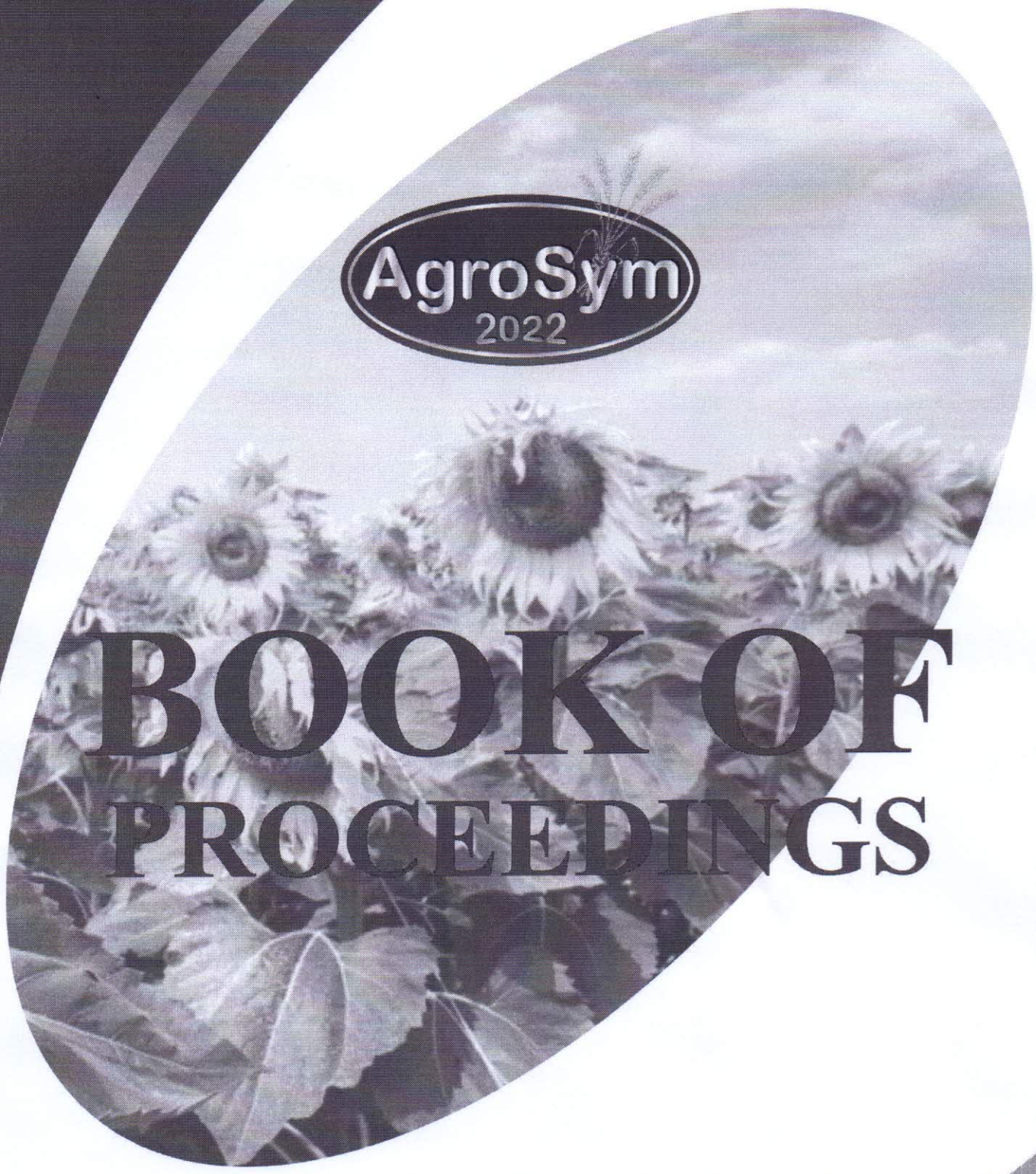

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CONTENTS

POPULATION DYNAMICS OF EARLY OAK DEFOLIATORS IN CORRELATION WITH MICRO-CLIMATIC TEMPERATURE CONDITIONS IN KRAGUJEVAC AREA IN SERBIA

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Abstract

Forest dieback that comes in waves since the early 20th century has lately grown into an epidemic, in particular in oak stands. For this reason, research was conducted of the population dynamics of early oak defoliators, which represent a grave danger in oak stands due to their gradogenic attributes. The research was carried out over a 5-year period in oak forests in the area of forest administrations Kragujevac and Gornji Milanovac. The samples used in the research were collected from bottom branches, where Geometridae were found in the largest numbers, as well as from the mid and upper parts of the crowns, where other species were found. Population levels of these pests were presented in laboratory conditions on winter branch samples and in newly foliated stands on site, depending on the basic parameters of the climatic conditions. The greatest deviation of the population level of early oak defoliators was noted in 2018 on all 6 presented localities through the analysis of winter branches and the analysis of their presence in newly foliated stands on site, and it was followed by the highest average air temperature.

Key words: *defoliators, oak, population level, forecast of attacks.*

Introduction

As a result of global climate changes, the enhanced forest protection system is being put in place with the highest degree of urgency. This is particularly important in unstable forest ecosystems (primarily in oak forests) in which defoliation, i.e. reduction in leaf area that most frequently occurs due to defoliating insects, is highly significant (Bosnjak, 2004).

Defoliating insects are prone to occasional and cyclical gradations, and as such able to compromise the production process in forestry and escalate the decline and degradation of forest ecosystems. Gypsy moth used to be considered intolerant to competition by early defoliators, due to which it would start gradations on its own. However, recent studies conducted in Germany as well as in Serbia demonstrate that gypsy moth gradations overlap with gradations of early defoliators, which makes it critical to establish the abundance of these pests.

Damages caused by oak defoliators are manifold. After major attacks by defoliating insects the production of early and late trees decreases, and the same happens in the period following the defoliation. According to research conducted by Simmons et al. (2014), the production of late *Quercus* trees drops by as much as 67% in the year of defoliation, while the production of early trees is decreased by up to 24% in the year following the defoliation. Moreover, Spaić (1986) states that defoliation is in part the cause of low acorn yield, and that rigorous suppression of defoliators in oak seed stands may significantly increase the yield.

Strength of the attack and spread of the pest partially may also depend on the type of host plants, as not all oaks are equally vulnerable to attack by defoliators. For instance, *Quercus petraea* was

found to be more sensitive than *Q. cerris* and *Q. frainetto* (Glavendekić and Medarević, 2010), however the impact of climatic factors remains crucial.

The greatest damage in oak forests is caused by species that show gradogenic attributes, as they occur in mass over certain time intervals. These include species from the family of geometrids (Lepidoptera: Geometridae), tortrix moths (Lepidoptera: Tortricidae) and noctuids (Lepidoptera: Noctuidae). They cause damage not only to leaves, but also to buds and shoots. Fluctuations of their populations are impossible to predict with certainty, and their outbreak does not follow any discernible pattern (Majović and Glavendekić, 2011). Beside gradogenic species, it is important to note the presence of other species whose individual effect is minor, but should under no circumstances be neglected in competition with gradogenic species (Mihajlović and Glavendekić, 2006) as it causes disturbance in the functioning of forest ecosystems (Darr and Coyle, 2021).

It is therefore necessary to conduct regular monitoring of the population level of these pests, based on the principles of forestry diagnostic forecast services as defined by the International Plant Protection Convention (UN) and directives of the European and Mediterranean Plant Protection Organization (OEPP/EPPO), which are incorporated into sectoral laws and bylaws as the obligation of every country (Law on Plant Health and Law on Forests, Rulebook on Lists of harmful organisms and Lists of plants, plant products and regulated objects).

The abundance of the population is determined by several methods: examination of winter branches under laboratory conditions at a constant temperature and air humidity; study of samples from foliated stands in which their numbers depend on climatic conditions; by means of glue boards which trap wingless females going into tree crowns to lay eggs. The degree of danger from defoliation by insects in the following spring (a critical number or threat of heavy defoliation) for winter moths is 1 female per 1 cm of tree diameter in Europe and in Serbia, and 2 females per 1 cm in Croatia (Spaić and Glavaš, 1988). In this paper, the first two methods were used and the obtained results were compared.

Materials and methods

On the basis of the Operative Plan, within the framework of the activity "Establishing the abundance of early oak defoliators from order *Lepidoptera* based on the results of laboratory experiments with winter branch samples, and the prognosis of their harmful effects in natural forest ecosystems", during the months of January and February the laboratory of the Institute for Forestry (Belgrade, Serbia) conducts the macroscopic analysis of the presence and abundance of individual gradogenic species of early oak defoliators on winter oak branch samples.

Branch samples roughly 70 cm long with buds are cut with pruning shears and packed into nylon bags, which are kept in the refrigerator at 4^0C to prevent hatching of caterpillars prior to the examination. Branches are placed in the laboratory for hatching and examined through a magnifying glass, where each sample undergoes double laboratory analysis.

The method used to establish population density of early oak defoliators in the larvae stadium is rearing winter branch samples in the laboratory (meaning, prior to commencement of vegetation and hatching of caterpillars under natural conditions). One of the disadvantages of this method is difficulty in collecting samples from different parts of the crown. Felling is not suitable due to a large number of trees needed, while climbing to the top is hindered during wintertime. For this reason, in some places the samples were taken from the bottom branches, in which Geometridae are present in the largest number, so the qualitative composition of defoliators does not reflect

the actual state in the forest. Moreover, in wintertime it is difficult to differentiate between the vital trees and those in various phases of dieback. Another downside is that it is often impossible to transport the branch samples immediately, so they are kept for days under inadequate conditions which diminishes their vitality and makes many buds dry out, while the caterpillars inside them die due to lack of feed.

Branch samples are reared for a month in glass jars with water, at the room temperature of 23°C. The samples are controlled daily, and after the first particles of excrement appear at the bottom of the jars, the first larvae of early oak defoliators are collected, determined and recorded. At the end of the laboratory experiment, each sample is once again thoroughly examined, all leaf buds are counted, and on this basis the calculation of the number of leaves in the sample is made (number of buds multiplied by 4).

In their respective studies, Kulfan et al (2019) and Sarvašová et al (2020) emphasize that monitoring the abundance of population of early oak defoliators only during wintertime is not sufficiently reliable to serve as basis for predicting the risk of defoliation the following spring. The samples analyzed under laboratory conditions are therefore only a likely indicator of the future real situation in the field. Given that development of pests directly depends on the climatic conditions during their growth, the exact numbers may be determined with certainty only through examination of foliated stands. An additional control examination of samples from foliated stands was thus performed during the month of May.

The paper presents the results of research of the population level density of early oak defoliators reared under laboratory conditions during winter, at a constant temperature, as well as in the nature (in the field) after the foliation. The presented research used the samples collected from 6 sites in the area managed by the Forest Management Office Kragujevac, and the research spanned a period of 5 years – between 2016 and 2020. (Pest Diagnostic Forecast Service reports 2016 – 2020). The climatic conditions for each year of the research are presented based on the average air temperature during the month of May (at the time of full foliage), and the data were sourced from Meteorological Almanacs of the Republic Hydrometeorological Institute of Serbia and taken at the measuring station Kragujevac. The results of the determined population abundance of early oak defoliators are presented in the table relative to the constant temperature under laboratory conditions during the month of February, and relative to the average temperature in the field during the month of May.

Results and discussion

Population level of early oak defoliators under laboratory conditions and in foliated stands in the field, in the period 2016 – 2020

Based on the data for each year of the research, Table 1 was compiled to provide a comparative view of the mean monthly air temperature and humidity that was constant throughout the laboratory examination of the winter branches (the temperature was 23^0C and the relative air humidity was maintained at 80%), however in the field, spring climatic conditions were changeable depending on the weather conditions during the year, which undoubtedly impacted the development of the examined pests in the spring.

Table 1. Population level of early oak defoliators reared in the laboratory on winter branch samples and in foliated stands in the field in the area of Forest Management Office Kragujevac, subject to basic parameters of climatic conditions, in the period 2016 – 2020.

Coordinates, Name of location (FMU, section)	Month, year	Mean monthly air temperature (^{0}C)	Number of caterpillars per 1000 leafs			
			Tortricidae	Geometridae	Other	Total
4888000;7509000 FMU Rogot, 8/a	Feb 2016	23.0	3.2	22.2	0.0	25.1
	May 2016	15.6	0.0	0.0	0.9	0.9
	Feb 2017	23.0	0,0	0.0	0.0	0.0
	May 2017	12.2	0.8	0.8	0.0	1.6
	Feb 2018	23.0	37.8	0.0	0.0	37.8
	May 2018	19.0	2.1	0.0	0.0	2.1
	Feb 2019	23.0	0.0	0.0	0.0	0.0
	May 2019	14.7	0.5	0.0	0.0	0.5
	Feb 2020	23.0	1.2	0.0	0.0	1.2
	May 2020	15.8	0.0	0.0	0.0	0.0
4884000;7466000 FMU Rudnik I, 105/6	Feb 2016	23.0	2.4	2.8	0.0	5.2
	May 2016	15.6	1.5	0.0	1.5	3.0
	Feb 2017	23.0	0.0	0.0	0.0	0.0
	May 2017	12.2	0.0	0.0	0.0	0.0
	Feb 2018	23.0	27.7	0.0	0.0	27.7
	May 2018	19.0	0.7	0.0	0.0	0.7
	Feb 2019	23.0	0.0	2.1	4.1	6.2
	May 2019	14.7	6.0	0.0	1.3	7.3
	Feb 2020	23.0	1.2	0.0	0.6	1.8
	May 2020	15.8	1.1	0.0	0.0	1.1
4883000;7467000 FMU Rudnik I, 104/a	Feb 2016	23.0	19.3	12.1	0.0	31.4
	May 2016	15.6	2.3	0.0	1.5	3.8
	Feb 2017	23.0	0.0	0.0	0.0	0.0
	May 2017	12.2	3.6	2.1	0.7	6.4
	Feb 2018	23.0	0.0	0.0	0.0	0.0
	May 2018	19.0	2.9	0.0	1.1	4.0
	Feb 2019	23.0	0.0	0.0	0.0	0.0
	May 2019	14.7	3.4	1.1	2.2	6.7
	Feb 2020	23.0	0.5	0.0	0.0	0.5
	May 2020	15.8	1.1	1.1	0.0	2.2
4881500;7459300 Rajac-Ostrvica, 57/a	Feb 2016	23.0	7.5	2.5	0.0	10.0
	May 2016	15.6	0.0	0.0	4.8	4.8
	Feb 2017	23.0	0.0	0.0	0.0	0.0
	May 2017	12.2	0.8	0.0	1.6	2.4
	Feb 2018	23.0	130.4	0.0	86.9	217.3
	May 2018	19.0	0.9	0.0	0.0	0.9
	Feb 2019	23.0	0.0	0.0	0.0	0.0
	May 2019	14.7	0.0	0.0	0.7	0.7
	Feb 2020	23.0	0.0	1.2	0.0	1.2
	May 2020	15.8	0.0	0.0	0.0	0.0
	Feb 2016	23.0	0.0	5.1	0.0	5.1

4873000;7454000 FMU Vujan-Rozanj, 64/a	May 2016	15.6	0.0	0.0	0.0	0.0
	Feb 2017	23.0	0.0	0.0	0.0	0.0
	May 2017	12.2	8.0	2.0	4.0	14.0
	Feb 2018	23.0	0.0	0.0	0.0	0.0
	May 2018	19.0	0.7	0.7	0.7	2.1
	Feb 2019	23.0	0.0	0.0	0.0	0.0
	May 2019	14.7	2.4	0.0	1.2	3.6
	Feb 2020	23.0	0.0	0.0	0.0	0.0
	May 2020	15.8	0.0	0.0	0.0	0.0
4892000;7459300 FMU Rudnik II, 76/б	Feb 2016	23.0	0.0	0.0	0.0	0.0
	May 2016	15.6	0.0	0.0	0.0	0.0
	Feb 2017	23.0	0.0	0.0	0.0	0.0
	May 2017	12.2	3.7	0.0	0.9	4.6
	Feb 2018	23.0	0.0	0.0	0.0	0.0
	May 2018	19.0	4.7	0.9	1.9	7.5
	Feb 2019	23.0	0.0	0.0	0.0	0.0
	May 2019	14.7	2.3	0.0	0.0	2.3
	Feb 2020	23.0	7.4	0.0	0.0	7.4
	May 2020	15.8	0.0	0.0	0.0	0.0

In the presented period of research, 2016 to 2020, the average temperature variation during foliation ranged between 12.2 and 19.0^{0}C, while over the duration of the experiment in the laboratory in wintertime the temperature was maintained at a constant 23.0^{0}C.

Deviations in the prognosis of abundance of early oak defoliators for each year of the research based on the laboratory examination relative to their abundance in the field during spring of the same year (period 2016 – 2020)

As previously stated, the analysed samples of winter branches are only a likely indicator of the real situation in the field, and given that development of pests directly depends on the climatic conditions during their growth, the exact numbers may be determined with certainty only through examination of foliated stands. For this reason, they were re-examined and counted during foliation in May.

The results presented in Table 1 clearly demonstrate that the greatest deviation in the level of population of early oak defoliators through the analysis of winter branches (February) and the analysis of their presence in foliated stands in the field (May) was recorded in 2018 in all 6 presented sites. In one site the deviation is drastic (217.3 versus 0.9), medium in two sites (37.8 versus 2.1; 27.7 versus 0.7), while in the remaining 3 sites the deviation is low (0.0 versus 2.1; 0.0. versus 4.0; 0.0 versus 7.5). The deviation in 2018 in all presented sites showed greater abundance of the pest population in winter branch samples. That same year, at the time of foliation, the highest average air temperature was recorded (19.0^{0}C), which alongside all other factors did not favour the development of the pests.

According to the reference sources (Fält-Nardmann et al, 2016), changes of climatic conditions may ease changes in the pest range and spread, but may also have a negative impact on herbivores insects in case of disturbance in the locally adapted synchronization between the insect phenology and the phenology of their host plants. The capacity of a pest species to

colonize new areas depends on its ability to adjust the time of phenological events in its bionomia.

In the year 2016, a slight increase of abundance was found in Forest Management Office Kragujevac, Forest Management Unit (FMU) Rudnik I, section 104/a, with the presence of 19.3 Geometridae caterpillars and 12.1 caterpillars of other species, which in total amounted to 31.4 caterpillars per 1,000 leaves. This led to conclusion that in this site the spring of 2016 a mild crown lightening may be expected, which did not happen as their total abundance decreased to 3.8 caterpillars. In spring 2016 in the area of FMO Kragujevac, the average defoliation amounted to 5 to 10%. Among other harmful insects and diseases, the presence of oak flea beetles, weevils, powdery mildew, leaf miners and gall wasps *Cynipidae* was found. These insects partially contributed to defoliation of the leaf mass along with early oak defoliators, while powdery mildew occurred in a narrow scope and had no effect on the increment of the stands.

Laboratory analysis of samples from the area of FMO Kragujevac in 2017 and 2019 did not detect any increase in the abundance of early oak defoliators, which was confirmed in the spring, and defoliations were very low (up to 5%). In FMU Rudnik I, section 105/b, the examination conducted in the spring 2017 uncovered severe damages of the leaf mass caused by frost (picture 13) and new leaf mass was in the process of forming at the moment of the examination, while among harmful insects and diseases the examination found oak flea beetles, leaf miners, gall wasps *Cynipidae,* and powdery mildew. In 2019, in the FMU Rogot, weevils were found to be present in large numbers, which contributed to defoliation

In 2018, laboratory analysis established a significant increase of the abundance of early oak defoliators in FMO Milanovac, FMU Rajac-Ostrvica, section 57/a, with great predominance of defoliators from the Tortrix month family (Tortricidae) – 130.4 caterpillars per 1,000 leaves. The increased numbers of these pests were also found in FMO Kragujevac, FMU Rogot, section 8/a in particular, where once again Tortrix moths dominated – 37.8 caterpillars per 1,000 leaves. It was therefore presumed that stronger crown lightening would occur in the spring, however it did not happen and the abundance of these pests was reduced to only 0.9 caterpillars per 1,000 leaves, which caused no significant defoliation of the leaf mass. In the spring of 2020, defoliation did not exceed 10% and mostly remained in the range from 2 to 5%.

In 2020, a slight increase of the abundance of early oak defoliators was found in FMO Milanovac, FMU Rudnik II, section 76/b, with dominant defoliators from the Tortrix moth family (Tortricidae) – 7.4 caterpillars per 1,000 leaves. It was again presumed that mild crown lightening would occur in the spring, however it did not happen as in the spring their abundance was reduced to the extent that no caterpillars were found during the examination of samples from foliated stands (0.0) (picture 14). In the spring of 2020, defoliation did not exceed 5% and mostly remained in the range from 0 to 2%.

Taking into account that in the presented research period 2016 – 2020 the presence of caterpillars of early oak defoliators in the area managed by FMO Kragujevac was below the threshold of harm and the damages to the leaf mass were minimal, no additional measures of protection were applied other than those prescribed that are regularly implemented every year.

Conclusion

Some of the main pests in our most valuable oak forests include large and small winter moth, oak leafroller, oak sawfly, and lackey moth, which together with other species of minor significance form the complex of "early oak defoliators".

Early oak defoliators show gradogenic attributes, as they occur in mass over certain time intervals. They cause damage not only to leaves, but also to buds and shoots. Fluctuations of their populations are impossible to predict with certainty, and their outbreak does not follow any discernible pattern. The samples analyzed under laboratory conditions are only a likely indicator of the future real situation in the field, given that development of pests directly depends on the climatic conditions during their growth and the exact numbers may be determined with certainty only through examination of foliated stands. Therefore, besides the examination of winter branches and rearing of pests under laboratory conditions, the prognosis of their abundance necessitates the examination of stands once they are foliated, which in Serbia's climate means during the month of May.

The main goal of the examination and control of abundance of the pest population in stands is to determine their presence and identify the degree of danger to which the forests are exposed.

In oak stands, beside gradogenic species, there is a significant presence of other species whose individual effect is minor, but should under no circumstances be neglected if they occur in competition with gradogenic species as it causes disturbance in the functioning of forest ecosystems.

The population level of early oak defoliators largely depends on climatic factors, primarily the temperature at the time of foliation. The greatest deviation in the level of population of early oak defoliators through the analysis of winter branches (February) and the analysis of their presence in foliated stands in the field (May) was recorded in 2018 in all 6 presented sites. In one site the deviation is drastic (217.3 versus 0.9), medium in two sites (37.8 versus 2.1; 27.7 versus 0.7), while in the remaining 3 sites the deviation is low (0.0 versus 2.1; 0.0. versus 4.0; 0.0 versus 7.5). The deviation in 2018 in all presented sites showed greater abundance of the pest population in winter branch samples. That same year, at the time of foliation, the highest average air temperature was recorded (19.0^0C), which alongside all other factors did not favour the development of the pests.

The work on researching the presence of defoliators and their abundance continues in order to ensure implementation of the required measures of protection in a timely manner and to prevent greater damage to our most valuable oak forests.

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References

Bošnjak, T. (2004): „Forest protection", Journal of Plant Protection 6/2004, pp 103-106.

Darr, M. N., Coyle, D. R. (2021): „Fall Cankerworm (Lepidoptera: Geometridae), a Native Defoliator of Broadleaved Trees and Shrubs in North America", *Journal of Integrated Pest Management,* Volume 12, Issue 1, pp 23.

Fält-Nardmann, J., Klemola, T., Roth, M., Ruohomäki, K., Saikkonen, K. (2016): "Northern geometrid forest pests (Lepidoptera: Geometridae) hatch at lower temperatures than their southern conspecifics: Implications of climate change". Eur. J. Entomol. 113, pp 337–343.

Glavendekić, M.M., Medarević, M.J. (2010): "Insect defoliators and their influence on oak forests in the Djerdap National Park, Serbia". Arch. Biol. Sci. 62, pp 1137–1141.

Kulfan, J., Sarvašová, L., Parák, M., Zach, P. (2019): "Effects of a host tree on movement and distribution of winter geometrid moths (Lepidoptera): Thickness of trunks and branches". Folia Biol. Oecologica 46, pp 83–90.

Majović, J., Glavendekić, M. (2011): „The most important early defoliators in the area of the Đerdap National Park and their parasitoids", Plant medical, Vol 39, No 6, pp 576-590. [in Serbian]

Mihajlović, Lj., Glavendekić, M. (2006): „The most important entomological problems in the suburban forests of Serbia ", Forestry, 58(3), pp 77-97. [in Serbian]

Sarvašová, L., Ján Kulfan, J., Saniga, M., Zúbrik, M., Zach, P. (2020): "Winter Geometrid Moths in Oak Forests: Is Monitoring a Single Species Reliable to Predict Defoliation Risk", Forests 2020, 11, 288, pp 1-12.

Simmons, M.J., Lee, T.D., Ducey, M.J., Elkinton, J.S., Boettner, G.H., Dodds, K.J. (2014): "Effects of invasive winter moth defoliation on tree radial growth in eastern Massachusetts, USA". Insects, 5, pp 301–318.

Spaić, I. (1986): „ Study of organisms that prevent the yield of English oak and attempts to preserve the yield by suppressing those organisms" , The Final report on the scientific research for the period from 1981 to 1985. Zagreb [in Croatian]

Spaić, I., Glavaš, M. (1988): „The causes of damages to the English oak in Yugoslavia", Journal of forest experiments: Annales pro experiment is forensics, 1988, 24, pp 199 - 226 [in Serbian]

Report on conducted "Pest diagnostic forecast service in forest protection and other matters of public interest in the field of protection of forest plants" on the territory of the Republic of Serbia without the territory of the Autonomous Province of Vojvodina, in the year 2016, Institute for Forestry Belgrade [in Serbian]
https://www.forest.org.rs/files/izvestaj-idps-2016-godina.pdf

Report on conducted "Pest diagnostic forecast service in forest protection and other matters of public interest in the field of protection of forest plants" on the territory of the Republic of Serbia without the territory of the Autonomous Province of Vojvodina, in the year 2017, Institute for Forestry Belgrade [in Serbian]
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Report on conducted "Pest diagnostic forecast service in forest protection and other matters of public interest in the field of protection of forest plants" on the territory of the Republic of Serbia without the territory of the Autonomous Province of Vojvodina, in the year 2018, Institute for Forestry Belgrade [in Serbian]
https://www.forest.org.rs/files/Izvestaj%20za%20idps%202018.pdf

Report on conducted "Pest diagnostic forecast service in forest protection and other matters of public interest in the field of protection of forest plants" on the territory of the Republic of Serbia without the territory of the Autonomous Province of Vojvodina, in the year 2019, Institute for Forestry Belgrade [in Serbian]
https://www.forest.org.rs/files/Izvestaj%20za%20idps%202019.pdf

Report on conducted "Pest diagnostic forecast service in forest protection and other matters of public interest in the field of protection of forest plants" on the territory of the Republic of

Serbia without the territory of the Autonomous Province of Vojvodina, in the year 2020, Institute for Forestry Belgrade [in Serbian]
https://www.forest.org.rs/files/IDPP%20IZVESTAJ%20ZA%202020.%20GODINU.pdf
The Republic Hydrometeorological Institute of Serbia (RHMZ) Meteorological Almanac – climate data, the Republic of Serbia [in Serbian]
http://www.hidmet.gov.rs/ciril/meteorologija/klimatologija_godisnjaci.php