CLIMATE RESPONSE OF RING WIDTH IN SOME SHRUB SPECIES IN THE FOREST-STEPPE OF NORTHERN MONGOLIA

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Introduction

The impacts of land use changes and climate change on shrub expansion have been extensively documented in the Northern Hemisphere. Studies conducted in the Tibetan Plateau indicate that shrub expansion is more reliant on soil moisture than in the Arctic, where results indicate that changes in temperature and precipitation have a significant correlation with shrub expansion. Studies on the spread of shrubs throughout Central Asia, including the northern part of our country, are, sadly, insufficient. We carried out studies on 6 shrub species present in Shatan river area to determine the response of several shrub species to climate factors, growth pattern and growth type of dependent from habitat types. Dendrochronological studies can help to predict future vegetation responses to environmental change by establishing how populations have responded to environmental variability in the past [1-4]. The use of dendrochronology in many Central Asian ecosystems is limited by absence of trees. Shrubs, however, are common and exhibit annual growth rings similar to tree species. This differential pattern indicator may function depending on the habitat. That being the case, dominant shrub species in southwestern Khentii taiga, Mongolia have successfully been proven to have a high dendrochronological potential and it is practicable to apply it for rangeland and ecological assessments.

Key findings

Dendrochronology, shrub species, climate change, habitats

Methods

Study area and climate

The study area is located in Batsumber Soum, Tov province (N48.52117, E107.83190), 120 km north of Ulaanbaatar. Geomorphology it belongs to the Tuul River basin and Orkhon-Selenge basin in the Mongolia (Figure 1-2).

Lab method: The collected samples were sectioned with a GSL-1 core microtome at the Dendrochronological laboratory, Department of Agroecology, Mongolian University of Life Science in accordance with the micro-core processing protocol which was described in detail in previous research [5].

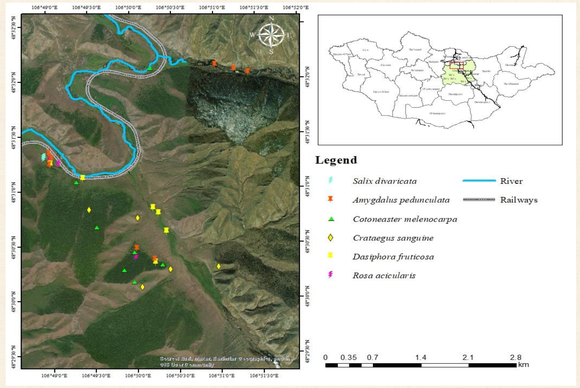

Figure 1. Study plots of shrub species in Shatan River Sites

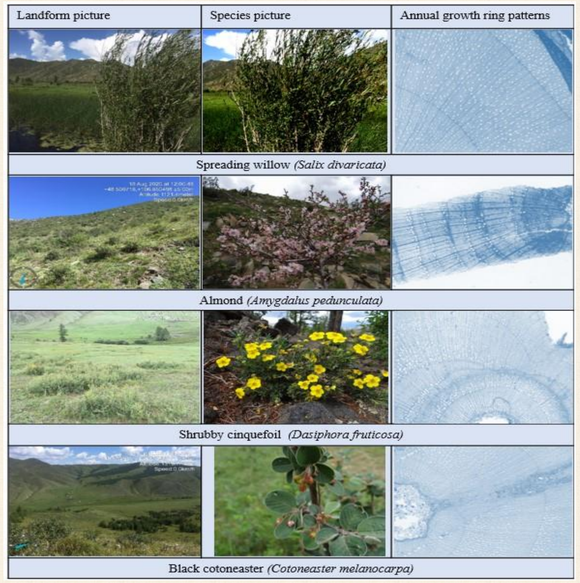

Figure 2. Annual ring patterns of shrub species

Dendrochronological analysis: Microscopes with objective magnifications of x10, x20, x40 were used for observations and photography. The samples were photographed using MotiCam 10+ and the annual ring widths were measured in mm using ImageJ software [6]. All samples were visually cross-dated using skeleton plots, as outlined by [7], and pointer years were recorded as well

Climate-growth relationships were investigated using linear regression between ring widths and a) the mean annual temperature, and b) total annual precipitation of the current and previous year, using data from the meteorological station.

Results

The cross-sectioning was impossible on individuals of *Ribes rubrum*, and *Malus baccata*. The oldest individual used in the chronology construction was a 14-years old wild almond individual (*Amygdalus pedunculata*), while half of the population consisted of 1-5 years old shrubs. A linear regression analysis between the diameter of the crown of the shrub and the height parameter shows that R^2=0.248 that is, there is a weak correlation between the diameter of the basal of the shrub and the height, R^2=0.25 or a weak correlation (Figure 3-4).

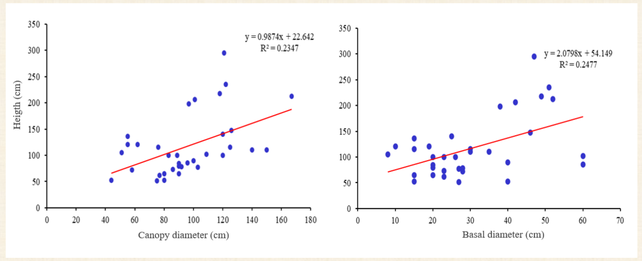

Figure 3. Relationship among morphological trait of shrubs

Linear regression analysis checked the effects of mean air temperature, total precipitation, and wind on annual ring width during plant growth, which differed among species.

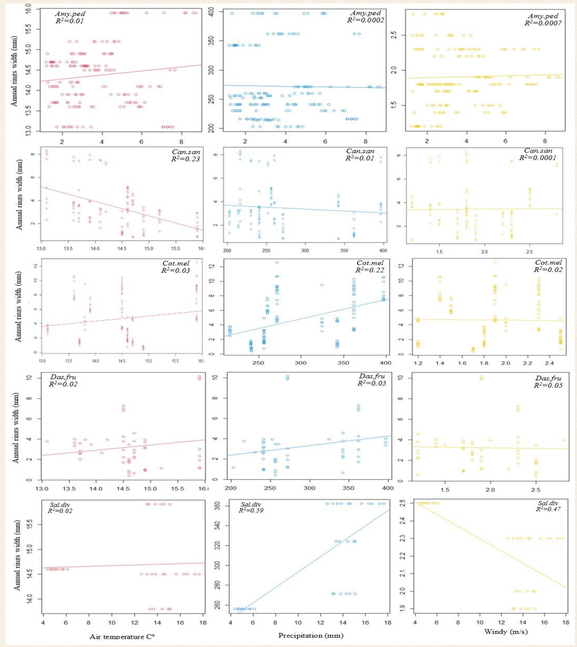

Figure 4. Relationship between annual rings width of shrub species and climate variables

Relationship between rings width and habitats

One-way ANOVA and Tukey-Kramer test were used to check whether the dendrochronological ability of shrubs varies depending on habitat differences. According to this, the growth of the annual rings of individuals along the river and on the slopes of the mountains was good, but the dendrochronological potential of the trees growing in the forest was weak Figure 5). Also, annual ring growth was statistically different when examining how it differed between species (Figure 6).

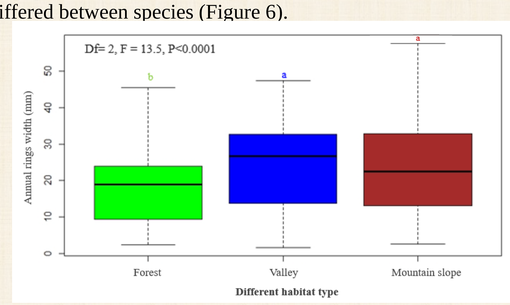

Figure 5. The significant of the analysis of variance among different habitat types

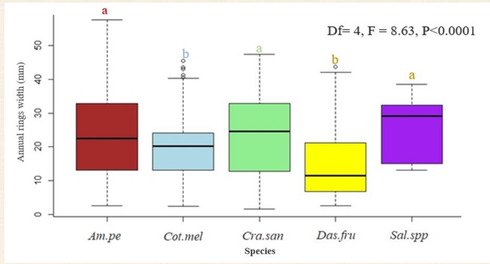

Figure 6. Tukey-Kramer test to detect between-individual differences in annual ring width growth results

Conclusions

In summary, our work indicates the potential for dendrochronological analysis of several Mongolian shrub species to be used in explaining and predicting vegetation change. The Arctic is anticipated to undergo a shift in the next few decades toward an environment that is more dominated by shrubs.

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