Primary growth of *Juniperus communis* in southwest Greenland

František Trkal[1], Jiří Lehejček[2]

[1]*Department of Forest Ecology, Faculty of Forestry and Wood Science, Czech University of Life Sciences in Prague, Kamýcká 1176, 165 00 Prague 6 - Suchdol, Czech Republic*
[2]*Department of Environmental Security, Faculty of Logistics and Crisis Management, Tomas Bata University in Zlín, nám. T.G. Masaryka 5555, 760 01 Zlín, Czech Republic*

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Introduction

Studies of tundra shrubs have become integral part of Arctic activities. The range of their applications varies significantly in fields such as population ecology, carbon storage, permafrost thaw, or environmental reconstructions. However, ecology as such has been chronically understudied for many shrub tundra species. This work thus aim to partially fill this knowledge gap and focuses on a primary growth of *Juniperus communis* L. in southwest Greenland. Primary growth is a growth in lenght (height) by the activity of primary meristems on an apex or at root tips. There are very few studies exploring the primary growth of shrubs in the Arctic tundra, mostly depending on the temperature increase (Hävstrom et al. 1993, Rozema et al. 2009, Hudson et al. 2011, Klady et al. 2011, Campioli et al. 2013). This is probably the first study dealing directly with primary growth of junipers in the Arctic tundra, which could provide light to the ecological specifics of this species. The specific aims of the work were as follows:

1. to determine the primary growth rate of junipers in this area
2. to check whether summer temperatures have a positive effect on primary growth of juniper as illustrated in other studies.

Material and Methods

The collection of individuals for this work was carried out in the Kobbefjord Bay (64°10' N; 51°19' E) in southwest Greenland. This low Arctic region is influenced by North Atlantic Current, which reaches 66° NW. The site is characterized by a relatively mild climate with average annual precipitation of 777 mm, the average annual air temperature of -1.3°C and the average summer air temperature of 5.8°C (Meteorological station Nuuk 4250, period 1981 – 2010; Cappelen 2014).

In August 2013, seven individuals were collected. One of the individuals had to be eventually eliminated because of the rotten center and therefore the impossibility to determine its age. All individuals were taken from relatively dry microsites in the northern part of the fjord with southeast to southwest orientation at an altitude of 20-150 m. The incline of the slope was between 15° and 30°. To capture the entire age and growth scale, individuals were selected for collection using a systematic grid. Individuals were taken from the random portion of the polycormon at the site determined by this grid.

Samples were taken from base stem of the individual and then in one or two other parts in the direction of stem growth. The final analysis was performed on 6 individuals, and 13 samples, respectively.

To determine the rate of the primary growth, the length from base to the next sample on the stem was divided by the difference in their age. It was then determined how long the individual had grown from one sample point to another.

Results

Juniper primary growth is presented in Table 1. The mean primary growth for all samples was 4.09 cm per year and its standard deviation was 1.61. The fastest growing individual grew at an average rate of 6.25 cm per year and it was in the first measured portion of the stem, in the second measured part of the stem the growth was significantly slower. The lowest measured value was 2.33 cm per year.

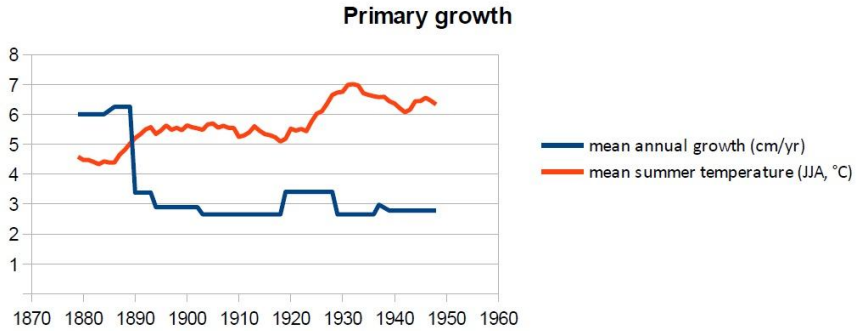

Fig. 1. Mean primary growth of all individuals over time is compared with mean summer air temperatures.

Sample	Beginning of growth	Distance from base (cm)	Growth time from base (yr)	Mean annual growth (cm/yr)	Mean summer temperature JJA (°C)
J10/1	1885	0	0	-	
J10/2	1889	25	4	6,25	4,9
J10/3	1902	25+44=69	4+13=17	3,38	5,3
J11/1	1918	0	0	-	
J11/2	1928	49	10	4,90	5,4
J13/1	1939	0	0	-	
J13/2	1948	25	9	2,78	6,3
J34/1	1894	0	0	-	
J34/2	1937	128	43	2,98	5,8
J40/1	1894	0	0	-	
J40/2	1936	98	42	2,33	5,8
J41/1	1879	0	0	-	
J41/2	1885	36	6	6,00	4,1

Table 1. Obtained data from individual samples *JJA = June, July, August.

Discussion

We documented no effect of temperature on primary growth as already seen in literature for other low Arctic species (Campioli et al. 2012). While average summer temperatures are recently rising, the primary growth trend is opposite. To better understand the drivers of primary growth of juniper we need more robust dataset but we assume, that the reasons for temperature insensitiveness combines: increasing drought stress, influence of juvenile growth on average values, and increasing competition among individuals.

Conclusion

In this paper, we determined the rate of Arctic juniper primary growth. However the hypothesis that summer air temperature has a positive effect on this growth has not been confirmed. Several possible factors have been outlined, but for a deeper understanding of the issue, it would be necessary to work with larger dataset.

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