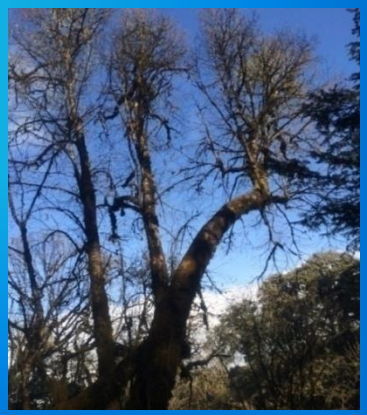
Ecological and Adaptation of Tertiary Relic Plant of *Tetracentron sinense* with climate change in Bhutan Himalaya

Karma Tshering

Senior Forest Ranger

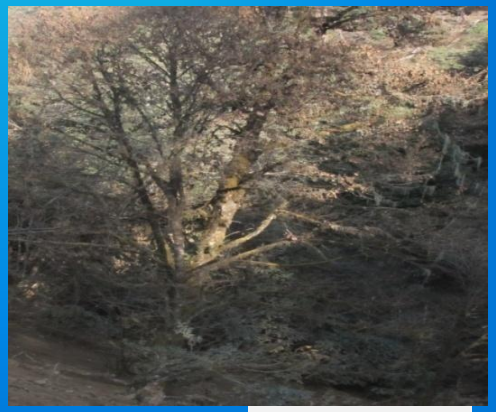
Department of Forest and park Service



Presentation outline

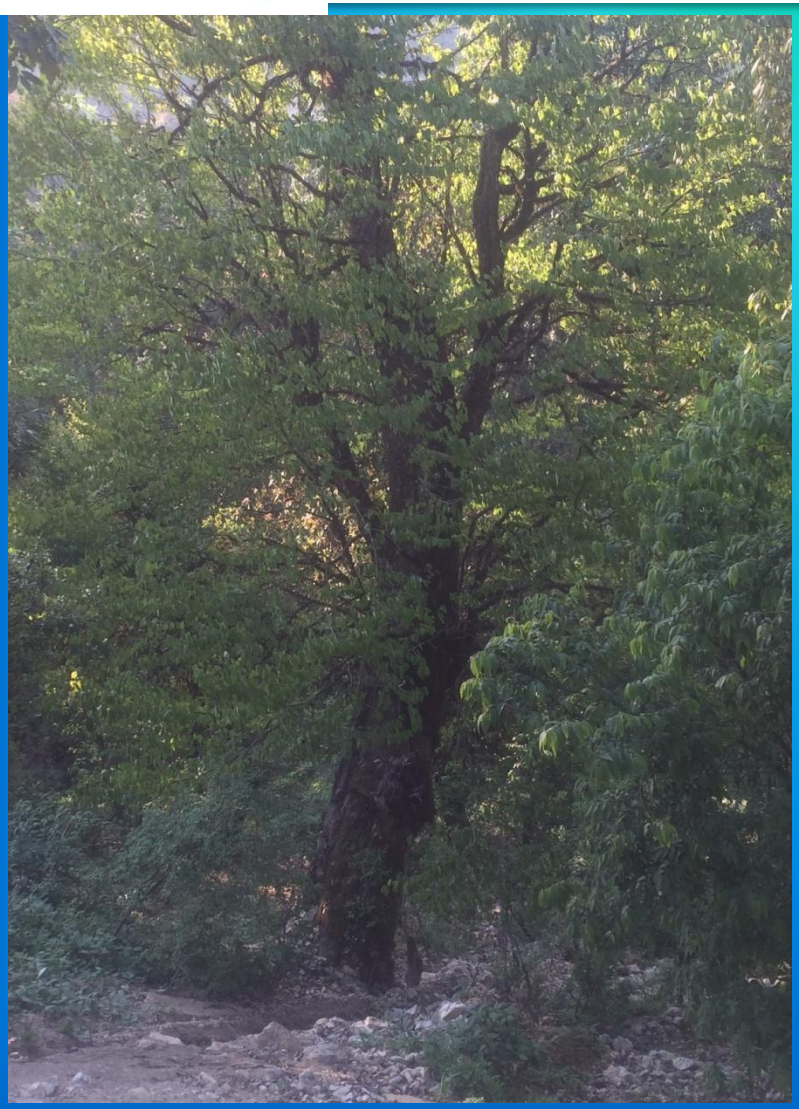
- Background
- Objectives
- Methods and Materials
- Results
- Conclusion

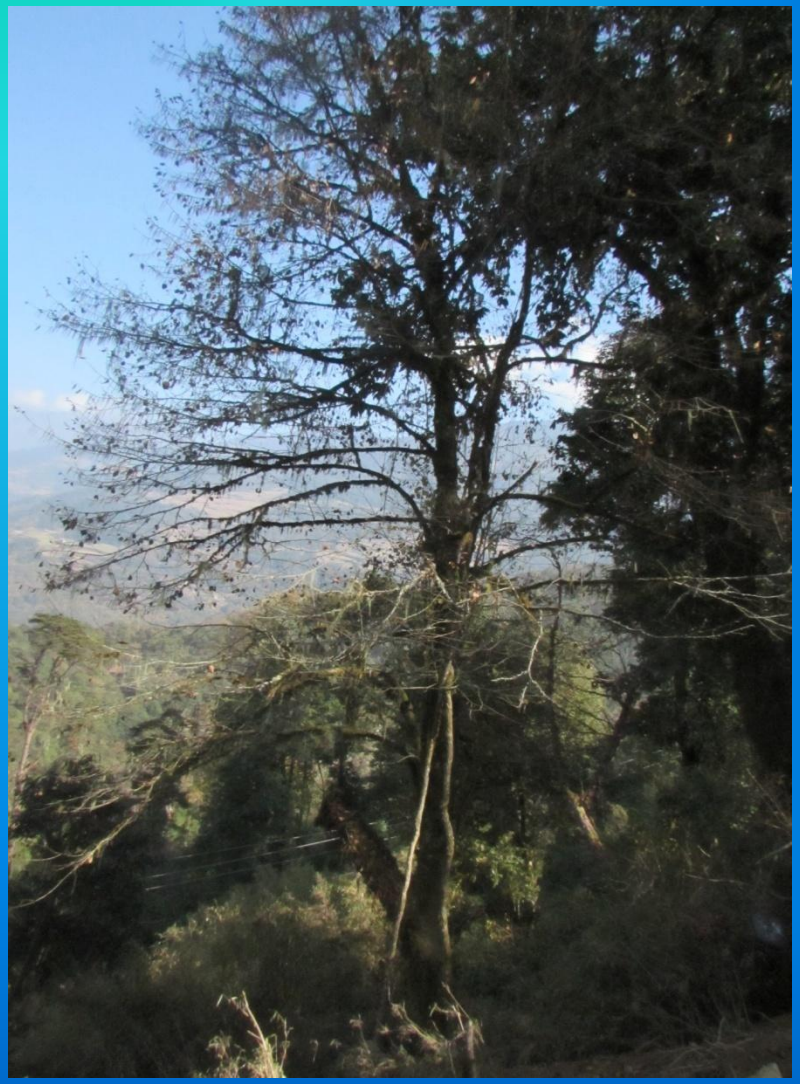
Extracting core



Disturb sites

Tetracentron sinense





Species are earth's life support that are biologically rich and threatened, we must strive to protect them

Background

- *Tetracentron sinense* Oliv 1889 is the monotypic, tertiary relic, primitive, endemic plant,
- The species is stated as ‘rare’ in IUCN and appendix III in CITES (Bjorklund,2009),
- Rapid destruction and fragmentation of natural habitats are causes of species extinction
- Lack of basic ecological information lead to the loss relict plants.
- Associated species are most critical ecological attributes for species to thrive
- No record of tree ring in the world for *T. sinense*

Taxonomy of *T. sinense*

- Primitive living genera (*Tetracentron sinense* and *Trochodendron aralioides*) sharing feature of secondary xylem without vessel.
- Family: Tetracentracea
- Order: Trochodendrales
- Subclass : Hamamelidae
- Class : Magnoliopsida (APG III, 2009)

Objectives

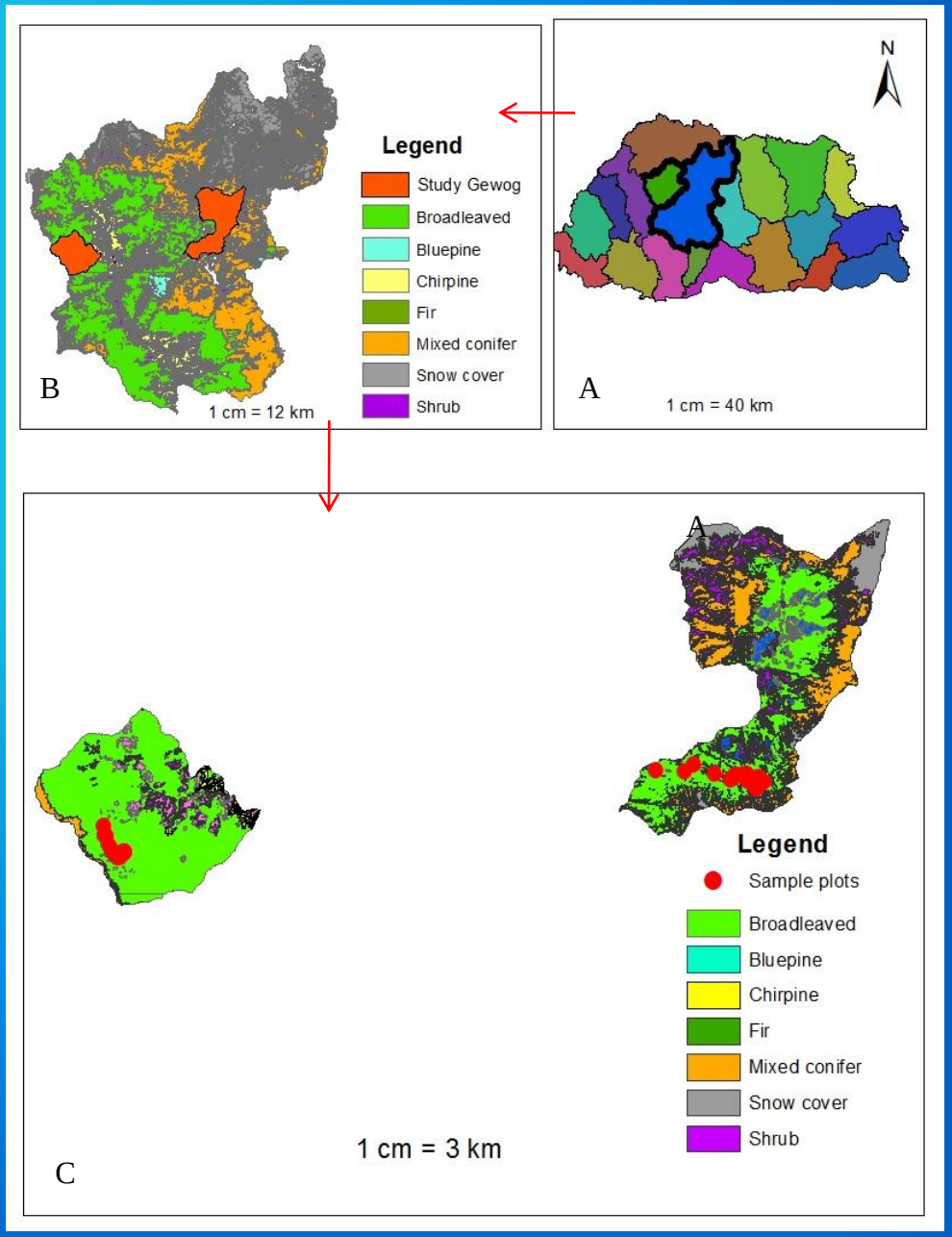
- Clarify the habitat ecology, environmental attributes and associated floristic composition of *T. sinense.*
- Find out the regeneration mechanism of *T. sinense*
- Investigate the radial growth performances of *T. sinense* in relation to climate change

Material and Methods

- Lamperi (2700 masl),Toepisa Geog, Punakha and Nobding (2800 masl), Dangchu Geog, Wangdue.
- Harbors diverse floristic composition including endemic plant species.

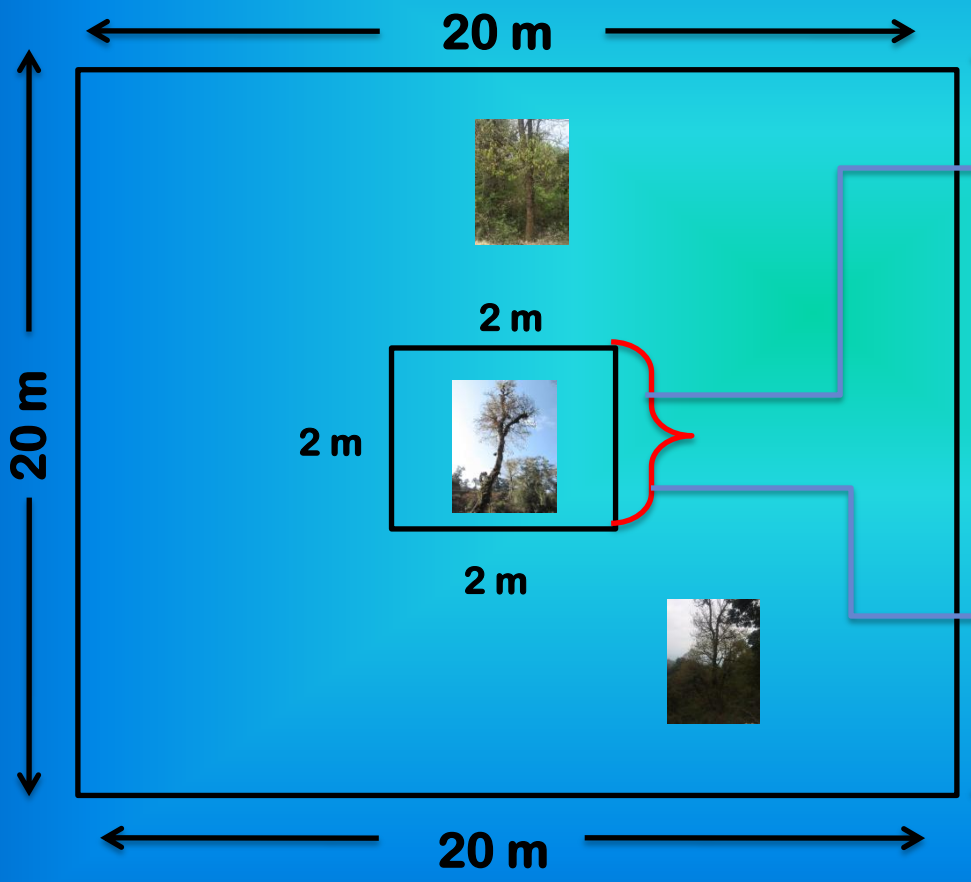
- **Material required**

  Increment borer, GPS, Hypsometer, measuring tape, Masking tape and Diameter tape



Field Methods

- Targeted samplings were done for coring
- Vegetation assessment



Regeneration layer (Ht & Age) Ht <1.3 m.

Tree layer (DBH & Ht) Ht ≥ 1.3 m.

Ground layer (Ht & coverage in %).

Soil sampling of 4 plots (0.5m x 5m quadrate)

Species are earth's life support that are biologically rich and threatened, we must strive to protect them

Laboratory method

Samples

Mounting

Drying

Sanding

Assigning years

Graph Plotting

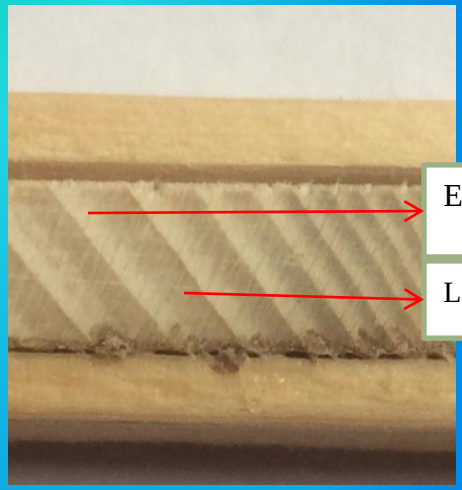
Measurement

Data Analysis

- Ring measurement by J2X measure apprecision of 0.001 mm
- COFECHA software program
- SPSS 23 – Linear regression, Correlation and *t* test
- Microsoft excel - Diversity, Relative dominance, Composition were analyzed by Pivotal table

Results

T. sinense Habitat



- Thrive in humid broad leaved of evergreen and deciduous forest up to transitional zone of mixed conifer (2500-2900 masl)
- Unstable habitats of frequent disturbances, steep slopes, rocky cliffs, stream margin, roadsides, and in bamboo coverage are found to be preferred habitat for endemic plant

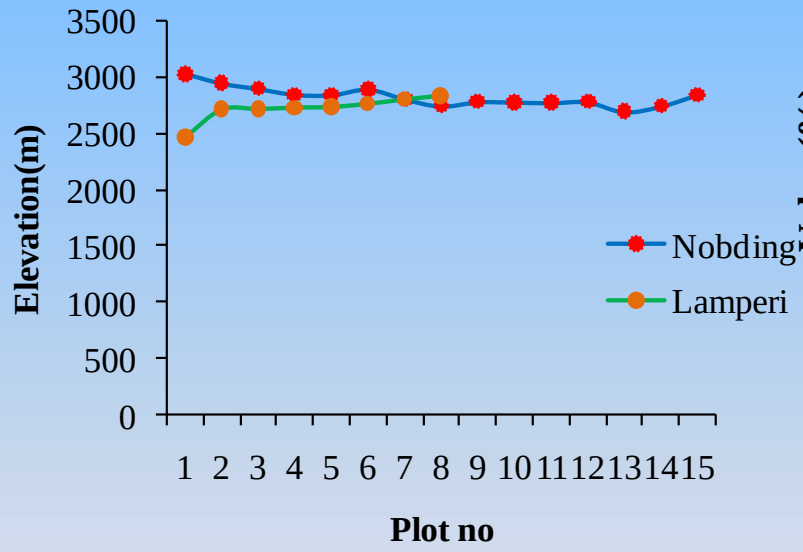
Environmental attributes

Aspect and slope

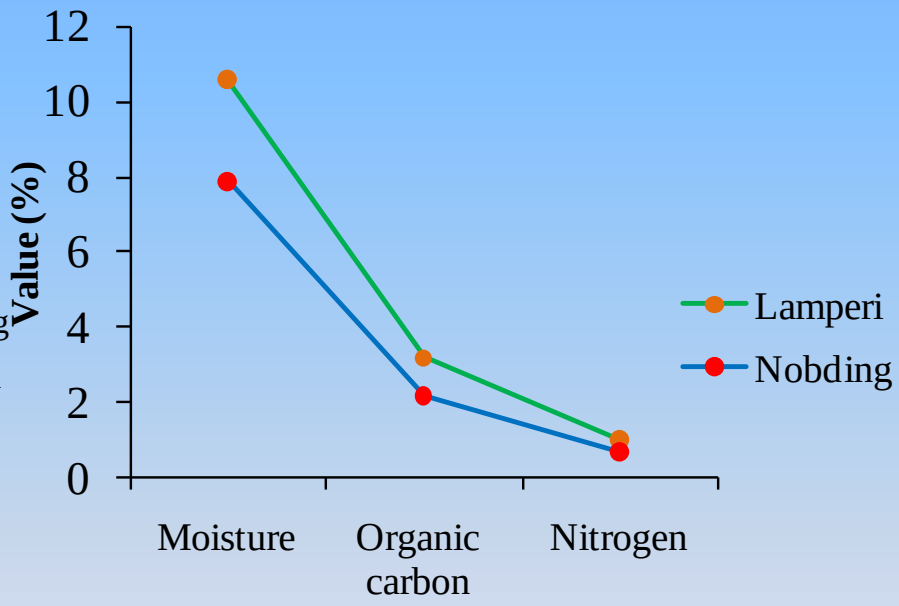
- All 8 plots in Lamperi and 11 plots in Nobding falls towards the North - East aspect.
- Topographically, the sites falls within 49% - 76% (Lamperi & Nobding)
- The most suitable/preferable altitudinal ranges from 2700 to 2800 m a.s.l.)
- Lamperi study sites showed slightly high soil moisture content, organic carbon, nitrogen, pH but low phosphorous compared to study sites at Nobding.

Plot locations and soil properties

- There is negative correlation between stem densities of *T. sinense* and nitrogen content, (*r = -.257, p > .05).*



Location of plots

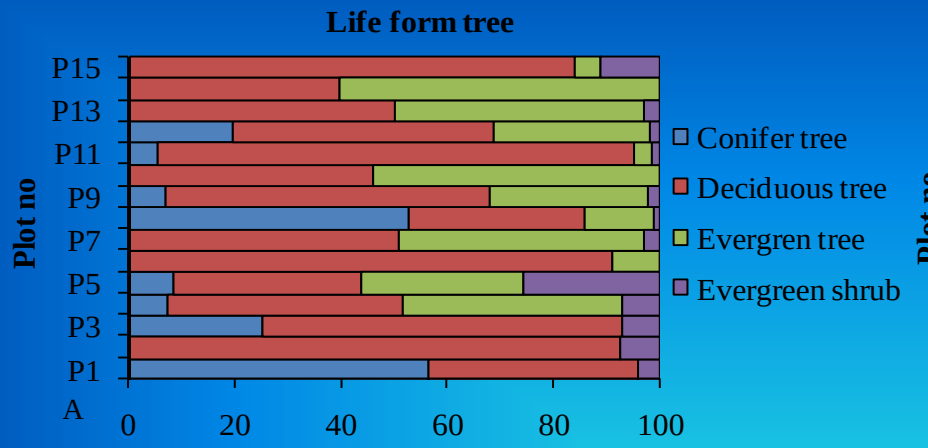


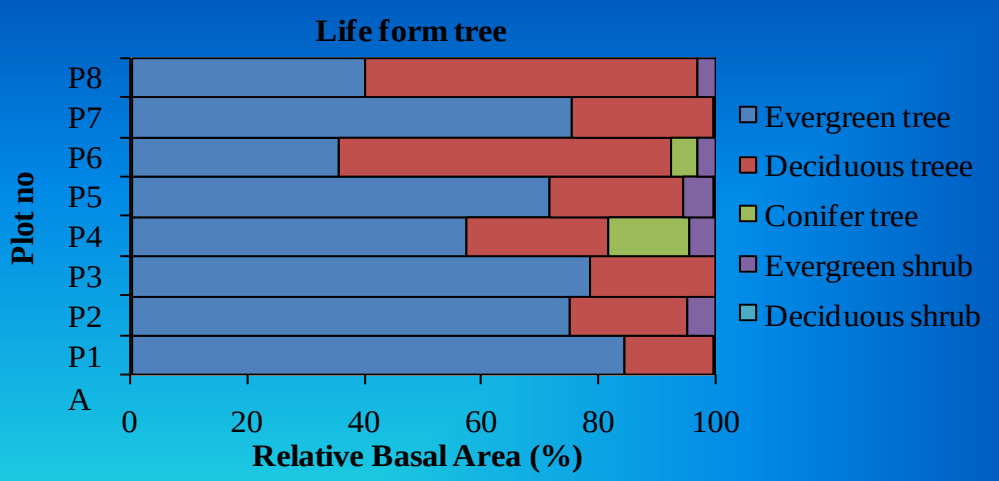
Trends of soil moisture, Organic carbon and nitrogen

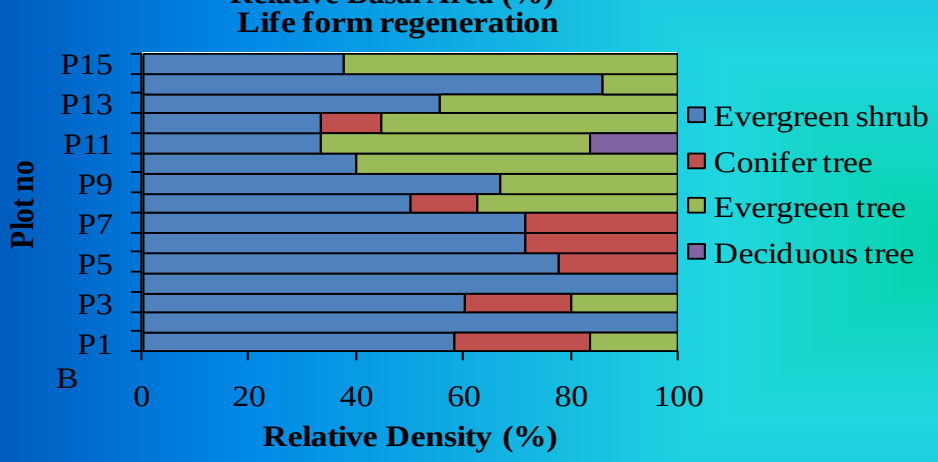
Floristic composition of major lifeform

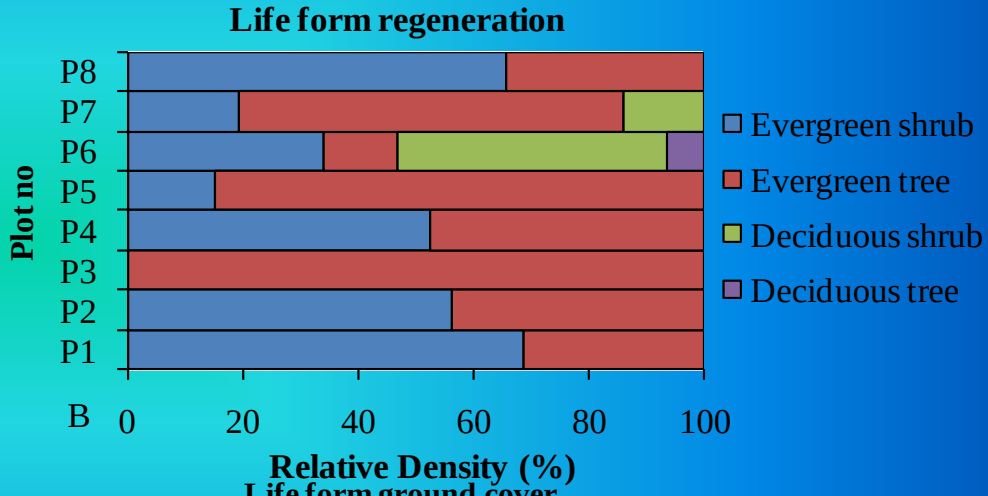
	Nobding	Lamperi
Tree	19 tree species 14 families 4 major life form of CT, DT, ET, ES	22 tree species 17 families 5 life form of ET, DT, CT, ES, DS
Regeneration	10 species 7 families 4 major life form of ES, CT, DT, ET	11 species 9 families 4 life forms from such as ES, ET, DS, DT
Ground cover	14 species 10 families 5 major life form of ES, H, F, C, B.	24 species 17 families 5 major life form of ES, H, F, C, B.

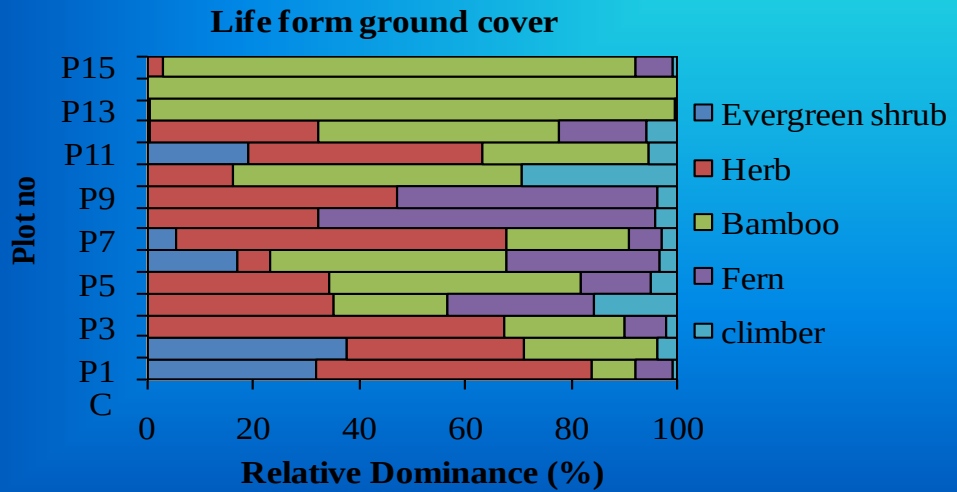
CT- Conifer tree, DT – Deciduous tree, ET- Evergreen tree, ES –Evergreen shrub, DS- Deciduous shrub, H-Herb, F- Ferns, C – Climbers, B- Bamboo

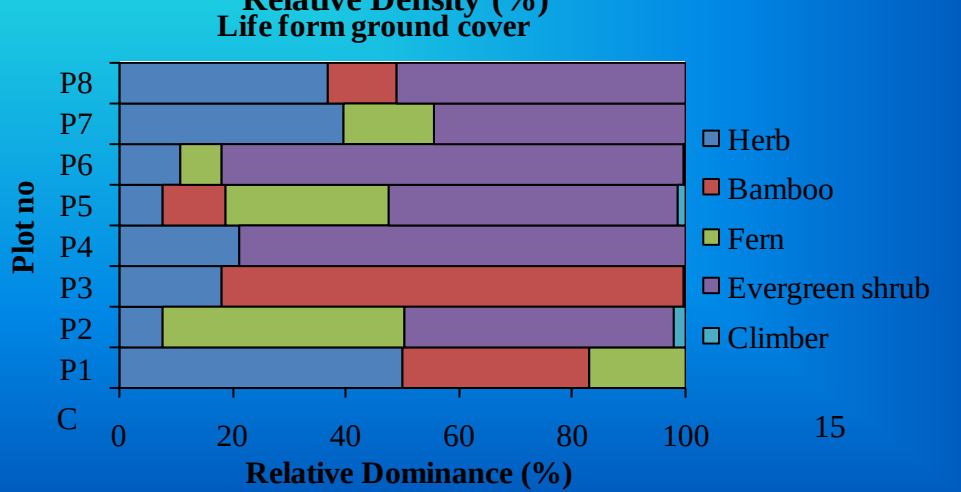

Life form tree
P15
P13
P11
P9
P7
P5
P3
P1
Plot no
A
0
20
40
60
80
100
Relative Basal Area (%)
Conifer tree
Deciduous tree
Evergren tree
Evergreen shrub


Life form tree
P8
P7
P6
P5
P4
P3
P2
P1
Plot no
A
0
20
40
60
80
100
Relative Basal Area (%)
Evergreen tree
Deciduous treee
Conifer tree
Evergreen shrub
Deciduous shrub


Life form regeneration
P15
P13
P11
P9
P7
P5
P3
P1
Plot no
B
0
20
40
60
80
100
Relative Density (%)
Evergreen shrub
Conifer tree
Evergreen tree
Deciduous tree


Life form regeneration
P8
P7
P6
P5
P4
P3
P2
P1
Plot no
B
0
20
40
60
80
100
Relative Density (%)
Evergreen shrub
Evergreen tree
Deciduous shrub
Deciduous tree


Life form ground cover
P15
P13
P11
P9
P7
P5
P3
P1
Plot no
C
0
20
40
60
80
100
Relative Dominance (%)
Evergreen shrub
Herb
Bamboo
Fern
climber

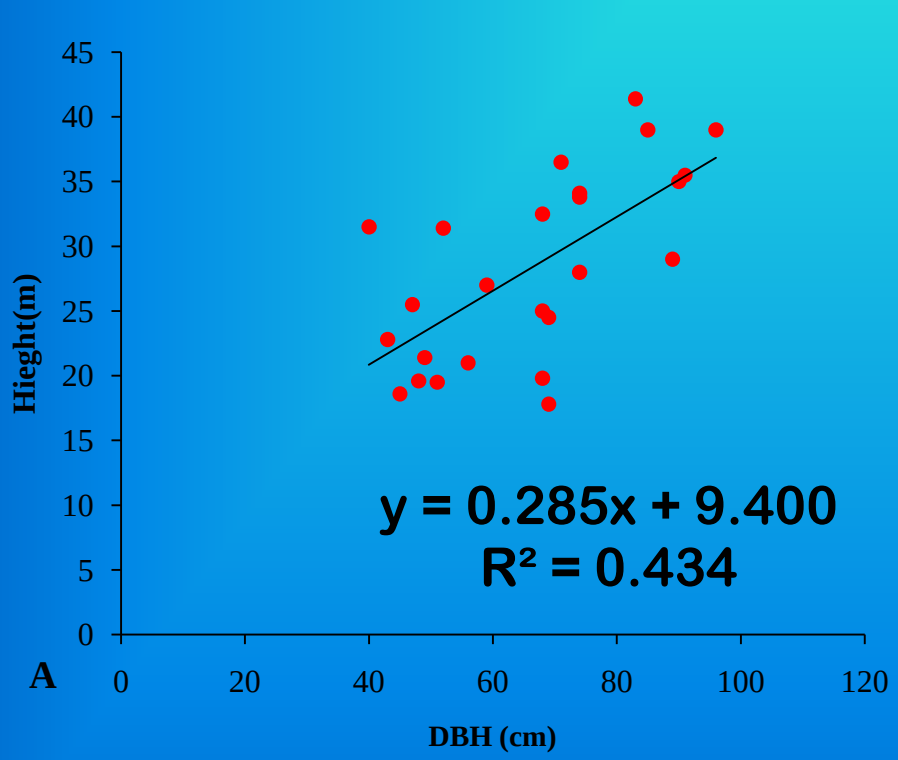

Life form ground cover
P8
P7
P6
P5
P4
P3
P2
P1
Plot no
C
0
20
40
60
80
100
Relative Dominance (%)
Herb
Bamboo
Fern
Evergreen shrub
Climber
15

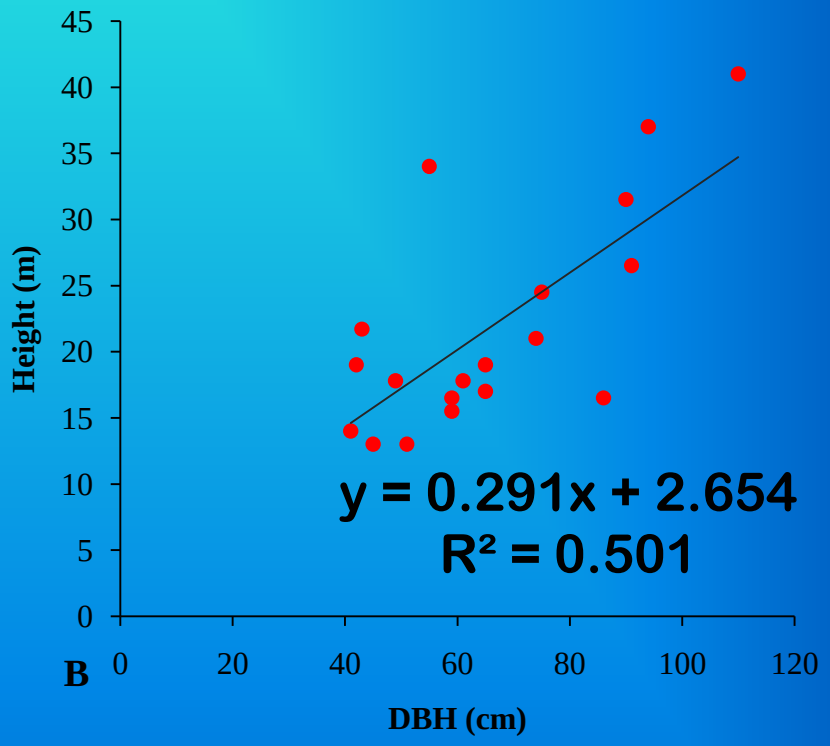
Dominant associated species of *T. sinense*

Category	Species	Family	Life form
Tree	*Quercus oxyodon*	Fagaceae	Evergreen
	Acer campbelli	Acerceae	Deciduous
	Acer sikkimense	Acerceae	Deciduous
Regeneration	*Ilex dipyrena*	Aquifoliaceae	Evergreen tree
	Daphne bholua	Thymelaeaceae	Evergreen shrub
Ground cover	*Sarcococca saligna*	Buxaceae	Evergreen shrub
	Yushania mycrophylla	Gramineae	Bamboo

Population structure of *T. sinense*

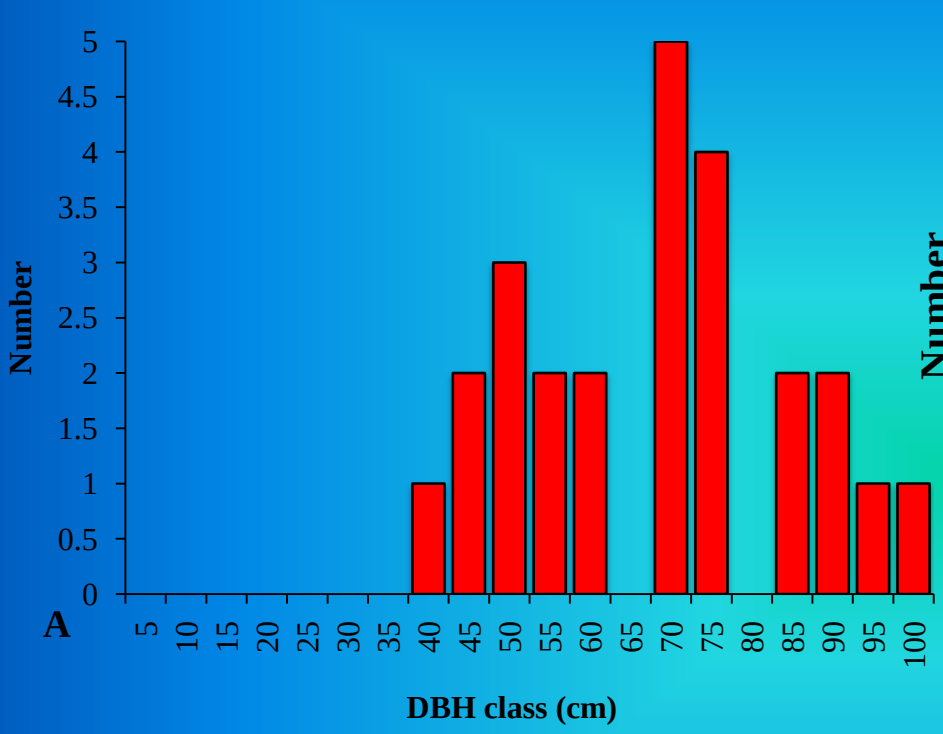
There is positive association between DBH and height of cored *T. sinense* in both sites

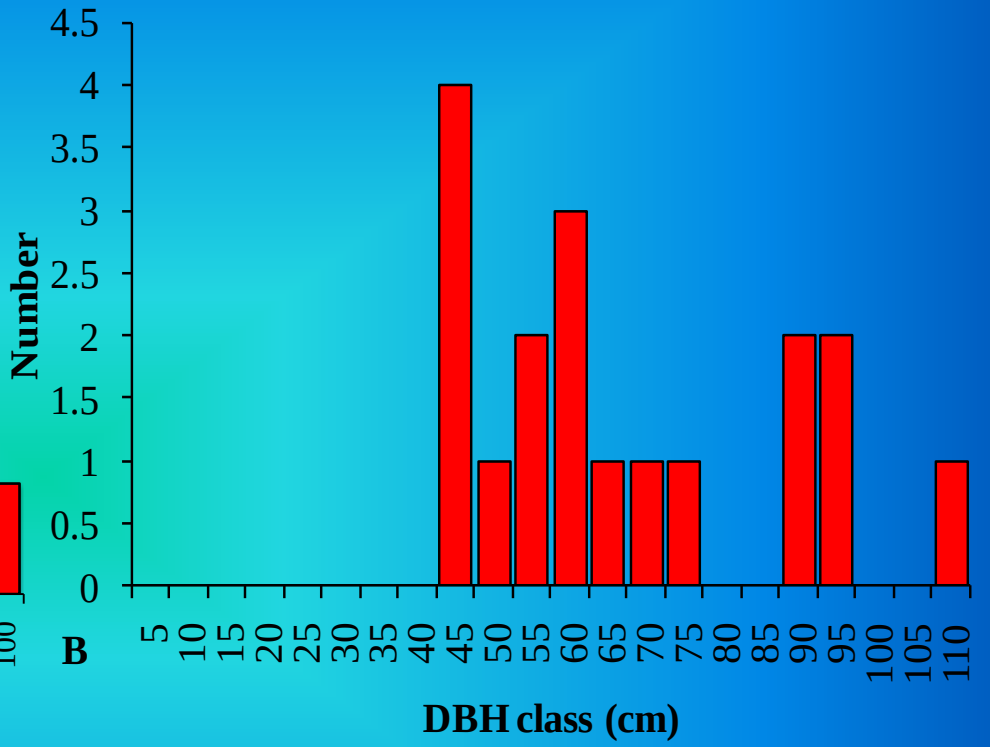




Linear regression for Nobding (A) and Lamperi (B)

Total population structure of *T. sinense*

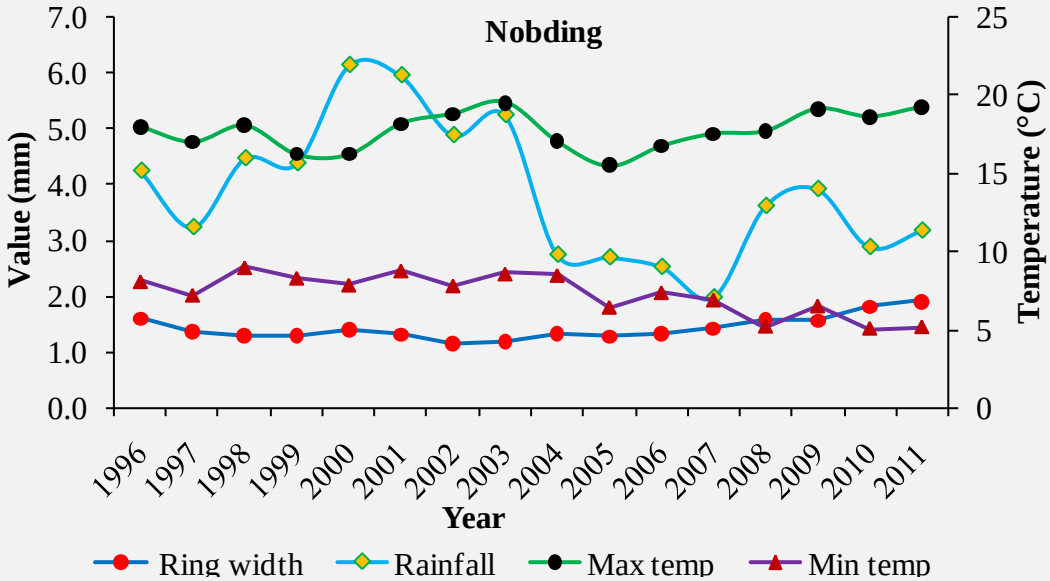


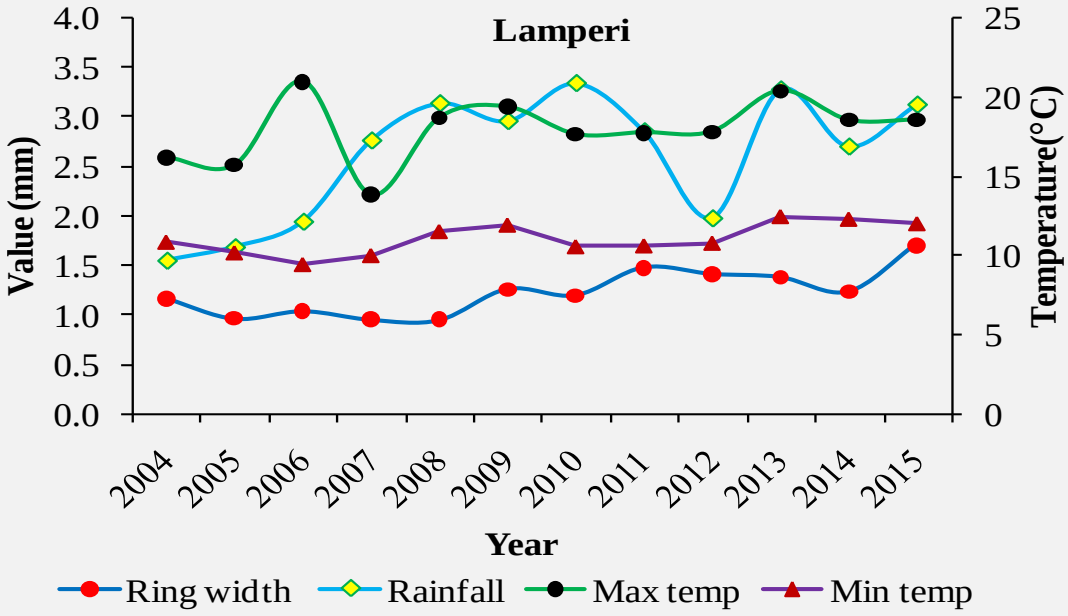


- Both sites showed similar trend of population structure (uni-modal type)
- Presence of matured trees
- No recruitment of *T. sinense*

T. sinense growth response to climatic factors

- Climate data from 1996 to 2011 for Nobding and 2004 to 2015 for Lamperi
- *T. sinense* exhibit non response to climatic factors due to low sensitivity
- Relic species will not adapt with increasing temperature in climate change scenario.

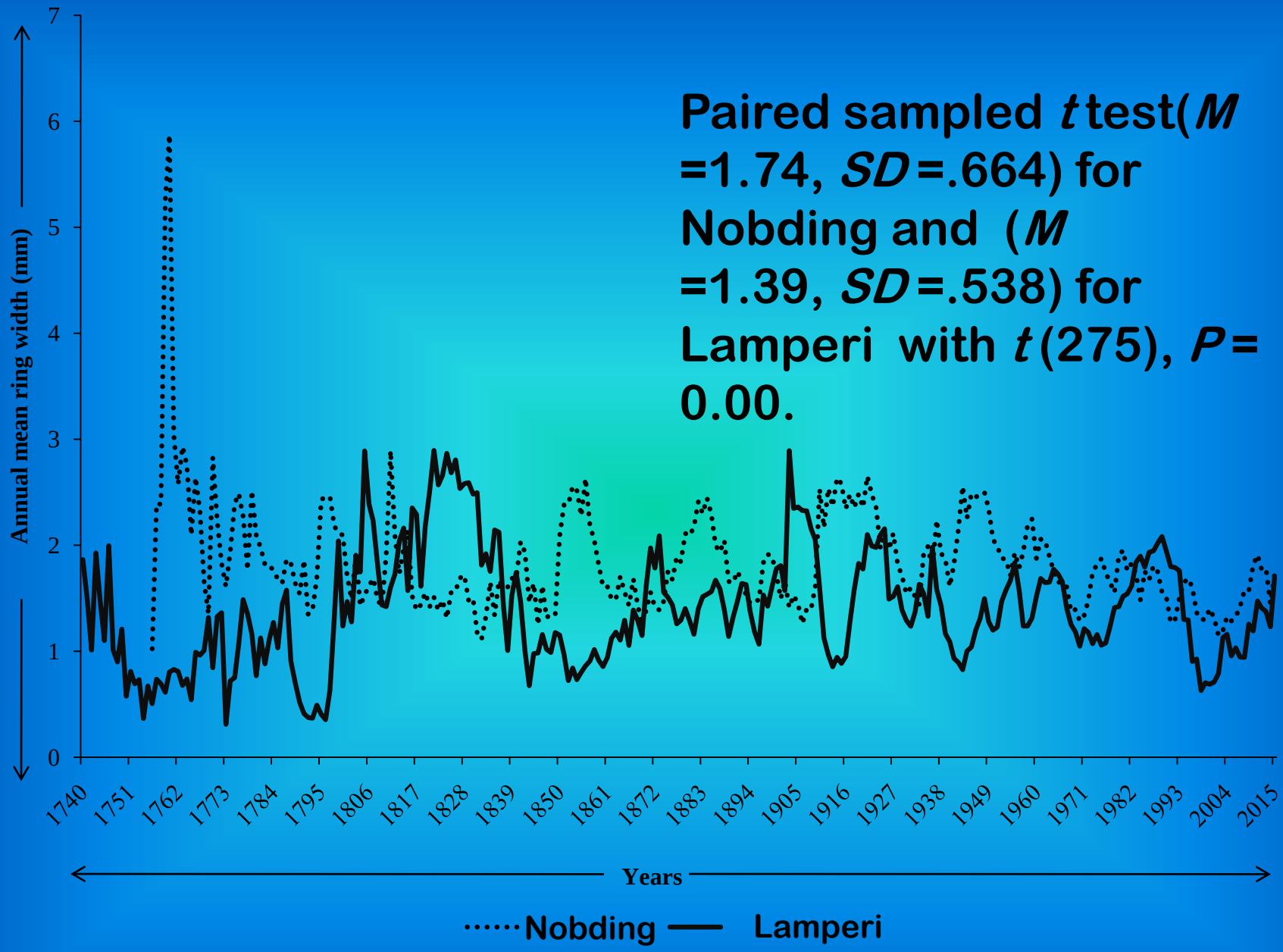




Minimum temperature (r = -.751, P < .01) Linear regression ($\hat{y}$ = 4.67x+13.94, R^2 = 0.563) for Nobding ($\hat{y}$ = 2.117x+8.457, R^2 = 0.255) in Lamperi.

Mean comparison of annual ring series in two sites

- In Nobding, 31 dated sample showed 0.127 inter correlation series with average mean sensitivity of 0.261 and means annual length series of 150.3
- In Lamperi, 13 dated samples showed 0.141 inter correlation series with average mean sensitivity of 0.300 and mean annual length series of 161.0
- The weak intercorrelation is due to differences in topographic gradients and micro site characteristic between plots.



Paired sampled *t* test(*M* =1.74, *SD* =.664) for Nobding and (*M* =1.39, *SD* =.538) for Lamperi with *t* (275), *P* = 0.00.

Species are earth's life support that are biologically rich and threatened, we must strive to protect them

Regeneration mode of the tertiary relic deciduous trees

- No regeneration, indicating the risk of future sustainability.
- *T. sinense* is minutes wind dispersed seed as reproduction happen unstable habitat
- Competitions narrow the possibility of regeneration.

Conclusion

- *T. sinense* is restricted in cool humid evergreen and deciduous forest to transitional zone of mixed conifer.
- No single regeneration and distribution pattern was uni-modal and sporadic
- Exhibit non response to climatic factors due to low sensitivity
- Not adapt with increasing temperature in climate change scenario

- Radial growth differences between two sites
- Sustenance of it’s genetic diversity is uncertain
- Protection of companion species
- One time data collection confined in two study sites
- limited climate data.
- Detail research with setting permanent observation plots for this species habitat necessary in future

Acknowledgements

The Rufford Foundation
www.rufford.org

Dr. Om Katel

Dr. N Norbu

Dr. Steve. F

ནགས་ཚལ་དང་གྲྭིང་ཀ་ཞབས་ཏོག་ལས་ཁུངས།
Department of Forests and Park Services
Ministry of Agriculture and Forests
Royal Government of Bhutan

Species are earth's life support that are biologically rich and threatened, we must strive to protect them

References

Babst, F., Alexander, M, R., Szejner, P., Bouriaud, O., Klesse, S., Roden, J. Ciais, P.Poulter, B., Frank, Moore, D, J, P. & Trouet, V. (2014). *A tree ring the terrestrial carbon cycle.* USA: University of Arizona.

Bjorklund,J.(2009).*Dendroclimatological analyses of an extended and updated tree ring network in Northern Sweden .* Sweden : University of Gothenburg, Department of Earth Sciences

Tang,C.Q. (2013). *Population status of the Tertiary relict Tetracentron sinense in the subtropical Ailao Mountains Yunnan, SW China, and proposed conservation eff*orts. China: Institute of Ecology and Geobotany, Yunnan University, Kunming 650091.

Wangda,P., Gyaltshen,D. & Norbu, T.(2010*). Influence of slope-aspect on the species composition and structural traits along the altitudinal gradients of the inner dry valleys*. Journals of Renewable Natural Resources Bhutan. 6 (1): 160-179.

Yang, Y., Watanabe, M., Li, F.,Zhang, J., Zhnag, W. & Zhai, J. (2003). *Factors affecting forest growth and possible effects of climate change in the Taihang* Mountains, northern China.


Thank You