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Climate Change and Informal Education in the Opinion of Forest Users in Poland

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Abstract: Climate change affects various aspects of the economy, agriculture, economics, and politics, including forestry. There is more and more talk about the real impact of the effects of climate change. This paper presents the results of a survey on the perceptions of two groups, foresters and recreational forest users, about climate change and its impacts on forested areas; 130 foresters and 146 recreational forest users participated in the survey (total n = 276). The survey was conducted from April to November 2019 and consisted of three parts. The first part included questions about the demographic characteristics of the respondents (gender, age, education, place of residence), the second part focused on the respondents' views on climate change and its implications for forest ecosystems, and the third part focused on informal forest education and its relationship to climate change. The results of our study indicated that progressive climate change affecting forest ecosystems is clearly felt by the professional group related to forests such as foresters, and to a lesser extent by people using forests for tourism and recreation. According to foresters, the effects of climate change on forest areas include rapid changes in weather patterns and more frequent insect infestations. On the other hand, people resting in forests mainly observe the lack of snow cover and occurrence of drought. Informal forest education insufficiently covers the topic of climate change. Thus, our study can help guide informal education towards topics related to climate change and the need for sustainable forest use.

Keywords: climate change perceptions; climate change impacts; forest education; forestry; statistical analysis

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1. Introduction

The term "climate change" is most often used in the context of global warming and the increase in the Earth's surface temperature [1–3]. Proper understanding of the subject is often lacking because of a sense of shared responsibility for the state of the environment [4–7]. A major global problem conditioning these changes is the consumerism and materialism of people [8,9]. According to Geiger et al. and Kellstedt et al. [8,9], global warming is one of the most important topics today, generating a range of emotions and heated discussions. The topic of climate change is increasingly relevant to forest management, which is due on the one hand to the fact that these changes are a source of threat to the stability of forest ecosystems and, on the other hand, because forests are seen as a natural buffer against climate change [10,11]. Understanding these threats as well as the importance of the forest for climate protection requires long-term, systematic public education [12,13]. Many people are still unaware of the consequences of climate change [14,15]. Kahan et al. [16] suggested that the apathy of the public towards environmental threats, including climate change,

is due to a lack of understanding of the importance of environmental problems. In turn, Pidgeon and Fischhoff [17] emphasized that too little scientific knowledge among the public contributes to the misinterpretation of various phenomena or facts about climate change. Misinterpretation, lack of empathy, insufficient education or limited access to it can intensify conflicts over the model of forest management [18]. Without an understanding of the magnitude of the threats, there can be no effective response to environmental hazards. Informal education can, therefore, be helpful in understanding the importance of environmental risks.

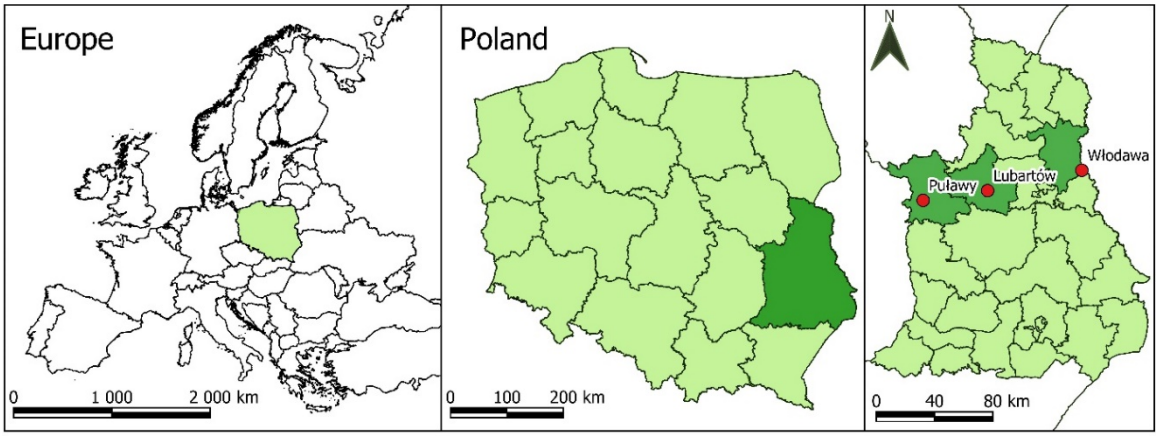
Informal, out-of-school education is nowadays increasingly appreciated because of its universality and the possibility of using a variety of educational forms and methods [19,20]. In Poland, since the 1990s, the leading role in informal education has been played by the State Forests, which manage the vast majority of public forests, representing 80% of all Polish forests. The annual publicly available Reports on the educational activities of the State Forests show that the number of recipients of educational activities is steadily increasing; in 2019, the total number of recipients of all forms of forest education was 1,852,129 [21]. The preferred form of education was classes conducted in forest areas with educators [21]. According to Referowska-Chodak, Hattie et al., and Becler et al. [22–24], for educational activities to bring the desired effects in changing the perception of forest management and the adoption of appropriate environmental attitudes, they must be conducted regularly, preferably in the natural environment [25,26]. Unfortunately, the reports on educational activities in National Forests do not show whether individuals regularly attended classes or if it was just a one-time activity, and there is also no information about the subject matter of individual classes, including those on climate change. Thus, we do not know whether and to what extent informal education in forests discusses the problems posed by climate change.

The aim of our research was to find out how forest users perceive environmental threats, whether the views of foresters and recreational forest users differ in this aspect, and which educational content about climate change in forests is most often communicated to the public.

2. Material and Methods

2.1. The Study Area

The research was carried out in three Forest Districts (Puławy, Lubartów, and Włodawa) belonging to one of the 17 Regional Directorates of State Forests in the Poland-Regional Directorate of State Forests in Lublin (Scheme 1).



Scheme 1. Basic data on forests within the administrative range of the above districts.

Each forest district is characterized by slightly different natural conditions and, consequently, related forest management methods (concerning harvesting, protection, and making forests accessible to the public) as well as the intensity of anthropopressure. The

Puławy Forest Inspectorate is located in the western part of the Regional Directorate of State Forests in Lublin, in the Vistula River valley, in an intensively urbanized area. Due to a considerable share of oligotrophic habitat [27], the forest stands of the Forest Inspectorate are dominated by pine as the dominant species (those that are most abundant in an area). The forests of this area are subjected to increased penetration, both by the local inhabitants and tourists visiting Kazimierz Dolny, the most interesting city in the region, which is a mecca for artists and culture creators [28]. On the other hand, the Lubartów Forest Inspectorate is located in the direct vicinity of the Lublin agglomeration, which makes it an object of intense anthropopressure, especially during holidays and weekends [29,30]. The Włodawa Forest Inspectorate is also characterized by outstanding value in terms of biodiversity. At the same time, due to its location in Polesie Lubelskie, this area is periodically subjected to intense pressure from tourists [31,32].

2.2. Study Procedure

The study used a questionnaire consisting of 13 questions: eight closed-ended single-choice, three multiple-choice, and two five-point Likert scale questions. The constructed survey questionnaire was reviewed by an experienced sociologist and then verified in the course of a pilot study preceding the actual survey research. The pilot study was conducted on a group of 20 people, including 9 foresters. The pilot study was only designed to confirm the accessibility of the survey content and its validity. In addition to questions about socio-demographic characteristics such as age, gender, education, and place of residence, the survey asked questions about whether climate change is observed in the forests, how it manifests itself, and what the scale of these changes was. The study also referred to informal education in sustainable development for climate protection by asking whether climate change is addressed in education classes, how often classes address the topic, to what extent they should address it, and what topics are typically discussed. The questionnaire addressed to foresters also asked about the number of years they have worked in forest areas and the frequency of recreational visits in the forest.

The survey of recreational forest users was conducted from April to May 2019 on adults visiting the forest. Surveys were conducted on the most frequently used hiking trails and recreational paths, with a sample of 146 people. In the case of respondents visiting in groups, the questionnaire was directed at one representative of the group only. The survey of foresters was conducted from September to November 2019. The questionnaires were distributed by ordinary mail to the respective forest districts. A total of 130 foresters working in the study districts were surveyed, representing 82.80% of all employed foresters in the three districts. All participants were informed about the nature and purpose of the study and gave their consent to participate in the study. The survey was anonymous, and no so-called sensitive data were collected. The authors assure that the study was completed without any potential conflict of interest. All procedures performed in this study were in accordance with the ethical standards of the Polish Committee on Ethics in Science and the 1964 Declaration of Helsinki, as amended.

2.3. Statistical Analysis

The obtained data were statistically analyzed using STATISTICA 13. Due to the qualitative nature of the dependent variables, non-parametric tests with a significance level of $p < 0.5$ [33] were used to test the significance of intergroup differences. Pearson's chi-2 test of independence was used to compare two groups of dichotomous variables (yes/no responses). The Mann-Whitney U test was used to compare ordinal characteristics. Responses regarding phenomena that respondents believed were consequences of climate change in forested areas were also analyzed using correspondence analysis.

3. Results

3.1. Characteristics of Respondents

The survey participants included 130 foresters and 146 recreational forest users. The detailed characteristics of the respondents are shown in Table 1. The group of recreational forest users was predominantly female (69.86%). The respondents were mostly between 30–39 years old (74.66%), with secondary education (50.68%), and living in towns with 1 to 10 thousand inhabitants (35.62%). The majority of foresters were men (59.23%). The most numerous group among foresters were people between 30–39 years old (45.38%), with higher education (54.62%), and residents of towns with a population of between 10 and 100 thousand (56.92%) (Table 2).

Table 1. Detailed characteristics of forest districts covered by the survey *.

Forest Districts	Surface Area	Forest Cover	Forest Habitats **		Dominant Species Composition ***		Average Age of Forest Stands
Forest districts Puławy	15,862 ha	22.41%	Fresh coniferous forest	29.79%	Scots pine *Pinus sylvestris* L.	64.35%	60 years
			Mixed broad-leaved forest	22.88%	Sessile oak *Quercus petraea* (Matt.) Liebl.	18.08%	
			Broadleaved forest	19.19%	Black alder *Alnus glutinosa* (L.) Gaertn.	5.19%	
			Fresh mixed coniferous forest	18.61%	Silver birch *Betula pendula* Roth	6.38%	
					Common hornbeam Carpinus betulus L.	3.75%	
Forest districts Lubartów	13,436.18 ha	22.15%	Mixed broad-leaved forest	52.37%	Scots pine *Pinus sylvestris* L.	77.78%	72 years
			Fresh mixed coniferous forest	15.68%	Pedunculate oak *Quercus robur* L.	13.14%	
			Broadleaved forest	10.33%	Silver birch *Betula pendula* Roth	2.96%	
			Fresh coniferous forest	7.90%	Black alder *Alnus glutinosa* (L.) Gaertn.	3.55%	
Forest districts Włodawa	22,758.62	28.8%	Mixed broad-leaved forest	38.57%	Scots pine *Pinus sylvestris* L.	63.24%	62 years
			Moist mixed broadleaved forest	17.44%	Silver birch *Betula pendula* Roth	12.56%	
			Fresh mixed coniferous forest	16.06%	Black alder *Alnus glutinosa* (L.) Gaertn.	11.73%	
			Moist mixed coniferous forest	8.06%	Pedunculate oak Pedunculate oak *Quercus robur* L.	10.23%	

* Received from each forest district. ** Forest habitat types according to the European Forest Types-European Environment Agency Available [27]. *** Species names based on the Checklist of Flowering Plants and Pteridophytes of Poland [34].

Table 2. Characteristics of respondents.

	Foresters	People Relaxing in the Forest
	[%]	[%]
Gender		
Female	40.77	69.86
Male	59.23	30.14
Age		
18–29	19.23	1.37
30–39	45.38	74.66
40–49	35.38	10.96
>50	-	13.01
Educational level		
Primary education	-	4.11
High school	45.38	50.68
University	54.62	45.21
Place of residences		
<1 thousand inhabitants	-	24.66
1–10 thousand inhabitants	43.08	35.62
10–100 thousand inhabitants	56.92	17.12
>100,000 inhabitants	-	22.60

3.2. Perception of Climate Change in Forest Areas by the Respondents

Analysis of the results obtained indicated that, according to the majority of foresters (80.8%) and recreational forest users (67.81%), the effects of climate change are observable in forest areas. However, the distribution of their responses was statistically different (Figure 1).

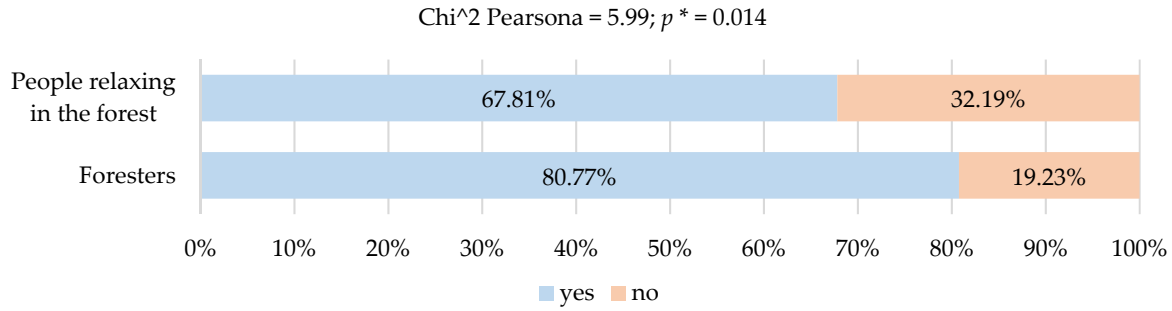


Figure 1. Perception of the effects of climate change on forests. * Statistically significant differences ($p < 0.05$).

Among the interviewed foresters, the prevailing opinion (37.14%) was that the effects of climate change are visible in the forest to a very large extent ($n = 204$). On the other hand, in the group of people relaxing in the forest, 41.41% were convinced that they are visible to a large or very large extent. A significant number of these respondents felt that such changes are visible to an average extent. Distribution of responses of analyzed groups was statistically different (Figure 2).

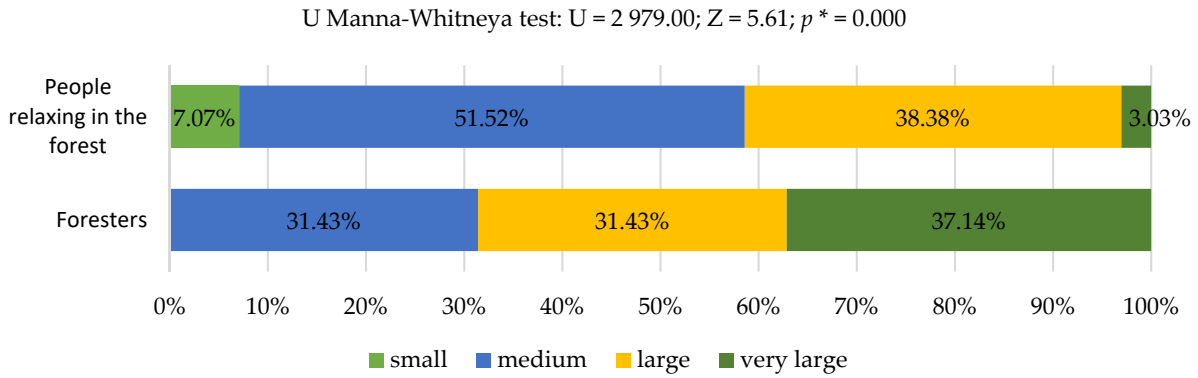


Figure 2. Perception of the degree of climate change in forest areas according to respondents. * Statistically significant differences ($p < 0.05$).

According to foresters, the most common phenomena occurring in the forest, and caused by climate change, include rapid changes in weather (62.86%) and frequent insect swarms (55.24%). According to the recreational forest users, the most prominent are lack of snow cover in forests (68.69%) and drought (56.19%). Statistically significant differences were not observed between the responses of foresters and recreational forest users only in the case of the occurrence of fungal diseases on trees and reduction of annual tree growth. The views of respondents from both groups differed the most on the effects of climate change regarding the lack of snow cover in the forest. On the other hand, the views of respondents were very similar in the case of reduced annual tree growth (Figure 3).

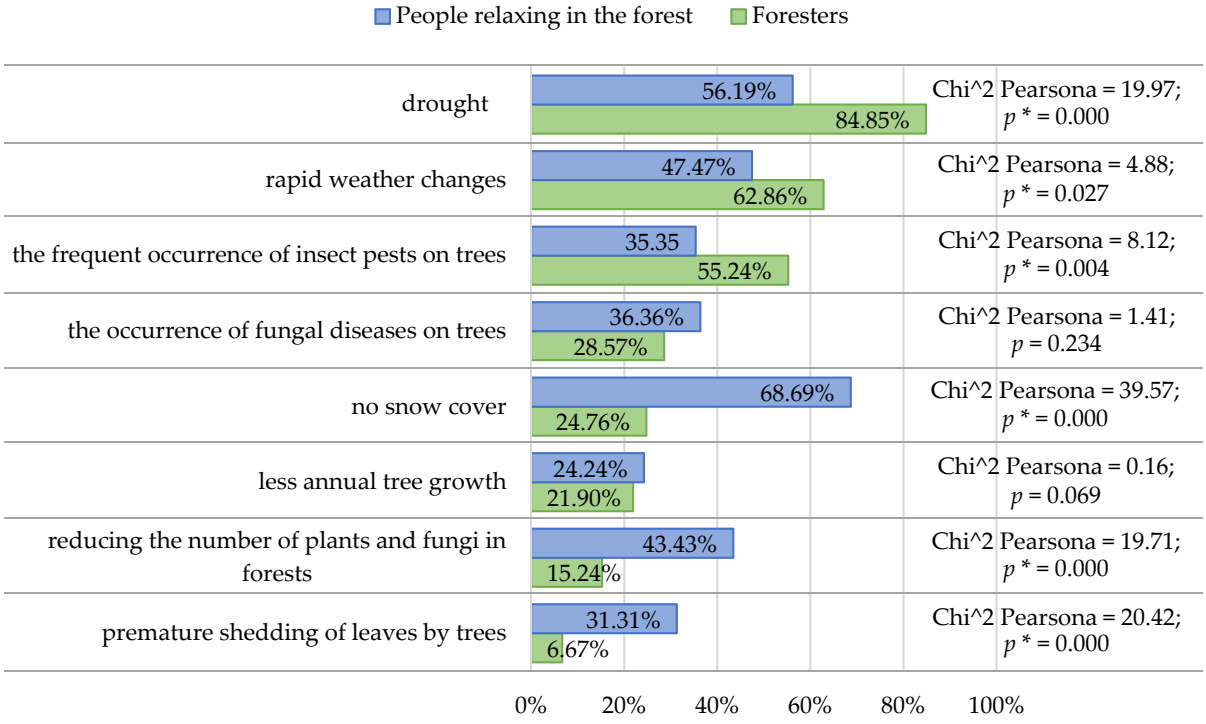


Figure 3. Respondents' views on the consequences of climate change that can be observed in the forest. * Statistically significant differences ($p < 0.05$).

The total inertia was 0.096 and was indicative of the low dispersion of the analyzed profiles. The two dimensions together explained 95.09% of the inertia (axis 1—81.34%, axis 2—13.75%). As shown in Figure 4, the opinions of both foresters, including foresters with different tenures, and recreational forest users differed significantly on the perception of climate change effects in the forest. Foresters with seniority of 6–10 years and more than 10

years expressed similar opinions about the consequences of climate change. Those relaxing in the forests paid particular attention to phenomena such as drought and lack of snow cover.

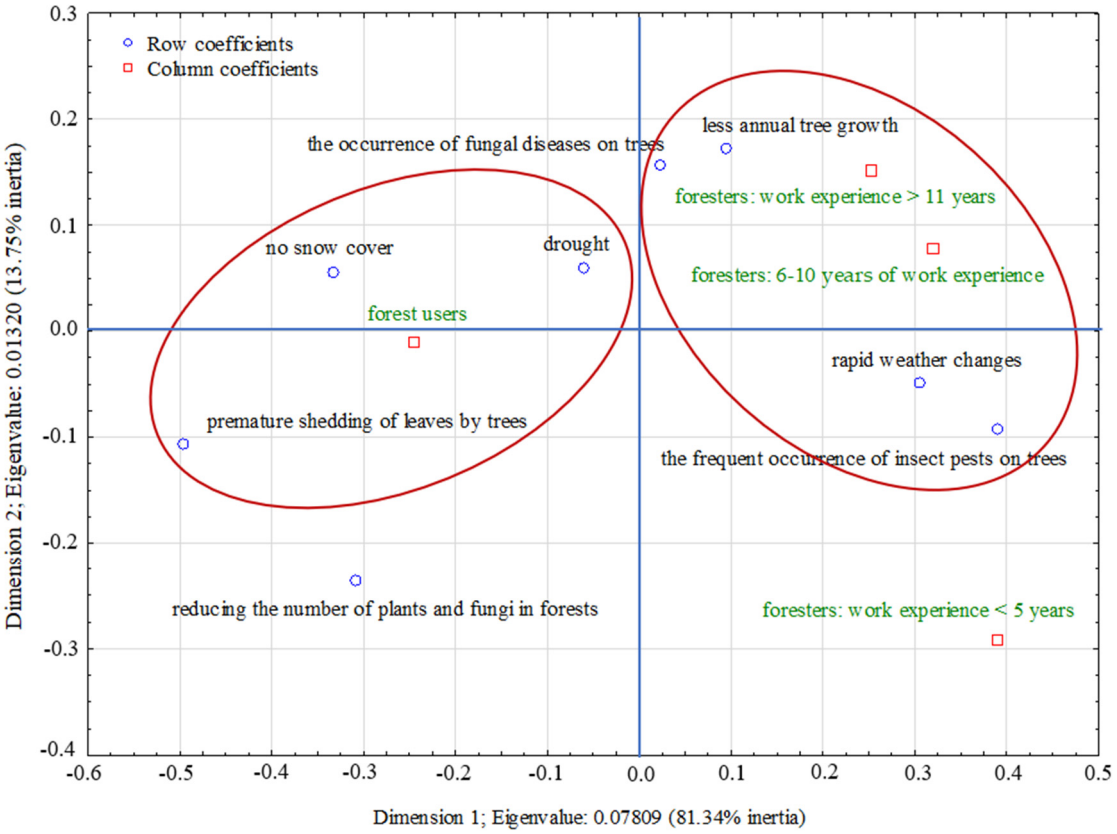


Figure 4. Perceptions of climate change consequences in forest areas by recreational forest users and foresters with different tenures (correspondence analysis).

3.3. Views on Informal Education Conducted in Forests

All foresters were involved in conducting forest education. The vast majority of recreational forest users (96.58%) came into contact with foresters' educational activities. The foresters much more often than the recreational forest users declared that the main topics of forest education were forest plants, mushrooms, water management, and forest management. According to the recreational forest users, the most common topics of forest education they encountered were animals living in forests, followed by plants and protecting nature (Figure 5).

The total inertia (inertia) was 0.046 and was indicative of low profile dispersion. The two dimensions together explained 92.03% of the inertia (axis 1—80.14%, axis 2—11.89%). The statistical analysis conducted showed that the foresters with the longest tenure indicated different problems for education than their younger colleagues, such as historical places and objects in forests, dead wood, and fungi in forests (Figure 6). Foresters with a shorter tenure were more likely to indicate insects and water in the forest, while foresters with 6–10 years of tenure indicated the topics of climate change, vegetation, and water in the forest. Recreational forest users were more likely to indicate educational content about animals and conservation (Figure 6).

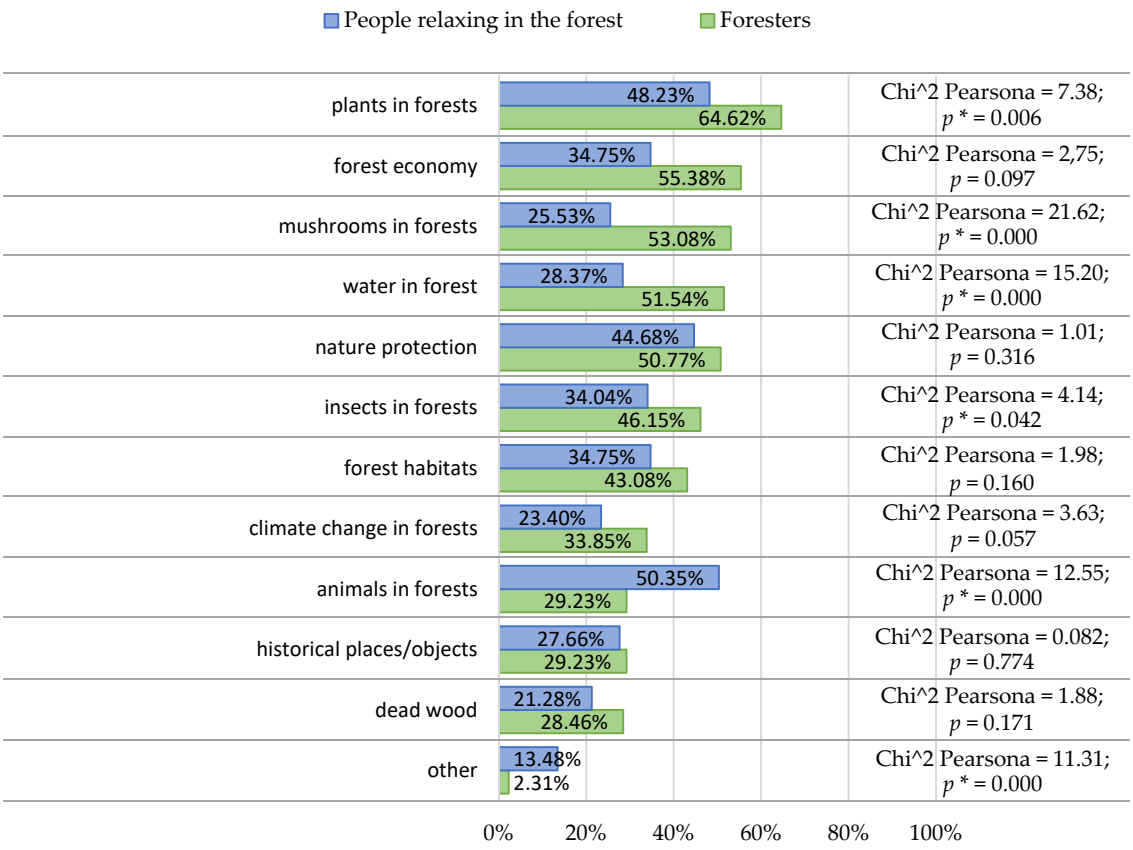


Figure 5. The views of respondents regarding the topics discussed during forest education classes. * Statistically significant differences ($p < 0.05$).

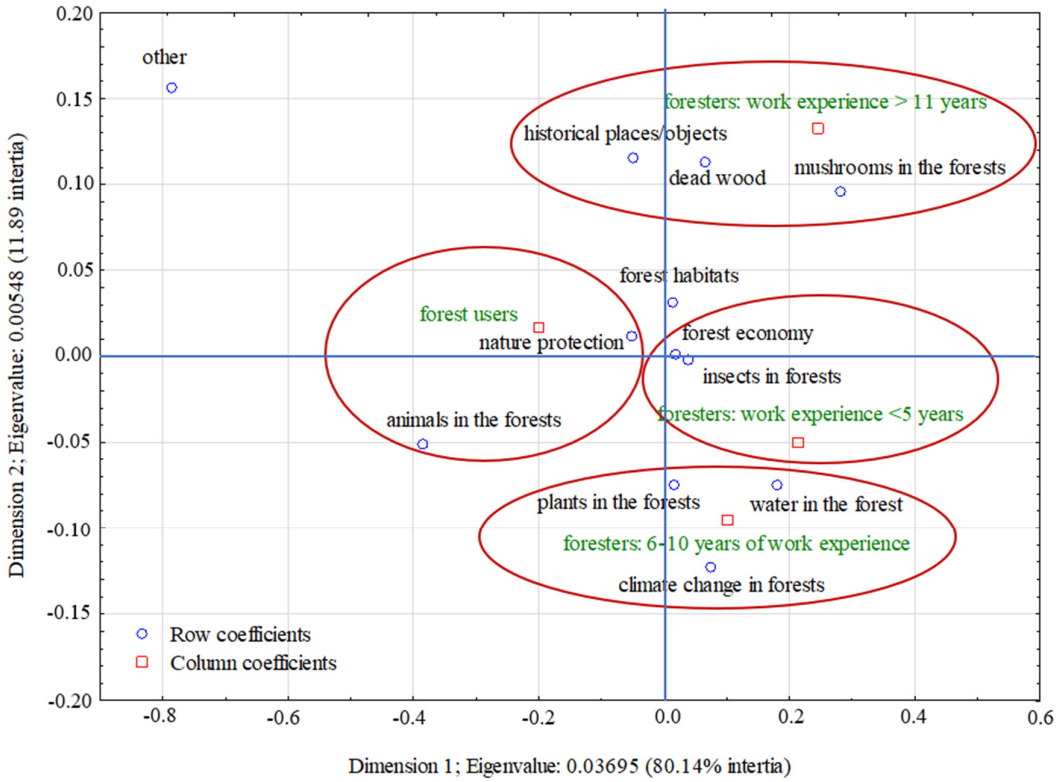


Figure 6. The importance of different topics in forest education classes in the opinion of the various respondents (correspondence analysis).

3.4. Forest Education and Climate Change

Both groups of respondents believed that forest education should also include climate change issues. This answer was declared by 100% of foresters and 96.58% of recreational forest users. In both groups, there was a prevailing opinion that these issues are important, but that they are somewhere in the middle, between other important general educational issues (Figure 7).

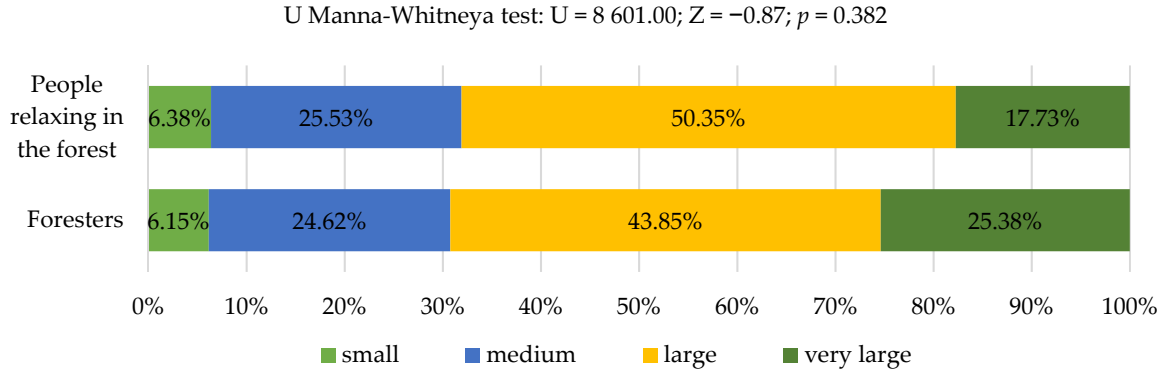


Figure 7. Formation of respondents' opinions about the position of "climate change" among other topics of general education conducted in the forest.

In the opinion of foresters, the following issues should appear in their climate education: the role of trees in absorbing pollutants (55.38%) and oxygen production by trees (34.62%). In the opinion of recreational forest users, the most desirable topics are oxygen production by trees (33.33%) and CO_2 fixation in wood (31.21%). The answers in both groups were statistically significantly different. Exceptions in this context were the role of forests in the absorption of pollutants and the adaptation of plants to climate change. The largest differences in responses occurred in the context of CO_2 fixation in wood (3.85%) and the role of trees in absorbing pollutants (27.01%) (Figure 8).

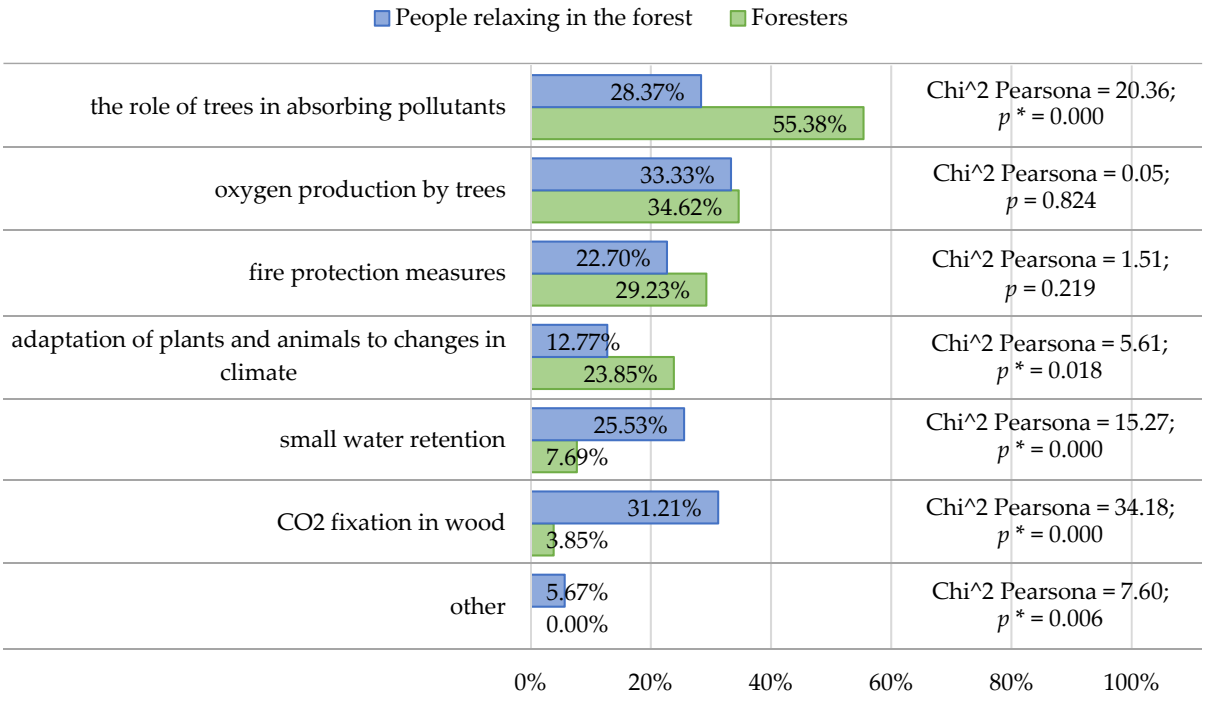


Figure 8. Issues of climate change and its protection which are discussed during the forest education classes according to the respondents. * Statistically significant differences ($p < 0.05$).

The total inertia was 0.196, indicating that the profiles were highly dispersed. The two dimensions together explained 98.49% of the inertia (axis 1—92.75%, axis 2—5.74%). Analyzing the distribution of scores (Figure 9), it can be seen that on the negative side of the axis of the first dimension were foresters of different seniority and on the positive side were forest recreationists. These groups differed in the respondents' perception of education in the context of climate change. The youngest and oldest foresters associated classes on climate change and its protection with classes on oxygen production by trees and adaptation of plants and animals to climate change. Foresters with a tenure of 6–10 years associated them with tree planting and fire protection activities. According to recreational forest users, such activities mainly concern CO_2 fixation in wood (Figure 9).

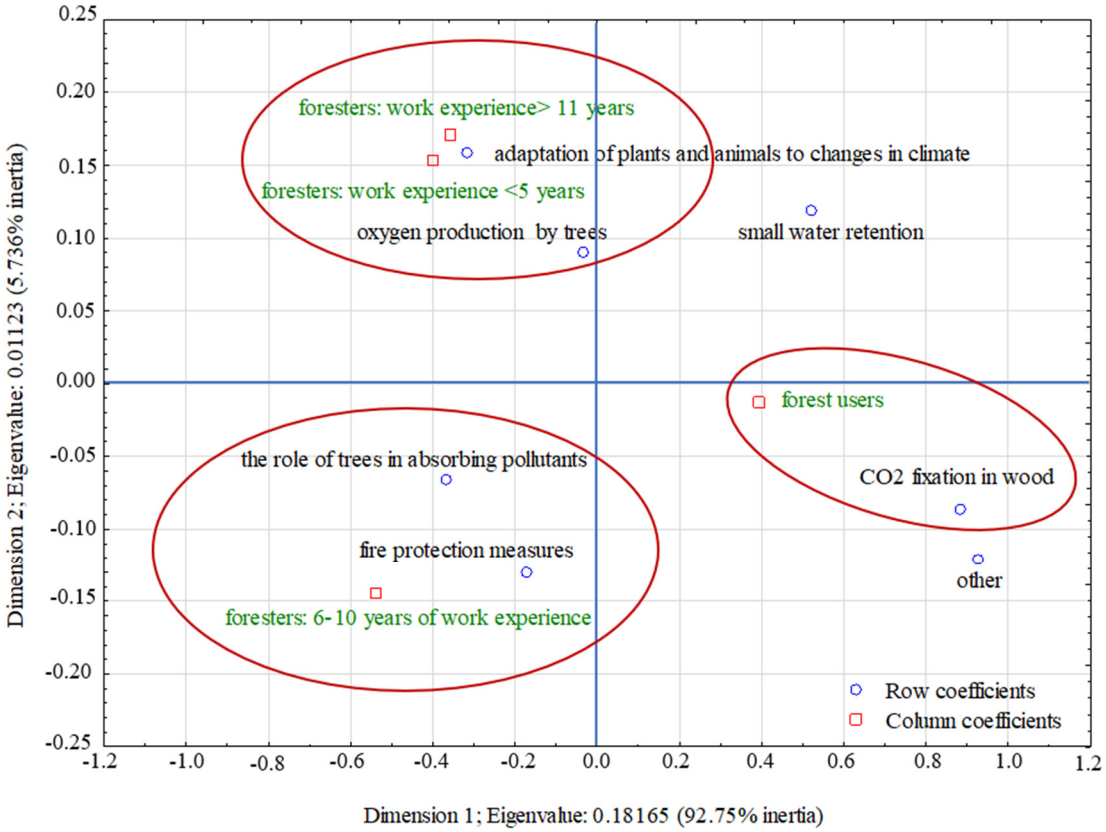


Figure 9. Issues of climate change and climate protection that respondents think should be discussed during classes conducted in the course of forest education (correspondence analysis).

4. Discussion

Public understanding of the scale and scope of climate change as well as the resulting environmental consequences is key to reducing consumption, changing behavior, and developing appropriate environmental attitudes [35–38]. It is also an important element to improve communication [36], whose task is to engage in dialogue with societies and decision-makers in order to implement real actions to curb climate change. According to Willamson et al. [37], social factors influence individual assessment of perceptions of environmental issues, which was also confirmed in our study. The professional group of foresters as well as people who use forest areas for recreation perceived that changes in forest ecosystems caused by climate warming are taking place (Figure 1). However, the impact of these changes was not perceived identically in both groups (Figure 2). Due to the fact that foresters work every day in open forest areas, have knowledge in the field of forestry protection and management of forest ecosystems, and often have many years of experience, their comments on the consequences of climate change are more precise [39]

when compared with people who use the forest for recreation. A significant proportion of forest users do not realize that climate change also affects the stability of forest ecosystems.

Another issue is how the respondents from each group assessed the real impact of climate change on forests. Foresters were far more likely to highlight the importance of severe weather anomalies and the much wider occurrence of insect pests as major consequences of climate change (Figure 3). This is probably due to their professional experience. In the last few years, phenomena such as swarms of the European corn borer or the sharp-toothed bark beetle, which cause significant losses in forest stands, have been a problem in Polish forests [39,40]. The same applies to dramatic changes in the weather; recently, forests in Poland have been affected several times by disasters resulting from the passage of hurricanes and storms. In turn, recreational forest users emphasized the fact of lack of snow cover during the winter and note that drought is more often felt in forest areas. These factors determine the use of forest areas for tourism and recreation to varying degrees. For example, due to the lack of snow in winter, various recreational activities requiring its presence (sleigh rides, cross-country skiing, etc.) are limited [41,42]. In Poland, droughts during the summer, which are a fire hazard, are often the reason for the introduction of temporary restrictions on access to forests [43].

Informal forest education can have the desirable effect of cultivating appropriate environmental attitudes [44,45]. The majority of people in our study had experienced informal forest education classes (Figure 5), which should, theoretically, translate into certain knowledge and perceptions of climate change and its impact on forest ecosystems. Foresters were knowledgeable about the effects of climate change (by virtue of their education and experience), whereas the forest recreationists participating in our study most likely only had knowledge from personal experience. Studies by Sellmann and Bogner [46] and Lombardi and Sinatra [47] indicate that even short informal educational activities can result in increased knowledge in the participants. Adults and adolescents form their views on the effects of climate change through informal education, using the available media or the opinions of peers [48–50]. Children, on the other hand, gain knowledge about climate change through school education [50,51] as well as social media [52,53]. However, there is still no accurate research indicating whether the use of formal education, which is supported by informal educational activities [54], has a real impact on people's views and attitudes towards climate change issues. Participants in our study overwhelmingly (100% of foresters and 96.85% of recreational forest users) believed that climate change topics should be addressed in forest education classes at a high level (Figure 7). However, in order to be able to more accurately determine the degree of effectiveness of forest education in the context of climate change, it is necessary to continuously monitor forest education, create well-targeted education and communication policies, and appropriately adjust the content of classes and educational materials to the audience.

5. Conclusions

Progressive climate change is affecting forest ecosystems, something which is clearly felt by the professional group associated with forests, such as foresters, and to a lesser extent by people using forests for tourism and recreation. According to foresters, the effects of climate change on forest areas are mainly rapid changes in weather and more frequent insect infestations. According to the people relaxing in the forests, they are mostly manifested by the lack of snow cover and the occurrence of drought. Informal forest education carried out in the Polish forests puts insufficient emphasis on the problems associated with the intensification of climate change and sustainable forest management, which also has to mitigate the effects of progressive climate change. The informal educational activities should, to a greater extent, raise issues related to the impact of sustainable forest management to the impact of climate change on forests and more often raise issues related to climate change.

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