# PINE FORESTS IN LABIN'S
# YESTERDAY - TODAY - TOMORROW

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## Abstract:


We decided to reinvestigate pine forests. We assumed that twenty years is a enough period in life of the forest and changes will be visible.

QUESTIONS: How old are the pine forests? What is the state of pine forests today and what is their future?

Work is divided into two parts: fieldwork at six locations, we determined coordinates, cover, age, degree of damage, and took samples of soil and needles, which we analyzed in the second part. In work, we used GLOBE protocols and instructions of the FORESTRY INSTITUTE, Zagreb.

Through research, we confirmed our assumptions and got answers to questions:

The pine forests of Labin are in a worse condition, because the level 3 and 4 damage has increased significantly.

The oldest forest is at the Pineta, it was planted 120 years ago, age in the other locations corresponds to the development of Podlabin and Rabac.

Sources of soil and air pollution are not significant for damage of forests.

In the past period, a series of human activities reduced the area of forests.

It has been noted that human care for forests is not enough considering the values that are obtained from them, so we believe that this is the biggest reason for the decline of pine forests in our area.

We will monitor activities related to the preservation of our forests.


**Key words:** pine forests, degree of damage, human activities, preservation

## Research Question and Hypothesis:

**In 2003**, the Globe group of our school investigated the state of the pine forests in the area of the town of Labin. Research has shown that pine forests are in a relatively bad condition!
**With this project our group was also part of the Croatian national team**
at the World Student GLOBE Conference, **GLE - Šibenik - 2003.**


**Figure 1.** GLE 2003. Šibenik.
**Source:** https://globe.pomsk.hr/gle_hrv.htm

**As part of the Global GLOBE Climate and Carbon Campaign 2024,**
"My Place Yesterday and Today",
https://storymaps.arcgis.com/stories/d861dccdfd1f4b2fb8ef758c40e3ce1b
we decided to re-investigate pine forests in LABIN after twenty years.

**OUR RESEARCH QUESTIONS:**
How old are the Labina pine forests?
What is the state of the Labina pine forests today and what is their future?

**OUR HYPOTHESIS**
We assumed that twenty years is a long enough period in the life of the forest and that changes will be visible.
We think that the condition of the forests will be worse because of many human activities in the past period.

## Introduction and Review of Literature:

**Forests** are terrestrial ecosystems that have evolved over millions of years. They represent a balanced, functional whole that renews, maintains and organizes itself.

The general protective functions of forests are: prevention of erosion, air purification, protection of settlements and roads from wind and snow drifts, protection of settlements from noise, preservation of animal and plant life, water purification and regulation of the water regime

Socially useful functions of forests are: beautifying the landscape, mitigating climatic extremes, maintaining ecological balance, a place for tourist facilities, place for hunting and a source of forest fruits.

**Forests occupy 40% of the vegetation surface of the Earth, and their role in the life of the entire biosphere is invaluable.**

**According to the Act on Forests of the Republic of Croatia** (Official Gazette 68/18, 115/18, 98/19, 32/20, 145/20, 101/23, 36/24), forests and forest lands are good and are of interest to the Republic of Croatia and have her special protection. The area of forests and forest land in Croatia is about 2,500,000 ha, which is 47% of the land area of Croatia.
**The Law on Forests** stipulates that forest management includes the cultivation, protection and use of forests and forest land, as well as the construction and maintenance of forest infrastructure with the aim of meeting all European criteria for sustainable forest management[(9)].


**Figure 2.** Pine forests in Croatia
**Source:** https://narodne-novine.nn.hr/clanci/sluzbeni/full/2008_09_107_3185.html

From "Total development of the city of Labin 2008 - 2018"[(7)],
state of the forest fund of Labinština:
Total forest area: 19076 ha
According to forest type:
85% are deciduous,
15% coniferous forest.

## Research Methods and Materials *(Including GLOBE Data!)*:

Cooperation was achieved with FORESTRY INSTITUTE, ZAGREB,
CROATIAN FORESTS, LABIN, and CITY OF LABIN, Spatial Planning Department

24 GLOBE students participated in the research, divided into six teams of four students each. Three teams worked in the field, two in the school laboratory, and one was in charge of analyzing the results and creating a presentation. Excellent team cooperation was achieved. The time of realization is from September 2023. until November 2024.

The research is divided into two parts: fieldwork at six locations of pine forests, in which we recorded the coordinates of the measurement points, determined the type of cover, the age of the forest, the degree of canopy damage, and took samples of the soil and plant material (needles), which we in the second part analyzed in the school laboratory.
From accessories and materials, we had everything we needed according to individual protocols.
We used our globe web database to compare the data.

In our work, we used the following work methods:
We used Globe GPS protocols(1) to determine geographic coordinates and Globe MUC protocols(2) for land cover classification. For soil analysis we used Globe soil protocols(3)
To determine the age of the trees, we used the "TREE RING" PROJECT PROTOCOL(4), in which our group joined in 2011. (Figure 3) and counting the years on the sawn trees.


**Figure 3.** Tree ring protocol

To determine the degree of damage to the crown of pines, we used the text APPEARANCE OF DAMAGED FIR, SPRICE AND BEECH TREES, Ph.D. VLADIMIRA KUŠAN et al.(5) and the proposal of the team of the FORESTRY INSTITUTE(8) from JASTREBARSKO led by Ph.D. BORISOM VRBEK, who ith his team in 2003 stayed in Labin on two occasions and worked in the field with our globe students.Together they devised a method for valuing pine trees crown (Figure 4.)that we compared with the RULES ON THE METHOD OF MONITORING DAMAGE TO FOREST ECOSYSTEMS,Official Gazette 67/2010(8) (hereinafter RULES) and as the methods match, we have created instructions and worksheet for observers in the field.

**INSTRUCTIONS AND WORKSHEET**

According to the RULE, trees are classified into four categories after a visual assessment:

| Degree | Crown appearance | Percentage of loss of needles/leaves |
|---|---|---|
| 0 | there are no absences | 0 – 10 |
| 1 | mild absence | 11 – 25 |
| 2 | moderate absence | 26 – 60 |
| 3 | strong absence | 61 – 99 |
| 4 | dead tree | 100 |

**Mode of operation:**

• If the location is small, all pine trees are counted and rated.

• If the forest is large, THREE research plots of 10 x 10 m are selected and counted on them and evaluate all pine trees.

| DEGREE OF DAMAGE | PERCTENTAGE OF DAMAGE | THE APPERANCE OF THE TREE |
|---|---|---|
| 0 | 0-10% | Normally thick crown, with slightly noticable less of leaves in the lower part. F you look at the tree from the bottom, the crown appers almost intransparent. |
| 1 | 11-25% | The fall of the needles starts inside out in the lawer and middle part of the crown. Dry twigs appear in the lower part looking along the trunk the crown looks partly transparent. |
| 2 | 26-60% | The needles appear to be more numerous in the lower and middle part of the crown. At the bottom of the crown same thicker dry branches appear. There are dry twigs over the whole crawn. Looking aside the structure can be seen. Looking along the trunk, the crown appears transparent to its top. |
| 3 | 61-99% | There are numerous needles and a certain number of dry twigs over the whole crown. There are some thicker dry branches at the bottom and in the middle of the crown. The structure can be seen clearly. There are green sprouts only on top. |
| 4 | 100% | Completely dry tree. |

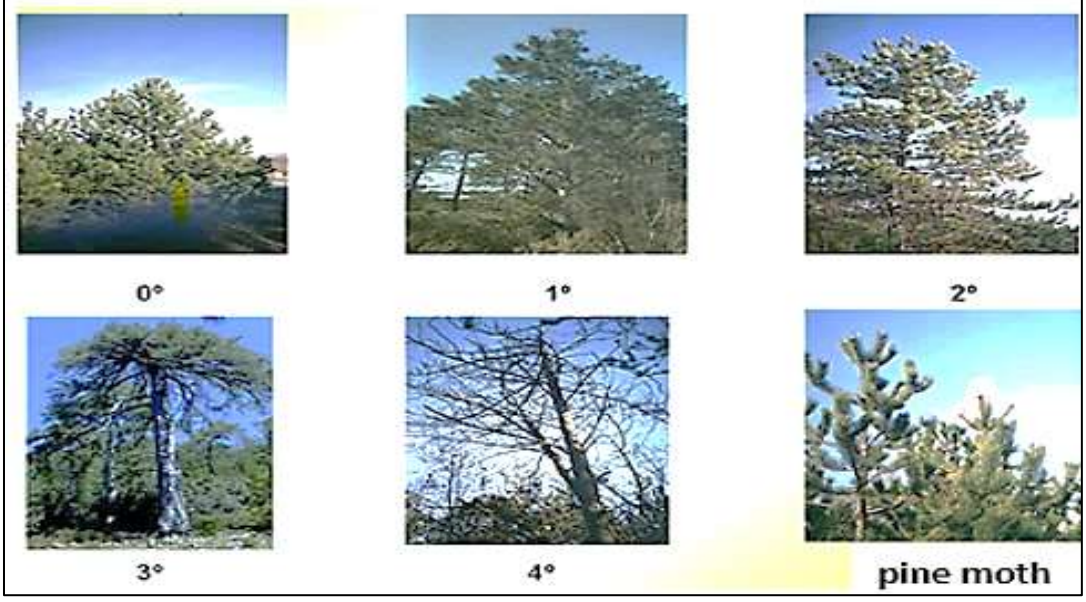



**Figure 4.** Crown damage

The analysis of pine needles was carried out according to the proposal of the Forestry Institute and is in accordance with RULES. The aqueous extract of pine needles was tested, (Figure 5.).

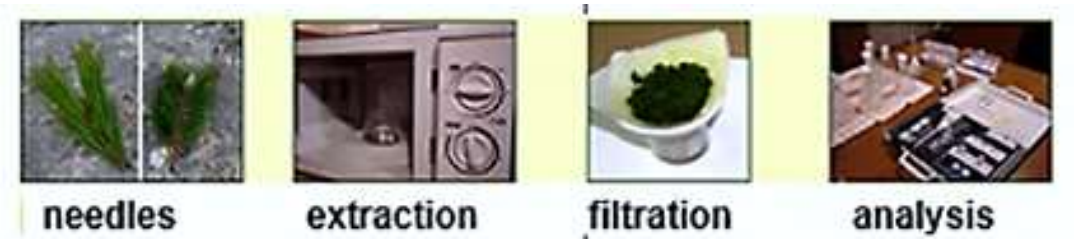



**Figure 5.** Needle analysis

## Results and data analysis:

### GEOGRAPHICAL DATA OF THE SAMPLING PLACE

We conducted research at the same measuring points as in 2003, so that the results would be comparable. We used our globe web database to compare the data.

**Table 1. D**ata of measurement locations

| LOCATION | LATITUDE-N | LONGITUDE-E | ALTITUDE- m | AREA -$m^2$ |
|---|---|---|---|---|
| 1. PINETA | 45.0875° | 14.1254° | 234 | 29912 |
| 2. STARCI | 45.0940° | 14.1126° | 157 | 1000 |
| 3. MUP | 45.0953° | 14.1212° | 225 | 3132 |
| 4. VODOVOD | 45.0888° | 14.1134° | 204 | 2000 |
| 5. LANTERNA | 45.0752° | 14.1660° | 32 | 7353 |
| 6.GIRANDELLA | 45.0786° | 14.1702° | 37 | 7846 |


**Figure 7**. Locations
**Source:** Own photos


**Figure 8 .** Data SSMB Labin
**Source:** https://data.globe.gov/#/entry

**MUC - COVER CLASSIFICATION**

Out of 6 locations, in 4 locations in the area of Labin, we determined the presence of ***Pinus nigra*** forests (Pineta, Starci, MUP and Vodovod), and 2 locations with ***Pinus halepensis*** forests are located in Rabac (Lanterna and Girandella).
According to the climatic distribution, these evergreen coniferous forests **sub-Mediterranean type.**
**The MUC code is 1121**, which is expected given the geographical and climatic conditions.

**Table 2.** MUC code

| LOCATION | TYPE OF PINE | MUC |
|---|---|---|
| 1. PINETA | *Pinus nigra* | 1121 |
| 2. STARCI | *Pinus nigra* | 1121 |
| 3. MUP | *Pinus nigra* | 1121 |
| 4. VODOVOD | *Pinus nigra* | 1121 |
| 5. LANTERNA | *Pinus halepensis* | 1121 |
| 6.GIRANDELLA | *Pinus halepensis* | 1121 |

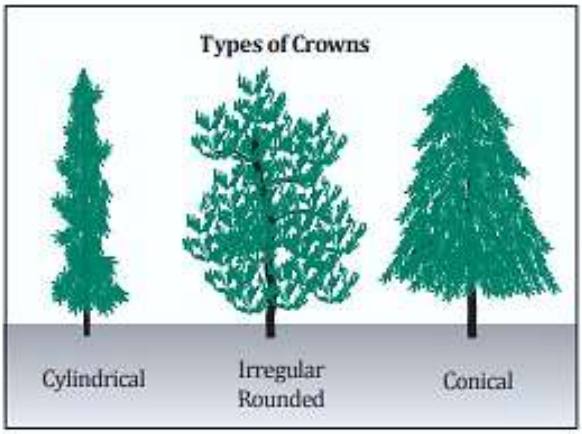



**Figure 10.** *Pinus nigra* **Figure 11.** *Pinus halepensis*
**Source:** https://www.plantea.com.hr

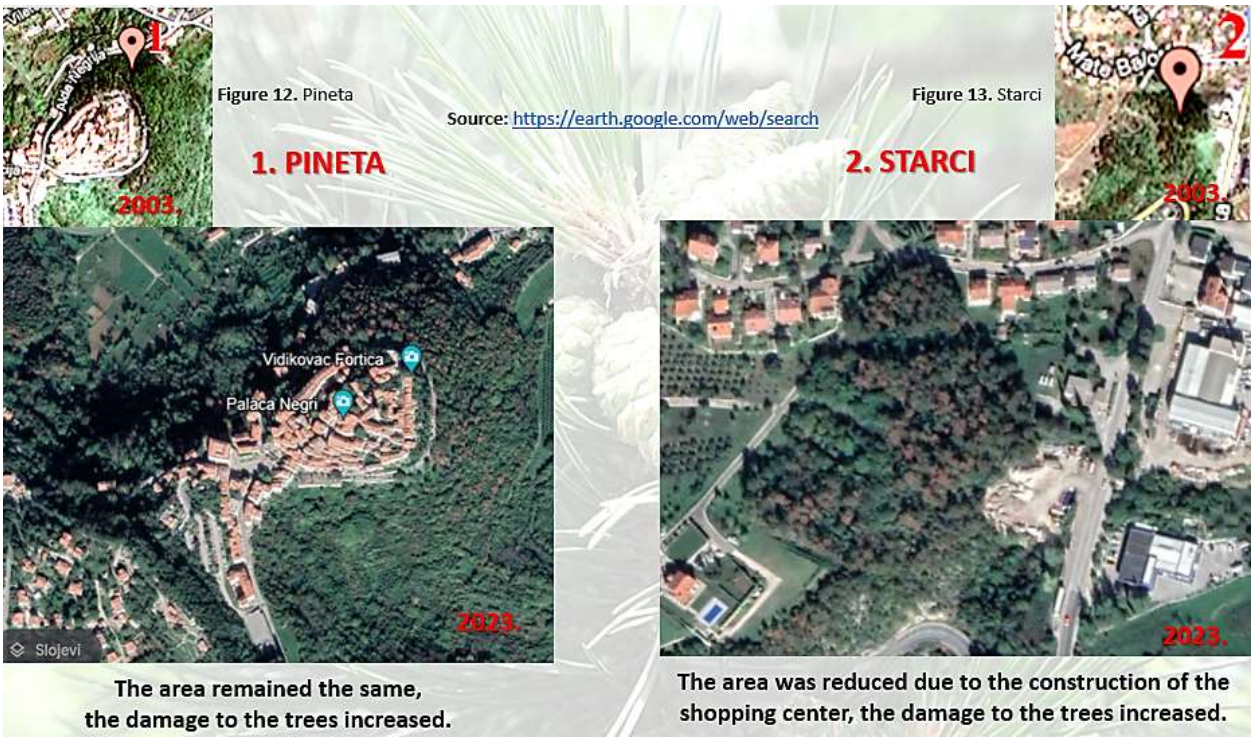
**MUC 1121** **Woodland, Mainly Evergreen, Needle-Leaved, Irregularly Rounded Crowns**

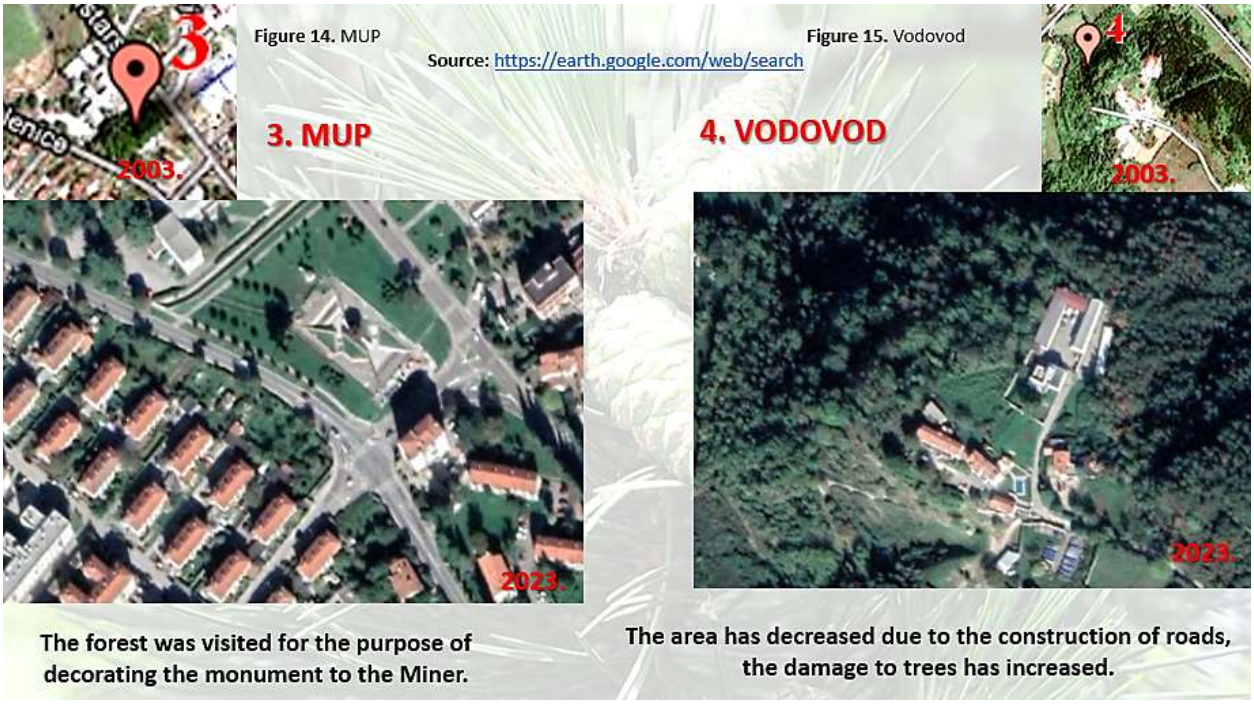
Dominated by trees (more than 50% of the canopy) with broad, irregularly rounded crowns (e.g., *Pinus*).

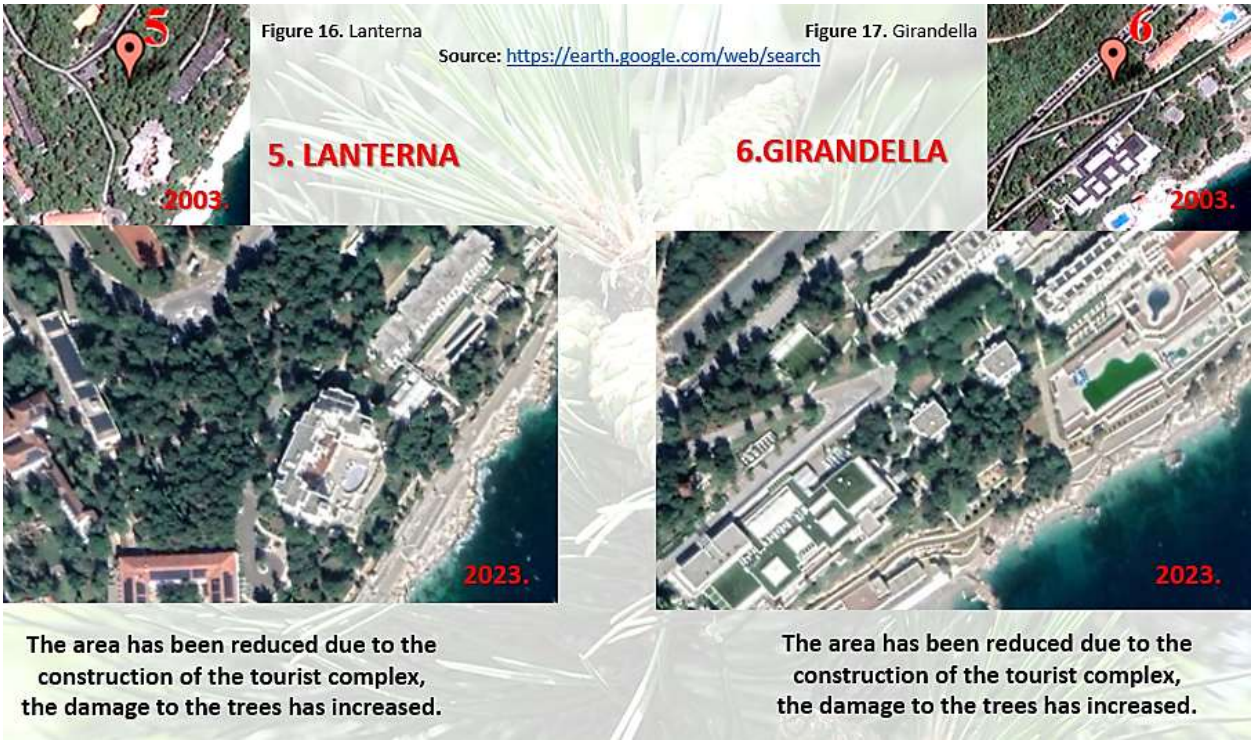
**Figure 9.** MUC code
**Source:https:** www.globe.gov/documents/355050/355097/MUC+Field+Guide

## DETERMINING AREA OF PINE FORESTS

The following photos show the changes on the surfaces of pine forests and the reasons for their occurrence.

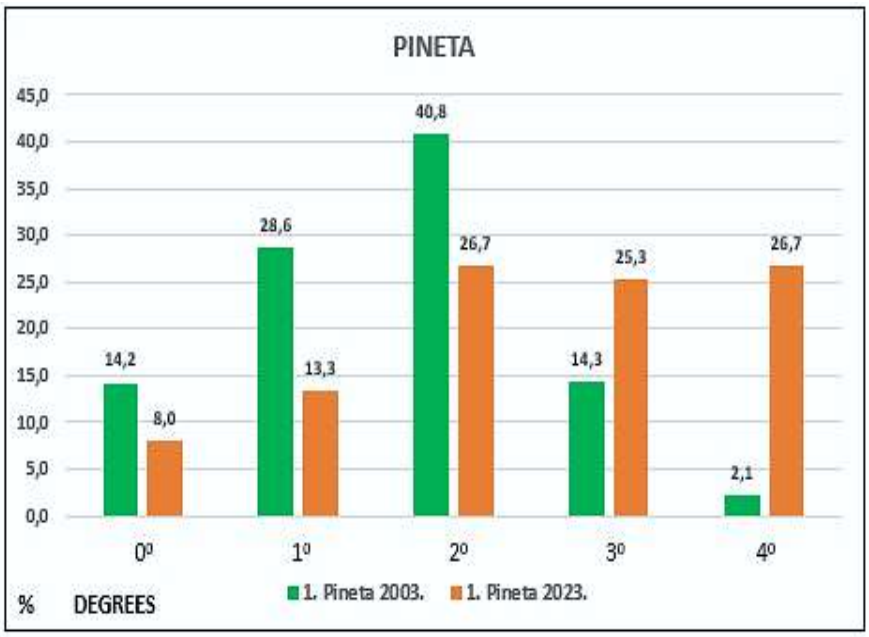




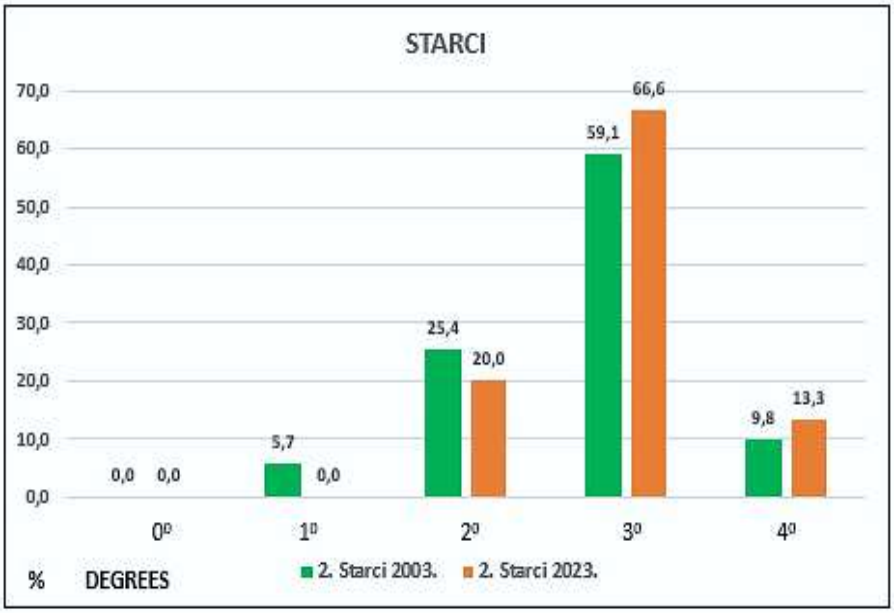

## DETERMINING THE DEGREE OF TREE DAMAGE

A **total of 833 trees** were inspected. **In 2003, 448 trees** were inspected, **in 2023. 388** trees were inspected in the same locations and the results were compared.
The graphs show the degrees of damage at individual locations and the condition after twenty years.



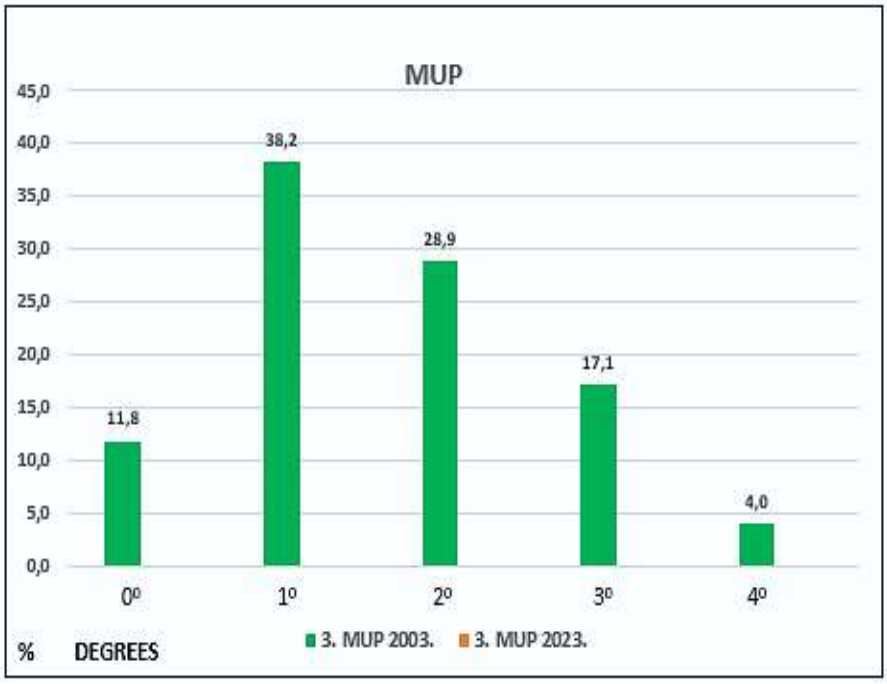

Decreased number of healthy trees, and a significant increase in the 2nd, 3rd and 4th degrees of damage.

**Graph 1. PINETA,** Comparison of canopy damage in 2003 vs. 2023.



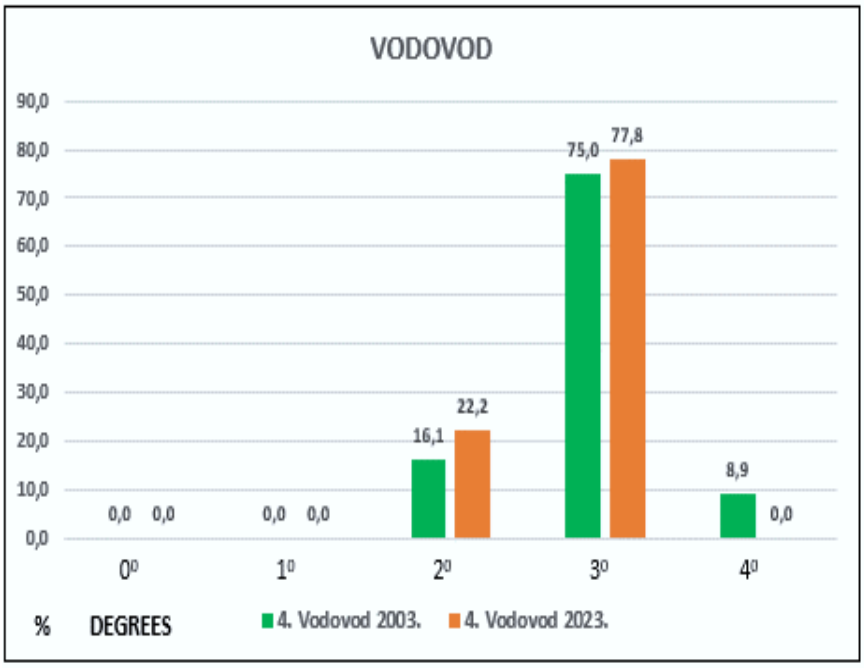

Significant increase in the 2nd, 3rd and 4th degrees of damage.

**Graph 2. STARCI,** Comparison of canopy damage in 2003 vs. 2023.



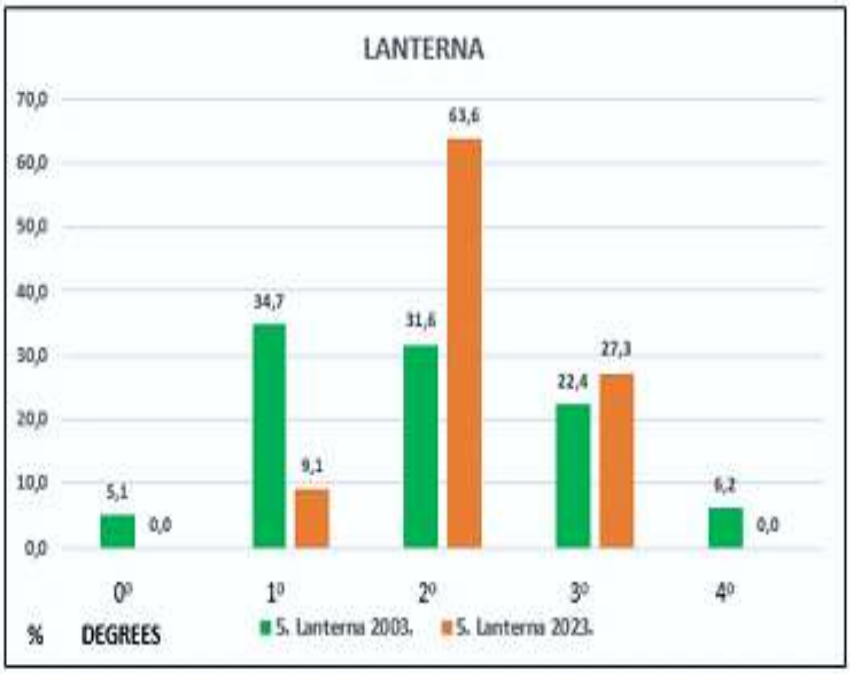

The forest has been visited

**Graph 3. MUP**, Comparison of canopy damage in 2003 vs. 2023.



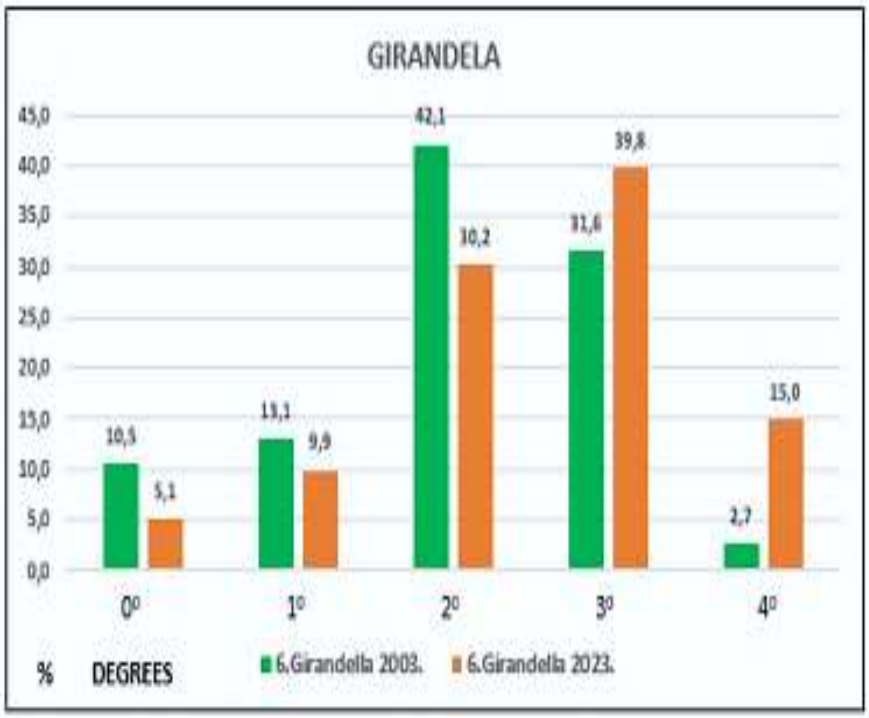

Increase in 2nd and 3rd degree damage

**Graph 4. VODOVOD**, Comparison of canopy damage in 2003 vs. 2023.




Decreased number of healthy trees, and a significant increase in 2nd and 3rd degrees of damage.

**Graph 5. LANTERNA**, Comparison of canopy damage in 2003 vs. 2023.




Decreased number of healthy trees, and a significant increase in 2nd, 3rd and 4th degrees of damage.

**Graph 6. GIRANDELLA**, Comparison of canopy damage in 2003 vs. 2023.

The degrees of tree crown damage were determined by fieldwork and the results obtained are the mean values of three measurements (table 3.).

**Table 3.** Degrees of tree crown damage.

| LOCATION | 1. PINETA | | 2. STARCI | | 3. MUP | | 4. VODOVOD | | 5. LANTERNA | | 6.GIRANDELLA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| degrees of damage % | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. |
| 0° | 14.2 | 8.0 | 0 | 0 | 11.8 | THE FOREST HAS BEEN VISIT | 0 | 0 | 5.1 | 0 | 10.5 | 5.1 |
| 1° | 28.6 | 13.3 | 5.7 | 0 | 38.2 | | 0 | 0 | 34.7 | 9.1 | 13.1 | 9.9 |
| 2° | 40.8 | 26.7 | 25.4 | 20 | 28.9 | | 16.1 | 22.2 | 31.6 | 63.6 | 42.1 | 30.2 |
| 3° | 14.3 | 25.3 | 59.1 | 66.6 | 17.1 | | 75.0 | 77.8 | 22.4 | 27.3 | 31.6 | 39.8 |
| 4° | 2.1 | 26.7 | 9.8 | 13.3 | 4.0 | | 8.9 | 0 | 6.2 | 0 | 2.7 | 15.0 |

By comparing the results of work from 2003. and 2023.,it is unfortunately evident that the number of healthy trees has decreased in all locations, and the 2nd, 3rd and 4th degree of damage has increased.

## DETERMINING THE AGE OF THE FOREST

To determine the age of the trees, we used the "TREE RING" PROJECT PROTOCOL in which our group joined in 2011. (Figure 18.) and counting the years on the sawn trees.
In table 2. the results obtained are the mean values of three measurements.


**Figure 18.** Extracted screws and visited trees.

**Table 4.** The age of the forest

| LOCATION | 1. PINETA | 2. STARCI | 3. MUP | 4. VODOVOD | 5. LANTERNA | 6. GIRANDELLA |
|---|---|---|---|---|---|---|
| AGE (year) | 124,3 | 63,3 | 93,0 | 54,3 | 53,0 | 52,0 |

The oldest forest is at the location of Pineta in old Labin, while the ages of the forests in the other locations correspond to the development of the mining Podlabin and touristic Rabac.

## DETERMINING OF SOIL QUALITY

According to the **GLOBE protocols** and instructions of the **Forestry Institute**, the soil was analyzed from a depth of 20 cm.

**Figure 19.** Taking a soil sample
and determining the type of soil in the field.

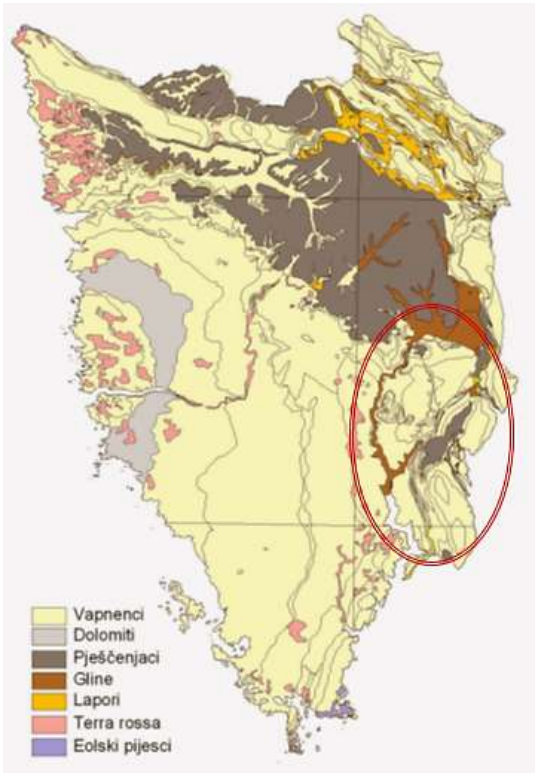



**Figure 20.** The area of Labinština
**Source:** Basic geological map of the Republic of Croatia

**Table 5.** Physical and chemical soil properties for 2003 and 2023., mean values of three samples

| LOCATION | 1. PINETA | | 2. STARCI | | 3. MUP | | 4. VODOVOD | | 5. LANTERNA | | 6.GIRANDELLA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INDICATOR | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. |
| Distribution % Clay Sand Silt | 67.8<br>27.8<br>4.4 | 72.0<br>26.9<br>1.1 | 62.3<br>35.5<br>2.2 | 62.0<br>35.7<br>2.3 | 67.9<br>27.7<br>4.4 | 67.8<br>27.6<br>4.6 | 66.5<br>28.0<br>5.5 | 66.0<br>28.5<br>5.5 | 61.8<br>36.0<br>2.2 | 61.5<br>36.2<br>2.3 | 60.0<br>35.5<br>4.5 | 60.3<br>35.1<br>4.6 |
| Type of soil | clay | clay | clay | clay | clay | clay | clay | clay | clay | clay | clay | clay |
| Porosity % | 46 | 45 | 43 | 44 | 50 | 50 | 52 | 55 | 44 | 45 | 44 | 46 |
| Contents of carbonats % | < 1 | < 1 | 3-5 | 3-5 | < 1 | < 1 | 3-5 | 3-5 | 1-3 | 1-3 | 3-5 | 3-5 |
| Contents of humus % | < 1 | 1-3 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| pH-value | 6.5 | 7.1 | 8.0 | 7.4 | 6.5 | 6.8 | 6.5 | 6.9 | 6.0 | 6.5 | 6.0 | 6.5 |
| Ammonium as $NH_4^+$ $mgL^{-1}$ | 5 | 1.0 | 10 | 5 | 10 | 5 | 0 | 5 | 5 | 5 | 7 | 5 |
| Nitrates / Nitritas as N $mgL^{-1}$ | 11.4 | 10.9 | 5.68 | 5.68 | 11.4 | 11.4 | 2.27 | 2.27 | 1.14 | 2.27 | 2.27 | 2.27 |
| Phosphates as P $mgL^{-1}$ | 3.25 | 3.05 | 1.63 | 1.63 | 1.63 | 1.63 | 2.26 | 2.26 | 3.25 | 3.25 | 3.25 | 3.25 |
| Potassium $mgL^{-1}$ | 0 | 10.0 | 0 | 50 | 100 | 100 | 100 | 100 | 150 | 150 | 50 | 50 |
| Chlorides $mgL^{-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 100 |
| Sulfates $mgL^{-1}$ | >400 | <200 | >400 | <200 | >400 | <200 | >400 | <200 | 300 | <200 | >400 | <200 |
| Copper $mgL^{-1}$ | 0 | 0 | 1 | 1 | 5 | 1 | 0 | 0 | 5 | 5 | 2 | 2 |
| Iron $mgL^{-1}$ | 0 | 0 | 1.5 | 2 | 0 | 1.5 | 3 | 3 | 1.5 | 1.5 | 1.5 | 1 |
| Lead/ Mercury $mgL^{-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

In the past twenty years, the properties of the soil have not changed significantly.
The soil is clayey, brown in color, poorly permeable with a small proportion of carbonates and humus, neutral,so it corresponds to the Mediterranean littoral zone.
The amount of nutrients is low, so the soil belongs to infertile soil.
There are no harmful substances in the soil.

## DETERMINING QUALITY OF PLANT MATERIAL (NEEDLES)

The analysis of pine needles was carried out according to the proposal of the Forestry Institute and it is in accordance with the Rulebook on the method of monitoring damage to forest ecosystems of the Republic of Croatia.
The aqueous extract of pine needles was tested.

**Table 6.** Analysis of plant material (needles) in 2003 and 2023, mean values of three samples.

| LOCATION | 1. PINETA | | 2. STARCI | | 3. MUP | | 4. VODOVOD | | 5. LANTERNA | | 6.GIRANDELLA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INDICATOR | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. | 2003. | 2023. |
| pH-value | 5.5 | 7,2 | 5.5 | 6,0 | 6.5 | 6,0 | 6.5 | 6,5 | 6.0 | 6,0 | 6.5 | 6,0 |
| Nitrates Nitrites $mgL^{-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sulfates $mgL^{-1}$ | <200 | <200 | <200 | <200 | <200 | <200 | <200 | <200 | <200 | <200 | <200 | <200 |
| Iron $mgL^{-1}$ | 0 | 0 | 2 | 3 | 3 | 3 | 0 | 1 | 1.5 | 2 | 1.5 | 2 |
| Lead $mgL^{-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mercury $mgL^{-1}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

In the water extract of pine needles, no amounts of harmful substances that would indicate soil and air pollution have been proven.

## Conclusion:

Through research, we confirmed our assumptions and got answers to our questions:

- The pine forests of the city of Labin are in a worse condition than twenty years ago, because the level 3 and 4 crown damage has increased significantly.
- The oldest forest is at the Pineta location in old Labin, which corresponds to literary sources that it was planted more than 120 years ago, while the age of the forests in the other locations corresponds to the development of the mining Podlabin and tourist Rabac.
- Sources of soil and air pollution are not significant, so we cannot attribute forest damage to this source.
- In the past period, a series of human activities reduced the area of forests and the number of trees.
- It has been noted that human care for forests is not enough considering the values that are obtained from them, so we believe that this is the biggest reason for the decline of pine forests in our area.
- We are particularly concerned about the fact that at the administrative level, care is being transferred from the city to the state level.

## Discussion:

In its project "Total development of the city of Labin 2008 - 2018", the city of Labin has set the monitoring of the state and **protection of forests as one of the most important tasks** within the framework of priority tasks.

**For a karst area like ours, the protective role of the forest is very important.**

The ability of the forest to filter and absorb large amounts of dust and harmful substances is a very significant property for our area with large air pollutants TC Holcim, ITV Most Raša, TE Plomin, roads and others.
Labinština is a very attractive tourist area, so the touristic and aesthetic function of forests is very important for our area.

**The vision of the City of Labin is defined as follows:**
"Labin is a city of preserved traditional values, historical and natural heritage, prosperous and social development that continuously raises the quality of life - a city tailored to man"

In addition to complete renovations of larger areas, regular maintenance is a priority, told us the experts of the utility company 1. maj Labin d.o.o.

We are pleased to announce activities for the restoration of the Pineta Urban Forest Park that surrounds the urban complex of the old town core of Labin, which is protected as a cultural asset and is part of the important Labin - Rabac - Prklog landscape.


**Figure 21.** Announcement of the renovation of Pineta forest
**Source**: https://labinskakomuna.eu/labin

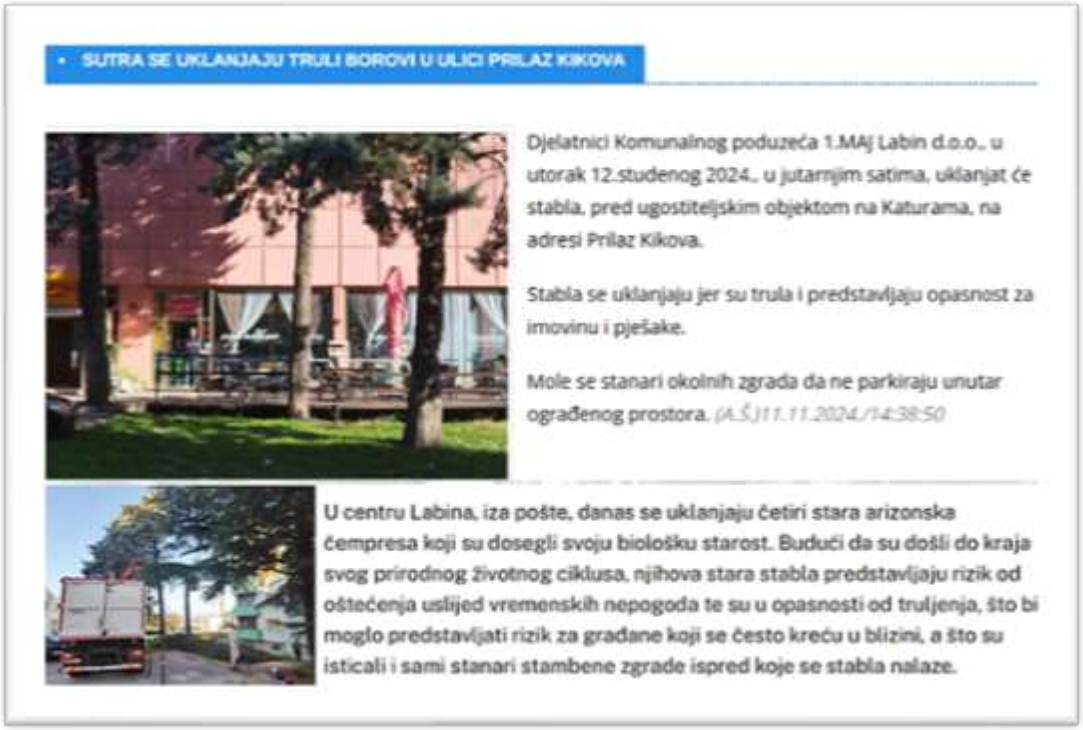



**Figure 22.** Regular maintenance
**Source**: https://5portal.hr/

**Finally, pictures and a song by our member in the local dialect.**

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## (Optional) Badge Descriptions/Justifications

### I AM A STUDENT RESEARCHER

This year we will mark the 20th anniversary of our first research project on pine forests in the area of Labin.
From the first day, we have also participated in the International Virtual Scientific Symposium, and as part of it, we have published 13 projects that you can see on the globe web pages.

### I AM A COLLABORATOR

24 students from the GLOBE group of Mate Blažine Labin High School participated in the research, divided into six teams of four students each. Three teams worked in the field, two in the school laboratory, and one was in charge of analyzing the results and creating a presentation. Excellent team cooperation was achieved. We also cooperated with the experts of the utility company to whom we presented our results, and they explained to us how they plan to restore old pine forests.

### I MAKE AN IMPACT

The death of pine forests in the area of Labin is becoming more and more pronounced, so we asked ourselves what their condition is after twenty years since our first research on the condition of pine forests. We showed the results to the experts at the city utility company and we are happy that we encouraged them to take more frequent activities to maintain the pine trees in the area of our city so that they do not become dangerous for the local population.

### I WORK WITH A STEM PROFESSIONAL

Cooperation was achieved with the Forestry Institute from Zagreb, with whose help we created a method for evaluating crown damage and pine moth infestation. Cooperation with the utility company 1.maj Labin d.o.o. in forest inspection and restoration activities.

### I AM A DATA SCIENTIST

In this project we used our Globe database, our results from projects in 2003. and 2011. Comparing these data with the data from this work, we came to the conclusion that the reason for the decline of pine forests is the age of the forests and human carelessness, so we are happy with the activities of the local utility company on the maintenance and renovation of our forests, in which we are also involved. Data analyses and data interpretations were carried out using statistical charts and tabular presentation.

### I AM A STEM STORYTELLER

As we have been doing research important for the local community for many years (research on water resources, air, soil, cover), we regularly publish our results on the school's website (https://ssmb.hr/ ), on the school's facebook (https://www.facebook.com/ssmb.labin ), on the eco group's twitter ( https://x.com/home ekoblazina16 and as short films on our mentor's you tube channel (https://www.youtube.com/results?search_query=olivera+tadi%C4%87 ). We think that in this way the problems becomes available to our fellow citizens and can encourage them to get involved in environmental protection actions.
We also present papers on and at student review in science from county to international level.