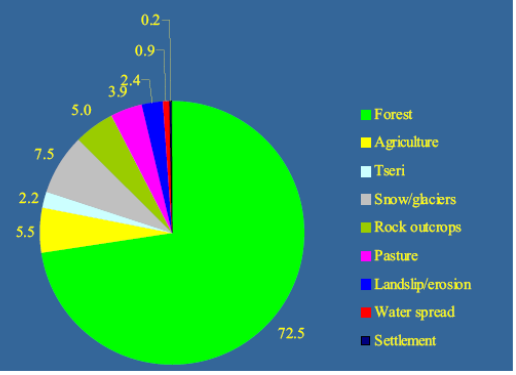
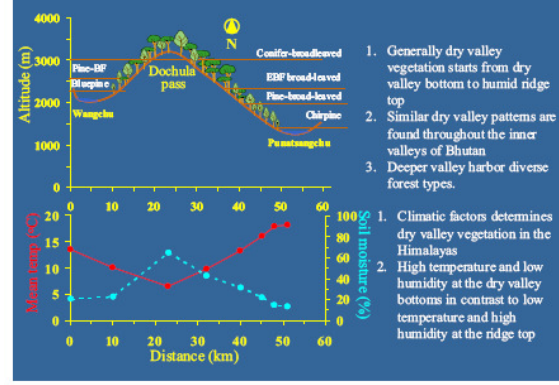
Chronology of Forest Degradation

Period (Year)	Forest for what (concept)	Forest institutions/ infrastructure	Forest degradation process
Before 1950	Forest for basic needs of people.	Forest uses administered by the community (*maang, reesups, meesups*)	Extensive forest fire damage (shifting cultivation)
1950-1960	Forest as potential resource for revenue generation	Civil Administration and Forest Department established (1952).	Accessible forests at the foothills degraded.
1960-1970	Forest for sustainable production	Nationalization of Forest through Bhutan Forest Act 1969.	Forests near roads degraded.
1970-1980	Forest for timber. Scientific management plan (silviculture).	Preparation of scientific management plan bringing experiences of American, European and Indian foresters.	Forest Management Units (FMU) established.
1980-1990	Forest for wood (wood based industry development)	Wood based industries (Plywood, particle board) established. Forest Research Division established (1980)	Fast growing tree species for industrial purposes introduced.
1990-2000	Forest for nature conservation and people	A network of Protected Areas established. Forest and Nature Conservation Act 1995.	Forests near settlements and critical watersheds degraded.
2000-to date	Forest for integrated natural resources and environment services	Social Forestry Division in DoF and participatory forestry field programs implemented.	Quality of forest in FMU, plantations and community forests decreasing.

Major land use types of Bhutan





1. Generally dry valley vegetation starts from dry valley bottom to humid ridge top
2. Similar dry valley patterns are found throughout the inner valleys of Bhutan
3. Deeper valley harbor diverse forest types.

1. Climatic factors determines dry valley vegetation in the Himalayas
2. High temperature and low humidity at the dry valley bottoms in contrast to low temperature and high humidity at the ridge top

Study Framework

Natural forest Ecosystem

Wasabi cultivation project

Forest Attributes — Biomass, Diversity, Regeneration

Soil Properties — Soil nitrogen, Soil pH, Soil carbon

Hypothesis: Change in forest ecosystem after the implementation of Wasabi Pilot Project

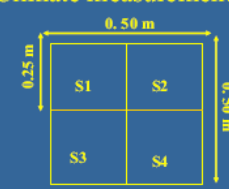
Method I: Soil and Climate measurement

A. Litter and soil

1. L layer (4 replicates)
2. F-H layer (4 replicates)
3. Surface soil (4 replicates)

Nutrients analysis

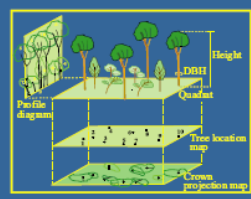
pH, C, N, Ca, Mg, P



B: Meteorological data measurement

1. Temperature & relative humidity (HOBO Onset data logger)
2. Soil moisture content measured by Hydro-sense

Method II: Vegetation survey



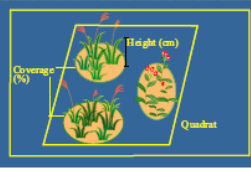
TREE LAYER

Height → Height class distribution

DBH → DBH class distribution

Basal area (BA)

= Dominance analysis
= Dominant species



HERB LAYER

H → Maximum height (cm)

C → Coverage (%)

Volume (H*C)

= Dominance analysis
= Dominant species

Data analysis

Diversity (H') = $-\sum_{i=1}^{N} pi \log pi$

Where N = number of species in a plot, pi=decimal fraction of a relative basal area

Basal area (BA) = $\{(DBH)^2 * \pi\}/4$

DBH=diameter at basal area

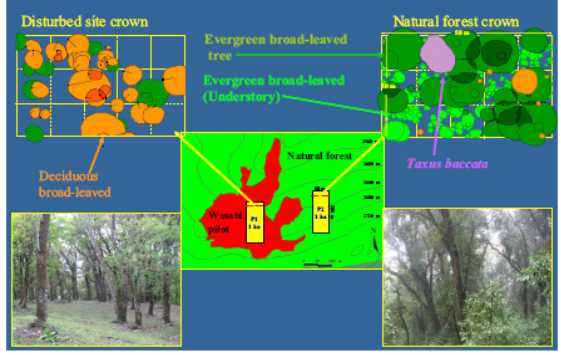
Dominance

$d = 1/N \{\Sigma (xi\text{-}x')^2 + \Sigma xj2\}$

$i \in T \quad j \in U$

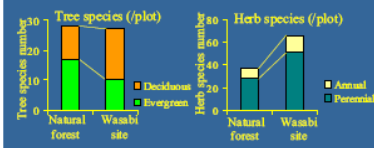
Where, xi is the actual percent share (RBA%) of the top species (T), i.e., in the top dominant in the one-dominant model, or the two top dominants in the two-dominant model and so on; x′ is the ideal percent share based on the model as mentioned above and xj is the percent share of the remaining species (U). N is total number of species.

Results: 1. Vegetation



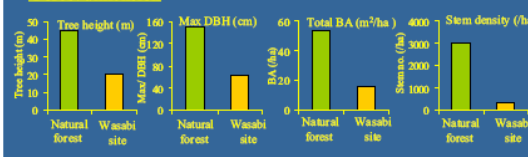
Results: 1. Diversity and forest structures

➢ Species richness

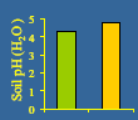


- The life-form has changed from evergreen broad-leaved to deciduous broad-leaved
- Herb species had increased indicating invasion of weeds after forest disturbance.
- Structrally forest had been reduced after wasabi cultivation.

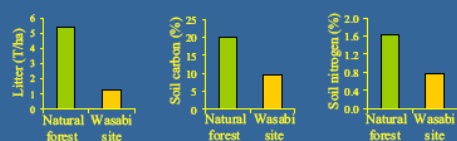
➢ Forest dimension



Results: 2. Litter accumulation and soil properties

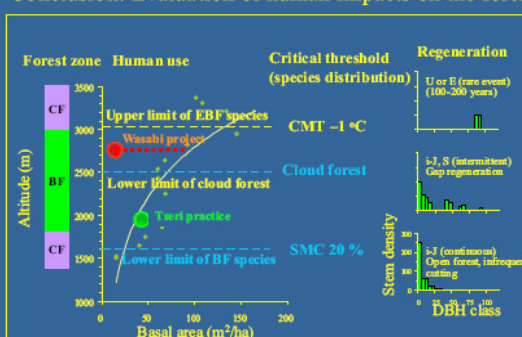


- pH was slightly increased in the disturbed site
- Low accumulation of litters were observed in the disturbed site compared to natural forest
- Organic carbon and total nitrogen were reduced after the Wasabi project.



Based on the quantitative data analysis, the impact of Wasabi project on the evergreen broad-leaved forest was disastrous both floristically and geologically resulting in disturbance to the forest ecosystem.

Conclusion: Evaluation of human impacts on the forest



Conclusion:
Introduced destructive development projects are disastrous to the forest that even evergreen broad-leaved forest cannot withstand the disturbance.