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PHENOLOGICAL OBSERVATIONS OF *FAGUS SYLVATICA* L. DURING 2012 IN THE BALKAN RANGE

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Abstract

In the frame of implementation of International Cooperative Program 'Forests' – second level – (ICP Forests), since 2011 phenologycal observations of beech vegetation in the station of 'Vitinya' were conducted. The targets of this study, along with the data from the many years of observations (2001), related to the assessment of defoliation, phytocenotic changes, leaf analysis, meteorological parameters, air pollution, soil, etc., were to identify the key factors and processes in the functioning of it. The results of observations of the phenologycal development of common beech (*Fagus sylvatica* L.) in 2012 are: duration of vegetation, start and end of leafing, timing of autumn discolouration of leaves, beginning and end of leaf fall. Assessment of the results was combined with the average minimum and maximum air temperature in 2011 and 2012 and average monthly relative air humidity in both years.

Key words: intensive monitoring, phenology, phenologycal stages.

Introduction

In the intensive monitoring program Assessment and Monitoring of Air Pollution Effects on Forests (ICP-Forest Manual 2000), forest phenology is defined as 'systematic observation and recording of the development of tree species, biotic and abiotic events and phenomena'.

Studies of processes during the development and duration of major life events (phenology) are important for assessing of the condition of the trees. They also have a significant impact on other components of the ecosystem (Menzel 2002, Badeck et al. 2004, Vitasse and Basler 2012). Shifting in the beginning and ending phases of development can be directly linked to climate change, due to natural climate changes or anthropogenic interference.

The main objective of the phenological observations in the plot of 'Vitinya' was to provide additional information on the status and development of trees observed during the vegetation period. The data obtained complement the collected information on the remaining components – plant communities, soils, air pollution, meteorological data, etc. to evaluate the effect of climate change on forest ecosystems (Pavlova et al. 2002–2011).

Materials and Methods

The phenologycal observations were made on *Fagus sylvatica* L. located in the western part of the Balkan Range, near 'Vitinya' Pass. The area is situated in the temperate forest vegetation area zone. The stand is dominated by Common beech, aged between 120 and 140 years, at an altitude of 950 m west, at 23°55´48" latitude and 42°55´39" longitude (Kolarov et al. 2002). The soil is Distric-Eutric Cambisols, CM (Kolarov et al. 2002, ICP-Forest Manual 2000).

The observed trees were 15, dominant, with good visibility of the entire crown, including its top, with an opportunity to conduct observations from the same side of the crown throughout. Surveys were conducted once a week during two periods of the active growing season (April–June and September–November). The observed phases were: bud burst and leafing, flowering, fruiting, fall colouring and autumn leaf fall (User Phenologycal Observations 1960, Slavov and Kazandjiev 2006, Dittmar and Elling 2006). Presence of abiotic or biotic damages was detected during the observations. The evaluation of phenological data was made by using information for humidity and air temperature for the preceding 2011 and the year of observations – 2012.

Results and Discussion

Leafing of the observed trees in 2012 started on April 21 and ended within the next 7 to 10 days. The duration of the process, compared with the previous year, was much shorter, as leafing ended with formation of the leaf stalks simultaneously in all individuals. Figure 1 shows the variety of the beginning of unfolding for the observed trees, and the timing of its end. On Figure 4 it is shown the duration of leafing of trees observed in the number of days. The duration of the process is 7 to 14 days (Fig. 2). The trees are divided in tree groups – 7, 10, and 14 days duration.

Flowering was observed in almost all the trees (except tree No 2) in May 2012. Surveys showed that the intensity of flowering is weak (excluding tree No 19).

The average minimum and maximum air temperature and average monthly rela-

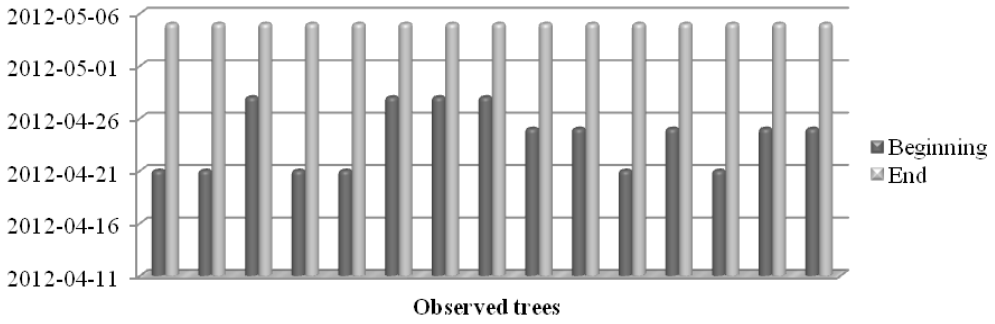

Fig. 1. Beginning and end of leafing, 2012.

tive humidity are shown in Figures 3 and 4. Minimum temperature in both years have a similar course. February 2012 is with the lowest average monthly minimum temperature. July is with the highest average monthly minimum temperature and it is higher than 2011.

The average monthly maximum temperature increase from March to December. For June, July and August excess is of 5 °C. Similar is the situation with the average monthly maximum temperature observed in October and November. In 2012 generally, relative air humidity was with lower values. Especially significant is the difference between the

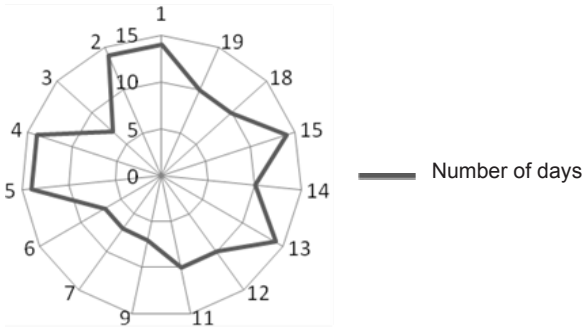

Fig. 2. Duration of leafing.

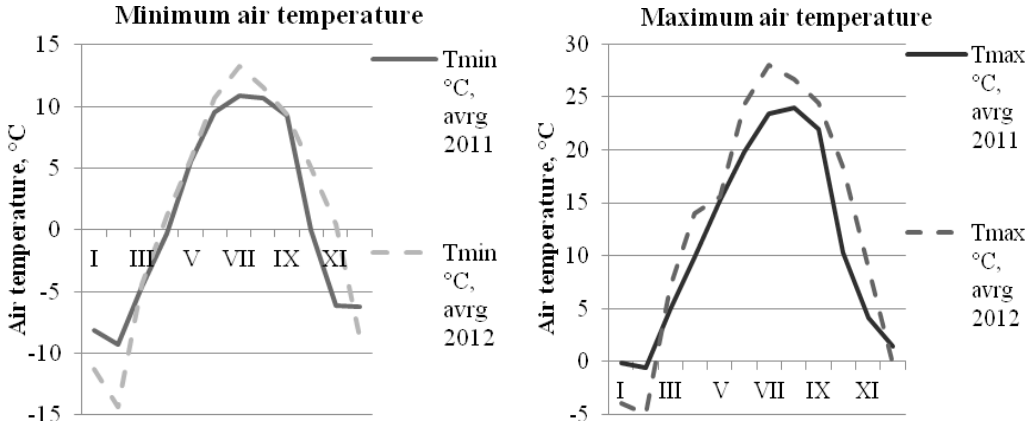

Fig. 3. Monthly average maximum and minimum air temperature in 2011 and 2012.

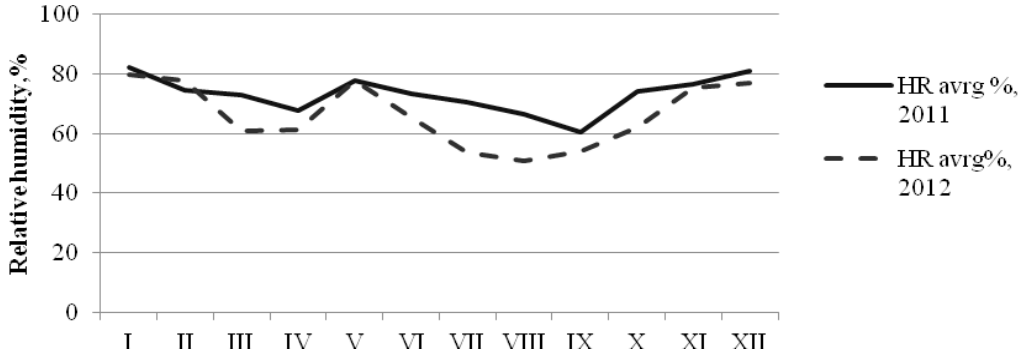

Fig. 4. Monthly average relative humidity in 2011 and 2012.

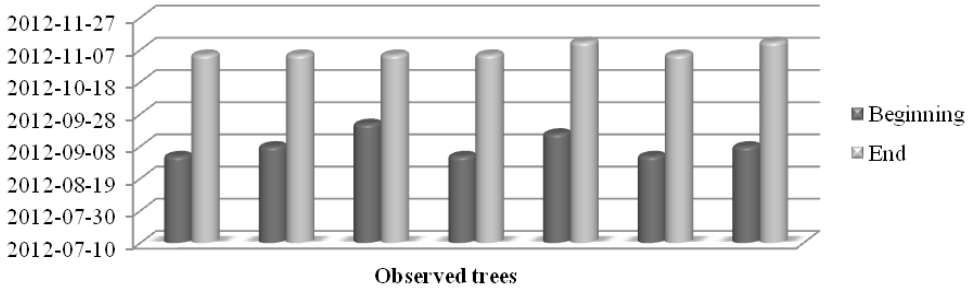

Fig. 5. Beginning and end of colouring in 2012.

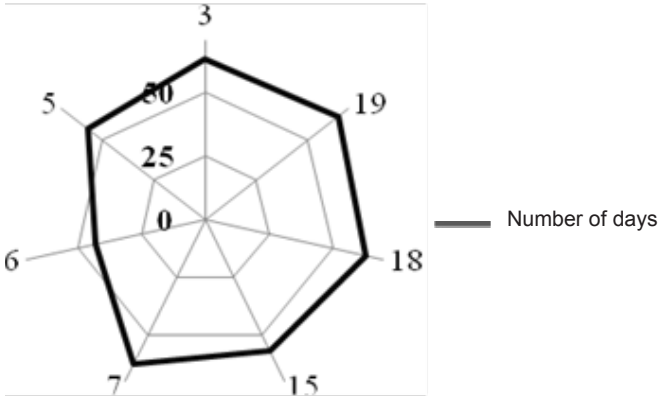

Fig. 6. Duration of yellowing in 2012.

two years in the period from May to November, when the accumulated air temperature and air relative humidity amounts directly related to the autumn colouring of the leaves.

During the reference year (2012) lack of fruiting was reported.

Autumn phenological phases in 2012 began very early. In the beginning of September instead of autumn colouring, was observed actively wilting of the leaves, which progressed to the middle of the month, and then the process was stable and relatively even (Fig. 7, 8, 9, 10, and 11). This is probably due to the low relative air

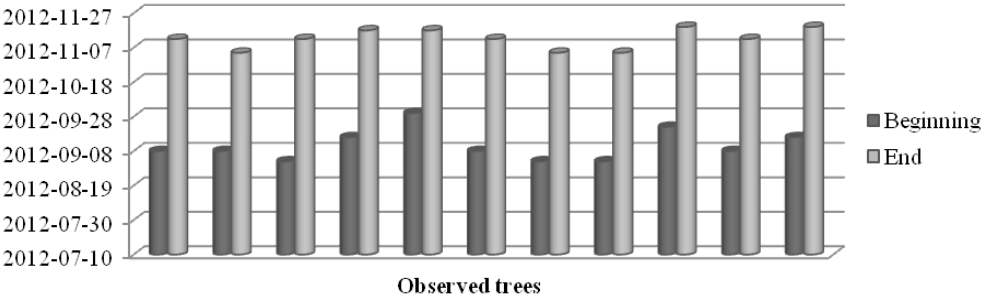

Fig. 7. Beginning and end of leaf fall in 2012.

humidity (Fig. 6) and high maximum air temperature (Fig. 5) recorded during the summer months. The combination of these weather indicators leads to difference in the occurrence of autumn phenological phases during 2012 compared to 2011. Yellowing of some of the trees continued 63 days in 2012. The longest phase in 2011 was 50 days. This is almost two weeks shorter than 2012.

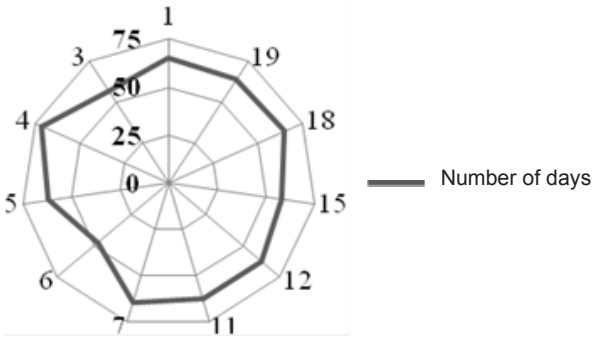

Fig. 8. Length of leaf fall in 2012.

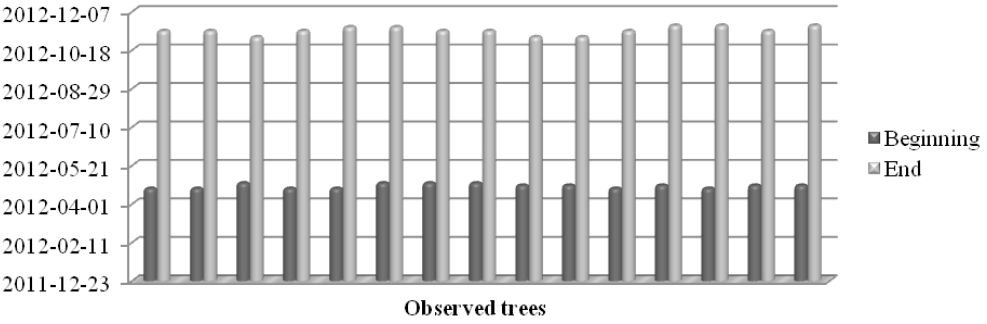

Fig. 9. Beginning and end of the growing season, 2012.

The autumn falling of leafs in 2012, and the autumnal colouring began very early (in the last days of August) due to the very high summer air temperature, low relative air humidity and drying of the leaves. After a rapid start, the process was gradually stabilized for about 65 days; all the trees passed through five levels of defoliation. Thus, during the reference year the ending of tree leafs falling was in the third decade of November unlike the previous year when it happened in the second decade of the month.

In general, the vegetation period in 2012 started in the second decade of

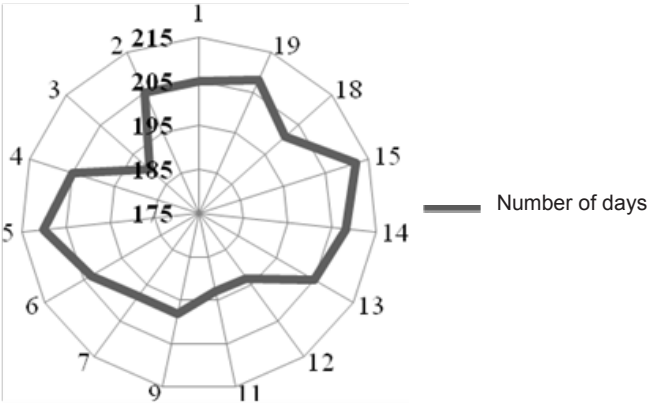

Fig. 10. Duration of the growing season, 2012.

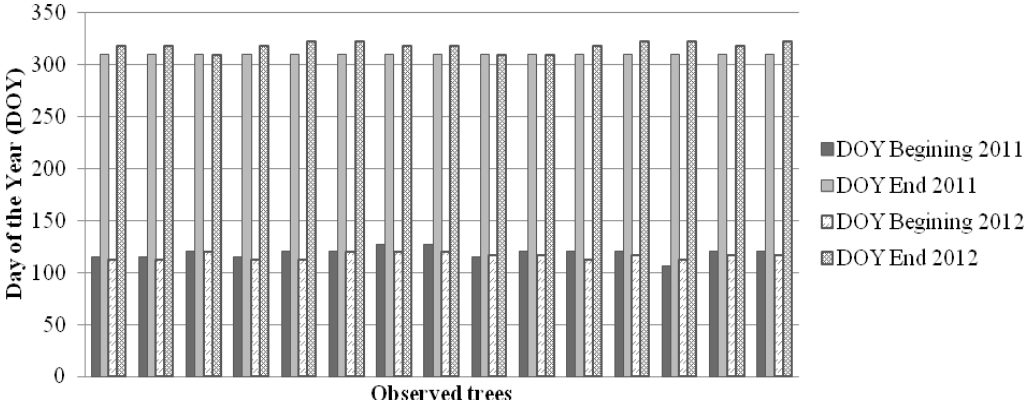

Fig. 11. Beginning and end of the growing season, 2011 compared with 2012.

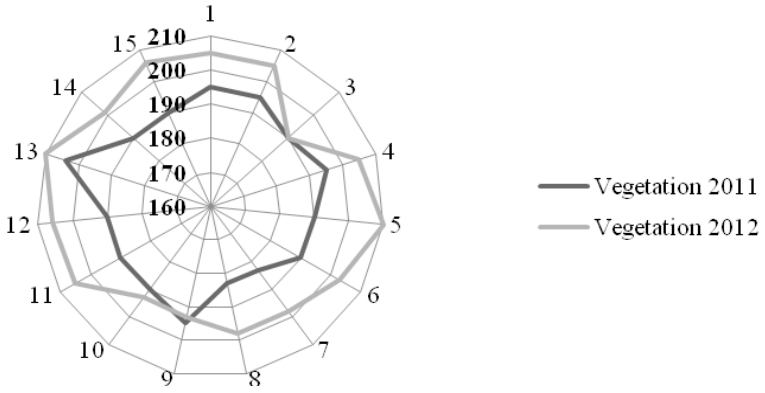

Fig. 12. Duration of the growing season, 2011 compared with 2012.

April with the bud burst, which – despite low minimum temperature in winter – almost coincides with those in the previous year. This is most likely due to the need to achieve a photoperiod of 13–15 h lighting of *Fagus sylvatica* L. (Čufar et al. 2012), suggesting little variation in leafing and spring phenologycal phases. In contrast, autumn phases were longer and, respectively, the growing season (Fig. 9 and 10) was extended in 2012. This is not the typical manner of an extension of the vegetation, as it generally is due to the extension of a flushing, but not in a delayed colouring and leafs falling.

Comparing 2011 and 2012 it is seen that the growing season began earlier and ended later in 2012 (Fig. 11). The duration of the process is longer in 2012 year and is 205 days, which is clearly seen in Figure 12 and in 2011 it is about 190 days.

Conclusions

In 2012 for *Fagus sylvatica* were observed the main phases of the development – buds burst, leafing, flowering, autumn colour change and leaf fall. The period of leafing in 2012 is in the range of 7–14 days, which is shorter than the previous 2011 year. There was an active flowering in all individuals. Extreme

climate data (2012), air temperature and relative air humidity were leading to differences in autumn phenologycal phases. In early September, instead of changing the natural colour of the leaves, typical for this time of year, drying was observed. This period covered about 2 weeks and then colouring passed into relatively natural limits. In some trees, this stage (colouring) had duration of 63 days, which is almost two weeks longer than the previous year. Leaf falling followed the colouring lasting about a week more, and ended in the third decade of November. The vegetation period had a longer duration, due to the extension of the fall phenologycal stages (colouring and falling of leafs). This trend is not very common, because the most European tree species increase the duration of the vegetation period due to a greater degree of spring phases of development, not because of autumn once (Davi et al. 2011, Vitasse et al. 2011).

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