Dendrochronological Analysis of the forests of the Ussuriysk National Natural Reserve,

Sampled: August 2013

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General

This report describes the tree-ring dating (dendrochronology) of the forests of the Ussuriysk National Natural Reserve. In August of 2014, Greg Wiles, Tatiana Maratovna Kouderina, and Eugenio Grabenko sampled living oak and pine trees at two different sites: Ussuriysk Reserve and Bear Place. The objective of this work was to provide a general age of the forests and a summary of how these trees respond to climate.

Methods and Analyses

47 oak cores and 30 fir cores were collected from trees at two sites within the Ussuriysk National Natural Reserve (Table 1).

Table 1. Tree-ring sites sampled within the Ussuriysk National Natural Reserve.

Site	Location	Species	Site Code	Period of Record	Cores (Trees)
Ussuriysk Reserve	43.6509N, 132.44759E	Quercus mongolica	URQ	1767 – 2013	35 (17)
		Pinus koraiensis	URP	1670 – 2013	28 (13)
Bear Place	43.64295N, 132.46237E	Quercus mongolica	BPQ	1746 – 2013	12 (6)
		Pinus koraiensis	BPP	1850 – 2013	2 (1)

Cores were prepared and cross-dated using standard dendrochronological techniques (Figure 1: Homes, 1983; Stokes and Smiley, 1968). The samples were carefully glued into grooved mounts and sanded to a high polish to reveal the annual tree-rings clearly. The core samples were dated and the rings widths were then measured under a microscope to a precision of ±0.001 mm. and cross-dated. The cross-dating of the measurements was assisted by the COFECHA computer program (Holmes 1983).

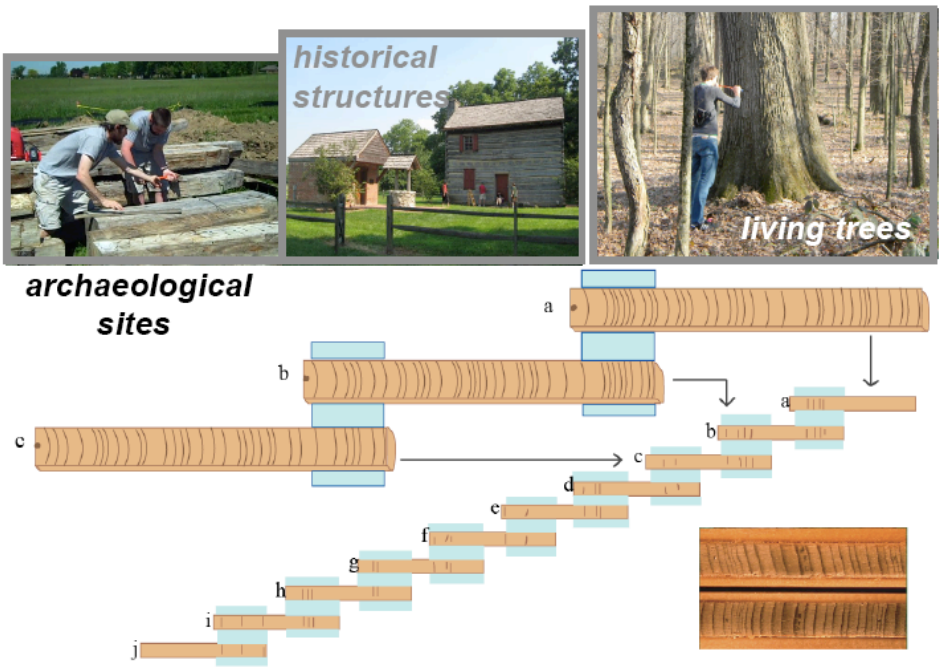

Figure 1. This diagram illustrates the process of tree-ring cross-dating. Patterns in ring widths from historic structures and wood associated with archeological sites are matched to living tree-ring chronologies and thus calendar dates can be assigned to each ring.

The ring width chronologies were subsequently standardized, using the computer program ARSTAN, in order to eliminate any systematic changes in ring width that are not climatically induced (Cook, 1985; Cook and Kairiukstis, 1990). A linear regression or negative exponential curve was used in standardization.

The site chronology was then correlated with average monthly temperature and precipitation values as recorded at the Vladivostok station.

Results

Bear Place Oaks

The oak ring width series at Bear Place, a site located within the Ussuriysk National Natural Reserve. The ring width indices are shown in Figure 2 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 3 and 4, respectively.

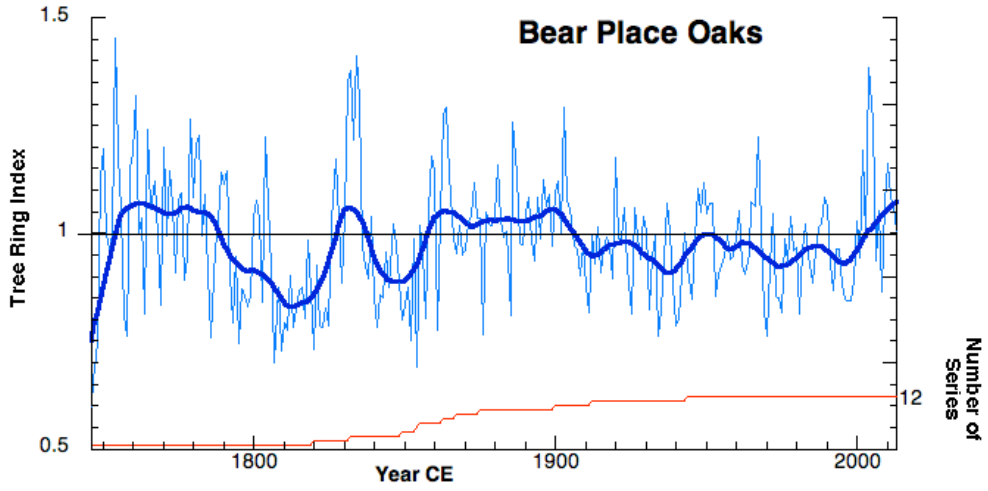

Figure 2. The oak tree-ring chronology for Bear Place. The indices as well as the number of series are shown.

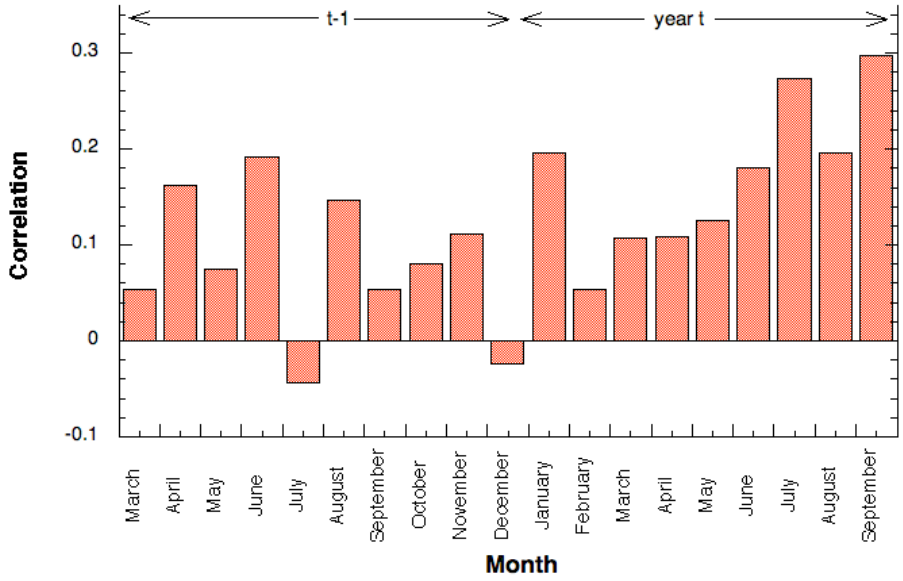

Figure 3. The correlations between the tree-ring width indices and average monthly temperature. The growth of these oak trees is shown to be only weakly correlated with temperature and none of the correlations are significant at the 90% confidence level.

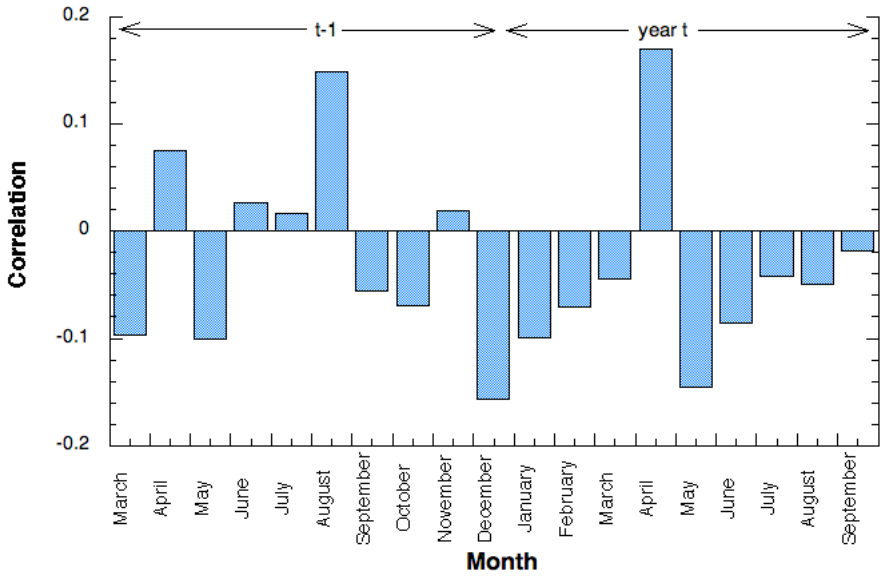

Figure 4. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these oak trees is shown to be only weakly correlated with temperature and none of the correlations are significant at the 90% confidence level.

Ussuriysk Reserve Oaks

The oak ring width series at the Ussuriysk Reserve site within the Ussuriysk National Natural Reserve. The ring width indices are shown in Figure 5 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 6 and 7, respectively.

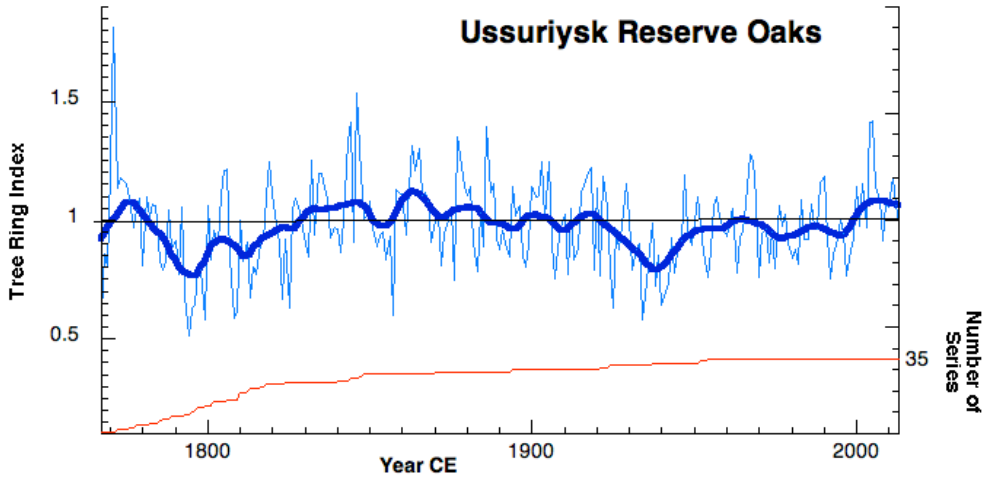

Figure 5. The oak tree-ring chronology for the Ussuriysk Reserve site. The indices as well as the number of series are shown.

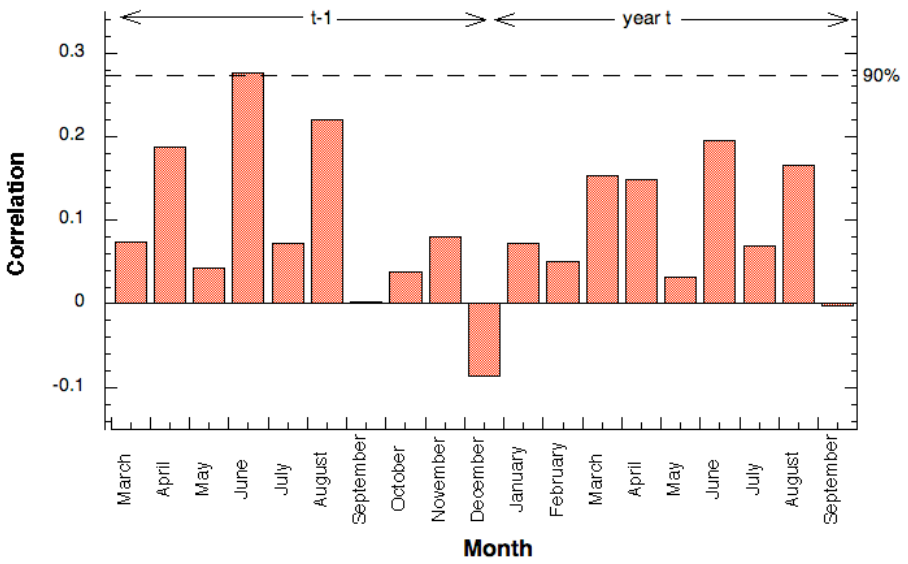

Figure 6. The correlations between the tree-ring width indices and average monthly temperature. The growth of these oaks is shown to have a strong positive correlation with June temperatures of the year previous to the year of growth, significant at the 90% confidence level.

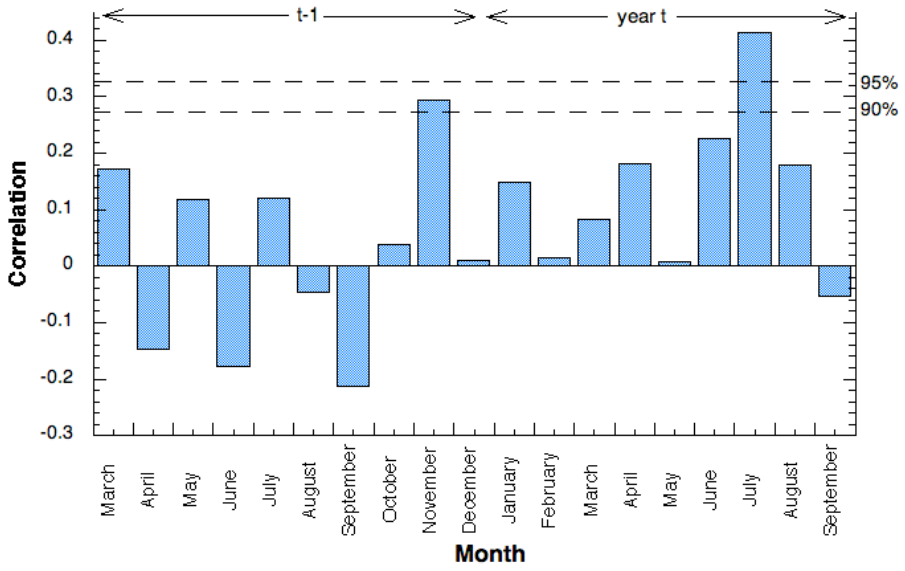

Figure 7. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these oaks is shown to have a strong positive correlation with July precipitation of the year of growth (significant at the 95% confidence level) as well as November precipitation of the year previous to growth (significant at the 90% confidence level).

Ussuriysk Reserve Pines

The pine ring width series for the Ussuriysk National Natural Reserve. Only two series were collected from Bear Place, so these were added to the Ussuriysk Reserve chronology. The ring width indices are shown in Figure 8 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 9 and 10, respectively.

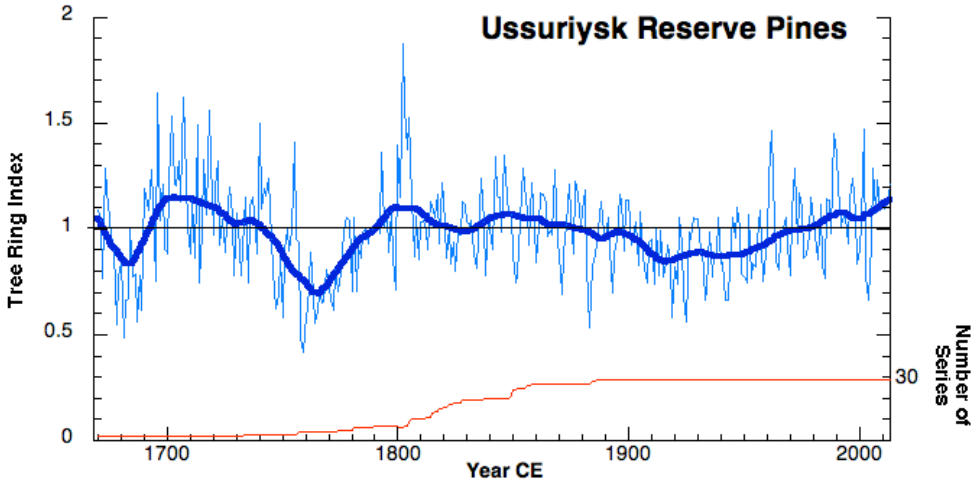

Figure 8. The pine tree-ring chronology for the Ussuriysk Reserve. The indices as well as the number of series are shown.

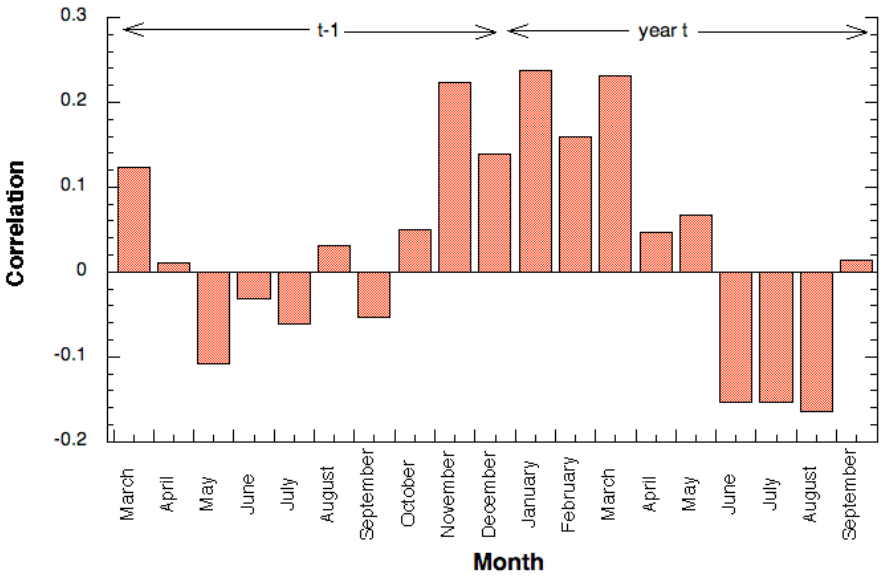

Figure 9. The correlations between the tree-ring width indices and average monthly temperature. The growth of these pine trees is shown to be only weakly correlated with temperature and none of the correlations are significant at the 90% confidence level. However, a general positive correlation with growth is observed between for winter temperatures and a negative correlation for summer temperatures.

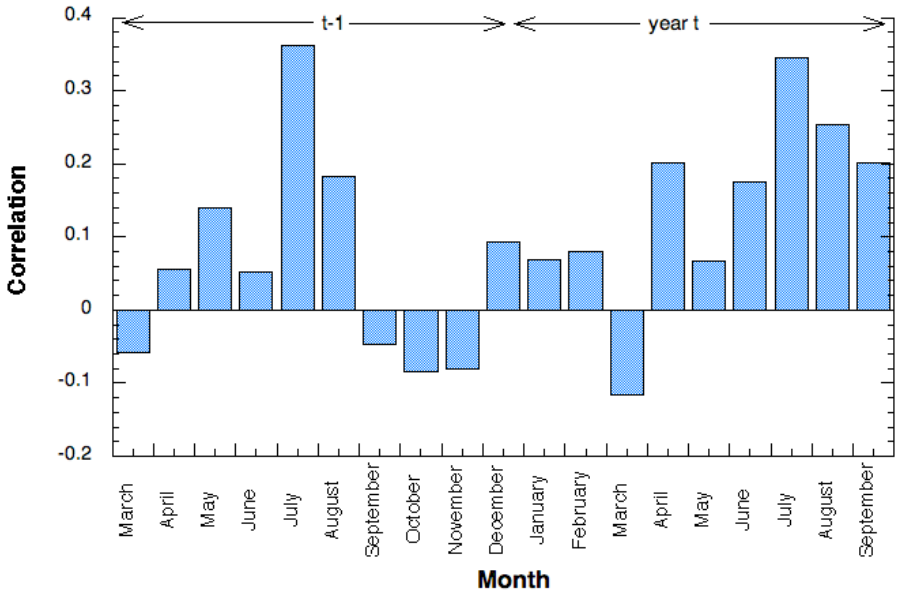

Figure 10. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these pine trees is shown to be only weakly correlated with precipitation and none of the correlations are significant at the 90% confidence level. However, peak correlation is observed between growth and July precipitation of both the year of growth and the year previous to the year of growth.

Summary:

The oak trees sampled in the Ussuriysk Pad Nature Reserve date back to the late-18th Century. While the oaks at the Bear Place collection site show a poor climate signal, those oaks sampled at the Ussuriysk site show a stronger response to climate. The growth of these trees has a strong positive correlation with June temperatures as well as precipitation of July of the year of growth and November of the previous year.

The pine trees sampled in the reserve date back to the late-17th Century. Though the annual growth rings of these trees do not have a strong climate signal, a common negative relationship between growth and summer temperatures as well as a common positive relationship between growth and winter temperatures are observed. In addition, positive peaks in correlation between growth and precipitation are detected for July of both the year of growth and the year previous.

References:

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