

SNOW COVER INFLUENCE ON PHENOLOGY AND PRIMARY GROWTH OF *Juniperus communis* L.

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Introduction

During the past decades the average temperatures has progressively increased and extreme climatic events have become more frequent and intense, affecting plants communities, especially those in the treeline ecotones.

Aims of the study

The purpose of this study is to evaluate the phenology and primary growth of the shoots of common juniper (*Juniperus communis* L.) in response to changes in period and duration of snow cover.

Material and methods

A snow manipulation experiment was carried out to study the effects due to the alterations of environmental conditions (duration of snow cover, air, soil, and bark temperatures, soil, water availability) on common juniper at a treeline area in the Eastern Italian Alps near to Passo Giau (San Vito di Cadore, Belluno) (Figs. 1, 2, 3).



Fig. 1 - Localization of the study site



Fig. 2 - Study site on 5th of December 2017



Fig. 3 - Study site on 7th of September 2017

The experiment setup included 15 plants of common juniper, grown in 3 plots (54 m²) with 3 different treatments (5 plants in each plot):

- S: covered by snow
- U: uncovered by snow
- C: control plots

For *U* plots a series of a metal nets have been placed in order to do not damage the plants during the snow removal operations started on March 2018 (Fig. 4).

Instead, for *S* plots, has been collected snow from the areas around the site and placed it over the plants and protected them using two different thermic blankets in order to postpone the beginning of vegetative growth as long as possible (Fig. 5).



Fig. 4 - Fine knit grids placed over U plots (30th of October 2017)



Fig. 5 - S plot covered with thermic blankets (March 2018)

Chart 1 - Plot design grid

Period	Control Plots (C)	Uncovered Plots (U)	Covered Plots (S)
October 2017	Control	Uncovered	Covered
Winter 2017 – 2018 (Nov. - Feb.)	Covered	Covered	Covered
March 2018	Control	Uncovered	Covered
April 2018	Control	Uncovered	Covered
May 2018	Control	Uncovered	Covered
June 2018	Control	Uncovered	Covered

Legend

- Covered by snow
- Uncovered by snow

Has been collecting data about:

a) meteorological data:

air temperature (min. max average) took twice every 15 minutes by two weather stations located 3 km between each other, respectively one in the center of study area (data collected from September 2017 to December 2018) and one in Cinque Torri (data collected since 1996);

b) phenology and primary growth:

length of the shoot of the year (mm);

presence and development of buds, new leaves, male and female sporophylls.

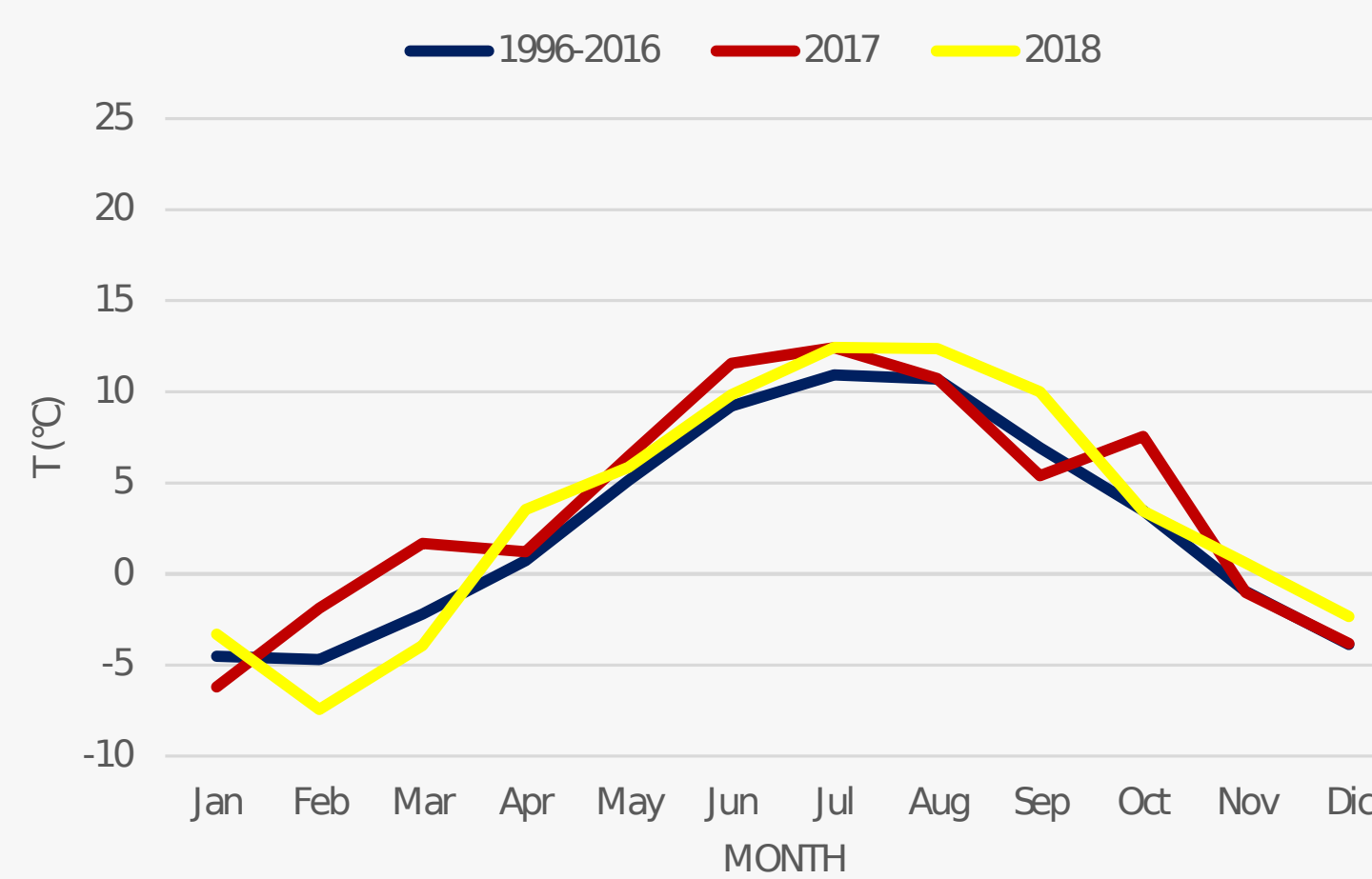
Results

a) Meteorological data:

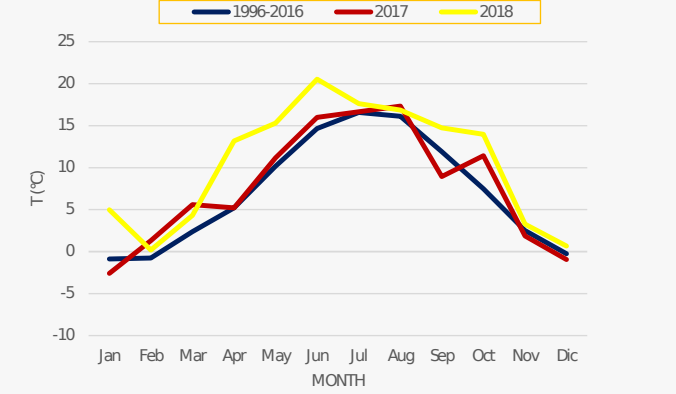
Comparison of monthly maximum, minimum and average air temperature between the period of time 1996-2006 and 2017 and 2018 (Figs 6, 7, 8).

Figs. 6, 7, 8 - Meteorological data

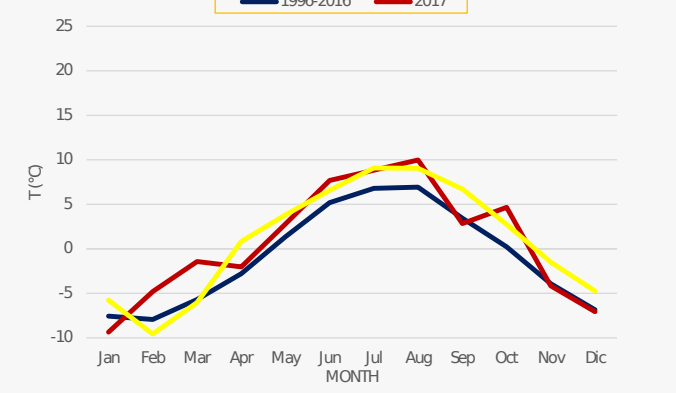
Comparison of T average between 1996-2016, 2017 and 2018



Comparison of T max between 1996-2016, 2017 and 2018



Comparison of T min between 1996-2016, 2017 and 2018



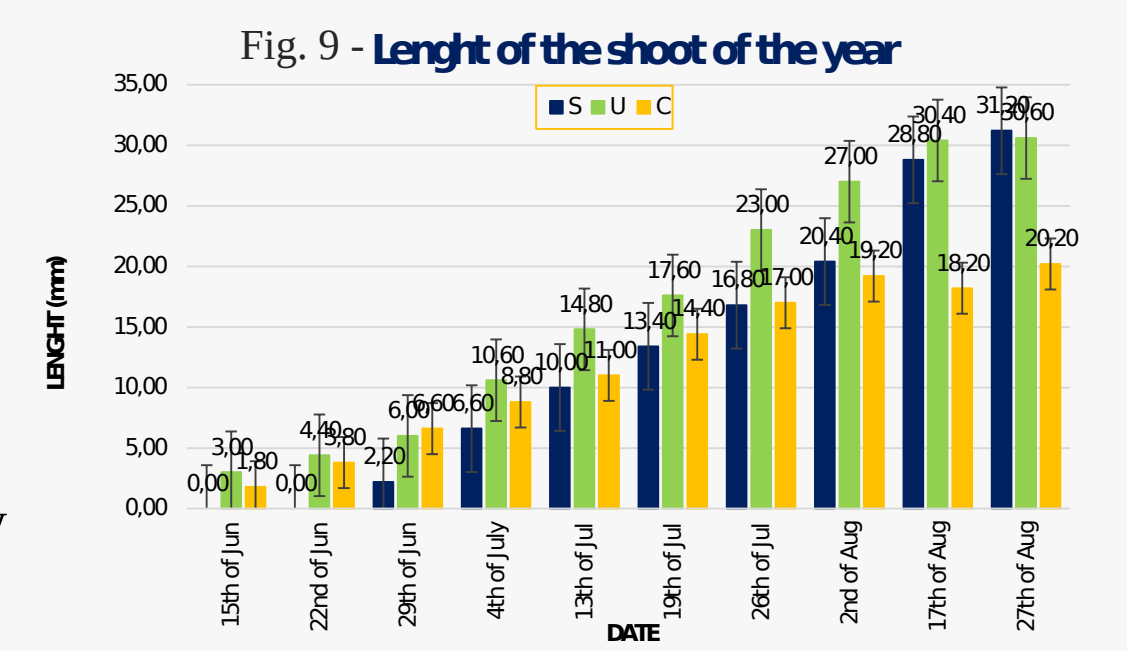
b) Phenology and primary growth:

Length of the shoot of the year in (Fig. 9)

C: ranges from 1,80 to 20,20 mm

U: ranges from 3 to 30,60 mm

S: ranges from 0 to 31,20 mm



Presence and development of buds, new leaves, male and female sporophylls:

- cones: data recorded from 15th of June 2018-27th of August 2018 (Figs. 10, 11, 12, 13);

- buds: data recorded from 15th of June 2018 -13th of July 2018;

- new leaves on the shoot of the year: grade of divergence (distance between needles and branch) during all the month of August 2018.



Fig. 7 - Female cones development

Fig. 8 - Green female cones (29th of June 2018)

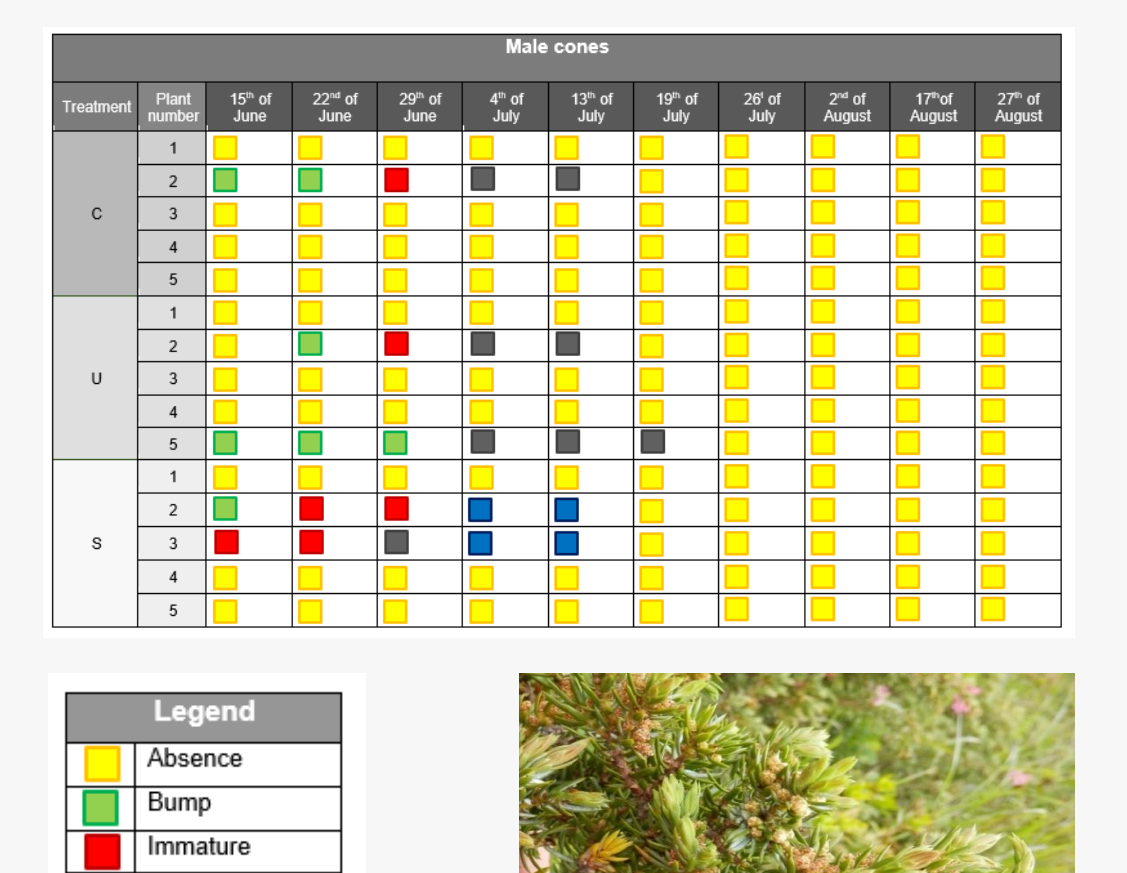


Fig. 9 - Male cones development

Fig. 10 - Male cones (29th of June 2018)

Discussion and conclusion

The air temperatures registrated during this study at the Alpine treeline confirm the global warming phenomenon. There is a considerable difference of the average, maximum and minimum air temperatures between the decade 1996-2016 and the years 2017 and 2018. The highest temperatures recorded are from April 2018 to June 2018 (Figs. 7, 8, 9, 10).

From this study we observed that the manipulation of the snow cover affects:

1. the shoot length in junipers grown covered by snow (S) with anticipated and longer branches;
2. in S plots the snow cover influences the plant phenology with a delay in maturation of the reproductive structures;
3. in uncovered plants (U) the stress due to extreme temperatures and frost have compromised the development of the buds.

This research is the first step of a long-term experiment in alpine treeline to evaluate changes in plant communities driven by the current and future environmental changes.