

## **Analysis of the level of knowledge of the local community about Białowieża Forest**

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**Abstract:** The research focused on ecological awareness and knowledge regarding the Białowieża Forest, conducting two survey studies in 2015 and 2022. The analysis covered ecological awareness, knowledge of forest stands, project awareness, and opinions on government decisions. The local community exhibited an average knowledge level, accompanied by a notable decline in ecological awareness. A surprising discovery was the increased knowledge among tourists, contrasting with ecologists who emerged as the most well-informed group. The study also assessed the impact of government decisions, drawing conclusions from data gathered across various respondent groups. The findings underscored the nuanced dynamics of ecological awareness within the community, highlighting the need for targeted educational initiatives and fostering environmental consciousness among the local population. Furthermore, the fluctuating awareness levels among different groups emphasized the importance of tailored strategies for effective communication and outreach. The research contributes valuable insights into the evolving landscape of ecological awareness and knowledge, shedding light on areas for improvement in environmental education and conservation efforts in the context of the Białowieża Forest.

*Key words:* ecological awareness, Białowieża Forest, survey studies, environmental education

### **INTRODUCTION**

The Białowieża Forest is a compact forest area located in two countries - Poland and Belarus. In total, it covers an area of 141,885 hectares. The Białowieża Forest, which has existed for at least 12,000 years, has been protected since at least the 14th century. Various forms of protection of the Białowieża Forest, applied for centuries, have made it possible to preserve the continuity of natural processes with little human influence on the forest. The area of the Białowieża Forest, included in the World Heritage List UNESCO, is considered the last forest with natural features in the lowland areas of Europe. (Niklasson et al 2010; Samojlik 2005). The possibility to study the natural environment of the Białowieża Forest, which is considered a reference point for other forest areas in Europe, is of great importance for science. The high importance of this area is evidenced by the very large number of scientific articles on the forests of the Białowieża Forest (Jaroszewicz et al 2019). The Białowieża Forest is a unique area for long-term biodiversity research. Many years of avifauna observations have been conducted (Tomiałojć and Wesołowski 2004; Wesołowski 2007), research on the ecology of mammals, including bisons and wolves (Samojlik et al 2017; Smith et al 2022; Bramorska et al 2023), and sites of rare species have been discovered (Gawryś, Szulc, 2017; Ginszt et al 2022). Most importantly, the forests of the Białowieża Forest are of fundamental importance for the study of the natural environment of the forest (Jaroszewicz et al.2019). For almost 200 years, numerous scientific papers have been published on various aspects of forest management, in which scientists observe and describe the natural processes occurring in the the Białowieża Forest, enabling their introduction in the context of forest management in the rest of the country

(Grzywacz 2019; Pommerening A. et al 2016 ). The Białowieża Forest area is also of great importance for society. In recent years, various approaches to the protection and management of the Białowieża Forest have become the basis of lively scientific discussion and socio-political debate (Perkowski et al 2022; Blicharska 2020; Witkowski 2017; Mikusiński et al 2017; Paluch 2012).

The unique object, the stands of the Polish part of the Białowieża Forest, is also the subject of research within the project “Comprehensive monitoring of stand dynamics in the Białowieża forest supported with remote sensing techniques” (LIFE ForBioSensing), funded by the European Commission under the Life+ Instrument, the National Fund for Environmental Protection and Water Management and the Forest Research Institute. The aim of the ForBioSensing project is to develop and apply a monitoring methodology for large forest areas using innovative techniques. The main results of the project, completed in 2022, were published in a scientific monograph on the current state and dynamics of changes in the stands of the Polish part of the Białowieża Forest entitled “The current state of Białowieża Forest based on the results of the LIFE + ForBioSensing project” (Stereńczak K. 2022). One of the sub-objectives of the project was to inform the public about the state and dynamics of changes in the forest stands of the Białowieża Forest. Within the framework of the project, a series of dissemination activities were carried out, which reached over 5 million recipients using various means of communication. In order to assess the impact of the dissemination activities carried out, two public opinion surveys were planned and conducted, the results of which are presented in this paper.

### **Study of the level of knowledge of the local community about the state of the Białowieża Forest.**

The examination of the local community's knowledge level regarding the state of the Białowieża Forest was part of a project conducted by the Forest Research Institute titled "Comprehensive monitoring of the dynamics of Białowieża Forest stands using remote sensing data." The project was co-financed by the European Commission's Life+ program and the National Fund for Environmental Protection and Water Management. It is important to note that within this project, two survey studies were conducted – the first in 2015 and the second in 2022.

The main goal of the study was to identify the level of knowledge about the state of the Białowieża Forest, understand the dissemination of information about the project, and assess the current state of knowledge and any changes during the project's duration.

The following research questions were formulated:

- 1. What is the overall ecological awareness of the respondents?**
  - a) How does the level of ecological awareness differ among different respondent groups?
  - b) What is the respondents' awareness of the impact of human activities on the environment?
- 2. What is the knowledge level of the respondents regarding the Białowieża Forest stands?**
  - a) What is the knowledge level of the respondents regarding the structure of Białowieża Forest stands?

b) What is the level of knowledge among respondents about the health status of trees in the Białowieża Forest?

c) To what extent are the respondents aware of existing threats in the Białowieża Forest?

**3. What is the knowledge level of the respondents regarding the project?**

a) Have respondents encountered information about the project?

b) What is the knowledge of respondents about the research methods used in the project?

**4. What impact did decisions made by local and central authorities have?**

a) What are the opinions of respondents regarding decisions made by authorities regarding the limitation of wood harvesting in the Białowieża Forest?

b) How do respondents evaluate the introduction of a state of emergency and restrictions on people's presence in the border zone? (Question 4 was included only in the surveys conducted in 2022).

The research conducted allowed for answering all research questions. In the next part - after a brief description of the methods, techniques and research tools, the selection of the sample and the people surveyed - general conclusions from the research based on a detailed analysis of the obtained data will be presented.

**METHODS, TECHNIQUES AND RESEARCH TOOLS.**

The study was conducted in four stages, including: 1st survey using the PAPI (Paper and Pencil Interview) technique, 2nd survey using the PAPI direct interview technique, a survey via an online survey and an occasional survey using an auditorium survey, carried out in during project meetings. When creating all of the above tools used closed, semi-open, ranking and checking questions. In the second study, the survey questionnaire was supplemented with additional questions. Based on the questions asked in this study, contained in the sections entitled "Ecological awareness", "Knowledge about the condition of the forest stands in the Białowieża Forest" and "Level of dissemination of information about the project", an ecological awareness level index was calculated, and each respondent could score a maximum of 18 points. The occasional and online survey were conducted based on the same tool design.

The study covered the following target groups: local community (residents of the following communes: Hajnówka, Białowieża, Narewka, Dubicze Cerkiewne and Czyże); tourists visiting the Białowieża Forest and experts: employees of the forest administration (forest district), employees of the administration related to nature protection (employees of the BNP, employees of the Directorate for Environmental Protection), employees of local government administration, employees of companies, organizations and local nature conservation activists. From the last mentioned group, in the period from April 2016 to December 2019, 685 people took part in the study and completed the survey available on the website of the Forest Research Institute.

A total of 900 residents of the 5 above-mentioned communes took part in the first stage of the research in 2015. The second stage of the research was conducted among residents of the same communes (total N=926) and among tourists (N=120) visiting the Białowieża Forest. A total of

1,046 surveys were completed. The sample size for the local community was calculated based on the following parameters: population size - 24,940 (commune residents over 18 years of age), fraction size - 0.5 and confidence level - 0.95. Random-stratified sampling was used.

The approach used to the size and structure of the sample ensured the representativeness of the study. It should be added that, as planned, employees of the forestry or local government administration who were residents of the surveyed communes also took part in the study. Their share in the total number of respondents was small and amounted to 1.5%. In the 2015 study, employees of forestry and local government administration constituted a total of 7.8% of respondents.

## RESULTS

### **Characteristics of the people surveyed**

In 2015, among the participants of the community survey (Survey I): the most numerous were those aged 46-65 (34.6%), and the least numerous were those aged 18-25 (10.8%); the most frequently declared education was secondary education (40.1%), less frequently: higher education (26.3%) and basic vocational education (21.6%), and the least frequently: primary education (10.8%); women predominated (52.2%) over men (47.8%). On the other hand, in 2022 (Survey II) - men (52.2%) outnumbered women (47.8%); respondents over 65 years of age were most represented (36.1%), and those aged 26-35 (8.1%) and 56-65 (8.6%) were least represented; respondents most often had basic vocational education (33.2%) and secondary education (32.9%), almost 18% had primary education, and only about 13% declared having a university degree. In 2015, membership of organisations, associations, societies or nature clubs was indicated by 2.2% of respondents, and in 2022 by 1.6%. Residents of Hajnówka dominated among the respondents (65.8%), a much smaller group were respondents from Narewka (14.9%), and the share of residents of other municipalities in the total number of respondents did not exceed a few percent. These were percentages in line with the representative distribution of the sample. The structure of the sample by place of residence of the respondent in the 2015 and 2022 surveys was similar, and the share of residents of each municipality in the sample was at a similar level. Also, the structure of the survey participants in terms of the length of residence in the municipality was very similar: in 2015, the proportion of the longest residents in the municipality was slightly higher (89.8%), while the share of the other categories did not exceed 3.5%; in 2022 - the vast majority of the respondents were those who had lived in their current place for more than 15 years (83.9%), while the share of the other categories distinguished on the basis of the length of residence in the municipality did not exceed a few percent.

In the case of the second target group, a total of 100 tourists took part in the survey in 2015 and women (64%) outnumbered men (36%) among the survey participants. In 2022, the number was 120, of which 57% were men and the remaining 43% were women. In 2015, the most represented age group was between 26 and 35 (42%), more than a quarter of respondents (28%) were between 46 and 65, just over a fifth were between 36 and 45 (22%), and the smallest group was between 18 and 25 (3%) and over 65 (5%). The largest group in 2022 were tourists between 36-45 (28%) and 46-65 and over 65 (24% each), and the smallest group were those aged 18-25 (10%). In 2022, 37% of respondents had tertiary education and 4% had primary education. In 2015, the largest number of respondents had secondary education (46%). Vocational and higher education were held by similarly large groups (26% and 28% respectively). As in 2015 (53%), the largest proportion of tourists in 2022 were from the Podlaskie (31%) and Mazowieckie Voivodeships (18% - 2022, 34% - 2015, respectively) Respondents also included representatives from 13 other voivodeships. As for experts - 685 people took part in the survey, of which 54% were men and 46% women.

The most represented age group was between 18 and 25 years old (34%) and the least represented was over 65 years old (3%). For the other age groups, the percentage of respondents

was evenly distributed: 26-35 years (22%), 36-45 years (22%) and 46-65 years (19%). The majority of experts (68%) declared that they had a tertiary education, and almost one in five respondents (19%) had a secondary education.

### **Ecological awareness of the respondents**

The level of environmental awareness among the surveyed target groups varied - the highest was characterised by experts, as 83% declared that the level of their general knowledge about the Białowieża Primeval Forest was at least satisfactory, with nearly half (42%) assessing it as at least good. This group was also characterised by a strong awareness of the impact of climate change on the state of the natural environment in the Białowieża Forest - 70% of the survey participants pointed to at least a high impact of climate change.

In contrast, residents of the surveyed municipalities declared an average level of environmental awareness. Approximately 60% of respondents assessed their general knowledge of the Białowieża Forest as at least satisfactory, but only 40% described their level of knowledge of changes occurring in the Forest as at least average. At the same time, almost half of the respondents (46%) assessed that their knowledge of the condition of the stands in the Białowieża Forest is at a satisfactory level. Respondents were much more likely to be aware of the impact of climate change on the condition of the natural environment in the Białowieża Forest and the impact of human activity on the condition of the Białowieża Forest's forests - at least medium impact of both factors was noted by 80% of survey participants each. Compared to 2015, a decrease in the general level of environmental awareness of the inhabitants of the highlighted municipalities was observed in 2022 - the percentages of respondents declaring: at least satisfactory level of general knowledge about the Białowieża Forest (60% in 2022, 90% in 2015), at least satisfactory level of knowledge about the changes occurring in the Forest (40% - 2022, 80% - 2015) or at least satisfactory level of knowledge about the condition of the forest stands in the Białowieża Forest (46% - 2022, 72.5% - 2015) were lower in 2022. The awareness of the inhabitants of the municipalities about the impact of climate change on the condition of the natural environment in the Białowieża Forest decreased slightly, although it still remained at a high level (in 2022, 80% of the respondents paid attention to at least an average impact, in 2015 - 85%), and the knowledge of the impact of human activity on the condition of the Forest remained at a similar level (80% - 2022, 81% - 2015).

Less than half of the tourists surveyed (41%) were confident that their knowledge of the Białowieża Forest was satisfactory or high. More than half (51%) rated their level of knowledge about the condition of its stands as satisfactory. Compared to the 1st survey, respondents' awareness of the impact of climate change on the condition of the natural environment in the Białowieża Forest increased - almost half (43%) of respondents described the impact as high or very high.

As already mentioned, an environmental awareness index was calculated in Survey II. No one scored the maximum number of points. The highest score - 14 points. - was scored by one participant in the community survey. Between 6 and 15 points were scored by 64.1% of the surveyed community residents and 73% of tourists. Compared to the 2015 survey, there was a significant (50%) increase in environmental awareness for tourists and a decrease (9.8%) for the local community survey. The average score for tourists was 4.6 points in the 1st survey and 6.8 points in the 2nd survey. For the local community, the average score was higher for Survey I at 8.3 points and for Survey II at 6.7 points.

### **Knowledge of the respondents on the condition of the forest stands in the Białowieża Forest**

Almost all the surveyed inhabitants of municipalities (97%) were able to indicate the two tree species most frequently occurring in the Białowieża Forest (Norway spruce and Scots

pine) and correctly identify at least one tree species most at risk of being colonised by the European corn borer (96% of indications for spruce, 15.2% for pine). We can speak of a significant increase in the knowledge of respondents compared to 2015, when the two species of trees most frequently occurring in the Białowieża Forest were correctly indicated by 52.5% of respondents, and among the species most threatened by the printworm attack, 63% mentioned the common spruce and 34% the pine. At the same time, in 2022, only 6% of the respondents knew that hornbeam is the tree species that is currently growing the most in the Białowieża Forest (this is a significant decrease in comparison to 2015 - 34% of the respondents showed correct knowledge then), and only 2.5% were able to correctly identify biotic threats to forest ecosystems, i.e. indicate harmful activity of insects, damage caused by fungi or damage caused by animals (significantly less than in 2015, when biotic threats to forest ecosystems were indicated by 58% of respondents). In 2022, knowledge of pesticides used in the Białowieża Forest was also not common - 18% of respondents knew about the use of pheromone traps for this purpose, significantly less than in 2015 (48% of respondents had such knowledge then). On the other hand, the belief that the impact of abiotic factors (i.e. hurricane winds, droughts or fires) on the Białowieża Forest could not be completely eliminated was widespread among survey participants (92.5%), with correct answers given more often than in 2015 (84%). More than  $\frac{1}{4}$  of the respondents (28.4%) declared that they knew what Dutch elm disease was, but at the same time only 3% correctly assessed that fungi spread by shrew beetles pose a high or very high threat to the forests of the Białowieża Forest. This means that the actual knowledge of Dutch elm disease is much lower than stated by the survey participants, also compared to 2015. More than 81% of the respondents did not know what remote sensing is, and only 4.6% gave the correct answer, indicating that it can be used to study the Earth's surface from aerial photographs and satellite images. The level of respondents' knowledge of remote sensing has decreased significantly compared to 2015 - at that time, the correct way to use remote sensing was indicated by 27% of respondents, while 54% admitted that they did not know what remote sensing was. In 2022, there was much more widespread knowledge among survey participants about how to study past climate parameters based on trees (77% indicated tree growth), but only 37% knew that aerial laser scanning could be used to analyse stand dynamics. Compared to 2015, the level of knowledge of municipal residents on how to study past climatic parameters based on trees increased (41% of tree growth indications in 2015), but the level of knowledge on how to use aerial tree scanning decreased (43% of correct answers in 2015).

Also, the vast majority of tourists surveyed (92%) were able to indicate the two tree species most frequently occurring in the Białowieża Forest and correctly identify at least one tree species most susceptible to be colonised by the bark beetle (92% indications for pine and 23% for spruce). However, only 7% of respondents knew that hornbeam is the tree species currently most abundant in the Forest. Spruce was considered to be the tree species currently increasing the most (49%). Both in Study I and II, the vast majority of respondents did not indicate harmful activity of insects, damage caused by fungi or animals as biotic threats to forest ecosystems (only 2% gave the correct answer, and 88% chose hurricane winds, droughts, low temperatures, fires). Also, knowledge of plant protection products used in the Białowieża Forest was not widespread - 22% of respondents knew about the use of pheromone traps for this purpose, and the majority believed that plant protection products are not used in the Forest (59%). The belief that it is not possible to completely eliminate the impact of abiotic factors on the Forest (i.e. hurricane winds, droughts or fires) was widespread among the respondents (88%), with the remaining people (12%) unable to answer this question. Admittedly, as many as 78% of the respondents declared that they knew what Dutch elm disease is, but at the same time, only 4% of the survey participants correctly assessed that fungi spread by shrew beetles pose a high or very high threat to the Białowieża Forest. This means - as in the case of the

communal residents surveyed - that the actual knowledge of Dutch elm disease is much lower than the survey participants declared. They also tended to lack knowledge on how to use remote sensing - 78% of respondents did not know what its functions were, and only 5% gave the correct answer. There was more widespread knowledge among respondents about how to study past climate parameters from trees - 81% indicated tree growth.

In the case of experts, the vast majority were also able to identify at least one tree species most at risk of being infested by the printworm (76% indicated spruce and 29% pine). Almost half (43%) knew that hornbeam is the tree species that is currently most abundant in the Białowieża Forest, and more than a third of the respondents (39%) correctly assessed that fungi spread by shrew beetles pose a high or very high threat to the Białowieża Forest. The vast majority of respondents (70%) knew what remote sensing was and the reasons for monitoring the processes occurring in the Białowieża Forest (84%).

### **Level of dissemination of project information**

More than ¼ of the surveyed inhabitants of municipalities (27%) knew about the project being carried out in the Białowieża Forest. The majority of people surveyed (65%) correctly indicated what the monitoring of processes occurring in the Forest could be used for. Compared to 2015, there was an increase in both the survey participants' knowledge of the forest dynamics monitoring project being carried out in the Białowieża Forest (in 2015 it was 23%) and their knowledge of what the monitoring of processes occurring in the Forest can be used for (in 2015, 55% of respondents indicated the identification of factors influencing changes in the Forest). In the case of tourists surveyed, slightly more - compared to the residents of municipalities - knew about the project being carried out in the Białowieża Forest (36%) and demonstrated knowledge of what monitoring of the processes occurring in the Forest could be used for (76%).

### **Issues of limiting the amount of logging**

Almost half of the surveyed inhabitants of municipalities (46%) did not have an opinion on the decision of the authorities to introduce a limitation on the amount of logging in the Białowieża Forest. 45% of respondents were positive about the idea, while 8.5% were negative. Participants in the survey were almost completely unaffected by the restriction to a minimum of tree felling in the Białowieża Forest.

Surveyed tourists were slightly more likely - than residents of municipalities - to have a positive opinion of the authorities' decision to introduce a reduction in the amount of timber harvesting from the Forest (51%), with 10% of respondents expressing a negative opinion. The decision to impose a state of emergency and subsequent restrictions on people's presence in the border area also had positive overtones among respondents. The vast majority (86%) thought this was a very good idea.

### **Coronavirus pandemic and imposition of a state of emergency and tourist traffic**

Both the coronavirus pandemic and the introduction of the state of emergency and subsequent restrictions on people staying in the border area affected tourism in the area where the survey participants lived, an opinion expressed by a large majority (95%). This impact was manifested by a definite reduction in tourist traffic in the area. Also, almost all the tourists surveyed (92%) stated that the occurrence of the global coronavirus pandemic had definitely reduced the frequency of tourist trips.

## **CONCLUSIONS**

In conclusion, the research conducted within the framework of the "Comprehensive monitoring of stand dynamics in the Białowieża forest supported with remote sensing techniques" (LIFE ForBioSensing) project has provided valuable insights into the ecological awareness, knowledge, and opinions of different target groups regarding the Białowieża Forest.

The forest, with its rich history spanning over 12,000 years, stands as a unique and vital ecosystem, contributing significantly to biodiversity research.

The surveys conducted in 2015 and 2022 revealed shifts in environmental awareness among the local community, tourists, and experts. Notably, experts exhibited high awareness, with 83% possessing satisfactory knowledge of the Białowieża Forest. In contrast, residents' awareness, although still significant, showed a slight decline from 2015, emphasizing the need for ongoing education and outreach efforts.

Knowledge about the Białowieża Forest's stands varied among respondents. While residents demonstrated increased awareness of tree species and threats compared to 2015, certain aspects, such as knowledge of hornbeam prevalence and biotic threats, declined. Tourists exhibited commendable knowledge, especially about tree species and the impact of climate change. However, both groups lacked awareness of specific ecological aspects, indicating areas for improvement in public education initiatives.

The ForBioSensing project played a crucial role in disseminating information, as evidenced by the increased awareness of the forest dynamics monitoring project and its purposes. This highlights the importance of such projects not only for scientific endeavors but also for engaging and informing the public about the environmental challenges and conservation efforts in the Białowieża Forest.

The reduction in timber harvesting sparked varied opinions among residents, with a notable positive response (45%) and a significant number expressing neutrality (46%). Tourists tended to favor the reduction, emphasizing the impact of such decisions on sustaining the forest's ecological balance. The imposition of a state of emergency and restrictions in the border area received widespread approval from respondents, underlining their recognition of the measures' importance in preserving the forest amid the global coronavirus pandemic.

The interplay between the coronavirus pandemic, state of emergency, and restrictions significantly affected tourism, leading to a noticeable reduction in tourist traffic. This underscores the delicate balance between conservation efforts and the socioeconomic aspects associated with tourism.

In conclusion, the research outcomes emphasize the dynamic relationship between humans and the Białowieża Forest. Ongoing efforts in education, conservation, and sustainable management are vital to ensure the longevity of this unique natural treasure and to foster a harmonious coexistence between humanity and the Białowieża ecosystem. The ForBioSensing project has not only contributed valuable scientific insights but has also played a pivotal role in raising awareness and fostering informed discussions among the public, contributing to the ongoing dialogue surrounding the future of the Białowieża Forest.

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**Streszczenie:** Badania zawarte w artykule dotyczą świadomości ekologicznej i wiedzy na temat Puszczy Białowieskiej. Przeprowadzono dwa badania ankietowe w 2015 i 2022 roku. Analizie poddano świadomość ekologiczną, wiedzę o drzewostanach, świadomość projektową oraz opinie na temat decyzji rządowych. Lokalna społeczność wykazywała przeciętny poziom wiedzy, któremu towarzyszył wyraźny spadek świadomości ekologicznej. Zaskakującym odkryciem był wzrost wiedzy wśród turystów, w przeciwieństwie do ekologów, którzy okazali się najlepiej poinformowaną grupą. W badaniu oceniono również wpływ decyzji rządowych, wyciągając wnioski z danych zebranych w różnych grupach respondentów. Wyniki podkreśliły zróżnicowaną dynamikę świadomości ekologicznej w społeczności, podkreślając potrzebę ukierunkowanych inicjatyw edukacyjnych i wspierania świadomości ekologicznej wśród lokalnej ludności. Co więcej, wahania poziomu świadomości wśród różnych grup podkreśliły znaczenie dostosowanych strategii skutecznej komunikacji i działań informacyjnych. Badania wnoszą cenny wkład w ewoluujący krajobraz świadomości i wiedzy ekologicznej, rzucając światło na obszary wymagające poprawy w zakresie edukacji ekologicznej i działań ochronnych w kontekście Puszczy Białowieskiej.

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