Research on tropical forests in Sarawak, Malaysia: toward understanding the ecosystems and social-ecological systems

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(RIHN)

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Area

  124,450 km2 (1/6 of Japan)

Population

  2.4 million (Chinese 27 %,
  Malay 23 %, Iban and other
  indigenous people 43 %

  Population density 20.1/km2

Original vegetation

  Tropical rain forests, dominated
  by tree family Dipterocarpaceae

  Extremely high biodiversity

Ecological studies in Lambir Hills NP

Collaborative research

    Sarawak

        Forest Department

    Japan

        Tohoku University, Nagoya University, Kyoto University, Kochi University, RIHN etc.

    USA

        Harvard University, CTFS

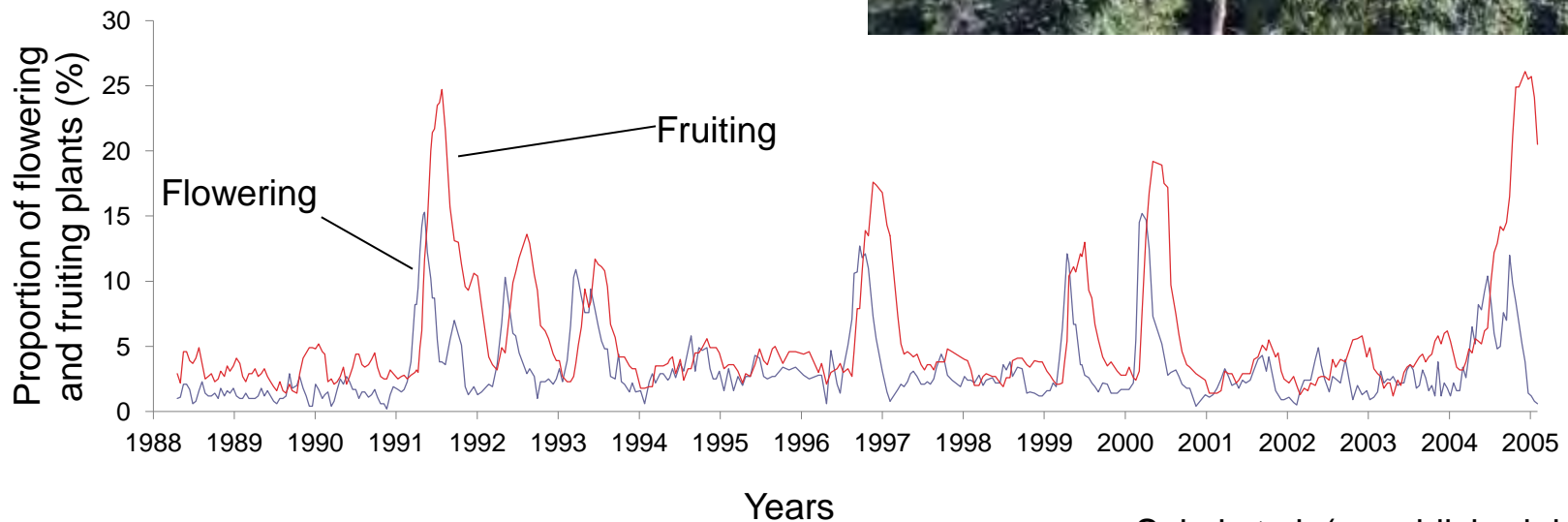Canopy access system

    Canopy crane

    Tree towers

Long-term monitoring

    1992~

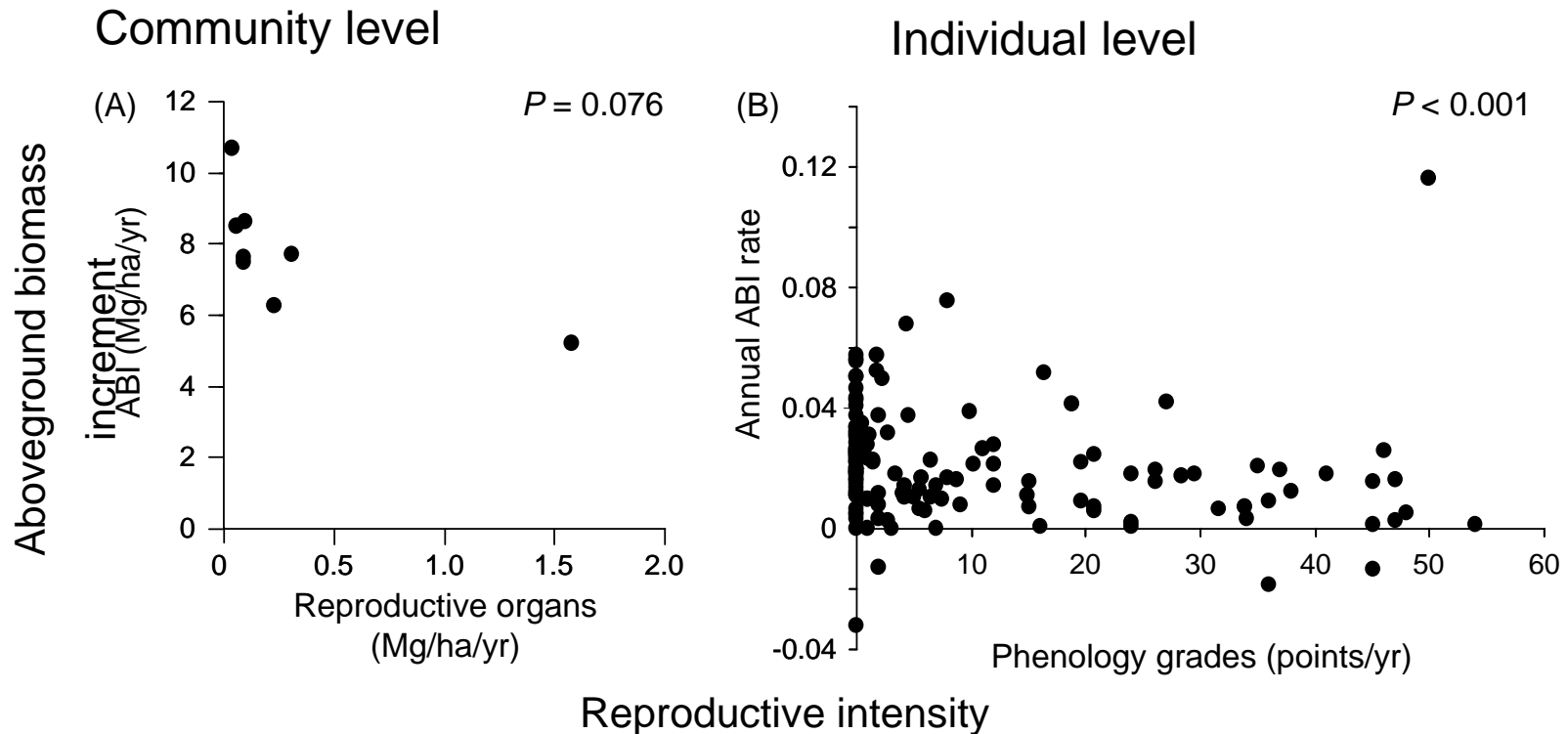# General flowering – masting at the community level

General flowering causes migration of pollinators (Itioka et al.), increase of mammals (Nakagawa et al.), and mortality of seedlings (Nakagawa et al.).

Sakai et al. (unpublished data)

Relationships between tree growth and general flowering

Community level

Individual level

(A) — *P* = 0.076
Aboveground biomass increment ABI (Mg/ha/yr)
Reproductive organs (Mg/ha/yr)

(B) — *P* < 0.001
Annual ABI rate
Phenology grades (points/yr)

Reproductive intensity

Nakagawa et al. (in press)

Deforestation outside of NP
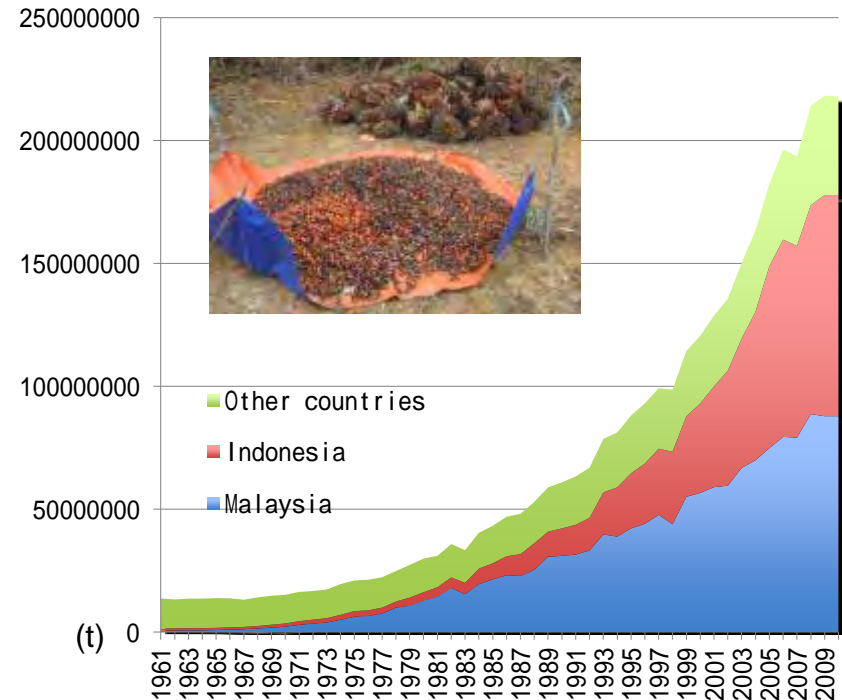
Changes in land cover

- Extensive commercial logging (1960s~)
- Expansion of oil-palm (1990s~) and Acacia plantations (2000s~)
- Primary forests have almost disappeared

Started research activities outside of protected areas

Increase of oil palm fruit production

Based on FAO statistics

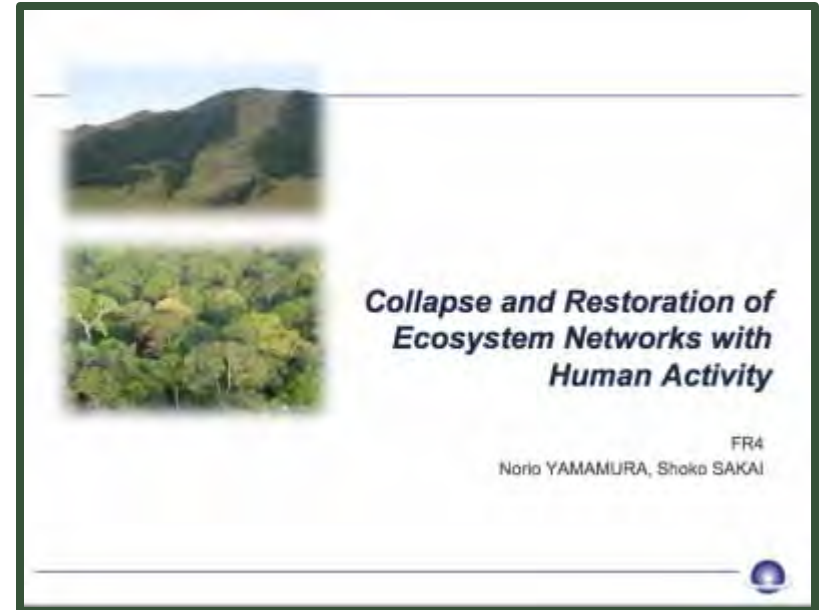# RIHN projects on impact of land use changes

2003~

Sustainability and biodiversity assessment on forest utilization options

PL: M. Ichikawa, T. Nakashizuka

2007~

Collapse and restoration of ecosystem networks with human activity
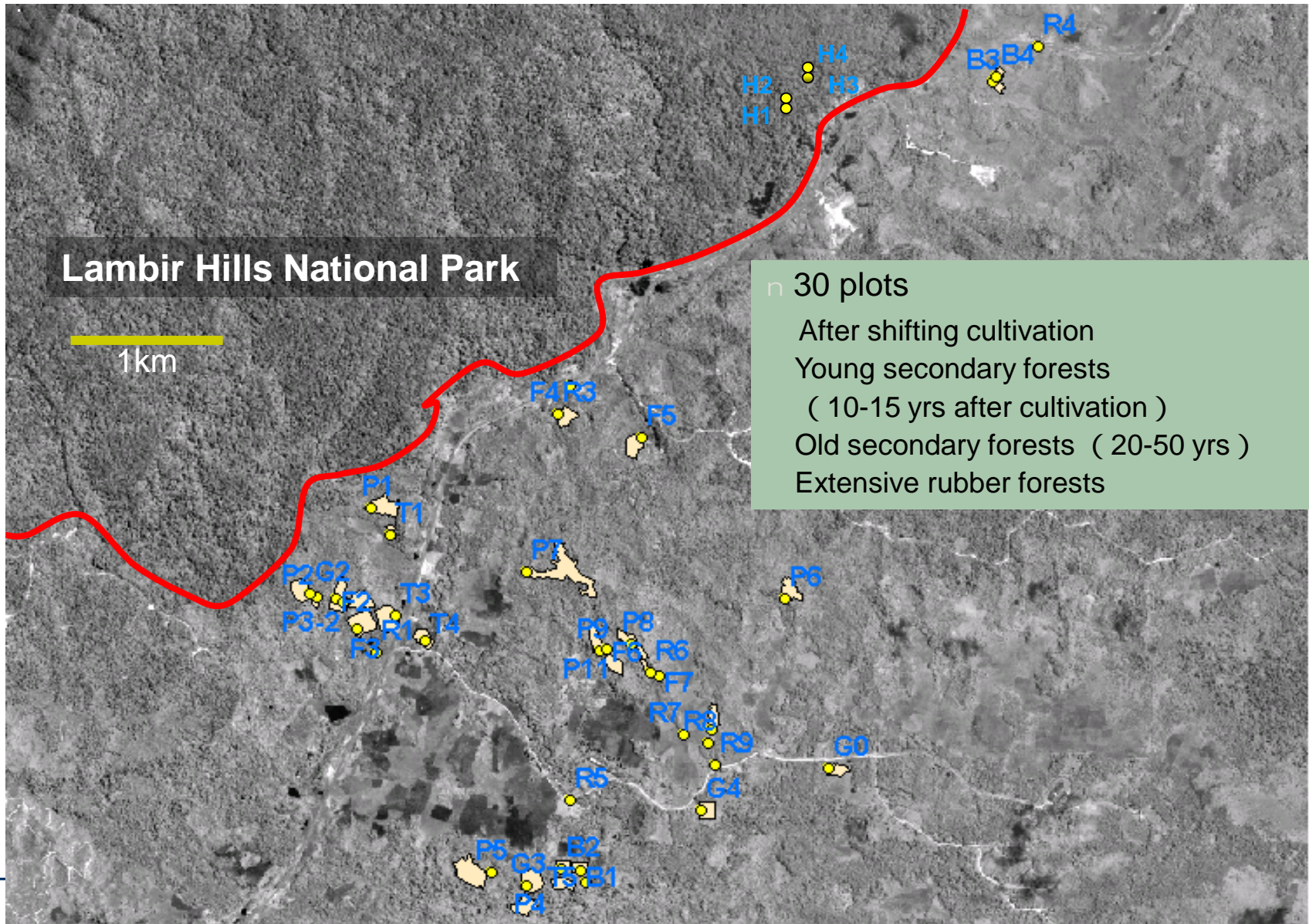
PL: S. Sakai, N. Yamamura

In this talk

Studies in Lambir Hills National Park

Effects of land use changes on biodiversity

Effects of land use changes on livelihood of local people

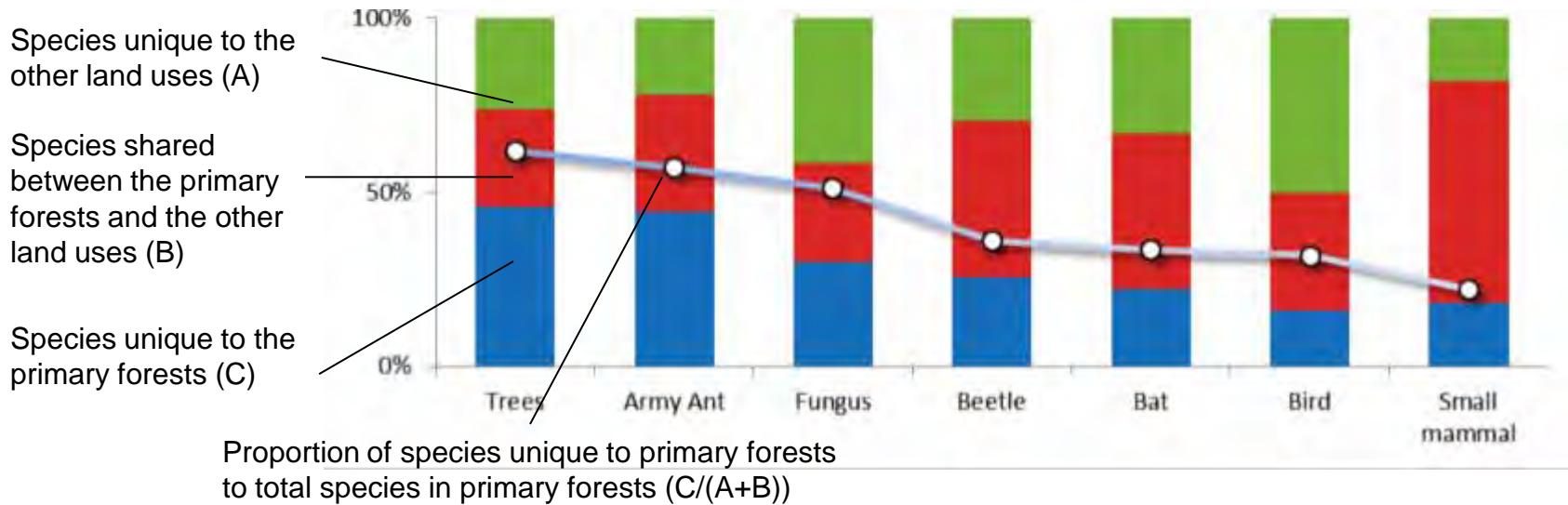# Biodiversity in secondary forests and other vegetations

Lambir Hills National Park

1km

n 30 plots

After shifting cultivation
Young secondary forests
  10-15 yrs after cultivation
Old secondary forests   20-50 yrs
Extensive rubber forests

Primary forests are essential for sustaining biodiversity

Ratio of unique and commonly observed species between primary forests and the other land use types (Takano et al.)

Species unique to the other land uses (A)

Species shared between the primary forests and the other land uses (B)

Species unique to the primary forests (C)

Proportion of species unique to primary forests to total species in primary forests (C/(A+B))

Primary forests

Oil palm plantations

Young secondary forests

Old secondary forests

Key result: Ecosystem network in Sarawak

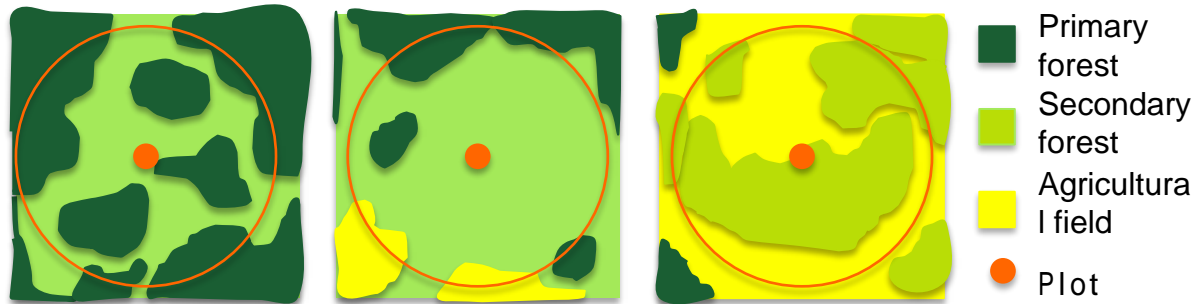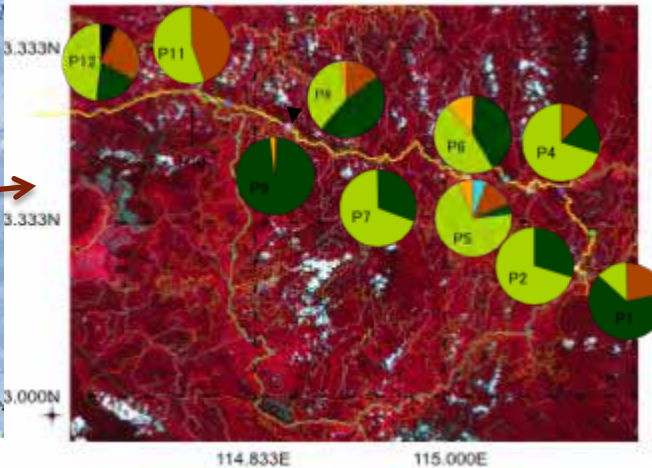# *Spatial scale of the effects*

Secondary forests with similar vegetation have different species richness depending on the surrounding vegetations

- Primary forest
- Secondary forest
- Agricultural field
- Plot

Study site

Baram River

Methods

Established 11 plots, in each plot we collected
   Dung beetles by flight Intercept trap
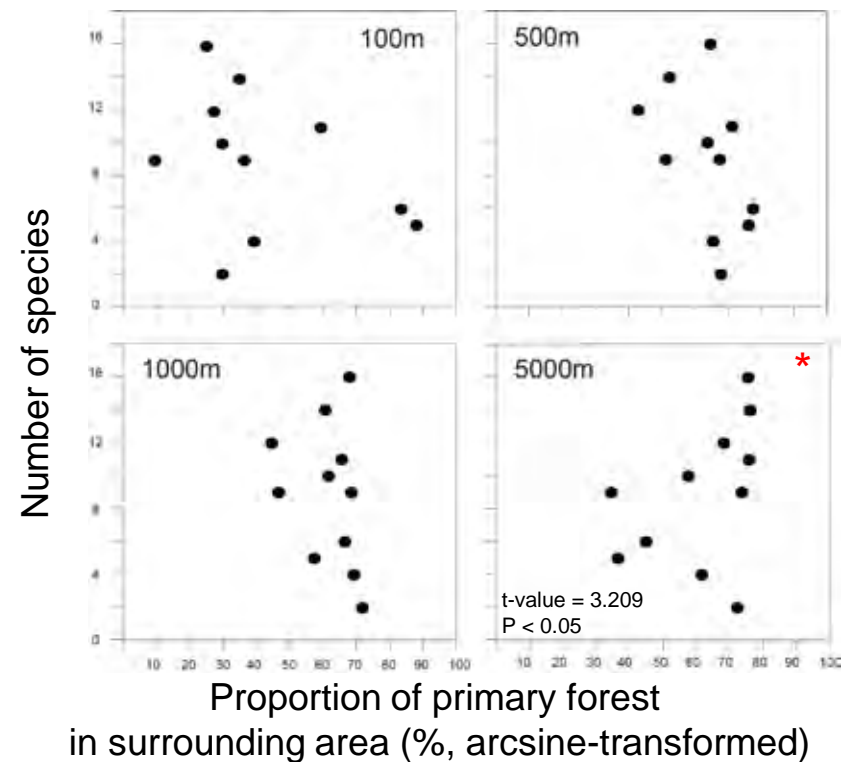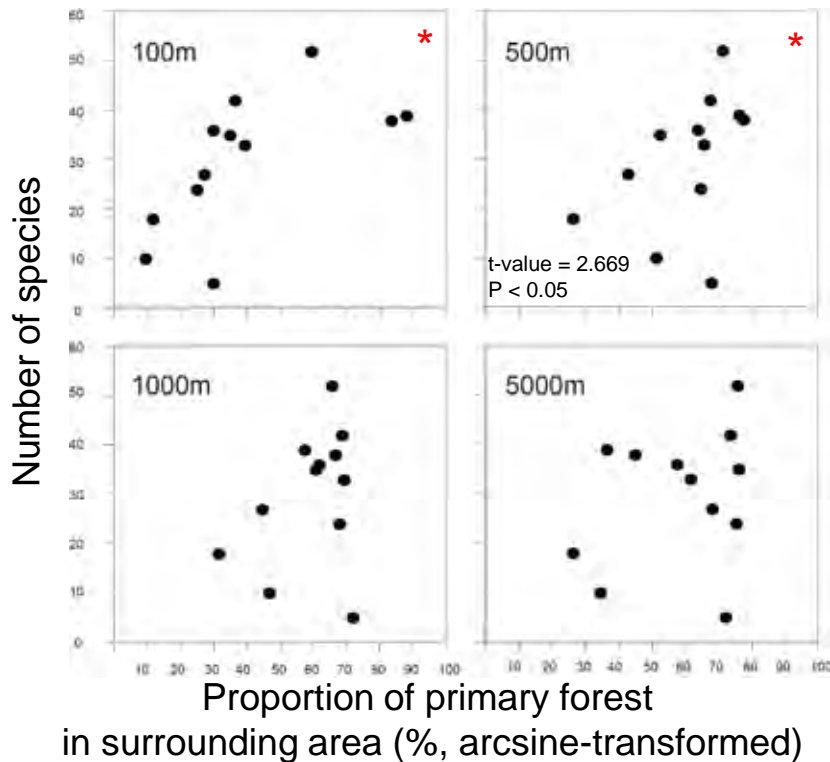   Ant by litter collection of 10 cm x 10 cm x 10 samples

Decline of primary forest also affects biodiversity in the surrounding area

Ants (Low mobility)
46 genera 150 species 2237 individuals

Dung beetle (High mobility)
3 Family 31 species 401 individuals
Including 13 new species

Number of species — Proportion of primary forest in surrounding area (%, arcsine-transformed)

(Ants panels) 100m *, 500m * (t-value = 2.669, P < 0.05), 1000m, 5000m

Number of species — Proportion of primary forest in surrounding area (%, arcsine-transformed)

(Dung beetle panels) 100m, 500m, 1000m, 5000m * (t-value = 3.209, P < 0.05)

Primary forests in surrounding area is important as a source of species for recovery of the secondary forest.

Key result: Ecosystem network in Sarawak

In this talk

Studies in Lambir Hills National Park

Effects of land use changes on biodiversity

Effects of land use changes on livelihood of local people

Consequences of forest loss on livelihood of local people

Land use changes
- Extensive commercial logging
- Expansion of oil-palm and Acacia plantations
- Primary forests have almost disappeared

Changes in local communities
- Decrease of activities using forests (hunting, shifting agriculture)
- Increase of importance of cash income
- Depopulation and migration to cities for work

Large scale questionnaire survey to understand relationships between changes in land covers and life of local people

Oil palm plantation

Swidden agriculture

Large-scale questionnaire survey

Questionnaire survey

We asked various questions about the lives and society of the village to a village leader ((VL) and 15-20 households) in 91 villages

Group	Village No.
Iban	39
kayan	6
Kenyah	21
Penen	13
Others	10
Total	91

Villages surveyed

Land cover

Proportion of forest cover and its change within 1~5 km from the village were evaluated based on the satellite data
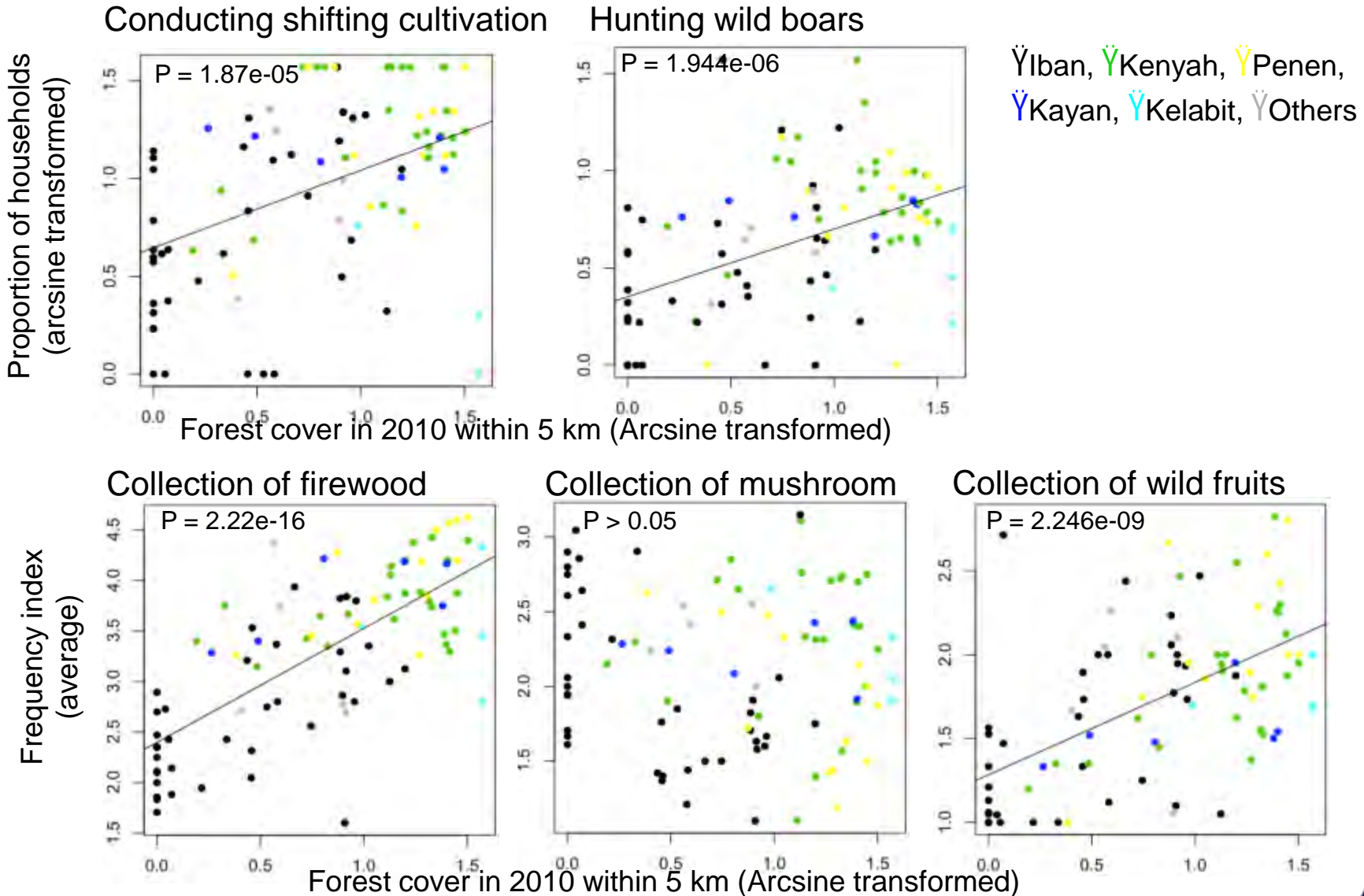(Source: CRISP insular Southeast Asia map 2010 (Miettinen et al. 2012))

Land cover class codes and legend for CRISP insular Southeast Asia map 2000

0	No data
1	Water
2	Mangrove
3	Peatswamp forest
4	Lowland forest
5	Lower montane forest
6	Upper montane forest
7	Plantation/regrowth
8	Lowland mosaic
9	Montane mosaic
10	Lowland open
11	Montane open
12	Urban

2000

2010

Is use of forests decreasing because of loss of forests?

Effects on local people

Conducting shifting cultivation — P = 1.87e-05

Hunting wild boars — P = 1.944e-06

Ÿ Iban, Ÿ Kenyah, Ÿ Penen, Ÿ Kayan, Ÿ Kelabit, Ÿ Others

Proportion of households (arcsine transformed)

Forest cover in 2010 within 5 km (Arcsine transformed)

Collection of firewood — P = 2.22e-16

Collection of mushroom — P > 0.05

Collection of wild fruits — P = 2.246e-09

Frequency index (average)

Forest cover in 2010 within 5 km (Arcsine transformed)

GLMM analyses to find important explanatory variables

GLMM with household as a sample

Response variables

Forest use (shifting cultivation, wild boars, firewood, mushroom, fruits)

Potential explanatory variables

Forest cover (data from Miettinen et al. 2012)

Remoteness

Richness of household
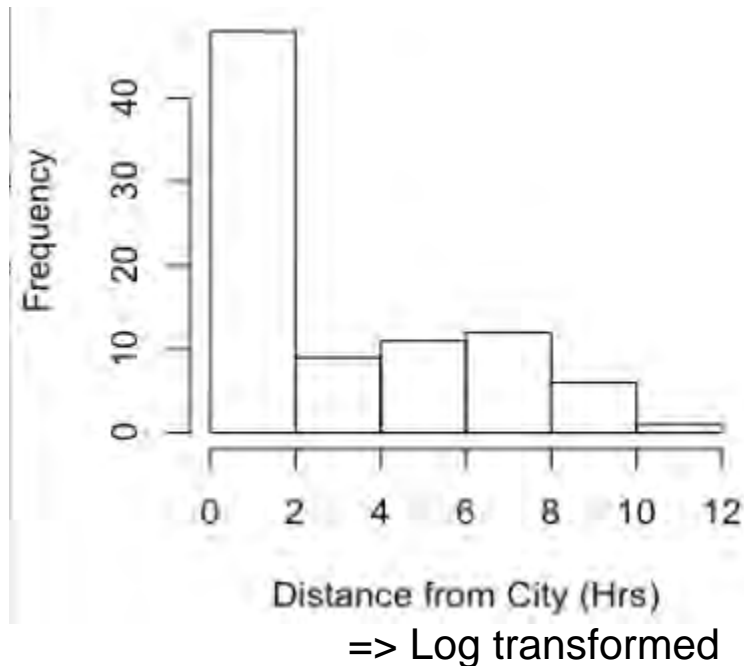
Random effect

Village

Selection of variables

AIC stepwise selection
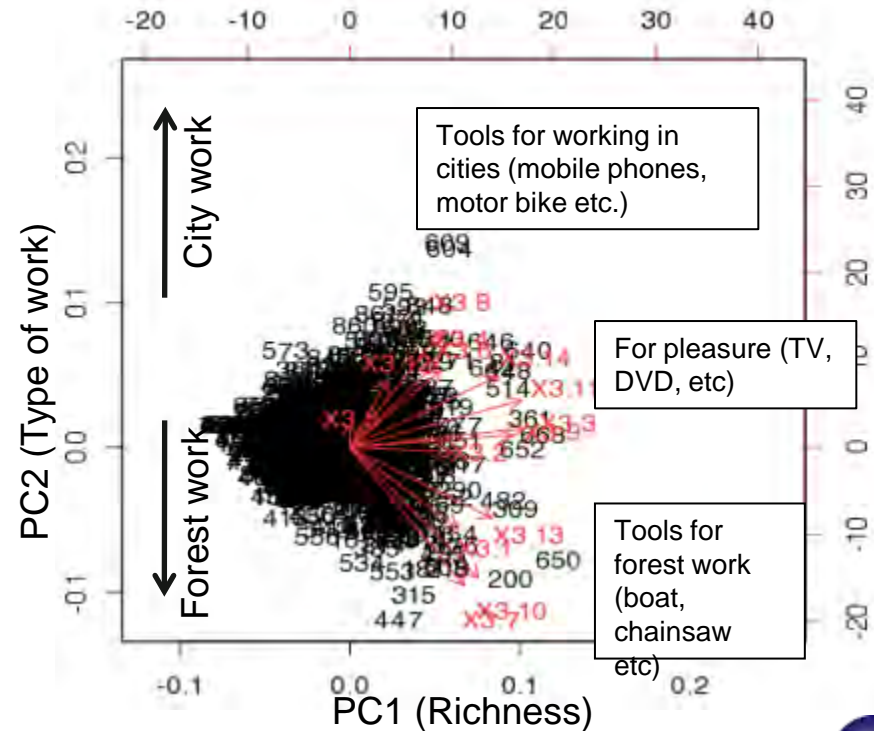
Explanatory variables

Remoteness

Time distance from city

Related with availability of food and other goods from market

Richness

Calculated based on the possessions (14 items) of household

=> Log transformed

Results of GLMM analyses

Response variable	Forest cover	Remoteness	Richness
Shifting cultivation	Not selected	Coeff. = 1.41145 P < 0.0001	Not selected
Hunting of wild boars	Coef. = 0.1602 P = 0.0030	Coef. = 0.7410 P < 0.0001	Coef. = 1.0331 P < 0.0001
Firewood	Coef. = 0.35632 P < 0.0001	Coef. = 0.11251 P < 0.0001	Coef. = -0.03527 P = 0.0003
Mushroom	Not selected	Not selected	Coef. = 0.03508 P = 0.0171
Wild fruits	Coef. = 0.92529 P < 0.0001	Coef. = 0.29259 P = 0.0004	Coef. = 0.04724 P = 0.0010

Intensity of use of forest products is related with forest cover at least in some type of the resources.
We will investigate further effects of land cover changes on society of local people.

Concluding remarks

Effects of land use changes on biodiversity and livelihood of people are extensive and not simple

To mitigate the problems, we need to understand characteristics of the ecosystem, and the social-ecological system