Title: Growth of the tropical *Pinus kesiya* as influenced by climate and nutrient availability along an elevational gradient

PRESENTER: **HO, Le Tuan**

INTRO

The reasons for growth reductions of individual tree species along elevational gradients in tropical mountain ranges are poorly known, especially for tropical conifers → testing whether climatic or edaphic conditions are responsible for the reduced growth of *Pinus kesiya* at higher elevations.

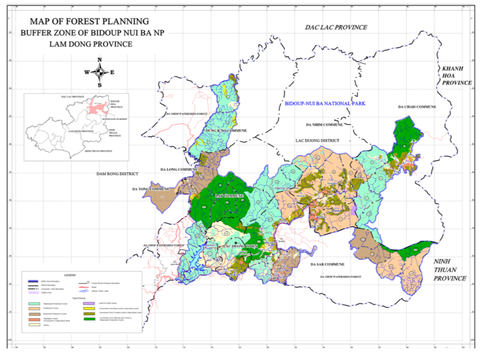

Figure 1

METHODS

- Sampling and tree-ring analyses were conducted on 246 cores from 126 trees derived from 17 stands across an elevational gradient (900 – 2000 m a.s.l.) in Bidoup – Nui Ba National Park, central highland of Vietnam (Fig.1,2).
- From one stand each at low, middle and high elevation, all tree-rings formed in the recent 35 years (1980 – 2014) from four tree cores (1 per tree) were selected for stable isotope analyses ($\Delta^{13}C$).
- Soil samples taken from the uppermost 20 cm of the mineral soil were analysed for pH, plant nutrients, total C, acidic cations (Al^{3+}, $Fe^{2,3+}$, Mn^{2+}) and $\delta^{15}N$.

RESULTS AND DISCUSSION

- **Tree growth and climate signals:**
  - Along with the reduction in tree-ring width, Basal Area Increment (BAI) decreased across the altitudinal gradient. (r = -0.801, P < 0.001) (Table 1).
  - The stem diameter increment correlated negatively with temperature or temperature anomalies in invidual time periods (October through December of the preceding year, June—November of the current year at lower elevation (< 1300 m a.s.l.)).
  - There was no distinct correlation pattern with precipitation.

Figure 2

The lower temperatures at higher elevations exert an indirect effect on tree growth by inducing higher C/N ratios and reducing the rate of nitrogen and phosphorus mineralization, which may be further hampered by lower concentrations of "base" cations (upon enhanced leaching by precipitation) and a negative feedback from low availability of mineralized N and P at higher elevations. Our results may be transferable until the uppermost growth limit of *P. kesiya* and to other montane regions of the species' occurrence.

FURTHER READINGS

Ho LT, Schneider R, Thomas MF (2019) Growth of the tropical *Pinus kesiya* as influenced by climate and nutrient availability along an elevational gradient. Journal of Plant Ecology (*submitted*).

Luu NDT, Thomas PI (2004) Conifers of Vietnam. Darwin Initiative, Hanoi, Vietnam.

Richarson DM, Rundel PW (1998) Ecology and biogeography of Pinus: an introduction. In: Richardson DM (ed) Ecology and Biogeography of Pinus. Cambridge University Press, Cambridge, UK, pp 3-46

Elevation (m a.s.l)	Number of tree rings	Age of the trees (years)	Mean tree-ring width (mm)	BAI (cm^2 $year^{-1}$)
900 - 1000	10	51 ± 1 **d**	4.04 ± 0.12 **ab**	35.5 ± 1.7 **a**
1000 - 1100	10	52 ± 2 **cd**	4.42 ± 0.13 **a**	36.2 ± 1.4 **a**
1100 - 1200	13	51 ± 1 **cd**	4.25 ± 0.12 **ab**	28.0 ± 1.2 **b**
1200 - 1300	9	65 ± 2 **bc**	3.48 ± 0.27 **b**	23.4 ± 1.0 **c**
1300 - 1400	9	61 ± 1 **bc**	3.59 ± 0.22 **b**	25.6 ± 0.8 **bc**
1400 - 1500	9	65 ± 2 **bc**	1.52 ± 0.05 **d**	12.7 ± 0.6 **de**
1500 - 1600	9 + 9	85 ± 1 **a**	1.27 ± 0.03 **d**	11.1 ± 0.5 **ef**
1600 - 1700	8 + 7	71 ± 2 **abc**	2.20 ± 0.07 **c**	8.7 ± 0.5 **ef**
1700 - 1800	8 + 8	70 ± 3 **bc**	2.16 ± 0.05 **c**	12.1 ± 0.5 **ef**
1800 - 1900	8	79 ± 2 **ab**	1.21 ± 0.04 **e**	7.9 ± 0.4 **f**
1900 - 2000	9	79 ± 3 **ab**	1.77 ± 0.05 **d**	15.7 ± 0.7 **d**

Table 1

- **Stable carbon isotope signals:**
  - BAI correlated significantly negative with $\Delta^{13}C$ (r = - 0.154; P = 0.024) (Fig.3) → the growth of *P. kesiya* was not controlled by water supply.

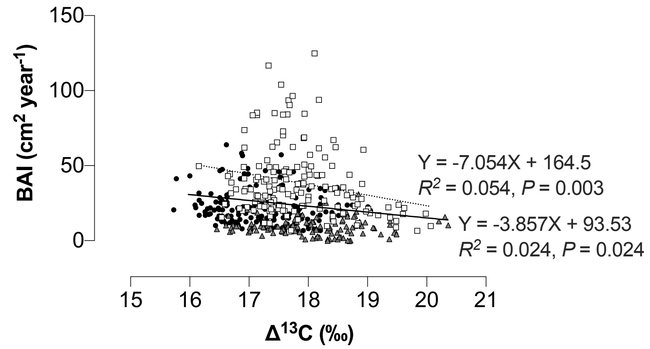

Figure 3

- **Tree growth and edaphic conditions:**
  - Tree growth decreased with an increase in the C/N ratios and with a decrease in the concentrations of Ca, Mg, K and plant-available P_a of the uppermost layer of the mineral soil (Fig.4).

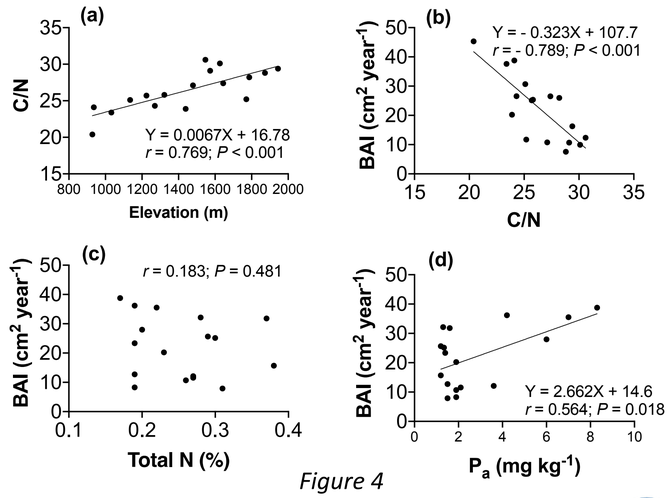

Figure 4

Le Tuan HO, Raimund SCHNEIDER, Frank M. THOMAS

Universität Trier