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FOREWORD

‘Societal Relevance of Polar Research’ conference, Sopot, 27—28 November 2018

‘Societal Relevance of Polar Research’ was a two-day mini-conference held in Sopot on 27—28 November 2018 in the Institute of Oceanology of the Polish Academy of Sciences.

62(4PB) issue of *Oceanologia* presents a selection of papers stemming from this event. The conference ‘Societal Relevance of Polar Research’ advocated a multidisciplinary approach to informing, educating and sharing information as well as raising awareness of environmental issues which the Polar Region is facing. The mixed group of natural scientists, sociologists, psychologists and representatives of humanities (authors, journalists, filmmakers, educators) discussed a variety of challenges, which we face with regard to this remote, polar region. We hope that this issue is a step to the promotion of sustainable thinking and hence use of the resources of this region. This sustainable approach must be based on a consensus of all sciences and a voice of all stakeholders must be heard. Only, then, we can count on societies to be more aware of the environmental challenges and be prepared to make proper science-based decisions.

Ten articles presented in this issue aim to be a brief trial in bringing interest to the theme of Polar research. The authors also try to answer the question of what the key drivers could be to create political and public support for the Polar research in Europe.

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ORIGINAL RESEARCH ARTICLE

The attractiveness of polar regions as the zones of silence

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Summary Post-modern societies are characterized by information-based functions that generate the anthropogenic stimuli (as opposed to the industrial society of energy processing and the traditional society whose activities are related to the production of natural crops). Hence, life in the information overload becomes a tiresome daily reality, from which only a very few may escape. These escapers might be regarded as consumers of the new type of 'luxury goods' such as: silence experiencing and positively valorized solitude allowing deeper insight into oneself. The polar regions provide an opportunity to withdraw from the anthropogenic noise of the civilization. I do believe that it is one of the most significant drivers of the increasing popularity of traveling to these regions of the world.

1. Research background: stimuli abundant postmodernity

Post-modern societies are characterized by information-based functions (as opposed to the industrial society of energy processing and the traditional society whose activities are related to the production of natural crops), which in practice means generating, modifying and selecting creative applications and many other processes related to operations on information. The processes of generating and transforming information are evidently accelerated by the technological development. This triggers a very rapid growth and knowledge transfer. It obviously has numerous positive effects (mainly in the form of the accelerated development of civilization), but it also generates the negative effects. Among them is the excess of informational stimuli that people are exposed to. This particularly alarming issue attracts increased attention from psychologists and sociologists, who report a number of cognitive and social functioning disorders such as: behavioral addictions, hyperactivity and difficulties in concentration as well as many other disorders (e.g. Bühler et al., 2005).

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The socio-cultural functioning of a man is embedded in the biological and physiological limits of the human body. Psychology has already described the mechanisms of cognitive functioning, which translate into social relations and include these biological limitations. An example is the process of stereotyping as a mechanism for selecting information and simplifying the perception in order to increase the behavioral effectiveness. Social impact of stereotypes has many minor functions but the most important is the right selection of information (Hinton, 2017). The amount of information needs to be reduced in situations where there is an abundance of incoming cognitive stimuli and at the same time there is a need to decide immediately on the application of specific behavioral strategies. Judgments are made quickly then. They can be wrong, of course. However, in the game of survival, where life is at stake, it is better to make decisions that are both too cautious and quick than decisions based on a long-term analysis of the specific data that require a valuable amount of time. In the postmodern world, 'psychological' survival is at stake – today a man basically does not experience a threat to his physical integrity. Despite the fact that the theoretical potential of the human brain is not fully exploited, at the empirical level, it is more often said that the cultural and civilizational development of a man precedes his biological evolution (Pilli and Mazzon, 2016). This means that the processes of cultural change that have been occurring in the last two hundred years go beyond the biological adaptation of humans to live in such conditions (for example, the increasing life expectancy of humans does not correspond to the biological potential of the human body). As a result, despite the application of advanced medical technologies for treatments and life prolongation, it is not possible to ensure its high quality, due to the somatic limitations of a man.

A counterbalance to the context of life of a man of the 21st century outlined above, is to be formed by lifestyles connected with the 'slow life' current, for which the basis is a return to close ties between a man and his natural environment, which unambiguously imposes a restriction in social contacts. In the field of social sciences, there is more in-depth reflection aimed at enhancing the value of building relations between a man and the nature (Giusti, 2019; Schweitzer et al., 2018; Seymour 2016). It is already clear today that this kind of reflection is a turning point in treating nature as a set of resources whose rational and sustainable use is of tremendous importance to the welfare of a mankind. The value of the natural environment is an autotelic value but it can also be understood using other approaches – one of them is the concept of ecosystem services (Norgaard 2009; Schaefer et al., 2015). This way of thinking is associated with the concepts of the natural capital and the so-called ecological economics. Ecosystem services are understood here as the contribution of the natural ecosystems to the broadly defined human welfare. Ecosystem services are the income generated by the natural capital. It proposes an approach to ecosystems in the broad sense of the term, in which attempts are made even to quantify the resources offered by ecosystems in the form of 'services'. They have a biological dimension (creating ecological niches, fostering biodiversity, generating products valuable for other living organisms, e.g. oxygen); production services – direct production of goods useful for the human being (e.g. food); regulating services – e.g. regulation of hydrological changes and cycles, climate regulation, mitigating the effects of extreme weather events and cultural services: aesthetic, tourist, recreational, historical, etc. Pointing to such a positively valorized offers generated by the natural environment aims to show that for a normally functioning human being it is necessary to have a relationship with the nature. Moreover, the aim to have a relationship with the nature is a natural tendency of a man as a specie – according to Edward O. Wilson, following Erich Fromm, this need is called biophilia (Lumber, 2017; Wilson, 1984).

The proposal to define ecosystems in service categories attempts to translate the high value of the environment as an important resource into the language of economics used by mercantile-oriented decision-makers. The subtext for this concept is the appreciation of the value of the natural environment and the striving to preserve it as a set of resources essential for the man, due to the functions it performs. In the anthropogenic era, these postulates are gaining strength today. However, the value of the environment should be seen as an autotelic value in itself, as I mentioned. This kind of approach is embedded in the pioneering works of the most important authors in the field of deep ecology: Arne Naess (2010) or Aldo Leopold (1968) and Henry David Thoreau (1980, 2018), the author that the previously mentioned researchers often referred to.

Thinking in terms of a deep ecology restores reflection on appreciating the value of the natural environment (Dean, 2018; Wu et al., 2015). The growing popularity of such an approach should be interpreted sociologically as an indicator of deficits, of certain needs felt at the individual level, which, however, after exceeding a certain critical mass, leads to the formation of social trends. In the previously outlined context of societies based on the generation and processing of information, the excess of anthropogenic stimuli overwhelming the contemporary man of Western culture becomes a serious psychosocial problem. The invasively emitted information overloads are omnipresent: they take the form of visual messages (advertisements in the media, outdoor advertisings, television broadcasts), audio messages (advertisements on the radio, but also the noise resulting from everyday life of people, especially urban agglomerations) and those affecting other senses (effects of smells, modification of space, which influences the social behavior).

In such a dynamic world, man has to make more or less conscious attempts to select the incoming stimuli or even to eliminate them, because, as I have indicated before, the human brain is biologically incapable of analyzing and processing all of these stimuli. Paradoxically, the search for peace and quiet becomes a kind of a psycho-biological environmental enrichment (this has been examined in animal shelters and zoological gardens, Coleman and Novak, 2017; Garvey et al., 2016). Silence is a resource and a resource in deficit. It can only be gained if social contacts are limited at the same time.

I observe the aspect of intentional disconnection from incoming stimuli in various human behaviors and at different levels of intensity: starting with the use of sound barriers (e.g. headphones – that are no longer just for listening to music, but also for not hearing the environment, used

by travelers on planes or trains and production workers in industrial plants); by insulating buildings with soundproofing materials or building houses away from the immediate vicinity of cities; to intentional spatial isolation, taking the form of peregrination to places that are inaccessible to the majority of people or accessible to a very limited extent (mountain climbing, solo sailing as well as living in areas with very low population density or holiday trips to such places). This last type of behavior is a good example of distancing one among five classical methods of soundproofing (Absorption, Damping, Decoupling, Distance and Mass – https://hushsoundproof.com/soundproofing-101/).

In such categories I also interpret the growing interest in traveling to the polar regions. This is, of course, one of the possible interpretations that draws attention to the search for broadly understood silence and isolation from the multitude of socially generated stimuli, but it seems to be an accurate one.

Based on the observations of the travelers, I propose to identify using the subjective judgments, four categories of people traveling to the polar regions. They are supporters of the post-Fordist ecological tourism (individual travelers, 'backpackers'); people with a high financial status (either traveling alone or in very small groups on expensive trips) and tourists using the forms of mass tourism, arriving by large tourist boats for one to two days. The fourth category is made up of researchers, scientists and journalists who are looking for cognitive experiences of a special nature. While a group of mass tourists cannot in principle experience the positive aspects of isolation (including silence) – by being on board of the ships designed for several hundred to several thousand passengers, the other three groups seem to be strongly motivated to travel to polar regions, precisely because of the search for positively valued isolation. A positive valuation of isolation can arise from different human assumptions.

2. Research question: polar regions as silence regions?

Marinologists and oceanographers claim that arctic regions are not as silent as this is expected. These statements however refer to the level of noise created by anthropogenic activities that influence the marine mammals. Their perception in obvious ways is different from the human perception. What in the perception of sound-sensitive animals is meaningfully noisy, by humans is sill perceived as silence (Haver et al., 2017). This is often reflected in somehow romanticized picture of polar expeditions presented in novels. Also, popular culture to polar regions as dominated by silence (Griffiths, 2010). Tourists asked about their expectations prior to the experience in the Canadian Arctic on cruises, indicated following expectations: to experience solitude – 3.2%, silence – 4.4%, lack of crowds – 3.9% (Hall and Saarinen, 2010).

Silence, emptiness and geographical isolation seem to be the first and foremost associated with deserts, as perceptually and empirically more accessible to people than polar areas, all the more so because the natural environment of a man is a savannah. This is an interesting regularity because in the spatial dimension it is the opposite: while the broadly understood deserts in the world occupy about twenty million square kilometers, i.e. about twelve per cent of the area, the polar regions (Antarctic and Arctic as a whole), cover about twenty-eight million square kilometers. Deserts in fact increase their range, absorbing in a certain sense also the polar regions. Both terms (desert and polar area) are defined on the basis of different criteria. The deserts are distinguished by the type of vegetation of the flora and fauna that can be found there due to the altitude of the temperatures and the amount of precipitation. In turn, polar areas are defined by the type of Earth's solar illumination. Deserts, however, due to their spatial proximity are more accessible to people, both in the form of physical peregrinations as well as in the sphere of cultural imaginations, descriptions and messages (in legends, literature, traditions and customs). Deserts are also visited by people as tourist attractions, which popularizes the experience of deserts, but also paradoxically increases the 'crowd' on them. In the context of the search for isolation, the deserts do not seem so attractive therefore.

The broadly understood polar regions are significantly less accessible to explorers, scientists and ordinary mortals. This is probably also due to the fact that staying there requires a more extensive infrastructure supporting the physical capabilities of people. Knowledge of the polar regions also seems to be less accessible in the common perception and is limited to a smaller number of messages (both in the education and in the pop culture). In this sense, one can risk the statement that deserts are much more accessible to human experience but they are also more exposed to the presence of anthropogenically generated noise stimuli.

As described by the alpinists, the Silence is also associated with the extreme expeditions particularly to the so called high mountains such as Himalayas (Cichy et al., 2019). Severe weather conditions in the mountains drastically limit the number of people present there and the sounds they produce. In their reminiscences and journals, the alpinists very often mention experiencing a remarkably striking silence: "Off, we go. Surrounded by the vast seemingly endless area, we feel very little and at the same time we are immersed in the sense of an incredible freedom" (Cichy et al., 2019). "We stop for a short while. (…) This is fabolous. It is quiet, windless and warm. We have set a new path and we award ourselves with the privilege of naming the crossed pass. As of today it is the Silent Pass" (Cichy et al., 2019).

It is an empirically researched that the tourist traffic in the Arctic regions is increasing and the attractiveness of this destination results from many factors. This area is interesting and unknown at the same time inaccessible and not universal (e.g. Baldacchino, 2006; Gyimóthy and Mykletun, 2004; Jaskólski and Pawłowski, 2017; Stewart et al., 2007). The type of available tourist attractions is specific: in principle, restricted to communing with nature (although some authors point to the presence of cultural monuments in the Arctic – for example Jaskólski and Pawłowski (2017) on the Spitsbergen). I also presume that precisely the isolation from civilization and a relatively low level of perceived anthropopressure as well as the possibility of experiencing the desolation and the silence are the factors influencing the sensation of attractiveness.

The sources of increased interest in the Arctic regions lie in the nineteenth century and the expeditions of then explorers, which undoubtedly contributed to the dissemination of the knowledge about this region: "The interest in the polar area as a potential area of tourism development was noticed as early as at the end of the 19th century. It was caused by the increase in popularity of Arctic expeditions, and above all by the travelers' race to reach the pole. In the middle of the 19th century, the pioneers of tourism began to visit the island on private yachts. In the 1870s, the first passenger ships to Spitsbergen began to operate. The first hotel in Spitsbergen was built in 1890 in Longyearbyen." (Jaskólski and Pawłowski, 2017). The development of tourism in this region of the world was also supported by economic changes (for example, the decline in coal mining in Spitsbergen led Norway to take measures to ensure the sources of income for its settlements — which resulted in the creation of national parks and nature reserves attracting (quite effectively) the tourists): "While by 2006 the number of tourists visiting Longyearbyen in the season did not exceed 30,000, in 2014 the city reported a record number of up to 50,000. This demonstrates that tourism has doubled in such a short period of time." (Jaskólski and Pawłowski, 2017). Such a dramatic increase in the number of visitors can be attributed particularly to the form of tourism offered by the tourism companies that organize cruises in the Arctic Ocean that enable people to experience their presence in the High North. The specificity of invasive Fordist tourism consists of defining locations as tourist attractions and promoting them as well as their exploitation and later abandonment. This process has a devastating impact on local communities and the natural environment. As the interest in the place increases, there is a necessity to make infrastructure available for tourists, which entails a real interference in the natural environment (e.g. Karhu and Osipov, 2017; Maciejowski, 2007; Vistad et al., 2008). It also has social consequences like changes in the local employment structure and reorganization of social structures as well as changes in traditions and customs. The mass tourism has therefore a significantly destructive effect not only on the natural environment of a man, but also on the man himself. Those who participate in such organized travels, however, do not have the technical possibility to experience what seems to be very attractive in the polar regions: the isolation from human civilization.

Dyson's SWOT analysis created to evaluate the tourism potential of Spitsbergen places on the Strengths side of the Spitsbergen 'the possibility of peaceful sightseeing (no crowds)' among other things (e.g. Dyson, 2004). The theme of the low intensity of human activity can also be found in other authors, indicating that it is attractive for tourists to visit the unexplored areas that no modern, civilized human has ever set foot on or at least rarely 'explored' (Maciejowski, 2007).

The restrictions in the number of social interactions and the number of stimuli seem to make the polar regions completely unique. This kind of isolation is not even considered as a tourist attraction anymore (according to Urry (2000, 2002) the attraction is the place and the object and here we are dealing with the extension of this catalogue with the status of mind) but as a desirable state of mind that is very difficult to achieve at the center of human civilization. The polar regions, geographically, are in fact at the margin for locating people's activity. The perception of isolation as a desirable good is, in a sense, a novelty in social processes and results from the specificity of the occurring changes.

3. Challenging aspects of solitude

For a long time, isolation has been, and for the vast majority of people still is, a sign of an oppressive, negative state, which is connected with the fact that there are high affiliation needs experienced by humans as species. Forced isolation of people in closed institutions (correctional institutions, prisons, camps) has always been treated as a form of an oppression. The additional factor of oppression is the fact that in such places, people are not able to decide for themselves. What is more — these isolating institutions always assume, that men under their supervision are exposed to a continuous surveillance by a special category of people (guards, educators), and that they are deprived of the possibility to decide whether they allow for this kind of surveillance or not. Here therefore we have a complex psychosocial phenomenon: forced isolation presupposes the impossibility of distancing from the people who are officers of the institutions. Obviously, imposing periods of isolation and social exposure becomes a punishment because it consists of limiting the choice.

Another example of negatively motivated and also negatively perceived isolation is the dispatchment of people to areas treated as unattractive and dangerous: Siberia (as an example of the polar regions) but also Australia and many other places, are examples of imposing isolation by transferring socially unadapted people to an area inaccessible to the average others (e.g. Bauman, 2003). Today, due to the impossibility of dispatching people to such geographically separated areas, in order to achieve spatial segregation, numerous, and deliberately constructed architectural barriers are used, allowing for the displacement of undesirable people outside the area of the direct contact (fences, intercoms, cameras or closed housing estates serve this purpose). In these phenomena and processes, isolation is either a rejection or even a punishment. It is driven by the reluctance of some people to interact with the others and it is executed by transferring these unwanted people to areas that are unattractive to the majority, on the basis of coercion and imposition of the will by force of top-down decisions. Such isolation processes concerned different locations, including polar regions, as well as (for example banishments).

Today, however, in the case of polar regions, the process is different. People who are not interested in interacting with the others in a quest for silence, among other things decide independently to withdraw to the areas unattractive to the human majority. It turns out that whatever they find in these areas and whatever kind of sensation is experienced it is highly rewarding while the isolation itself has a positive nature.

The social mechanisms of isolating people as a form of punishment are based on a psychological assumption regarding the averse nature of social deprivation. Separation from social and cognitive stimuli has been studied through various experiments, conducted by Harry Harlow (1959, 1965) among others, who, by separating young rhesus monkeys

from mothers, observed severe developmental disorders that led to death. The lack of stimuli generated in this way had to be felt as a negative type of stimulation. In the context of extreme and forced sensory and social deprivation, especially of herd animals, the negative interpretation of the procedures to which animals are subjected is evident (today there is no doubt that such practices are a source of suffering for animals). It is different, however, when it comes to making choices, while knowing the options available and while taking into account one's own preferences (or competences demonstrated by individuals). From a psychological point of view, the more conscious the choice is, the more cognitively and emotionally prepared a person is to make the selection, and the more action is taken in accordance with the preferences and motivations of the person, the less likely it is to feel discomfort or even interpret the situation as oppressive. The perception of the situation is also influenced by personality traits and the individual's own life experience.

In publications on spatial isolation in polar regions, Jan Terelak (1982a, 1982b) points out that particularly long-lasting stays in polar research stations (so-called wintering, covering the period of Arctic winter) were assessed by the participants as difficult experiences that carried negative emotions (e.g. Piepiórka, 2019). In the first place, however, the motivation of the participants should be taken into account, in the second place their personalities and competences, and in the third place their access to information on social and living conditions in the stations, which was very limited until the internet appeared. Terelak (1982b) confirms that the motivation to take certain actions was crucial for the evaluation of the quality of the experience of staying in the conditions of Arctic isolation. The research of Soviet expedition participants, recalled by Terelak (1982b), indicated mainly their financial and adventurous motivations. It is difficult to find in the publications mentioned above research threads devoted to motivations resulting from in-depth reflection on the level and type of one's own needs. It is also important to note that these works were created half a century ago, when anthropopressure was weaker. It is necessary to point out that Terelak, when presenting the results of his research, focused on the negative emotions accompanying the polar explorers during their trips to the polar regions. He disregarded the rewarding aspects and deep motivations that were not the subject of the research. The selection of participants for this type of expeditions should be based on a precise adjustment of the personality profile to the type of task. It should therefore result from an in-depth analysis of the motivation, level of needs and the type of personality of the candidates. The participation in the expedition itself should be undertaken very consciously, on the basis of the analysis of the arguments for and against, and taking into account the possible negative consequences (e.g. Węsławski, 2019). Terelak's research dates back to the historical period (the seventies and eighties of the twentieth century), when the participation in 'exotic' character expeditions (which included, and still includes, participation in polar expeditions) was determined by the level of classification and numerous informal and non-substantial factors, such as political functions. To consider such factors as sufficient for participating in the expedition, given the motivation of the participants, which was rather due to mercantile motives and taking into account the competition as well as the desire to be distinguished, must have resulted in an inappropriate selection of participants. Negative emotions demonstrated by the inadequately selected people on polar expeditions are a natural reaction to stressful situations. It may appear, among other things, when it is necessary to confront difficult living conditions (e.g. cold or prolonged darkness). Failure to include the risk factors in the assessment of the circumstances may have resulted in an erroneous perception of the situation, reinforced by poor preparation for the journey (or lack of preparation at all) and by a 'culture shock'. I assume that the participants could have been experiencing such a culture shock in a very specific form. Traditionally, the culture shock is defined as a confrontation with new normative-directive orders, which causes the known behavioral strategies to become inadequate or insufficient. This may result in a depressed mood and lower self-esteem, as the existing knowledge and experience are not sufficient to effectively cope with the requirements set by the environment.

Today, when, following Rosi Braidotti (2013), we indicate the continuity of nature and culture and treat them as one continuum rather than two opposing states, it is legitimate to interpret the change in natural conditions as a change in cultural conditions.

In coping with the culture shock, the emphasis is specifically given to the role of preparing for the journey, the need to plan tasks to be performed on the site and the need to provide social support to those affected by the shock. In Terelak's work, the polar explores are depicted as convicts, forced to separate from the desired social environment, rather than as conscious, autonomous individuals who decide to take upon the journey on the basis of deep reflection and in pursuit of satisfying their needs, including the need for solitude. As De Korte and Oosterveld (1978) points out in an extremely interesting report on wintering, the inappropriate selection of people chosen to participate in the expedition and the neglect of psychological and sociological evaluation, leads to numerous disturbances resulting in difficulties, emotional challenges and conflicts that jeopardize the success of the whole mission.

4. Hypothesis: Solitude as a value

Effective selection of participants for projects requiring solitude increases not only the quality of the task performance, but also guarantees positive experiences for the participants. Reflection of this rule can be found in many opinions of those undertaking trips into challenging geographical regions where solitude is one of the unavoidable elements of the project: "Instead of 'sensory deprivation', I remember the most colorful, attractive and adventurous one and the other year, where every day was like a nature film unfolding before my eyes. Instead of the group stress, I remember the impression of solidarity, unconditional confidence in friends, the joy of overcoming risk and physical exhaustion. Please note — I'm talking about a small group of friendly young scientists who went to spend a year in the field research, next to us there were of course others — our colleagues who experienced it differently and their motivations were different." (Węsławski, 2019). Węsławski

argues further that difference in the ways of experiencing solitude derives from differences in motivations that participants of Arctic research demonstrated prior to the trips. For those whose main motivation was financial one, the trips appeared much more difficult, demanding and challenging than for those inspired by curiosity and willingness to discover. Węsławski as a participant and researcher also sees another difference in experiencing solitude in the Arctic. He claims that in order to experience positive emotions during the trip it is crucial to assign proper 'scope of duties' to participants. Subjects researched by Terelak were usually assigned simple tasks based on routinely performed duties, important, but usually very unattractive and monotonous (e.g. non-stop meteorological measurements every couple of hours). Those persons were lacking interest and motivation in discovering surrounding reality. As he claims members of this kind of groups would tend to stay in the base building, except for the necessary walks on duty against white bears. The main stresses and strains of this group of winterers concerned the diet, the amount of alcohol available and the fear of additional, unplanned activities. Most probably it was this group that was experiencing the 'sensory deprivation' described by physicians.

On the contrary, Węsławski's research team consisted of completely different people, motivated by curiosity not by the financial reward and a desire to experience the polar expedition. These participants prepared themselves for the trip by winter hiking in the mountains, camping in the snow and sailing in a small boat on a rough sea. This group also possessed knowledge about specificity of the climate and realm of arctic regions. Mindset of its member was focused on the field work with as little as possible stays inside the base buildings. Factors mentioned by Węsławski are the key elements in building proper motivation, expectations and attitude towards the undertaken task, which changes emotional response of participants towards experiencing solitude and silence, as well as social isolation.

One of the travelers, who was visiting Spitsbergen for the first time, wrote: "I am alone, but I do not feel more or less lonely than in Poland or anywhere else. The difference is that it's quieter here and you can focus more, and thus see things more clearly. This expedition is a journey into myself. Rather than walking to the pole I travel through my life. I march through various events. I meet people and step by step everything that occurred comes back. Even the shortest events or small gestures that emerge from memory unexpectedly out of nowhere. Despite the fact that I pull the sled, I feel at ease. I do what I really wanted to do. Alone in a white empty field. I am free and happy. Here, life returns to its original path. Existence consists of simple and repetitive, but not always obvious acts. The existence only to satisfy the primary needs." (Cichy et al., 2019).

In the 21st century, the possibility of experiencing the silence becomes not only a quality commodity, but also a luxurious one. This is emphasized by the offer of upscale hotels, as well as tourist resorts such as agrotourism. (Thurlow and Jaworski, 2010). Offering the experience of silence resulting from the isolation takes the form of a dichotomously designed proposal. Either it is aimed at separation from the nature and from the sterile purity, maintaining absolute control over what stimuli are acceptable (this kind of rhetoric is used by the upscale hotels, where the purity, silence and delicacy as well as a full control over the possibility of any external stimuli is emphasized, and the visual message uses light and subdued colors that create an impression of harmony and peace) or it is directed towards the proximity to the natural environment and the possibility of interacting with the chaos resulting from the specificity of this environment, which is, however, contrasted with the civilizational control of stimuli and space encountered in urban agglomerations (the perception of wind and presence of insects or falling leaves as well as a kind of the 'roughness' of natural circumstances — spaces that require physical fitness, mountains, waters, etc.). However, with the egalitarian consumption and the popularization of access to higher quality products, the concepts of new forms of luxury have emerged and they not only include goods that are expensive and inaccessible, but also the goods that satisfy the specific needs of respite from everyday struggle and the emotional needs as well as the goods that provide positive experiences (Veblen, 2004). In this context, what is becoming more and more visible is the tendency for affluent people to settle on large and isolated from the access of social masses plots, but still privileged in terms of natural attractiveness. (e.g. the encyclical letter *Laudato Si*, Francis (2015)). Traditionally, rare goods are considered to be the luxury goods (Veblen 1994). Access to nature and its natural dynamics, including the experience of sounds devoid of anthropogenic influences, is not common today and can clearly be considered as one of the very much sought higher quality goods.

It appears, however, that the isolation is attractive not only for a contemporary human but it was valued already in the past.

Positive appraisal of silence has always been associated with the in-depth reflection resulting from religious, mystical or at least deeply contemplative experiences. The practice of embedding the reflectiveness of the monks, shamans and priests in an environment of complete silence, with the possibility of focusing on ones thoughts, is still and was present in all religions, both polytheistic and monotheistic. The rituals of transition are accompanied by the social isolation, and consequently by the isolation from the acoustic stimuli, as indicated by van Gennep. In both cases, the isolation is intended to deepen the reflection and enable focusing on the essential matters as well as to allow the separation from the information overload and the inflow of stimuli as distractors. Remaining in silence (often associated or even identified with the social isolation) is, however, so difficult to experience that it has also become a kind of challenge: for example, in some of the scouting organisations members gaining further degrees of initiation (badges) are asked to attempt the behaviour in which silence and remaining in silence is ordered. It is a kind of task that diagnoses the ability to concentrate on oneself and one's own experiences, the so-called inner life. As Thoreau (2018) indicates in *Walden*, only the isolation from the social environment that generates sounds, that Thoreau interprets as a noise and a hum, provides a real opportunity to reflect on the surrounding world and its phenomena. Moreover, this reflection

may only be exercised in a properly deepened manner, only in a close contact with the nature.

The needs to experience silence as well as to experience sounds are adjusted by not only the given culture and species, but also by the individual's need for this kind of stimulation or its limitation. A type of psychological regularity has already been thoroughly studied — it is also applied in a 'negative' manner, i.e. in torturing of the suspects of crimes. By the people imprisoned, for example, the experience of a constant noise, or even a background noise, is indicated as very oppressive. Therefore, the elements of meditation in the silence and darkness are introduced as part of certain kinds of group therapies conducted in prisons (the silence and darkness are the two very limited experiences in prisons).

The torturous use of a noise to exercise psychological pressure was used by the American armed forces not only in the attempted arrests of Manuel Noriega, the Panamanian ruler and dictator, but also in the fights against the Talibans in Afghanistan (see Michaels, 2010). This kind of over stimulation led not only to sleep deprivation, but also became so extremely difficult to endure that it was perceived and used as a torture to induce certain behaviours of people subjected to it.

The human natural need for affiliation assumes various levels of intensity in different people, which automatically indicates that the solitude and isolation from the inflow of stimuli will be felt differently by various people. The aforementioned authors wrote about the positive valorization of solitude and the experience of silence, whose works became the foundations for reflection undertaken within the framework of the deep ecology trend: Aldo Leopold and Arne Naess, but these motifs are also present in contemporary psychological research, in which the motivations to travel alone or in extremely difficult conditions are analyzed. These analyses indicate that such measures result from broadly understood personality needs (Kajtna et al., 2004). Therefore, the solitude is treated as a value by lonely travelers, Himalayan climbers or sailors, and certainly not as a threat. The solitude evaluated in such a manner became a creative inspiration for Henry David Thoreau's deliberations (Thoreau, 2018). With all his conviction, he stated that it is the solitude, silence and the possibility of staying 'in the forest', i.e. in contact with the natural environment, that determine the potential of human intellectual development. In *Walden* Thoreau (2018) also emphasizes that communing with nature and listening to the sounds of nature are a form of luxury: experiences inaccessible to the masses. This reflection is particularly interesting given the fact that Thoreau's works were created in the 19th century. Silence and a valuable opportunity to experience nature alone were also the basis for thinking about the man and his surroundings, presented by Aldo Leopold (Leopold, 1968).

The intensified desire for silence, which is directly linked to the social isolation, is currently reflected in the more and more successful trend called: The Mindfulness. The Mindfulness can be described as: a mental state achieved by focusing one's awareness on the present moment, while calmly acknowledging and accepting one's feelings, thoughts, and bodily sensations, used as a therapeutic technique. In this sense, Mindfulness, means focusing on the here and now while consciously rejecting any stimuli that might disturb this state. Disturbing stimuli are interpreted in a broad sense as a 'noise pollution' where 'pollution' are not just the typical sound stimuli, but also various distractors causing a lack of concentration and generating a sense of fear, anxiety or inability to experience the current mental state of an individual. Mindfulness can be described as the ability to create a state of isolation from the surrounding and stimulating world. This is intended to improve the comfort and well-being of life. The Mindfulness technique is deeply embedded in meditation practices and represents a response to the necessity of functioning in a world where silence and disconnection from the flow of stimuli is both difficult and impossible indeed.

It is precisely this desire to separate from the anthropogenically derived acoustics, social and visual stimuli that provokes people to seek isolation in the Arctic: "Spitsbergen stuns me. The blue, the white and the unbroken silence. Everything is so different from the riot of colours and sounds of tropical countries. I'm fine there." (Cichy et al., 2019).

The increasing presence of a man in the polar regions leads however to specific paradoxical situations in which the inversion of what is valuable and what is without value, what is desirable and what is unwanted, what is valuable and what is unnecessary occurs. In my opinion, today we can make a statement that the uniqueness of the polar regions, apart from their natural specificity, stems from the fact that they are isolated from the major population centers. Similar values based on the isolation from the stimuli typical for human civilization can be found in such regions as high mountains, jungle and desert. Anthropopressure in such places assumes an apparently innocent form of 'trekking' tourism. However, the tourism is a developed branch of commercial human activity which has its dark sides in the form of degradation of the areas which are the most touristically popular. Increasing popularity of arctic regions as travel destinations raises therefore a question, how long we'll be able to take part in following kind of experience: "I'm heading back, to the world of noise and hustle and bustle. The wind is getting stronger. I'm listening to its noise, just like for so many days. These are the last moments in a place where life is simple, where each thing and every action makes sense and serves the purpose of surviving and living, and enjoying life as it is." (Cichy et al., 2019).

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ORIGINAL RESEARCH ARTICLE

Artists in the face of threats of climate change

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Summary In contemporary visual culture, the subject of climate change and the need for commitment to counteract it (Demos, 2016; Körber et al., 2017; Tsing et al., 2017) are increasingly being addressed. The artists' observation concerns not only the natural effects of climate change but also their impact on the social and cultural heritage of the inhabitants of regions of the most endangered areas. Areas most vulnerable to destruction: oceans, coral reefs and polar regions are becoming a particular subject of interest for artists. A reflection of this interest can be the increasing number of exhibitions devoted to the current state of the environment (i.e. the project *Plasticity of the Planet* presented in 2019 in Ujazdowski Castle Centre for Contemporary Art in Warsaw).

In the article selected artistic strategies to publicize the problems of ecology will be indicated. The first strategy is the exhibition of the beauty of the natural environment and the melancholy associated with its disappearance. An example of this can be *Art of the Arctic* by environmental photographer Kerry Koeping who focuses the audience's attention on ocean literacy by means of affecting landscapes of the Arctic or the artistic residence in PAN Hornsund Polar Station of Janusz Oleksa. The second way is to indicate the physical and biological effects of climate change. An example would be the work of Kelly Jazvac who, in collaboration with an oceanographer Charles Moore and a geologist Patricia Corcoran, presents plastiglomerate by Agnieszka Kurant — new forms of fossils, resulting from the combination of shells and stones with plastics or artificial compounds. The third method is the presentation of the residents' experience. The

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examples are works of Subhankar Banerjee, who draws inspiration from ethnographic research and documentary films and Jakub Witek's documentary about Polish emigrants living in Iceland. The artist presents the consequences of climate change for the inhabitants of the polar regions. The fourth way is to build a metaphor for the presence of a 'stranger' — a traveller, an explorer or a scientist. An example is a photographic performance entitled *Polaris Summer* by Kuba Bąkowski conducted during a scientific expedition to Spitsbergen, or three-screen projection by John Akomfrah's showing the relationship between man and oceans in the context of exploitation of natural and human resources.

For the artistic practices described in the article, I use the theoretical framework of environmental art that binds together aesthetics, ethics and politics. The purpose of the article is to check whether such a connection can be attractive to the audience.

1. Introduction

From 15 March to 22 September 2019, in one of the most important Polish contemporary art galleries, Ujazdowski Castle Centre for Contemporary Art in Warsaw, *Human-Free Earth* and *Forensic Architecture* exhibitions were held as part of the larger project entitled *Plasticity of the Planet* (Figure 1). The artists presented, among others, plastiglomerate samples (Kelly Jazvac), imitated new natural habitats based on artificial substances (Diana Lelonek and Bonita Ely) and analysed the political use of herbicides as biological weapons (Forensic Architecture collective). The event[1] was the first in Poland such a big presentation of a lively developing trend in environmental art (sometimes known as ecological art), which has been around since the late 20th century, and whose aim is the reflection on changes in nature which occurred as a result of human activity (Thornes, 2008).

At the same time, another Warsaw gallery presented the project *Alienations or the Fire Next Time*, i.e. a show of 7 films telling about the human feeling of being overwhelmed by the complex global reality.[2] The convergence of the exhibitions' themes is not accidental. It is an expression of the artists' profound interest in the links between the exploitation of natural resources and the state policies, the development of IT infrastructure and natural changes and their impact on people's lives. In the works presented at both exhibitions, the artists concentrate on areas where this change is extremely overwhelming, such as seas, oceans, polar and subtropical regions, and is particularly distressing for the inhabitants and affects the shape of the planet (Bloom et al., 2012; Demos, 2016; Körber et al., 2017; Tsing et al., 2017). 'Environmental art' would, therefore, be a name for artistic activities originating, among others, from land art, ecological art and participatory art. The trend represented by artists from various cultures and continents refers to the fundamental problems for their communities (therefore the scope of questions raised by *Plasticity of the Planet* in Poland will differ from the issues displayed at e.g. the *Arctic* exhibition in the Louisiana Museum of Modern Art in Denmark in 2014 and in other shows). In environmental art, aesthetic and ethical threads are intertwined (e.g. the question about the importance of beauty in the presentation of ecological and social problems) with political threads (the entanglement of nature in commercial globalization and the fight for political influence) and social engagement (activation of recipients to take specific actions) (Demos, 2017). In the works discussed in the paper, we find common features. These are the following: (1) focus on local problems (even if it later serves to build a global metaphor), (2) close connection with current scientific knowledge, (3) cooperation with scientists and research laboratories during the implementation, and (4) translation or explanation of scientific observations in the language of art (Bakke, 2010; Kluszczyński, 2011).

The article presents and comments upon the findings of the research into the relationship between arts and environment, mostly in the contexts of polar regions. Its objectives are to: (1) review the literature on the theoretical background of environmental art and (2) summarize the classification of artistic strategies applied to the representation of the changing natural environment in the polar regions. Four approaches were distinguished: (1) highlighting the beauty of the natural environment, which allows directing the attention of the audience to the importance of the protection of the world on the brink of extinction. Following this strategy, the artists apply mostly photographs and films. (2) Showing the 'evidence' for climate change, e.g. new geological forms resulting from the melting of artificial and natural substances, as well as diagrams, maps, satellite and aerial photographs. (3) Focusing the audience's attention on the consequences of global warming for indigenous and incoming polar inhabitants (e.g. the change of coastline and the consequent need for migration). The works refer both

[1] Exhibitions: Human-Free Earth *and* Forensic Architecture, *curated by Jarosław Lubiak, artists:* Ursula Biemann and Mo Diener, Bonita Ely, Gast Bouschet and Nadine Hilbert, Kelly Jazvac, Agnieszka Kurant, Diana Lelonek, Angelika Markul, the Mycological Twist (Eloïse Bonnevioti and Anne de Boer), Pakui Hardware, Tom Sherman, Aleksandra Ska, Monika Zawadzki, Marina Zurkow, Forensic Architecture Team, Ujazdowski Castle Centre for Contemporary Art, Warsaw 15.03.2019—22.09.2019.

[2] Exhibition: *Alienation of the Fire Next Time*, curated by Maria Brewińska, artists: John Akomfrah, Allora & Calzadilla, Yuri Ancarani, Clément Cogitore, Camille Henrot, Arthur Jafa, Angelika Markul, Zachęta National Art Gallery, Warsaw, Poland, 13.07.2019—29.09.2019.

Figure 1 The view of the Human-Free Earth exhibition in Ujazdowski Castle Centre for Contemporary Art, photo by Bartosz Górka (in the foreground — Bonita Ely, Plasticus Progressus, 2017).

to human and non-human subjects and user documentation that reaches back to the tradition of ethnographic film, as well as autobiographical narratives. (4) Telling a metaphorical story about the social consequences of research expeditions and the myth of the 'distant north'. The artists perceive political, economic and social problems behind the scientific research as a reflection of the colonial and global exploitation of resources.

These strategies offer the viewers a variety of ways to access knowledge about climate change: from an emotional commitment to rational explanation. Typical of the selected examples is the diversity of fields and methods of artistic activity. The artists use films, photographs, objects, installations and realize artistic activities together with participants of the events. It is not uncommon to find sources of artistic inspiration in scientific practice. Common features of the above-mentioned strategies emerge only after the formulation of the purpose which the works discussed here serve.

The avalanche increase in the number of works created within the framework of environmental art begs for selection. The article focuses on examples of artworks devoted to Arctic themes (with two exceptions). This area has been recognized by the artists as exceptional for several reasons, going beyond the visual attractiveness of the depicted space: (1) culturally it was identified with the myth of inhumanity, a distant area and, apparently insensitive to human activity, while natural changes show that it is one of the most sensitive areas; (2) it becomes the area of political struggle for mineral resources; (3) the myth of polar regions as uninhabited is disproved — both the presence of indigenous inhabitants threatened by climate change and the consequences of the appearance of 'new' inhabitants, i.e. both workers and scientists, is emphasised. Artistic practice becomes an ally of polar studies, showing their significance for the cultural conditions of social life.

2. Theoretical background

2.1. Environmental art in the theory of culture

The artistic current described here belongs to a broader cultural process, observable both in contemporary audiovisual culture (literature, reportage, popular productions, films and TV series and social media[3]) as well as in philosophy and reflection on culture. In each of these fields, at least since the second half of the 20th century, the representatives of the theory of post-humanism have critically observed the effects of human activity on the world.

Initially, the researchers' reflection focused on the consequences of digital technologies for the concept of the human being, on opportunities and threats brought along with artificial intelligence and biotechnology (Braidotti, 2013; Haraway, 1985; Maldonato, 2017), gradually shifting the attention towards the effects of human activities (especially industrialism) on the environment. The question of whether it is possible to give up the primacy of man over his/her environment and consider him/her as one of many organisms participating in it becomes a matter of dispute. The reflection of this is increasingly more frequent reference

[3] Connected with the growing public interest in environmental issues (examples include popular series with fantasy elements, such as *Fortitude* (Great Britain, 2015), and *Frontera Verde* (Columbia, 2019).

to the Anthropocene concept[4] (Steffen et al., 2011) understood as a new geological era, or Capitalocene (Klein, 2014; Malm, 2016) describing the results of corporate globalization and political consequences of exploration of resources, such as transferring production into distant (and usually poor) regions of the world. Some researchers support the concept of natureculture, which questions the philosophical dualism of natureculture and man-animal (Fuentes, 2010; Haraway, 2003), emphasizing the bio-social interdependence of natural and cultural phenomena. In this cultural landscape, artistic creation plays a special role because art is treated as a laboratory in which the links between knowledge and cultural practices are recognized and tested, hence the emergence of new hybrid approaches to humanities, such as environmental art or cultural climatology (Thornes, 2008).

2.2. Environmental art in the perspective of relational aesthetics and art-based research

The works analyzed in the article represent an approach characteristic for contemporary art, according to which artistic activities are to comment on the surrounding reality. Among the sources of such an understanding of the social role of art is the avant-garde, which has been developing since the 20th century (including futurism, dadaism, constructivism), through neo-avant-garde and counter-cultural experiments (Situationist International, Collectif d'art sociologique) to contemporary participatory art (in Poland for instance represented by Cecylia Malik and Paweł Althamer). This kind of artistic activity assumes that the artist works with and for people, or even that people become the material of a work of art (a concept of 'social sculpture' by Joseph Beuys; Kaczmarek, 2001). A critical look at this trend points to a specific cultural 'compulsion to participate' and makes artists today look for new ways to activate the participants (Bishop, 2012). New ways of inspiration are sought in the concepts of 'aesthetic field' (Berleant, 2000, p. 92) and 'relational aesthetics' (Bourrieud, 1998, p. 56). Arnold Berleant emphasizes the relationship between the environment and the human being, referring to a deeper reflection on the scope of the artist's and recipient's actions in relation to four aspects of experience: creative, objective, performative and evaluative (Berleant, 2000). Berleant wrote: 'In the environmental arts such as happenings, environments, city planning, films, light shows, and mixed media, the qualitative nature of the experience of art has been identified with its intuitive sensuousness through direct involvement in the immediacy of pure experience' (Berleant, 2000, p. 92). For Nicolas Bourrieud, on the other hand, the work of art enters into a relationship with the social system, creating 'community spaces' specific to artistic activity (Bourrieud, 1998, p. 56). Although both Berleant and Bourrieud focus on interpersonal relations, undoubtedly the approach of relational aesthetics makes it possible to pursue the goal of the contemporary environmental art discussed here, i.e. the involvement of the audience in ecological issues.

2.3. Analysis of a work of art in the perspective of cultural studies

The works analyzed in the article belong to different fields of creativity. They are not homogeneous in terms of genre, created with the use of different techniques, containing images, text, and created in cooperation with others. Mieke Bal proposes a method of cultural analysis for such hybrid realizations which is a way of 'reading' a work of art in which the author's intentions and biography are as important as the meanings given by the cultural context and the narrative of the recipient (Bal, 1999, pp. 6—9; Maryl, 2013, pp. 320—321). The cultural analysis assumes that knowledge does not have an autonomous character. Its many intricacies include historical, linguistic, economic, ethical, political and disciplinary aspects (Bal, 2013, p. 12). It also has a processual character i.e. knowledge 'happens' and its resources are never exhausted. Bal's attempt to construct a concept for cultural analysis was accused of individuality, uniqueness and subjectivity of interpretation (Elkins, 1996, p. 591). However, it seems right that in the cultural analysis it is an object of research, in this case, the work of art, or a selected fragment of it, that will suggest the context of the reading. In this sense, in the area discussed in the article, the context will be related to ecological issues and the knowledge of natural sciences. The stabilizing factors include the object of the analysis, the historical space of the realization and the position of the recipient-reader of the work. Therefore, if we consider that cultural analysis is an approach to reach the knowledge contained in artefacts and activities (Bal, 2013, p. 60). We will see fundamental similarities with the goal of environmental art, defined by T.J. Demos as 'the practice that has to be brought together with aesthetics, ethics, and political science' (Demos, 2017, p. 272).

2.4. Arts-based research in the perspective of science

Relationships between sciences, natural sciences and humanities, focusing on questions about the language of particular fields of knowledge, disciplinary and academic divisions, are the focus of research interest. This reflection is echoed in the concepts of 'third culture' (Snow, 1959), studies on the social construction of scientific facts (Brockman, 1995; Latour and Woolgar, 1986), as well as qualitative art-based research that has been gaining in popularity since the 1980s (Eisner and Barone, 2012; Kosińska, 2016; Leavy, 2009). Among the differences between research practices of science and art, the following are indicated: formal features of scientific cognition, such as the codification of scientific representations (discursive, logical, typological), or generalizations characteristic of science, juxtaposed with the free expression of the artistic approach (Kosińska, 2016, p. 12). Marta Kosińska puts forward a number of counter-arguments that point to the similarities between scientific and artistic cognition, and to the chances

[4] Paul Crutzen, an atmospheric chemist, and Eugene Stoermer, a biologist, should be considered contemporary promoters of this term. Inspired by the works of the 19th century geologists (e.g. Sir Charles Lyell), they proposed new dating in 2000, pointing to irreversible changes in the environment caused by human activity.

of enriching scientific cognition by art. These include various ways of codifying the language of art (e.g. in conceptualism and post-conceptualism), the formal and research correctness of artistic actions required by the institutional context of art, responsibility towards groups, communities and subjects involved in artistic actions (especially in the area of public art), as well as the use of generalization tools (registration of regularity and cyclicality) in works based on data (Kosińska, 2016, pp. 12–18). Patricia Leavy sees a different kind of benefit in art-based methods (including literary writing, music, performance, dance, visual art, film and other media). They make it possible to use creative arts in a participatory way and to combine theory and practice, which is particularly useful in social research (Leavy, 2009). Therefore, art is more and more often considered to enrich scientific cognition. Visual messages are particularly important because of their polysemy, prediscursiveness and the ability to engage the audience. This is particularly important in interdisciplinary activities and projects of activist, political and social character, which refer to the emotional and tactile experience of reality (Kosińska, 2016, p. 18).

2.5. The methods of researching the impact of art on social behaviours of viewers

The influence of art on social behaviour and cultural beliefs is studied in the social sciences and the humanities by quantitative and qualitative methods (Curtis et al., 2014; Kay 2000, Lucas et al., 2008). Discourse analysis, based on the belief that cultural content is manifested in textual statements and language, is particularly useful (Manzoor et al., 2019). In the area of digital humanities, discourse analysis methods are used with the help of advanced algorithms for estimating citations (Enge et al., 2012). In turn, the producers of statistical programs (e.g. Google Analytics and Google Trends) provide tools for measuring the interest of recipients in specific topics (e.g. exhibition topics or artists' names).

In turn, social sciences use the triangulation of quantitative and qualitative methods such as data surveys, qualitative interviews, case studies, and audience surveys during exhibitions (Armitage and Rathwell, 2016; Curtis et al., 2014). This helps to estimate the involvement of participants in the project, or the knowledge of recipients before and after viewing the work. For example, in a research project on specific regions of Australia (Curtis et al., 2014) values and beliefs important in determining environmental behaviour, awareness of the consequences of climate change, people's self-concept through interactions with others, and finally, art understood as an act of self-expression were taken into account. Curtis, Reid and Reeve stated that artistic tools (especially those described in the previous section of participating art) encourage participants to discuss the impact of man on the environment, synthesize knowledge about change and promote pro-ecological solutions. Research among Inuit artists from Nunavut, Canada (Armitage and Rathwell, 2016) focused on combining indigenous environmental knowledge with scientific data and looking for relationships between the local context and global change. Based on the survey, it was found that artistic methods were perceived by the respondents as particularly useful (Armitage and Rathwell, 2016).

Both, research on participation in culture as well as the rapidly growing audience development trend indicate a growing need for this type of research and finding new data. Such might be an insight into the data on the exhibition turnout expressed in the internal statistics of cultural institutions. During three months of the show *Plasticity of the Planet* was visited by 37153 people (data of the Promotion and Communication Department of the Centre for Contemporary Art Ujazdowski Castle, unpublished), which is a good attendance result in the Polish exhibition context.

However, quantitative and qualitative research into the real impact of art on human behaviours not only requires long-term studies but also has its limitations. For this reason, the article focuses only on artists' narratives and does not refer to quantitative research on the audience. I will also discuss doubts regarding these methods in the summary.

3. Artists' narratives about climate changes

3.1. To speak with the beauty and the sublime

The visual attractiveness of the polar landscape has attracted the attention of audiences for centuries. On the one hand, it played a special role in Romantic painting (Caspar David Friedrich), inscribing itself into the model of the aesthetic category of the sublime[5] (Immanuel Kant, Edmund Burke), depicting the desire to reach what is distant and superhuman. On the other hand, drawings, lithographs and (finally) photographs taken during polar expeditions since the end of the 18th century have focused the viewers' attention on empirical cognition. Today, this visual history of the Arctic is the subject of research by historians and anthropologists (Condon, 1989; Kaganovsky et al., 2019; Lewis-Jones, 2017; MacKenzie and Stenport, 2015), and also constitutes a significant part of art shows (e.g. in the *Arctic*[6] project in the Louisiana Museum of Modern Art the exhibition's leading themes such as 'The Sublime', 'The Wide World', 'Destruction & Mythologies', 'Voices & Facts' were highlighted both by the works of eminent artists (like Gerhard Richter and Wolfgang Tillmans) and expedition documentation (e. g. Andrée's Balloon expedition).

In contemporary visual culture, Arctic landscape photography evolves from travel photography (accessible through printed and digital publications, thematic channels and social forums) to environmental photography. The creators of

[5] The dispute over the beauty (positive category: harmonious and cognitive, rational) and the sublime (negative category: indescribable and fearsome, experiential) is one of the main motifs of contemporary aesthetics (Lyotard, 1991). Kant wrote: 'Lofty oaks and lonely shadows in sacred groves are sublime, flowerbeds, low hedges, and trees trimmed into figures are beautiful. The night is sublime, the day is beautiful' (Kant 2011).

[6] Exhibition: *Arctic*, curated by Poul Erik Tøjner, artists: Daren Almond, Evgenija Abrugayeva, Per Bak Jensen, Marcelo Moscheta, Sigmar Polke, Gerhard Richter, Wolfgang Tillmans, Guido van der Werve, Museum of Modern Art, Louisiana, Denmark, 25.09.2013–2.02.2014, http://arktis.louisiana.dk/Arktis-en.html.

Figure 2 Janusz Oleksa, *Project Svalbard* (2011), courtesy of the artist.

this movement do not call themselves landscapists, but environmental photographers. By defining themselves in this way, they underline the importance of a commitment to the environment.

An example is the Art of the Arctic initiative (available at https://arcticartsproject.com/) launched by Kerry Koeping, with such photographers as Joshua Holko, Örvar Borgeirsson, Iurie Belegurschi and Carsten Egevang. The artists publish photographs and films, and promote meetings, articles and projects. As we read on the project website: "The Project mission is to educate, inspire, and provide perspective on the kinetic evolution of the Arctic, on a global scale. The goal is to present a visual body of work that, within its content, will reveal a unique perspective of climate change in the Arctic" (https://arcticartsproject.com/info.shtml).

Analyzing the assumptions and formal aspects of the published photographs, one should notice that for environmental photographers the beauty of the image (manifested in a thoughtful composition, a captivating arrangement of colours, capturing the uniqueness of the time of day and the phenomenal character of the natural environment) becomes a rhetorical tool.

From an artistic perspective, environmental photography can serve as an example of overcoming the model in which art is perceived as useless (Groys 2016). The aestheticisation of the image is not autotelic,[7] but can be a cultural or even political tool. As Boris Groys observes: 'Total aestheticisation not only does not preclude political action, it creates an ultimate horizon for successful political action if this action has a revolutionary perspective' (Groys, 2016, p. 60). This usefulness, therefore, falls within the scope of artistic means which can influence the public more effectively than discursive reasoning.

Janusz Oleksa, a Polish photographer, has chosen a different path, using a much more visually restrained language of modern photography. *Project Svalbard* (2011) is a series of photographs taken during the photographer's stay in Spitsbergen (Figure 2). The photographer presents almost geometric forms of buildings that blend into the landscape. Pictures taken against a smooth, grey sky are deprived of the illusion of perspective. They are flat, almost like abstract compositions. At the same time, Oleksa deconstructs the image of the Arctic as an uninhabited and inaccessible space by means of these images, deprived of the sight of man, but full of traces of human presence. The effects of human activity become part of the natural landscape, transforming this area into a natural-cultural one.

While Koeping's and Oleksa's works can be classified as beautiful, it is worth noting that the poetics of sublimity can be an equally effective tool for influencing the audience. An example of this is the work of Angelika Markul (this is one of the two examples in the article that does not refer directly to the Arctic region but Antarctica). In *Memory of Glaciers* (2017) Markul presents large-format audiovisual projections based on the documentation of the melting ice fields of Patagonia and calving glaciers. Using montage, long camera rides, close-ups, wide frames and a poignant soundtrack, Markul immerses the viewer in the landscape of superhuman and untamed forces that are activated by human action and unstoppable. If we return to Kant's understanding of sublimity as a moral sense: horror, felt by man against the forces of nature, then undoubtedly such fear is passed on through Markul's works.

[7] Autotelic means here respecting their values and goals, independent from the historical and social context. One can say that 'the aim of art is art'.

Figure 3 Agnieszka Kurant, *Post-fordite* (2019), from the exhibition Human-Free Earth in Ujazdowski Castle Centre for Contemporary Art in Warsaw, phot. Marianna Michałowska.

3.2. Look what you've done

In 2018 archaeologists Bjørnar Julius Olsen and Þóra Pétursdóttir (representing the studies on material culture and the current of the so-called 'return to things', Olsen, 2010) organised with their co-workers an exhibition entitled *Arv. Mankind's unpleasant cultural heritage*.[8] The Norwegian word 'Arv' means heritage, inheritance. The exhibition shows rubbish which was thrown away on Norwegian beaches: remnants of plastics, e.g. toys, everyday objects, as well as new geological forms — plastiglomerates (an alloy of plastics and natural substances). On the one hand, what Olsen does, the presentation of artefact fragments, is typical of archaeological practice, on the other hand, it raises a few questions. 1) The context of archaeology, which no longer deals with ancient civilizations but with the contemporary past (Shanks, 1992). As once clay shells, plastic is a testimony of our lives today, 2) the status of an artistic object, i.e. a new embodiment of a ready-made object. The flagship examples of Dadaist provocation, exhibited in 1917 by Marcel Duchamp, were mass-produced objects of everyday use: a bottle dryer and a urinal had the critical potential for the bourgeois model of art, the artist's gesture sublimated the object into art. 3) The status of the object as a scientific proof and archaeological artefact. Olsen's objects constitute a collection of objects, which have lost their functionality and became an unforeseen 'cast-off' of industrial civilization — a proof of environmentally invasive actions.

Not only archaeologists but also artists are sure that nothing appeals as strongly to the imagination of the audience as material evidence of certain physical and geological processes. Therefore, the presentation of plastiglomerate at art exhibitions becomes a forceful argument proving the environmental changes caused by man and at the same time broadening the area of the ocean literacy, i.e. the knowledge about the processes taking place in seas and oceans. From the aesthetic perspective, plastiglomerate is attractive, from the perspective of knowledge about the environment, it is convincing.

Kelly Jazvac and Agnieszka Kurant[9] presented plastiglomerate at the aforementioned exhibition. A collection of objects integrated in a natural process from fishing nets, plastic waste with rocks, sand and wood was collected by Jazvac in collaboration with an oceanographer Charles Moore and geologist Patricia Corcoran on the Hawaiian coast in 2013. Kurant, in turn, presents speculative, but potentially new geological formations, such as post-fordite formed from the build-up of paint layers in factories in Detroit or mutations of melted works of art (Figure 3).

The presentation of objects in each of these three examples takes the form known from exhibitions more characteristic for natural, ethnographic and historical history museums than art museums. Therefore, the cabinets and displays in which the exhibits are placed evoke an educational context. The objects are juxtaposed with a commentary informing about what we see, which creates an emotive effect. Substantiality speaks more strongly than words.

Garbage found on the coasts of Norway by archaeologists, plastiglomerate from the Hawaiian coast and invented new geological 'fossils' indicate the global nature of the changes. Man-made waste migrates, and its circulation is not limited to human habitat. The processes observed in the polar region also occur in the Pacific Ocean, both in the densely and sparsely populated areas. By presenting waste and plastiglomerats, one can express what Catherine

[8] Exhibition: *Arv. Mankind's unpleasant cultural heritage*, curated by Bjørnar J. Olsen and Þóra Pétursdóttir, Norges Arktiske Universitetsmuseet, Tromsø, Norway, 2018, https://cas.oslo.no/in-depth/arv-mankind-s-unpleasant-cultural-heritage-article3110-1167.html

[9] Here is the second case in the article that does not refer to the Arctic.

Malabou understands by *plasticité* in the language of philosophy (Malabou, 2010). The concept originally refers to both giving and receiving a form. The term created for the interpretation of philosophical concepts, in the context of reflection on natural changes, means that nature ceases to be a background for human activities and transforms into an unbridled and evasive force. Due to the plasticity of life forms, they are irreversibly transformed, some of them perish, others arise.

An artistic strategy based on the presentation of objects — evidence of change, regardless of whether creators show objects found in the natural environment or whether they produce them themselves, is a subversive comment on the idea of 'returning to things'. While the relationship between man and non-human actors is fundamental for the understanding of contemporary culture, nowadays it is necessary to consider not only those materialities that have been intentionally created by man but also those that have been created as unwanted waste.

3.3. To be with others

While the activities presented earlier referred to the presentation of material dimensions of the effects of climate action, in the next part I will present those activities that are directly inspired by the trends prevailing in participatory art and relational aesthetics. The examples will involve Subhankar Banerjee's actions and Jakub Witek's documentary activities.

Banarjee is primarily interested in the impact of industrialization on traditional communities. His work concerns two areas: *Arctic* (2006) and *Deserts* (2010). Interestingly in the context of the article's subject matter, the first series of works was realized in cooperation with the Gwich'in and Iñupiat communities in Arctic Alaska. The photographer cooperates with their representatives to give the most complete picture of their lives in the changing climate. In Banarjee's large-format photographs, we see captivating landscapes with discreetly outlined traces of human and animal activity: tiny silhouettes of traditional whaling vessels suspended on the horizon, traces left by wandering caribou herds and ruts resulting from the movement of heavy equipment for extracting raw materials. The problems of the modern Arctic emerge from the surface of the picturesque landscape: the war for natural resources, climate change forcing human and animal inhabitants of the Arctic to migrate, social problems connected with the disappearance of traditional communities. Each photograph is accompanied by a comprehensive commentary highlighting the political, social and economic context of the depicted space. In 2012 Banerjee published the book *Arctic Voices: resistance at the tipping point* collecting statements by activists, researchers and writers. These first-person narratives are the leading voices of resistance to the exploitation of the Arctic causing an ecological disaster (Banerjee, 2012).

The latter of the mentioned artists, a Polish documentary filmmaker, is the author of the award-winning film *Isoland: Icelandic Stories of Polish Emigrants* (2017).[10] The film intertwines two narratives: the travel story of the author himself, reporting his trip to Iceland, and the stories of Poles who decided to live on the island. On the one hand, it is a record of the author's fascination with the High North, on the other hand, it is a collection of private stories of people who reconstruct their individual choices and the circumstances that led them to Iceland. In this story, paradoxically Iceland turns out to be not a place of isolation but a place of fulfilment, not a place of loneliness, but a manifestation of being with others.

In both cases, the main focus is on the relationship between people and their surroundings, as well as on questions regarding the way of surviving and the future of the inhabitants in changing climatic conditions (Demos, 2017). What is important, in the work on both projects, the artist is not only an observer of the changes but also a companion. The realizations are the result of long-term cooperation, during which the creators can get to know their heroes and their problems. Thanks to this, they can more fully depict them and allow their voices to sound. Both examples illustrate the increasingly popular trend in visual culture, in which ethnographic, journalistic and artistic approaches are intertwined.

3.4. Towards a visual metaphor

Banarjee and Witek use a documentary approach to the depicted subject matter. However, equally interesting are those artistic projects whose creators use a poetic metaphor. Thanks to the metaphor, the image referring to a local case (e.g. Hornsund, Silesia) is placed in a global context, becoming a commentary on human relations with others and the environment of their lives. The examples I will use here are the works of Kuba Bąkowski and John Akomfrah.

Polaris Summer (2009) by Kuba Bąkowski is a photograph, which is a record of the performance realized during a polar expedition to Spitsbergen organized by the Institute of Geophysics of the Polish Academy of Sciences (Figure 4). The photo shows a figure with the head of a polar bear in a suit used by the participants of polar expeditions against the background of the ice landscape of Spitsbergen. In the hand of the figure, there is a stick, ended with a flashing lamp, pointing in the direction in which the Pole Star should be found, which is not visible during the polar day. This surprising and disturbing image has been constructed with thoughtful elements. The costume of a bear is a disguise used during 'leading a bear', i.e. a folk ritual from the village of Żywocice in the Opole region (Berlińska, 2013). A woman-researcher working at the Polish Academy of Sciences station in Hornsund posed for the performance. In this single photograph, which is the summary of the whole stay, many levels overlap; the motif of a post-humanistic hybrid of a bear-human, observing each other, the motif of an artificially created polar star in the place of this invisible one, and finally the motif of a 'Polish' polar bear, it is not known for what reasons it appears in the folk tradition and tourist ritual. As the author himself says, the work is a fragment of an unfinished cycle, initiated by the performance *Ursa Major* (2008), with the participation of miners from the Bobrek mine (Berlińska, 2013). The flashlights on their helmets were arranged in the shape of the Greater Bear. The series would culminate in a fragment realized in Japan. Bąkowski, creating this strange space for his bear-human hybrid, does

[10] Available at http://www.kubawitek.com/isoland.

Figure 4 Kuba Bąkowski, *Polaris Summer* (2009) photography, courtesy of the artist.

not explain all the meanings of the work, leaving space for interpretation by the viewer. So perhaps we should ask another question, namely, who is the scientist going to Spitsbergen? A lonely, romantic traveller? A worker? What trace of their research do scientists leave in the Arctic environment?

John Akomfrah also focuses on the consequences of human presence in the world. *Vertigo Sea* (2015) is a three-screen projection that consists of fragments of nature documentaries, archival films showing hunting scenes for Arctic animals, shots based on romantic images showing a figure of a lonely wanderer, and staged shots showing slave ships. The picture is accompanied by a soundtrack composed of fragments of novels and memoirs of travellers, as well as music passages. In this extraordinary panorama, John Akomfrah constructs a story about the relationship between man and oceans and seas. The means used by Akomfrah (similar to those employed by Markul) such as a large-screen projection make it possible for the viewer to be surrounded by an image so that his or her emotions are transferred to the screen. Mieke Bal uses the term affective images for such a manner of presentation (Bal, 2007). This expression includes the aim of the projection, i.e. to appeal to the viewer with an audiovisual narrative, which will be perceived almost subconsciously and which will absorb the audience. However, the visual narrative by Akomfrah is not an illustration of harmonious coexistence, but a brutal and poignant story about colonial exploitation of the natural environment, about the annihilation of species and people who were denied humanity because of greed. Akomfrah's story is intertwined with shots of the polar regions and the Caribbean, the underwater world and the ocean where people sail. It is a metaphor of globalisation which destroys and in which there are no more 'places undiscovered' by man.

4. Discussion and conclusion

Research in environmental art requires the development of interdisciplinary methods, drawing on both scientific and cultural-social knowledge. Assuming that science is a part of the culture (Kmita, 2007), it should be regarded as both a striving for knowledge and understanding of the world. Art and science, therefore, are not opposing disciplines, and the environmental art trend shows that they are mutually beneficial.

A general assessment of the impact of art on social habits and behaviour is difficult. Quantitative research (e.g., surveys or statistics) does not give full insight into the human experience, which is fundamental for such an evaluation. What's more, algorithms often depend on program producers, and search results can be subordinated to commercial purposes. More reliable data, which can be useful in the study of art are provided by triangulation of quantitative and qualitative research focused on case studies and small groups (Armitage and Rathwell, 2016; Curtis, 2014). They help to track changes in worldview that occur due to specific artistic activities. Undoubtedly, more evidence-based work is needed with respect to differences between scientific cultures and languages.

Although the article devotes special attention to the work of Polish artists, environmental art can be treated as a

transnational phenomenon, just as the problem of climate change is global. This is, therefore, an example of glocalization (Robertson, 2012). It does not assume homogenization and searching for universal solutions for the planet. In addition to the consistent observation that global changes are taking place (e.g., which shows the spread of plastic) and despite the fact that they require some joint political and economic decisions (e.g. replacing the carbon-based economy using natural energy sources), the specific solutions (e.g. type of crop, people's behaviour towards the environment) are local.

Content of works of art relates to the political and social aspects of the place where the work is created. While it has a long tradition in the Scandinavian countries, Australia and the USA, where ecological awareness and organizations developed (as well as research on the impact of art on social awareness), it is a relatively new trend in Central European countries. However, as shown by the interest of Polish artists, environmental art is quickly gaining popularity also in countries distanced from the polar area.

The article highlights three basic aspects of environmental art: (1) The environmental artist can be described with two metaphors: a witness and a whistleblower. As the former one, he or she documents and records changes taking place in the world, as the latter one, he or she informs about system faults and alerts by showing the dramatic effects of Anthropocene in oceans and on lands. Both functions are fulfilled by the works of environmental photographers, Banerjee, Witek, Jazvac, described in the article. They are also clearly visible in Olsen's project. (2) The works discussed in this article use different methods of reaching out to the audience. They share a common goal, i.e. to search for a way of argumentation that will convince the audience of the inextricable link between human activity and the environment. The most commonly used artistic means (e.g. in Markul's and Akomfrah's works) is to appeal to the recipient's emotions by creating affective images, which is to be an incentive for a more rational analysis of the phenomena depicted. Each of the four artistic strategies described (i.e.: sublimity, object, documentary, metaphor) finds its supporters among viewers. (3) The social value of these works lies not so much in illustrating scientific knowledge as in introducing a problem into the cultural discourse. More and more often scientists notice that climate change is not only a natural problem but also a cultural one. The emerging new hybrid disciplines of science, such as cultural climatology (Latour, 2018), are a manifestation of this. On the other hand, art is permeated by the awareness that knowledge about changes in the climate is nowadays a basic resource of social competence and it is the role of artists to publicize it.

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ORIGINAL RESEARCH ARTICLE

Perception of Arctic issues among young learners in Poland and Lithuania

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Summary In this work, we show the results from two different types of approaches designed to map the Arctic (Polar) perception of young learners in Poland and Lithuania. The first case study is composed of both closed and open questions (Case Study 1), while the second one is a closed, multiple choice type of questionnaire (Case Study 2). We have questioned a total of 274 learners in Case Study 1 and 80 in Case Study 2. In both cases, learners were divided into four age groups. The results show that the Case Study 1 questionnaire, due to its structure, provided more comprehensive information about the state of awareness among young learners in comparison with the limited option for answers (no open option) in Case Study 2. The results show that documentaries and nature films together are the dominating sources of information for all age groups. A very interesting finding came out from Case Study 1, which shows that school lessons dominate in public schools, with exception to high schools, however, other means of learning were also mentioned. Educational workshops play a very important part in learning among three youngest groups of students of public schools. In case of autonomic schools, it is lessons that play a key role in knowledge transfer at all levels of education, which is most likely related to the educational system in these schools, which regularly conduct

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group projects. Both studies show that nonformal education has an important role in education of young learners in Poland and Lithuania.

1. Introduction

The earth is experiencing critical climate change and the Arctic is influenced by these processes faster than other regions (IPCC, 2014). We now realize that processes, which take place in the Arctic have a significant influence on other parts of the globe, and this includes impacts on both marine ecosystems and human activities, which in turn have serious socio-economic implications for the rest of the world, with special significance for Europe (ACIA, 2005; Arctic Council, 2013; IPCC, 2014). Understanding and evaluating the rate and pace of these changes is among the most urgent challenges for humans, so that appropriate adaptation scenarios for specific economic sectors and human activities could be prepared for the next generations (IPCC, 2014; Kerr, 2007; Walker, 2007). At the moment, a large amount of attention is given to environmental sensitivity and sustainability of the Arctic region, however, without the engagement of all people, not only indigenous but also those from other regions, these key issues will remain unresolved (Access-EU, 2019; Arctic NGO Forum, 2019).

To what extent will the climate change influence the Arctic environment and societies, hence societies of the world? Since climate change is rapidly altering the geography and modifies region's biodiversity, it is becoming increasingly clear to the European society that the Arctic is of key importance for the future of the next generations (Arctic Council, 2013; Arctic NGO Forum, 2019; Millennium Ecosystem Assessment, 2005; Potts et al., 2016). Therefore, much of European research activities are focused on the Arctic (Polar Regions) (Williams, 2012). What is important, decision-makers have realized that a proper approach to tackle scientific problems of the Arctic requires studies, which cross different disciplines, including oceanography, geosciences, physics, biology, space sciences and astronomy, as well as environmental sciences, socio-economic sciences and humanities (Access-EU, 2019; Arctic NGO Forum, 2019; Bray et al., 2012; Williams, 2012).

For centuries, Polar expeditions and discoveries have been given special attention by the general public. Harsh and unknown climate, low temperatures, the remoteness of the places has always created a special aura around places and people, such as explorers, scientists and journalists who worked in these regions. This is especially true in the case of young people, who have always been fascinated by the beauty of the Polar Regions and by Polar exploration and research.

It is crucial to increase the awareness of how much Polar issues are important in order to develop the next generation of world's society that will be ready to make science-based decisions for Polar regions protection and will provide secure outcomes for the entire planet. In times of globalization, which results in global change including global environmental changes, it is obvious that science-based education plays a critical role in increasing the current condition of young learners awareness of the changing world (Bray et al., 2012; Hovelsrud et al., 2012; Kotynska-Zielinska and Papathanasiou, 2018). Properly designed and conducted science provides tools for meeting various social needs, including quality education (Herrenkohl and Bronwyn, 2017). There is a strong need for both researchers and educators to provide modern approaches to produce science-based information and hence secure proper means of education (Penuel, 2017). Such approaches should adopt an environmental perspective (Dawson, 2017; Philip and Azevedo, 2017), and they must take into consideration, that non-formal education involves a number of various contexts, many of which do not appear in schools (Philip and Azevedo, 2017). One of these aspects involves the danger that these activities are focused on those who are already well taken care of and thus will not benefit a lot (Feinstein, 2017). In this process, Polar issues are among the greatest challenges for educators of all levels.

One of the major issues that formal school systems face in these terms is lack of dedicated courses during which students could obtain a holistic picture of the changes, in which Polar issues should be of special importance, and thus be prepared to adapt and mitigate to the climate change (Arctic NGO Forum, 2019; Hovelsrud et al., 2012; Stocklmayer and Bryant, 2012). The majority of formal school education systems have not adapted to the changing world yet (Feinstein, 2017; Kotynska-Zielinska and Papathanasiou, 2018). Most textbooks and educational materials at all levels of formal education, include only bits and pieces of information used in various contexts at different lessons, at different school levels (http://www.access-eu.org).

This paper is the first attempt to study young learners' perception of the Arctic in countries which are distant to the region. Additionally, with this study we hope to map the ways of education which are most suitable for learners of various ages and in different types of schools.

2. Methodology

In our research, we aimed at the evaluation and assessment of the best practices in the area of teaching about Polar issues at different school education levels, various types of schools, in two non-Polar countries, Poland and Lithuania.

In order to match with the modern approaches, as described above, we designed the study to be able to map the differences between different age groups, gender, and types of schools. Our approach was dual, from an open question

questionnaire used in Poland to a closed, multiple choice question questionnaire used in Lithuania. We realize that this sample is not globally representative, but with the results from these surveys, we obtained important information, which will be used in our further research. Using the results of the surveys, we are aiming at the creation of dedicated courses/workshops for students of all ages and their teachers in order to provide necessary skills and know-how to get acquainted with the special characteristics of the Arctic environment, and the changes, which occur there. Having to deal with youth from non-Arctic countries, we decided to use two different types of questionnaires, hoping to deliver the best practice questionnaire as one of the results of this study.

Thus, in the first case study (Case Study 1), the questionnaire consisted of both closed and open questions and was applied to Polish young learners, of four educational levels, who came from 4 schools. The second case study (Case Study 2) provides information from 9 closed (multiple choice) questions, which were applied to youth from Poland and Lithuania. Both studies were conducted during the spring semester in 2018 and they were run independently. We decided to combine the results and analyze them since, we observed many similarities in answers, despite the differences in the approaches. In both case studies, questionnaires were anonymous and conducted in schools by the teachers. All teachers, who were responsible for the questionnaires were trained on Arctic (Polar) issues as well as on the survey itself. During the survey, teachers were ready to respond to any questions and/or problems. We didn't record any complications with an understanding of the questions from students. The same procedure was repeated in all cases. After 10 minutes, all students submitted their questionnaires and those were then analyzed by the team of researchers and educators-the authors of this paper. For the analyses of the responses, the results have been divided into different categories.

And so, in Case Study 1, all data were analyzed in four age groups, with respect to gender and type of school, semi-private (autonomic) and public. Knowing, that all respondents knew the purpose of the survey and understood all questions (no misunderstanding cases reported), in the remainder of the paper we assumed that all *No* and *I don't know* answers are negative answers.

For Case Study 2, all Polish questionnaire participants were of ages above 20, so their responses are not used in this study. In the case of Lithuania, we gathered a total of 80 questionnaires. All those young learners came from the public school system. Case Study 1 and 2 questionnaires were as follows.

2.1. Case Study 1

The first questionnaire is constructed to map the basic level of knowledge (questions 2 and 3). Questions 1, 5 and 6 provide information on how students perceive their formal and non-formal education activities and needs. Question 4 refers to the general interest of surveyed youth in Arctic (Polar) issues. The form of the questionnaire, which was given to Polish young learners is presented in Table 1.

2.2. Case Study 2

The questionnaire with 9 closed questions, which was given to young learners in Lithuania is presented below (Table 2). We have collected a total of 80 responses in Lithuania. Similarly to the first questionnaire in this study we map students' perception of the region (questions 4, 5 and 6), the role of the school versus other forms of gaining knowledge (questions 1, 2, 3) and their real interest in the Polar issues (questions 7, 8 and 9).

3. Results and discussion

3.1. Case Study 1. Closed and open questions applied to Polish young learners

In this section, we analyze the results of the surveys given to Polish learners. We consider 4 levels of education, two types of schools, autonomic (we use this name since this is an official English name of the surveyed schools) and public ones and we discuss the gender aspect in responses.

A total of 274 students from 4 schools and 4 educational levels were questioned (Figure 1). The division of the total number of boys and girls is presented in the graph. The largest number of students came from elementary schools, in two age groups 8 to 9 (early elementary) and 13 to 14 (elementary school) and the lowest from high school, ages, 17 to 19 (high school), with the highest number of boys and girls of ages 14—15 (junior high school).

We had a total of 186 students from public schools and 88 from autonomic schools. In terms of gender division, we questioned 131 girls and 143 boys in all four age groups (Figure 2).

In the following figures, we present the responses to all 6 questions of the questionnaire Figure 2 and analyze information in the graphs. Question 1: Did you learn anything about the Arctic during school lessons (Figure 3)?

It is obvious that the results are quite dispersed. In both cases of school types, the greatest number of negative answers came from students of ages 13—14 and 14—15, together. At the same time, the greatest number of positive answers came from a 14—15 age group of the public school and 13—14 age group of the autonomic schools. In both cases

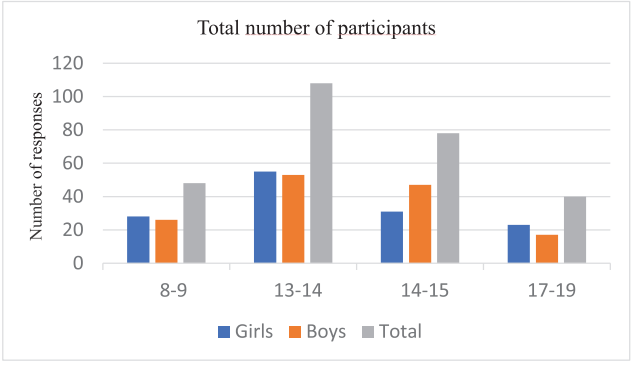

Figure 1 Division of the groups of students who participated in the survey.

Table 1 Case Study 1 questionnaire.

SEX (MARK WITH CROSS)	□ FEMALE	□ MALE	COUNTRY:
AGE:	SCHOOL:		
1. DID YOU LEARN ANYTHING ABOUT THE ARCTIC DURING SCHOOL LESSONS?	□ YES	□ NO	□ DON'T KNOW
A. IF YOUR ANSWER IS NO GO TO QUESTION 2.			
B. IF YOUR ANSWER IS YES PLEASE WRITE IN WHAT LESSONS.			
C. IF YOUR ANSWER YES PLEASE WRITE WHAT YOU LEARNT.			
2. PROVIDE TWO WORDS WITH WHICH, YOU ASSOCIATE ARCTIC.			
3. CAN A POLAR BEAR EAT A PENGUIN?	□ YES	□ NO	□ DON'T KNOW
4. WOULD LIKE TO ENHANCE YOUR KNOWLEDGE ABOUT THE ARCTIC?	□ YES	□ NO	□ DON'T KNOW
5. WHERE DO YOU GAIN YOUR KNOWLEDGE ABOUT THE ARCTIC FROM? □ DOCUMENTARY □ NATURE FILM □ ANIMATED FILM □ BOOKS □ EDUCATIONAL WORKSHOPS □ SCHOOL LESSONS □ OTHER.....			
6. HOW DO YOU BEST ABSORB KNOWLEDGE? □ BOOK □ SCHOOL LESSON □ EDUCATIONAL WORKSHOP □ MEETING WITH A SCIENTIST □ OTHER.....			

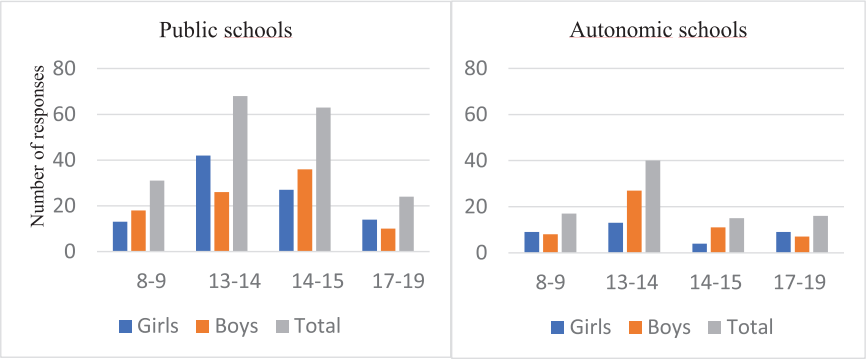

Figure 2 Division of the groups of students who participated in the survey, with division to a type of school and gender.

of school types, a number of positive answers shows a decreasing trend with age. Only the 14—15 age group from public schools breaks the pattern, however, these statistics can be distorted by different numbers of questioned students at different age groups. This response is somewhat confusing, since the older the students, the more occasions for learning about the Arctic they had. This situation is especially interesting and should be further investigated. Figure 4 presents the statistics for Question 1, with respect to gender.

In case of the gender division, the results are such, that in early elementary age both girls and boys give very positive feedback in both types of schools. In autonomic schools 100% responses were positive at this level of education, while in public schools the negative or uncertain responses were very few, among both boys and girls. Situation changes with the next level, where, the vast majority of boys and girls of ages 13—14 in public schools give negative feedback, and the situation is similar for autonomic schools. In the next education level, in case of both types of schools, situa-

Table 2 Case Study 2 questionnaire.

Address each question with a rank from 1 (very little) to 5 (agree very much).
1. In school, I have learnt mostly about: A) Polar regions B) Jungle C) Hot deserts D) Oceanic Islands
2. In school, I was most interested to learn about: A) Jungle B) Polar regions C) Oceanic Islands D) Hot deserts
3. I was seeing feature movies in the cinema and/or TV about the exploration of: A) Oceanic Islands B) Hot deserts C) Jungle D) Polar regions
4. I think that the most interesting stories were about: A) Hot deserts B) Jungle C) Oceanic Islands D) Polar regions
5. The landscape most endangered due to climate change is at: A) Polar regions B) Jungle C) Hot deserts D) Oceanic Islands
6. Most of the world's biodiversity can be found at: A) Jungle B) Polar regions C) Hot deserts D) Oceanic Islands
7. Having an opportunity to join the adventure expedition I would go to: A) Oceanic Islands B) Polar regions C) Hot deserts D) Jungle
8. The most important from the practical point of view are: A) Jungle B) Oceanic Islands C) Hot deserts D) Polar regions
9. Having a special reward at my disposal, I would offer it for the new exploration of: A) Hot deserts B) Polar regions C) Oceanic Islands D) Jungle

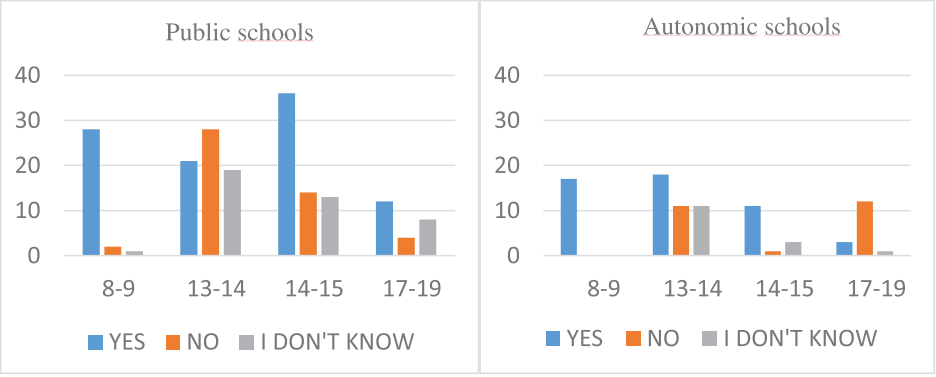

Figure 3 Did you learn anything about the Arctic during school lessons?

tion changes, and most girls and boys provide positive feedback. In case of high school students, the situation is very much mixed up. In public schools, more girls gave negative answers than positive, while significantly more boys gave positive answers to Question 1. An interesting case is observed for this age group in autonomic schools, where 100% girls responded negatively as well as the majority of boys.

Expecting to have a picture of how particular groups of students feel about their knowledge regarding the Arctic obtained in school, we decided to check if the information they absorbed reflect a proper understanding of the region (Figures 5 and 6). Thus, the following two questions are as follows: Question 2: Provide two words, which you associate with the Arctic, and Question 3: Can a polar bear eat a penguin?

In both types of schools and all educational levels students associate the Arctic with proper, yet common pictures of the region, i.e. ice, cold, white, snow and frost. Three animals are present in the responses. Polar bears appear in answers of all age and gender groups in autonomic schools and public schools in groups of students of ages from 14 to 15 and older. It seems that seals are better recognized,

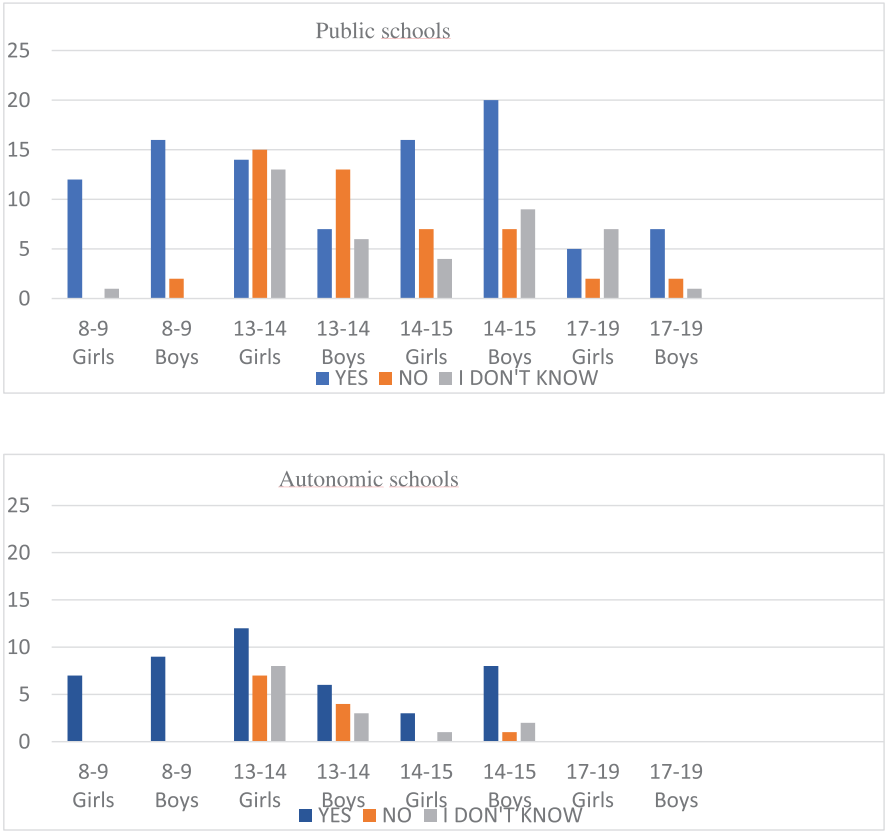

Figure 4 Did you learn anything about the Arctic during school lessons? Division with respect to gender.

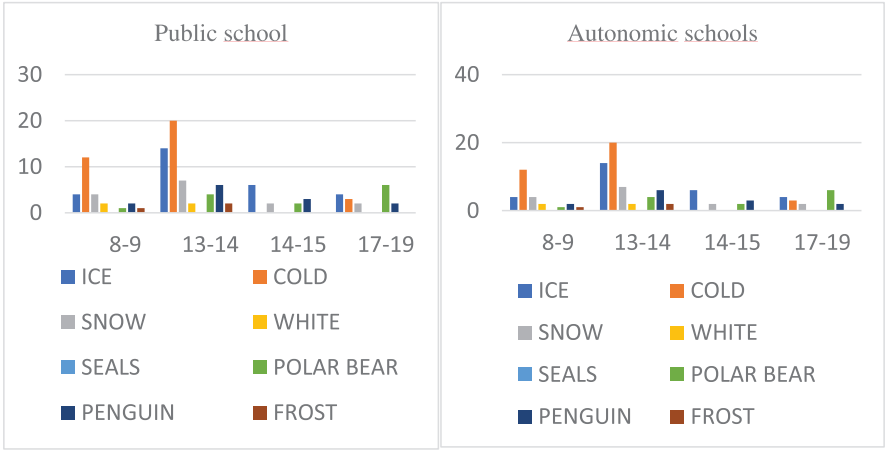

Figure 5 Question 2: Provide two words, with which you associate the Arctic.

since they appear in answers of all age groups in both public and autonomic schools. There is, however, a significant representation of penguins in every age group in both types of schools.

Anticipating certain level of confusion between the Arctic and the Antarctic the third question was to map to what extent this confusion is common among the learners. The results are presented in Figure 6.

This is an interesting case. Even though students in public schools claimed that they learnt something about the Arctic, we can see that perhaps not all proper things, since there are many *Yes* answers to this question. If you combine them with *I don't know* response then we get more than 50% affirmative or undecided responses at all levels of education. These proportions are much better in case of autonomic schools, especially at younger ages. 100% learners of ages 8—9 gave a negative answer, then in age group 13—14, a combined *Yes* and *I don't know* responses exceed the *No* ones, and then at two oldest age groups, the number of negative and positive responses are comparable.

Following the anticipation that the level of knowledge about the Arctic is limited, the next question was drafted to find out if the learners are interested in learning anything more about the Arctic, hence, Question 4, was as follows:

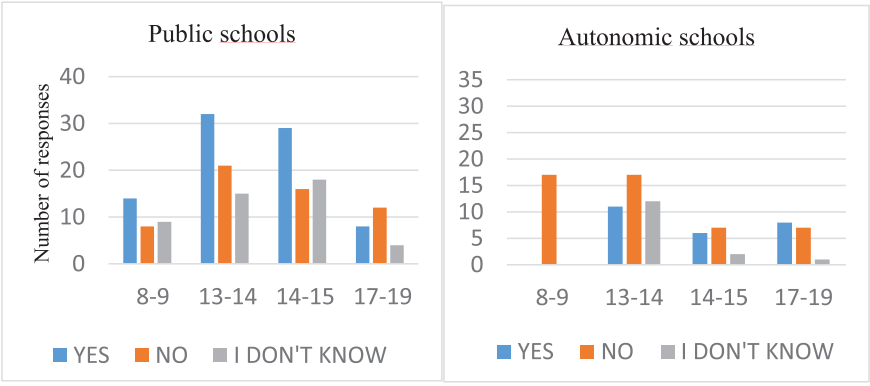

Figure 6 Question 3: Can a polar bear eat a penguin?

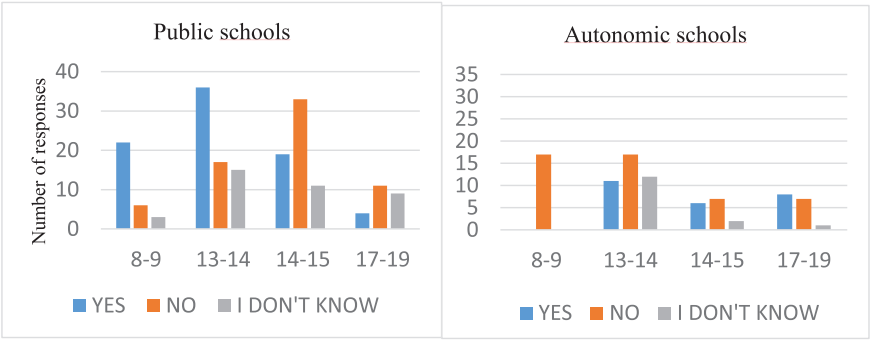

Figure 7 Question 4: Would you like to enhance your knowledge about the Arctic?

Would you like to enhance your knowledge about the Arctic? The results are presented in Figure 7.

In both types of schools, the results are mixed up. We can see that a significant number of students of all ages and in both types of schools are not interested or are not sure if they want to learn anything more about Arctic issues. The trend of not being interested increases with the age of students in both types of schools. There are more learners eager to learn something more about the Arctic than those uninterested only at the earliest education stage (ages 8–9). In other age groups, most learners give *No* or *I don't know* responses. There is only one exception from this rule, learners from age group 17–19 in autonomic schools, who are willing to learn more about the region. This result is in accordance with the results of other researchers, who reported that students' interest in gaining knowledge, while in schools, declines with years of being in the schooling system (Heddy and Sinatra, 2017; Osborne and Dillon, 2008; Vedder-Weiss and Fortus, 2011; Zusho et al., 2003).

The following two questions in the questionnaire were aiming at mapping where students gain their knowledge and what are their preferences in learning methods. Thus, these questions were as follows, Question 5: Where do you gain your knowledge about the Arctic from? Then Question 6 was as follows: How do you best absorb knowledge. In both cases, students could choose from suggested methods or could write other suggestions, not listed for the choice.

Students were informed that the documentary is intended to "document reality, primarily for the purposes of instruction or education, while the nature film is a documentary about animals, plants, or other non-human living creatures, usually concentrating on film taken in their natural habitat but also often including footage of trained and captive animals" (Wikipedia.org).

It is obvious that documentaries and nature films together exceed other responses in all age groups, in both types of schools (Figure 8). These two sources are followed by animated films, which are most popular among learners of ages 13–14, in both types of schools. School lessons are also an important source of knowledge, especially for age groups 13–14 and 14–15, and, it is not so obvious in high school. Books are more popular among age groups 8–9 and 13–14 (both school types), than among the older learners. Both graphs show that educational workshops play a very small role in educating our students about Arctic issues, and this is true for both types of schools. Other sources, such as e.g. games, Internet, film series, Wikipedia have been mostly provided by learners of ages 13–14 and 14–15, in both types of schools.

These results may be explained by a number of school lessons with the Arctic issues being discussed/mentioned, which students have at different levels of education. In Polish schools it looks as follows:

1. Early elementary school level: There is nothing in the curriculum about the Arctic.
2. Elementary school: 5 hours. There aren't lessons dedicated to the Arctic in elementary school, however, the Arctic is mentioned while talking about animals, climate, the landscape of ice deserts, climate and landscape zones, global environmental hazards, continents and oceans.
3. Junior high school: 7 hours. 1 hour dedicated to the Arctic and Antarctic plus 6 hours about: ice deserts, water

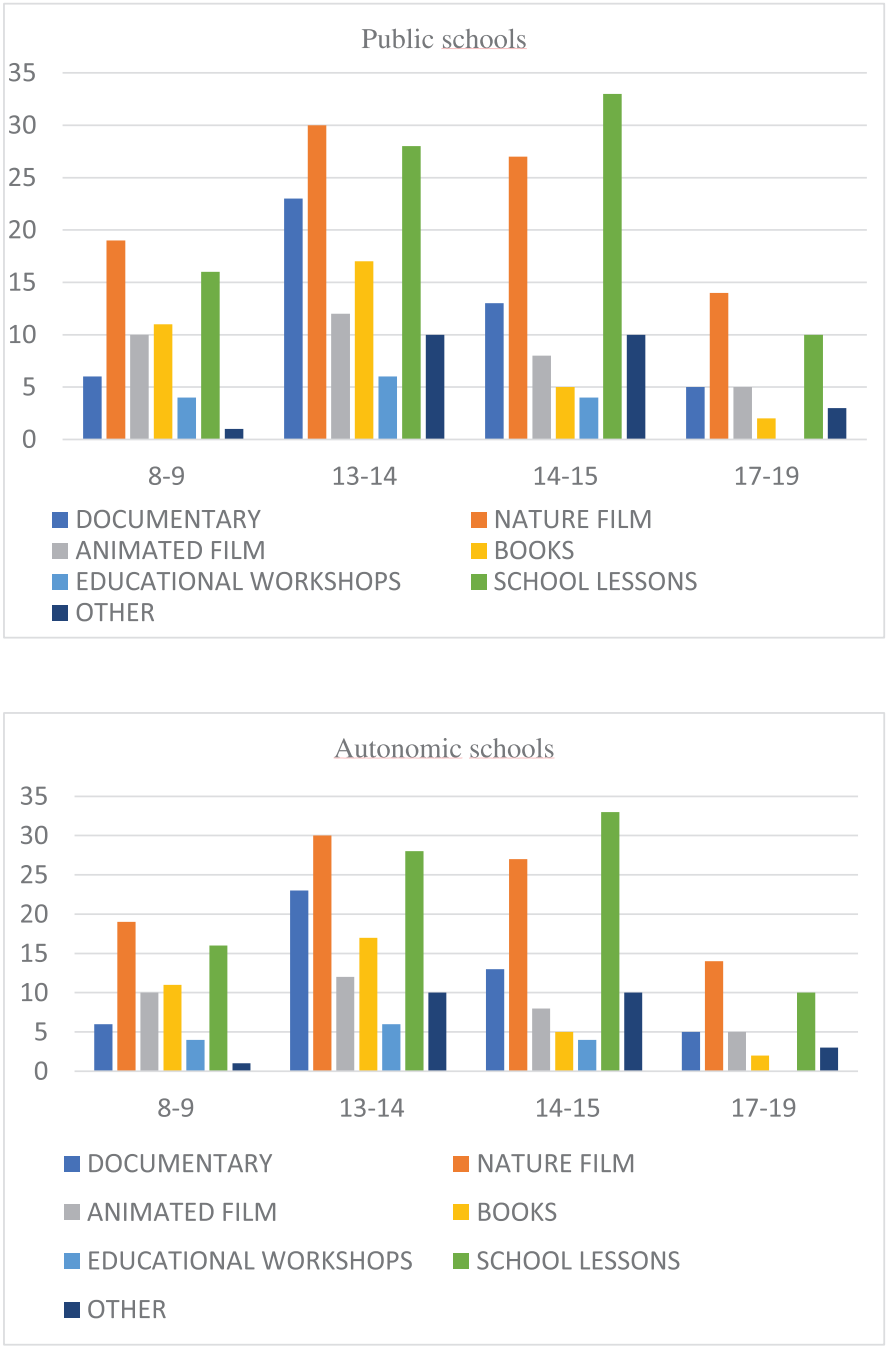

Figure 8 Question 5: Where do you gain your knowledge about the Arctic from?

cycle, continents and oceans, glaciers, life zones and climate.

4. High School: 1 hour. The Arctic is mentioned with regard to populations, culture circles, settlements, human impact on an environment or marine economy.

The final question was aiming at mapping student ways of learning. The answers are presented in Figure 9.

School lessons dominate in public schools, however, in high school, other means of learning (such as Internet or Wikipedia.org) were mentioned as dominating. Interestingly, educational workshops also play a very prominent role in learning among the three youngest groups of students in public schools. Books and meetings with scientists play a lesser, however, visible role in the process of gaining knowledge. In case of autonomic schools, lessons play a key role in knowledge transfer at all levels of education. Books are quite important, especially for both types of elementary schools, while educational workshops are important, however, they don't vary much from other options and in case of the 8—9 age group, educational workshops are almost not mentioned.

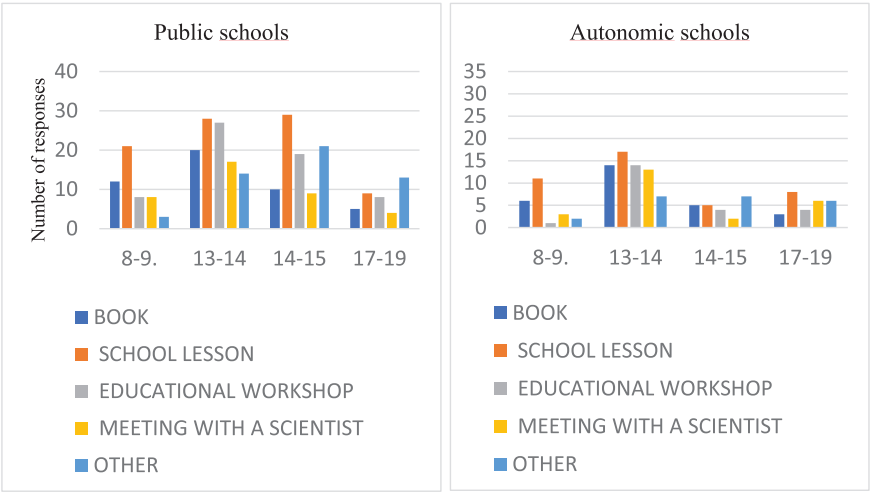

Figure 9 Question 6: How do you best absorb knowledge?

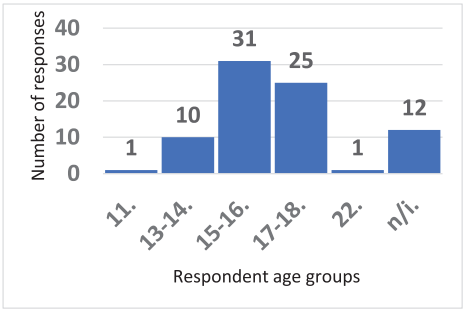

Figure 10 Distribution of students in particular age groups.

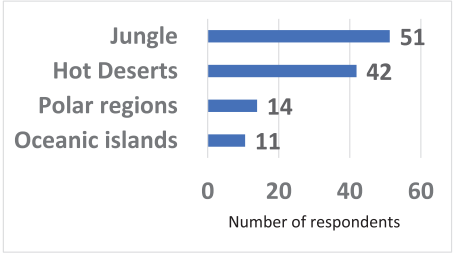

Figure 11 Question 1: In school, I have learned mostly about … (% of participants that indicated scores 4 and 5 answering the question).

3.2. Case Study 2. Closed (multiple choice) questions applied to the Lithuanian young learners

In case of Lithuania, a total of 80 young learners in several age groups were questioned. The distribution of a number of students per each age group is provided in Figure 10.

Statistically speaking, age groups 11 and 22 do not contribute to the entire picture created based on the responses.

The first question in the questionnaire: In school I have learned mostly about ... The answers (only 4 – agree, and 5 – agree very much) to four suggested topics were as follows (Figure 11).

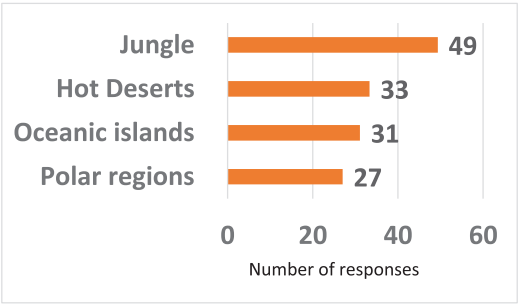

Figure 12 Question 2: In school, I was most interested to learn about… (% of participants that indicated scores 4 and 5 answering the question).

The vast majority of responses name the jungle (51%) and hot deserts (42%), while Polar regions were named by only 14% of respondents, followed by 11% who depicted oceanic islands. This may be explained by the results of the responses to the second question (only 4 – agree, and 5 – agree very much): In school, I was most interested to learn about… (Figure 12).

The division overlaps with the answers to the first question. Most students chose jungle and hot deserts, while oceanic islands and Polar regions were mentioned a similar number of times. So, the interest in particular topics most likely determined what the students wanted to study and thus remembered from school lessons. This has also influenced the responses to further questions, 3 and 4, i.e., Question 3: I was seeing feature movies in the cinema and/or TV about exploration of…, Question 4: I think, the most interesting stories were about… In responses to these questions, 57%, 64% of respondents chose the jungle for Question 3 and Question 4, respectively. Those were again followed by a comparable number of responses for oceanic islands, Polar regions and hot deserts, 49%, 45%, 44%, respectively (Question 3) and 44%, 42%, and 38% for oceanic islands, hot deserts and polar regions, respectively (Question 4). These statistics refer to the percentage of participants that indicated scores 4 and 5.

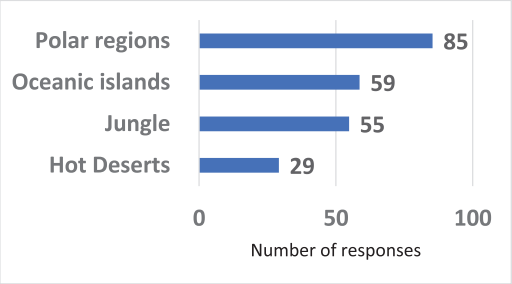

Figure 13 Question 5: The landscape most endangered due to climate change is at …. (% of participants that indicated scores 4 and 5 answering the question).

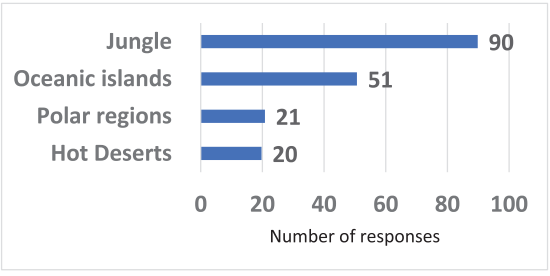

Figure 14 Question 6: Most of the world's biodiversity can be found at… (% of participants that indicated scores 4 and 5 answering the question).

Interesting responses came from respondents to Question 5: The landscape most endangered due to climate change is at …. (Figure 13).

A striking 85% of responses refer to Polar regions, while jungle and hot deserts are mentioned only by 55% and 29% of respondents, respectively. Oceanic islands are also perceived as endangered regions (59%). With previous responses it may seem that Polar regions are not sufficiently reflected in films and TV programs, stories about them are not so interesting comparing with other environments. An interesting set of answers was provided in case of Question 6: Most of the world's biodiversity can be found at… (Figure 14).

Ninety percent of respondents chose the jungle, which was followed by oceanic islands (51%), and Polar regions and hot deserts with 21% and 20% of responses, respectively. In general, this set of responses shows that students have a proper understanding of the environmental problems caused by climate change and global patterns of biodiversity. This is also reflected in responses to Question 8: The most important, from the practical point of view, are…, for which 72% of respondents chose the jungle, which was followed by 54% of responses choosing oceanic islands, 47% for Polar regions and only 22% for hot deserts.

The last two analyzed questions are, Question 7: Having an opportunity to join the adventure expedition I would go for… and Question 9: Having a special reward at my disposal, I would offer it for the new exploration of … Both questions show a sort of emotional attitude of respondents to

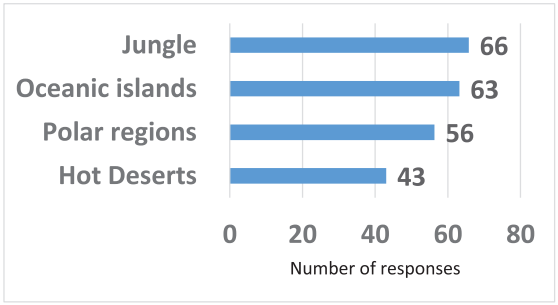

Figure 15 Question 7: Having an opportunity to join the adventure expedition I would go for… (% of participants that indicated scores 4 and 5 answering the question).

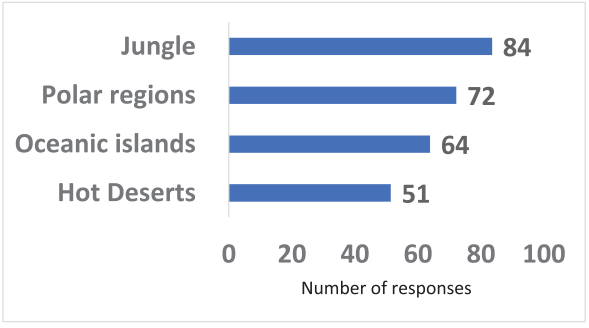

Figure 16 Question 9: Having a special reward in my disposition, I would offer it for the new exploration of… (% of participants that indicated scores 4 and 5 answering the question).

different regions of the world. The responses are presented in Figures 15 and 16.

Keeping in mind the previous answers regarding students' interests, 66% of jungle choices, followed by 63% of responses for oceanic islands, are not surprising. Polar regions were mentioned by 56% and hot deserts, by 43% of respondents. Slightly different is the distribution of responses in the case of Question 9 (Figure 16).

Eighty-four percent of respondents would support new explorations of the jungle, and 72% would support Polar explorations. Oceanic islands obtained 64% votes and hot deserts, 51%. Obviously, the jungle is at the top of all the answers provided by the respondents in Lithuania.

4. Conclusions

In this work, we have discussed the results from two types of questionnaires on the Arctic and Polar issues, which were conducted in Poland and Lithuania. Both studies vary in structure and so do the results. The following detailed conclusions encompass all important findings from both studies.

1. The Case Study 1 questionnaire, with a number of open questions, provided more inspiring responses from respondents, then the Case Study 2 questionnaire, in which only four fixed responses were to be chosen, and thus a rather limited space for imagination was provided to re-

spondents. Therefore, these responses can be regarded as bias. As a result of such a set-up, the Case Study 1 yielded more comprehensive information about the level of awareness of young learners regarding the Arctic issues.

2. The Case Study 1 (Questions 2 and 3) provided information, that a large number of Polish school students (independent of age and gender) are still confused about the Arctic issues, and this is true for both types of schools, public and autonomous. At the same time, the vast majority of respondents in Lithuania chose Polar regions as those most endangered due to climate change, which proves a certain level of awareness.
3. Question 4 in Case Study 1, yielded an interesting set of responses, i.e., most of the Polish learners are not interested in enhancing their knowledge about the Arctic. This is in line with the findings from other studies worldwide (Heddy and Sinatra, 2017; Osborne and Dillon, 2008; Vedder-Weiss and Fortus, 2011; Zusho et al., 2003). Simultaneously, jungle, hot deserts and oceanic islands have been chosen as interesting school topics by most Lithuanian students. Additionally, Lithuanian students would be less willing to support Polar exploration, versus the jungle exploration. It would be interesting to find out if this is related to a greater number of information in the Lithuanian media and schools regarding these regions versus the Polar ones.
4. Question 5 in Case Study 1, provided important information about the sources of knowledge about the Arctic. It is clear, that documentaries and nature films together exceed other responses in all age groups, in both types of schools. These two sources are followed by animated films.
5. A very interesting finding came out from the last question in the Case Study 1, which regards the means of how students best absorb knowledge. School lessons dominate in public schools, with exception to high school, where other means of learning (such as Internet or Wikipedia.org) were also mentioned as dominating. Interestingly, educational workshops play a very important part in learning among three youngest groups of students of public schools. Books and meetings with scientists play a lesser, however, visible role in the process of gaining knowledge. In case of autonomic schools, lessons play a key role in knowledge transfer, at all levels of education. This is most likely due to the fact that many school lessons are of group project type in autonomic schools, so students are familiar with such type of classes.
6. Both studies confirm the results from other studies that non-formal education has an important role in education, however, the level of its implementation is still not sufficient in schools and outside of school. Additionally, Polish students from autonomic schools, seem to benefit from modern approaches more than the students from the public school system.

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ORIGINAL RESEARCH ARTICLE

The formation of a pluralistic society and its impact on climate change — implementation of the lifelong learning concept

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Lifelong learning;
Pluralism;
Climate change;
Public policy

Summary In this work, the author refers to the own research entitled *"Citizens' participation in the creation and implementation of public policy. Electoral participation"*. The aim of this study was to analyze factors affecting civic participation in the form of participation in general elections. The study gave a reason to look more deeply into the formation of a pluralistic society in the age of climate change and social unrest. In this article, however, the author analyzes the impact of climate change in the process of creating a pluralistic society. The focal point of the paper has to do with the implementation of the Lifelong Learning concept in contemporary society. The aim of this work is to indicate the public authority the need for the more effective methods of activating and educating our society in the fight against climate change.

1. Introduction

Climate change is a fact and one not to be taken lightly. The question remains what we as a society can do to counter those changes. Unfortunately, a big chunk of our society and a big part of our political elite is focusing on a different question. They are still focusing on the question of whether climate change is man-made. That is not the right approach to the problem. For the scientific community, there is no question as to our involvement in the process of climate change. But even if there was such a discourse it would not be the focus of the conversation. Shifting the focus to the question of what we as a society and as individuals have

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to do to counteract climate change is crucial. To achieve that change we must educate our society throughout their entire life. The project known as 'Lifelong Learning' or 'Lifelong Education' is co-financed by the European Union under the European Social Fund, which was established in 2010. Its main task is to promote the idea of education, regardless of age and previously gained professional experience (Prauzner, 2011). It is vital that we educate people after they end their formal education so they will keep an open mind about the changes happening in all facets of our life. There needs to be an understanding that the heatwave, on its own, is unlikely to cause the collapse of civilization, nor even ruin an economy for a decade. It needs social co-factors to do this (Butler, 2018). One of those social co-factors is an unstable political system and the other is an uneducated, divided and apathetic society not willing to take action because of convenience.

2. Material and Methods

The author deeply believes that what is the most suitable form of government for ensuring a social and democratic balance as part of climate change prevention is the model proposed by Robert Dahl. This belief is supported by earlier research (Wiśniewski, 2017). In this so-called 'horizontal' theory of democracy, there is a clear division of society between two groups — the ruling elite and the sovereign. What distinguishes that theory from the earlier 'vertical' theory of democracy is the presence of intermediaries serving as mediators between these two groups. Those intermediaries are in R. Dahl's theory the essence of civil society and they can take the form of different associations, clubs, trade unions and business organizations (Dahl, 2006). A pluralistic society, being a diverse one allows for people in it to believe all kinds of different things and tolerate each other's beliefs even when they don't match their own, is by its definition less likely to operate as cohesively as is necessary for counteracting the climate change.

The effectiveness of actions for a pluralistic society is dependent on the socio-political engagement of that society. In his research entitled *Citizens' participation in the creation and implementation of public policy. Electoral participation* author analyzes the factors affecting civic activity in the form of participation in general elections.

The survey was conducted using a questionnaire interview technique on a sample of 300 residents of Gdańsk in the second half of 2018. The research sample reflects the structure of the city's adult residents (from 18 years and older) based on the following socio-demographic variables: (a) gender and (b) age (18–29 years, 30–59 years, more than 60 years). In addition, the study took into account the division of the respondents' place of residence based on the territorial criterion, i.e. the division into 34 administrative units of the City of Gdańsk. Administrative units were grouped into three aggregates. In each aggregate, a proportional number of surveys was carried out in accordance with the population's share of the total number of inhabitants of the City. The study has provided the following conclusions[1]:

1. The level of interest in politics among the respondents is average. Older and better-educated people are more interested in politics. High rates of interest in politics are associated with high turnout, a high level of civic activity, a high propensity to consume content in the media and a high level of electoral mobilization.
2. The scale of civic involvement is average. Almost half of the respondents do not engage in any forms of activity, and an even larger group of respondents declare that they will not engage in socio-political activities in the future.
3. The declarations show that between 60% and 70% of respondents participated in various general elections in 2010–2015. Older and better-educated people participate in them more often. Young people relatively often declare a low level of interest in politics and mobilization to participate in subsequent elections.
4. The most common motivation to participate in general elections is the belief that this is a citizen's duty. Also popular are the willingness to support a particular candidate/party and proximity to the polling station. For young people, the role of the environment is of key importance, and older people attach more importance to the sense of responsibility associated with voting.
5. Nearly half of the respondents declare that they will definitely take part in the next general election. Women, the elderly and those with higher education are more likely to participate in the elections.

3. Discussion

Those conclusions with the addition of the results of the latest edition of the Democracy Index[2] (which shows that democracy has been eroded around the world in the past year with the global score of 5.44 out of ten being the lowest recorded since the index began in 2006) (The Economist Intelligence Unit, 2020) support a hypothesis that our civic society does not function on the level that is needed in order to make necessary changes to our climate policies. Social involvement in matters of policymaking is described as an average which means that a big chunk of our society is not involved or even interested in the state of policies both on domestic and international levels. Well developed, pluralistic democracies have so far shown a stronger stand in climate change mitigation than non-democratic regimes (Povitkina, 2018). But democracies are no remedy for climate change especially when pursuing electoral victory. They do often focus on the provision of visible outcomes for their electorate rather than prioritize solving global problems in their programs (Povitkina, 2018).

Democratic decision-making takes time, and time is one thing that our society is running out of (Randers, 2014). According to the facts and figures presented by J. Randers, by the time we reach the year 2052, our climate will no longer be a stable one and we will no longer have any generational and social harmony. Three of the most

[1] Corresponding tables and figures from the research available in the appendix.

[2] It rates the state of democracy across 167 countries based on five measures: electoral process and pluralism, the functioning of government, political participation, democratic political culture and civil liberties.

interesting figures presented in *2052 a global forecast for the next forty years* are the temperature and sea level increase, CO_2 emissions and the use of different energy sources. Those figures suggest that the time to act against climate change is not only now but that the time to be indifferent is long gone (Randers, 2014). If our society's involvement in policymaking remains at the current level (as described in the mentioned own research) then our ability to combat climate change will be severely undermined. Since education and democracy are highly correlated (Glaeser et al., 2007) those conclusions give a reason to put more emphasis on educating our society throughout their lifespan.

Considering that our society operates on a principle of organic solidarity which comes from the interdependence arising from the specialization of work and the complementarities between people (Durkheim, 2013) it is crucial to convince or even force our society to educate themselves even after the formal part of education is completed. That is exactly what the Lifelong Learning Program is set out to do. The problem is that the LLL program is not implemented quickly enough and efficiently enough throughout the European Union not to mention democratic countries outside of the EU which don't have that sort of program at all.

Education in the fight against climate change is already a part of preschool and early school education. Even at the higher levels of education, there is still an effort to include environmental awareness as part of the study program. The importance of that was highlighted in the 2011 report *Education for All. Global Monitoring Report 2011. The Hidden Crisis: Armed conflict and education* (UNESCO, 2011). In that report, it was stated that education has the following effects on our society:

1. One extra year of education increases an individual's earnings by 10%.
2. Education helps people to make environmentally sustainable decisions.
3. Education helps combat stigma and discrimination.
4. Education helps to combat preventable diseases (Durkheim, 2013).

All of these effects were observed at the level of universal primary education. If we want to maintain those positive effects of education throughout the entire profile of society we have to keep educating adult members of the general public.

At the European level, there were 3 main surveys providing insight into adult education and training in the EU. Those surveys were: The EU Labour Force Survey (EU LFS); The Adult Education Survey (AES); The Continuing Vocational Training Survey (CVTS). Together those studies provide more general data on the participation of adults in Lifelong Learning.

The EU LFS gives us information about achieving set goals when it comes to adults participating in education (LLL Program for the EU countries). The benchmark set for EU counties is set at 15% — to be reached by 2020 — neither the USA, Canada, Japan or Korea will be able to reach that goal (OECD Statistics, 2019). According to the results of the 2009′s survey, the Nordic countries, the Netherlands and the United Kingdom have already attained the agreed objective, while Austria and Slovenia are close to the target. However, the participation of adults in education and training lags far behind the EU benchmark in Bulgaria and Romania (where less than 2% of adults participate in education and training) and also in Greece, Hungary, Slovakia, Poland and Turkey (where the level is below 4%) (Eurydice, 2011). If we fast forward to 2019 we can see that the newest surveys published in the *Eurostat regional yearbook 2019 edition* (The European Commission, 2019) prove that not much has changed from 2009 to 2018.

In 2018, one in nine of the EU-28 adult population participated in education and training which adds up to 11.1%. Regions where the participation rate for adult education and training was still below 5%, including every region of Bulgaria, Croatia, Romania, all but one of the regions in Greece and Slovakia, big parts of Poland and Turkey. Also, many regions of Italy, Spain, and Portugal fluctuate between 5% to 10% range (The European Commission, 2019). Those numbers show us that the last decade was all but wasted when it comes to the educational inclusion of adults in UE. The benchmark of 15% is not likely to be achieved by the assumed deadline of 2020. It seems that a decade is not enough time for a current democratic decision making to make significant progress in matters of crucial importance. And education is not the only thing that has to evolve in order to counteract climate change.

In order to expand the efficiency of democratic decision making and proficiency of implementation of those decisions the time-frames of democratically elected governments must adopt the pluralistic forms of ensuring the social and democratic balance (Wiśniewski, 2017).

4. Conclusions

All signs point to the conclusion that we are losing the fight against climate change. To counteract that pessimistic conclusion, we need to take up drastic measures. Unfortunately, drastic measures are not what our society is willing to do and that is why education seems to be the key to changing that false, social disposition. Considering that early education seems to be doing better and better in regards to climate change awareness we should focus your actions on educating adults. Projects such as the 'Lifelong Learning' program are a step in the right direction but the implementation of those types of programs proofs to be subpar. That subpar level of policy implementation can be correlated with low interest in policymaking in general and with the low levels of civic involvement where almost half of the general public do not engage in any forms of activity, and an even larger group declares that they will not engage in socio-political activities in the future (based on the research Citizens' participation in the creation and implementation of public policy. Electoral participation). Those points indicate a low quality of pluralistic form of democracy in contemporary society and deformation of democracy itself. The low interest in policymaking with a connection with the slow democratic process and poor implementation of crucial policies may prove to be the deciding factor in our inability to fight with climate change. Recommendations for policymakers are mostly ignored but still necessary to give. The main recommendations coming from this paper are:

1. Adopt a more pluralistic form of democracy for the quickening of the democratic process.
2. Strengthen the civic society in order to be able to spearhead and implement crucial policies.
3. Educate society outside of the formal education throughout their lifespan.

Adopting those guidelines should prove beneficial in our fight against climate change and will be crucial in putting the conversation about climate change on the right course.

Appendix

(Tables 1–4) for the *Citizens' participation in the creation and implementation of public policy. Electoral participation* study.

Table 1 Basic sociodemographic data of respondents participating in quantitative research. Data in (%), n = 300.

SEX	%
Woman	54.3
Man	45.7
AGE	**%**
18–29	13.3
30–59	45.0
60+	41.7

Table 2 The scale of interest in politics at the local and national levels (on a scale of 1 to 10). Data in (%), n = 300.

Response	%
1	18.3
2	5.7
3	5.7
4	4.7
5	13.7
6	7.0
7	11.7
8	12.7
9	5.3
10	15.3

The respondents were asked about the scale of interest in politics at the local and national levels. Among the respondents, the most (45%) are people who declare a high interest in matters related to politics. The interest determined by the respondents for 7 or more points on a scale of 1 to 10 was considered high. Moderate interest (5–6 points) is shown on average by every 5 respondents, while 1/3 is interested in politics to a small extent (1–4 points). Interestingly, the most numerous are groups of people declaring the lowest possible (18.3%) and the greatest interest in politics (15.3%) respectively. The average level of interest in politics is average (5.6 points).

Table 3 Scale of interest in politics at the local and national levels (on a scale of 1 to 10) broken down into socio-demographic variables. Data in (%).

Interest in politics	Sex		Age			Education		
	F	M	18–29	30–59	60+	Elementary and vocational	Secondary	Higher
Low	32.5	36.5	55	29.6	32.8	58.2	35.8	24.7
Medium	22.7	18.2	20	25.2	16	18.2	21.1	21.3
High	44.8	45.3	25	45.2	51.2	23.6	43.2	54

Table 4 Declared turnout in individual general elections by socio-demographic variable. Data in (%).

General elections	Sex		Age			Education		
	F	M	18—29	30—59	60+	Elementary and vocational	Secondary	Higher
PARLIAMENTARY ELECTIONS IN 2011								
Yes	67.3	64.8	42.9	65.9	73.3	34.6	59.8	81.7
No	29.4	28.1	25.7	31.7	26.7	51.9	34.5	16.9
Not authorized to vote	3.3	7	31.4	2.4	0	13.5	5.7	1.4
PARLIAMENTARY ELECTIONS IN 2015								
Yes	70.7	66.9	51.4	70.8	72.1	37.7	62.5	84.2
No	26.1	26.9	20	26.9	27.9	49.1	33	14.4
Not authorized to vote	3.2	6.2	28.6	2.3	0	13.2	4.5	1.4
PRESIDENTIAL ELECTIONS IN 2010								
Yes	69.2	66.2	23.5	72.3	75.4	41.5	61.8	81.3
No	26.9	25.4	35.3	25.4	24.6	45.3	31.5	16
Not authorized to vote	3.8	8.5	41.2	2.3	0	13.2	6.7	2.8
PRESIDENTIAL ELECTIONS IN 2015								
Yes	73.1	67.4	61.5	72.3	71.3	40.4	67	83.1
No	24.4	26.7	15.4	25.4	28.7	46.2	29.7	15.5
Not authorized to vote	2.6	5.9	23.1	2.3	0	13.5	3.3	1.4
LOCAL ELECTIONS IN 2010								
Yes	61	59.4	17.6	64.1	68.3	37.3	51.7	73.6
No	35.1	32	41.2	33.6	31.7	49	41.4	23.6
Not authorized to vote	3.9	8.6	41.2	2.3	0	13.7	6.9	2.8

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ORIGINAL RESEARCH ARTICLE

Changing Arctic. Firm scientific evidence versus public interest in the issue. Where is the gap?

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Summary The authors provide hard evidence for a significant environmental impact of long-distance atmospheric pollution advection to the Arctic. Results from literature and of their research show that the atmospheric inflow of pollution to the Arctic has been increasing over the decades. The authors show evidence that biomass burning has a greater potential impact on radiative budget of the region than the well-known spring Arctic Haze phenomenon, which has always been regarded as the most prominent atmospheric pollution manifestation in the Arctic. Warming, which is observed in the Arctic, results in decreasing ice coverage of the region, which in turn, leads to the major changes in the ecosystem, hence affects human well-being. At the same time, the authors present results of two independent studies, dedicated to the recognition of the awareness and the level of interest of people in eight Arctic countries and among young learners in Poland. The results show that not only the level of public interest is low, but it is both decreasing or, at the best, low to societies. This is in strong contradiction to information available and the daily experience of the societies, which inhabit the region. The authors believe, that such contradiction results from a low level of knowledge and interest of the Arctic and the climate change itself. Finally, the authors provide some hints on how to

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link hard scientific evidence for Arctic environmental changes with proper communication to the general public, and hence to increase the level of interest among citizens.

1. Introduction

The Arctic is a key driver of the world ocean and climate system and plays a vital part in many environmental processes. Climate change in this region tends to be larger, especially with regard to trends and variability of surface air temperature, than for the Northern Hemisphere and globe as a whole. This problem in the Arctic, known as an Arctic Amplification, could be partly explained by the observed changes in aerosol horizontal distribution due to the changes in aerosol concentrations and their optical properties, which influence radiation balance of the region. Still, Arctic amplification has many causes operating on different time and space scales but is strongly linked to declining sea ice extent, while its extend is well beyond the Arctic region. The impact of climate change on this region is already visible with serious consequences regional, for the Arctic, and global (ACIA, 2005; Arctic Council, 2013; IPCC, 2014). The crucial issues regarding the state of the Arctic environment include:

- Arctic climate is thought to be very sensitive to any climate change, where we observe the fastest increase in temperature, known as an Arctic amplification;
- long-range transport of pollution to the Arctic. The region has become a global sink for contaminants discharged from industry, energy production, agriculture and other human activities;
- biodiversity, since ecosystems are put at risk due to the changes in the state of the environment, mostly to the global warming and increase of the pollution levels;
- environmental impacts of economic development, which pose pressure on the vulnerable Arctic environment;
- the need for knowledge and understanding of the Arctic environment.

To understand and estimate the pace of environmental change in the Arctic is one of the key challenges for a global society. Since the changes in the Arctic have global implications humans must undertake proper mitigation and adaptation measures so that future generations are fully prepared for the changing environment and hence the world around them (IPCC, 2014; Kerr, 2007; Nquyen and Williams, 2012; Stocklmayer and Bryant, 2012; Walker, 2007). A common problem for learners and all non-scientists across the world is that research results are often discussed without a wide context and the possible interactions with their own lives and thus they seem irrelevant to them. No wonder that naturally curious people often lose further interest.

Along with political involvement in the Arctic issues, the EU plays a vital role in research, monitoring and assessment of the Arctic environment and in studies on ecosystem change trends. To emphasize the magnitude of the Arctic operations it is worth adding that around four million people inhabit the Arctic region, and almost a half of a million are the European Union citizens, mostly from three EU countries, Denmark (Greenland), Finland and Sweden. Iceland and Norway are members of the European Economic Area, while Russia, USA and Canada are among core partners of the European Union (Arctic Council, 2013). The European Union is an active partner in a number of Arctic initiatives, such as Convention for the Protection of the Marine Environment of the North-west Atlantic (OSPAR) which covers about one-third of the Arctic Ocean up to the North Pole, it is a Permanent Observer on the Arctic Council and a member of the Barents Euro-Arctic Council (BEAC). Among many EU research objectives, there is one that supports studies and channels the results to create the best knowledge base, which can be used to appropriate challenge of the changes which occur in the Arctic.

The Earth is experiencing global environmental changes, and thus it is critical to properly communicate research findings, and as the EU sees it, channel the information to societies of the entire world. In the process of increasing the awareness of the changes, education, at all levels, plays a crucial role (Arctic NGO Forum, 2019; Bray et al., 2012; Hovelsrud et al., 2011; Kotynska-Zielinska and Papathanasiou, 2018).

Still, despite the pan-European engagement in the Arctic issues, the social research results show, that societies in both Arctic and non-Arctic countries do not realize to what extent the climatic change influences both the Arctic and global environment and hence these societies.

This paper is a preliminary attempt to compare the scientific results regarding the changes for the Arctic ecosystem, with those regarding peoples' interest in the problem. In conclusions, the authors formulate some questions and suggestions for further discussions of this issue. The detailed description of the methodological approach and the results is provided in the subsequent sections of this paper.

2. Approach and methodology

This paper has been prepared by an interdisciplinary team of researchers, who represent both natural and social sciences, with research applied to the natural environment of the Arctic. Knowledge and understanding of the Arctic environment are essential for describing further trends and building future global and regional scenarios of the changes (Pakszys and Zielinski, 2017). The authors present strong evidence about recently increasing advection of pollution to the Arctic, related to both natural and anthropogenic activities, simply caused by global change and Arctic Amplification, and are able to presume the further adverse environmental changes in the region.

Aerosol impacts on the Arctic environment, based on data available in the literature and our own results, are described below. The authors present the changes of atmospheric aerosol and black carbon concentrations, and general behavior of aerosols in the Arctic, describing fundamental processes as well as experiments made, also with the cooling effect, shipping emissions and changes in Arctic clouds. We deal only with the long-range transport of pollution, namely various types of aerosols and we analyze yearly aerosol loads, which have been observed over Svalbard archipelago over decades. Atmospheric aerosols are among key elements of climate change and according to IPCC reports they still pose a significant unknown in determinations of the Earth radiative balance. All the analyzed aerosol events represent various sources of atmospheric pollution, from Arctic Haze phenomenon, through the event of the Eyjafjallajökull volcano eruption in spring 2010, to biomass burning events and anthropogenic events from North America (Ferrero et al., 2019a). The data presented in this work are based on sunphotometric studies using stationary sunphotometers, Cimel CE-318 (within the AERONET network) and the hand-held sunphotometers Microtops II. All data were collected in three locations, Ny-Ålesund, Longyearbyen and Hornsund. Additionally, the authors present the results from the Copernicus Atmosphere Monitoring Service (CAMS) model reanalysis, which assimilated modules of atmospheric chemistry, aerosols and greenhouse gases, also, two basic factors used in this work: Aerosol Optical Depth (AOD), which is an indirect measure of atmospheric pollution and the Angström Exponent (AE), which describes aerosol particle sizes. Then, in order to describe the air mass trajectories and the composition of the air masses the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) backward trajectories model was applied (which is not presented here, but the results are described). Such approach provided a comprehensive description of aerosol events with background information regarding sources and types of aerosol particles measured over Svalbard.

Having this strong scientific evidence of remote natural and anthropogenic activities, which are influencing the environment of Svalbard, we discuss the societal awareness of Arctic issues based on the Rethinking the Top of the World: Arctic Public Opinion Survey Report, Vol. 2, issued in 2015 by the Gordon Foundation (Rethinking the top of the world, 2015) and the results of non-formal educating project of young learners from Poland regarding their perception of the Arctic, which was run in 2017/18. We show that despite obvious and measured changes, which are quite commonly known, the level of perception of these changes among society is not high. We argue that proper education at all levels, including general public regardless of age, is the proper option to fill in the gap between hard science evidence and peoples' interest in the change of the Arctic, hence other parts of the world.

The presented results provide an empirical perspective on how various groups of publics, from different countries, relate to the Arctic and climate change issues. In this work we discuss only the questions which relate to the state of the Arctic environment, and the awareness of institution as important as the Arctic Council.

The Polish questionnaire was run during the course of interdisciplinary workshops dedicated to young learners. The questionnaire is constructed to determine if Polish young learners have knowledge about the Arctic and if they are interested in learning something more about the mentioned region and its matters. All students were given the same anonymous questionnaire and were under uniform conditions while filling it. The study involved in total a 274 young learners aged from 8 to 19, who have been divided into 4 age groups and each group was additionally divided with a respect to the gender.

3. Data analyses and discussion

3.1. Discussion of selected natural science findings important for the Arctic ecosystem, observed by the authors

It is well known that the Arctic is subject to an amplification in which the temperatures increase faster (twice) than the global average (IPCC, 2013; Serreze and Barry, 2011; Shindell and Faluvegi, 2009). Scientific evidence showed that the "Arctic amplification" (AA) is the result of complex global feedbacks, like the perturbation of longwave radiation fluxes between ocean and atmosphere due to sea ice retreat, changes in the cloud cover (Francis and Hunter, 2006; Screen and Simmonds, 2010a, 2010b) and variation in the heat transport driven by atmosphere and oceans (Yang et al., 2010). All these processes can be altered by the deposition of black carbon on snow, and the changes in the atmospheric aerosol and black carbon concentrations (Flanner, 2013; Hansen and Nazarenko, 2004; Serreze and Barry, 2011; Shindell and Faluvegi, 2009).

Thus, several important research campaigns were carried out to unravel the processes behind the changing Arctic. First of all, the Arctic Haze phenomenon was discovered, which is related to the inflow of pollution from mid-latitudes occurring in winter/spring (Barrie and Hoff, 1985; Brock et al., 1989; Jacob et al., 2010; Radke et al., 1984; Shaw, 1995; Stohl, 2006). Stohl et al. (2006) demonstrated that atmospheric pollutants can be transported into the Arctic at low-level or with an uplift outside the Arctic followed by a descent until ground. The ARCTAS campaign results showed high altitude air pollution layers transported from North America and Asia in spring (Jacob et al., 2010), while the ARCPAC campaign went deeper clustering the aerosol pollution during the Arctic haze in four categories: from background troposphere with sulfate-rich aerosol to organic-rich biomass burning aerosol and pollution layers dominated by fossil fuel combustion (Brock et al. 2011).

Recently, Ferrero et al. (2016) classified the vertical behavior of aerosols in the Arctic, and it was reported that during springtime four types of profiles were present: 1) homogeneous profiles with constant background properties with altitude (15% of occurrence); 2) positive and negative gradient profiles due to an increase and a decrease of aerosol and black carbon concentrations with altitude influenced by long-range transport (17% and 48% of occurrence); 3) decoupled negative gradient profiles when negative gradients were located at different altitudes in function of aerosol size (20% of occurrence). They are important as homogeneous profiles are representative of Arctic back-

ground conditions, positive gradient profiles describe the long-range transported aerosols, which can influence the cloud cover and thus the longwave fluxes. Negative gradient profiles show the entrance of long-range transported aerosol inside the boundary layer: it is important because the deposited black carbon can reduce the snow/ice albedo (Hansen and Nazarenko, 2004). Finally, 4) negative gradients located at different altitudes in function of size showed ground-based locally formed secondary aerosol during snow melting, which is important as a secondary aerosol can act as cloud condensation nuclei. Kupiszewski et al. (2013) confirmed such aerosol formation reporting new particle formation events in the near-surface layer, possibly related to biological processes (ASCOS campaign). Black carbon behavior was exploited in other campaigns. PAM-ARCMIP (Stone et al., 2010) and HIPPO (Schwarz et al., 2010) projects showed elevated black carbon concentrations both at ground-level and in the upper troposphere. High black carbon ground concentrations were also measured across the whole Arctic ocean (Ferrero et al., 2019a).

These above-discussed experimental pieces of evidence are fundamental since the same kinds of aerosol particles can produce opposite effects on climate (from warming to cooling) depending on their vertical location (Ferrero et al., 2019b; Flanner, 2013; Sand et al., 2013; Shindell and Faluvegi, 2009; Zielinski et al., 2016). The black aerosols absorb the incoming shortwave radiation heating the surrounding atmosphere (Ferrero et al., 2011a, b, 2014, 2018; Ramana et al., 2007; Samset et al., 2013, 2014), but the final surface temperature response is influenced by the altitude of the black carbon layer. While they warm the Arctic if deposited above snow and ice, they have a cooling effect when located in the free troposphere (Brock et al., 2011; Flanner, 2013; Hansen and Nazarenko, 2004; Seinfeld and Pandis, 2016). Not only black carbon is important, but the total aerosol properties are also fundamental as aerosols can trigger the cloud formation promoting an indirect effect. Changes in the Arctic cloud cover, especially low-level Arctic stratus, increase the downward longwave flux (Francis and Hunter; 2006; Serreze and Barry, 2011) mainly warming the Arctic surface (Intrieri et al., 2002; Vavrus et al., 2009).

The net effect of the whole ensemble of these processes is the warming Arctic in which the first complete opening of the Northwest Passage was observed in 2007 (Serreze et al., 2007). This brings attention to new commercial routes into the Arctic. Particularly, the importance of increasing shipping emissions has been recently underlined (Corbett et al., 2010; Eckhardt et al., 2013; Granier et al., 2006). It has been reported that during summer a considerable impact of ship emissions is observed in the Arctic, particularly, during ship passage in the Arctic, aerosol and black carbon concentrations reached values usually measured in urban continental areas (Ferrero et al., 2016). The impact of increased ship presence is just one of the anthropogenic impacts locally occurring in the Arctic. Other local emissions like the residential heating and gas flaring also showed huge impacts. Increasing anthropic emissions in the Arctic could significantly increase the aerosol effect on the climate change that the Arctic is already experiencing. However, as aerosols are short-lived pollutants (~few weeks of residence time) they act as short-lived climate forcers. Their reduction could be employed in short-term climate strategies (Jacobson, 2010; Ødemark et al., 2012; Quinn et al., 2008; Shindell et al., 2012).

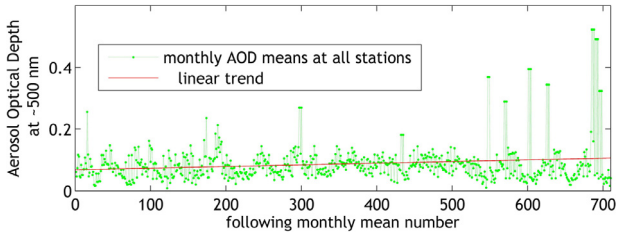

Figure 1 Timeseries of monthly mean AODs for all measurement datasets.

In 2018, Paulina Pakszys, in her Ph.D. dissertation (Pakszys, 2018) provided a thorough analysis of aerosol processes, which were observed during research campaigns in the Arctic, based on information collected by an international team of researchers and from her CAMS analyses. The analyses of data and model results showed a noticeable increase in AOD between 2000 and 2015, leading to the alteration in the state of the Arctic atmosphere, as certain differences between stations can be observed. Monthly averages of AOD values showed an increasing trend with some local maxima. The overall increase was from 0.07 to 0.11 (Figure 1). AOD increase in Ny-Ålesund was from 0.07 to 0.11 (Figure 2a), in Hornsund (Figure 2b), from 0.08 to 0.12, and the largest increase was recorded in Longyearbyen from 0.05 to 0.12 (Figure 2c).

Figure 3 presents monthly means for AOD, during several years at various Spitsbergen stations. Some outliers in AOD are visible and these high peaks are connected with the events in the atmosphere that occurred in high Arctic. The peaks were observed mostly during spring (around 120 day of year), in 2006, 2008, 2010 in Hornsund, 2003 in Longyearbyen and in 2006 in Ny-Ålesund. The highest peak occurred in summer of 2015, in Hornsund during the biomass burning event. Some months in certain years show very high values of AOD due to strong aerosol events such as the Arctic Haze (spring 2004, spring 2005, May 2006, March 2008 and 2011), forest fires (summer 2004, June 2015) and volcano eruptions (August and September 2008, April and May 2010, May 2011).

One of the most recent Biomass Burning events, from North American intense fires occurred in July 2015 (according to the Global News Canada and Natural Resources Canada 2016, it was one of the worst within the last five years in terms of the number of forest fires). This event caused a record high AOD values, that at times were 10 times higher than expected (Figure 4).

Intensive wild fires in North America started in middle May 2015, while the culmination was observed on 28 June 2015. Fire spots were active continuously until late June 2015 and the number of forest fires was the highest over a long period of time (Global News Canada, 2015). MODIS-derived AODs significantly increased on 10 July 2015 around Spitsbergen Island reaching 0.7 AOD (0.6 at 550 nm), increaseswere observed during two following days in the region of Svalbard. AOD values of more than 1 (c. 10 times higher than expected) were recorded by SP1A sunphotometer in Ny-Ålesund, while simultaneous measurements

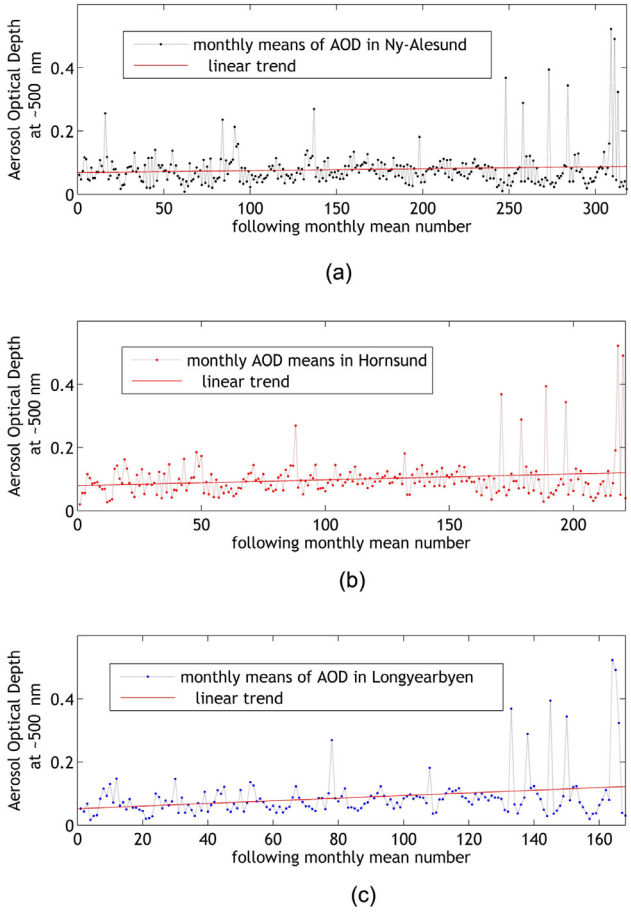

Figure 2 Timeseries of monthly mean AOD for all datasets in Ny-Ålesund (Fig. 2a), Hornsund (Fig. 2b) and Longyearbyen (Fig. 2c).

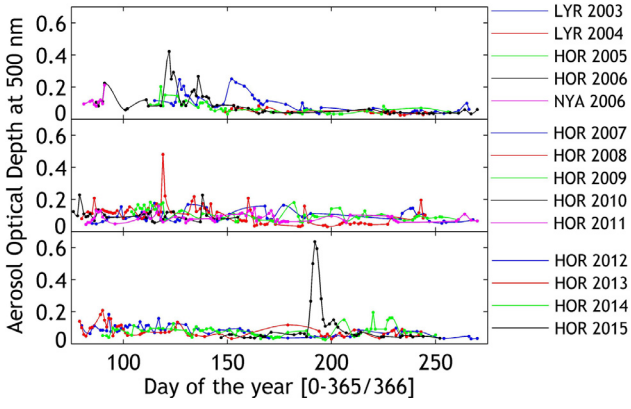

Figure 3 Inhomogeneity in AOD during the period 2003–2015, between years and stations based on AERONET dataset.

in Hornsund showed very high values (0.9) using CIMEL and lower (0.7) using Microtops II Sunphotometer. The CAMS model calculated AOD at 550 nm and showed that the maximum values occurred on 10 July 2015 and this peak lasted until 16 July at all three stations.

Changes in the Arctic climate are important because the Arctic acts as a refrigerator for the rest of the world. This rapid warming trend is anticipated to continue into the next

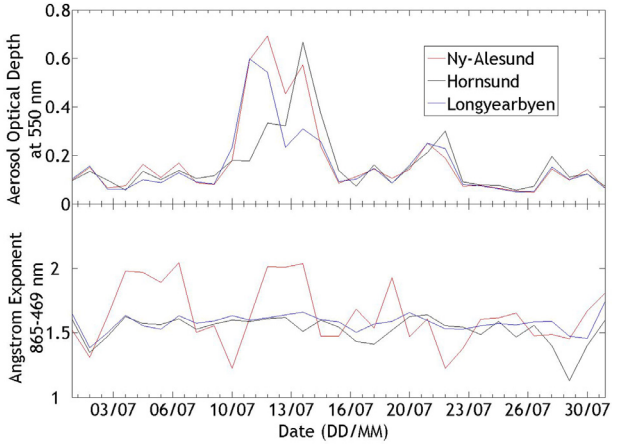

Figure 4 AOD values at 550 nm (upper plot) and AE from 865 nm–460 nm (lower plot) in Ny-Ålesund (red lines), Hornsund (black lines) and Longyearbyen (blue lines) during biomass burning event in July 2015 based on CAMS model.

century with temperature increases exceeding those predicted in the rest of the Northern Hemisphere and will result in accelerated loss of land and sea ice, and an increased rate of sea level rise, with global consequences. These changes affect both local and distant communities, and they can be profoundly observed in many environmental aspects. These changes are leading to significant economic and cultural upheaval particularly for the indigenous peoples of the Arctic.

3.2. Data regarding societal attitudes towards the Arctic issues

The first study, which is discussed in this paper, has been conducted in 2015 within the framework of the Arctic Public Opinion Survey. The results of the study, which was conducted in 8 Arctic countries, and additionally in Canada and USA, with division to the region of the country. In case of the Arctic Council, the results are compared to the first such survey, which was conducted in 2010.

The selected results from the survey are presented in the Table 1 and 2 below. Only questions regarding interest in environmental issues and the awareness of the Arctic Council are presented in this work.

The numbers of respondents varied from 866 in Iceland up to 3000 in Canada, while other countries have been represented by over a 1000 respondents. In the first analyzed question, which is *What do you think is the greatest threat facing the Arctic region today?* authors use only the environmental issues. The majority number of responses noticed the climate change and global warming as an Arctic threat, however, the interest do not exceeds 50% of responses in any given country. The lowest number has been recorded in Russia (20%) while the highest in Denmark (46%). These relatively numerous responses were not followed in the second question, connected to the ice cap and permafrost melting. Only 2 to 19% of people in the investigated countries consider those problems as Arctic threats. Interestingly, the highest number of climate change issue responses came from Russia while the lowest from North Canada (2%), where the issue is expected to be the most obvious. Environmen-

Table 1 Responses to selected questions regarding environmental issues, from the Arctic countries (Modified from Rethinking the top of the world (2015)).

Country/Region	North Canada	South Canada	Alaska	South USA	Russia	Sweden	Finland	Norway	Denmark	Iceland
Number of respondents	770	2042	500	1016	1011	1003	1002	1002	1000	866
What do you think is the greatest threat facing the Arctic region today?										
Global warming, climate change	37%	40%	30%	37%	20%	32%	43%	26%	46%	30%
Ice caps melting, melting of sea ice/ permafrost	2%	8%	3%	14%	19%	12%	8%	4%	5%	3%
Environmental damage/degradation (negatives to flora/fauna/pollution/land...)	8%	7%	5%	1%	5%	7%	5%	7%	7%	11%
Human/outsider interference/intrusions, negative effects on land/North, lack of understanding/ignorance of area, lack of respect for the North	2%	1%	3%	2%	4%	1%	3%	2%	3%	3%
Do not know/refuse	14%	15%	26%	35%	38%	35%	28%	49%	29%	36%

Table 2 Responses to the question regarding recognition of the Arctic Council, from the Arctic countries (Modified from Rethinking the top of the world (2015)).

Country/Region	North Canada	South Canada	Alaska	South USA	Russia	Sweden	Finland	Norway	Denmark	Iceland
Number of respondents	770	2042	500	1016	1011	1003	1002	1002	1000	866
Have you ever heard of an intergovernmental forum or group called the Arctic Council that is made up of eight countries with Arctic regions?										
Yes, vaguely.	27%	26%	20%	20%	42%	28%	36%	34%	29%	21%
Yes, clearly.	32%	8%	15%	12%	12%	11%	8%	12%	28%	49%
Yes, clearly as in 2010	35%	15%	-	2%	7%	9%	17%	20%	30%	36%

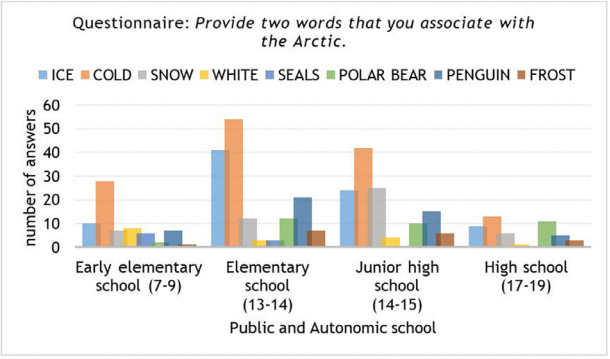

Figure 5 Responses of Polish young learners to the question: *Provide two words that you associate with the Arctic*.

tal damage is also not perceived as an important issue and the percentages range from 1% (South USA) to 11% (Iceland). Another interesting result came regarding the human interference with the environment of the region. The highest number of answers to the mentioned issue were reported in Russia (4%), while in South Canada it was only 1%. Relatively high percentages of responses refer to the question: *Don't know/refuse*, with lowest 14% in North Canada up to 49% in Norway. These answers can be summarized as: *I am not interested*. This assumption can be supported by the results presented in Table 1, where respondents refer to their knowledge about the Arctic Council. The positive answers with good recognition of the Arctic Council were given by less than 50% of respondents in each country/region. The highest percentage (49%) of those answers came from Denmark and the lowest 8% was reported in Finland and in South Canada. Compared with the survey from 2010, the percentages of the responses are in 6 cases lower than in 2015, 3 were slightly higher (South USA, Russia, Sweden) and in one case there are no data from 2010 (Alaska).

These answers go well with the responses provided by Polish young learners regarding their perception of the Arctic. Figure 5 shows the division of responses to the question: *Provide two words that you associate with the Arctic*.

When we look at the responses, we can observe that Polish young respondents of all age groups, think about the Arctic in a rather typical (cliché?) manner, since the majority of responses independent of age group and gender mostly mention: cold, ice, snow and penguins. None of the respondents provided such associations as: climate change, degrading Arctic environment or melting glaciers. Some respondents mentioned polar bears. However, quite a number of respondents mentioned penguins, which shows that the knowledge about the Arctic is at their best not too clear.

The next question of the survey: *Would you like to enhance your knowledge about the Arctic?* provides information about the level of interest and potential concern about the Arctic among the young learners. The results are presented in Figure 6.

In all cases, there is a great number of students in all four groups of ages who are simply not interested in the Arctic issues or cannot decide if they want to learn anything about this region. The number of uninterested students is relatively low in young ages and becomes more dominating among older students.

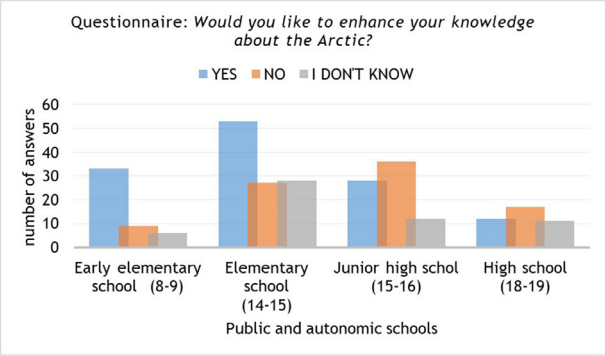

Figure 6 Responses of Polish young learners in public and autonomic schools to the question: *Would you like to enhance your knowledge about the Arctic?*

The results of the questionnaire in these two independent studies, which concern eight Arctic countries and Poland, a country without geographical connection with the Arctic, but with long-lasting presence (exploration and research) in the region, show that in all cases investigated members of each society do not seem to be very much interested and concerned about the Arctic, its changes, problems and hazards. People do not seem to realize what role we have in modifications of the state of the Arctic and what consequences they pose on the region.

4. Conclusions

The following conclusions can be formulated based on the findings presented in this paper.

1. There is no doubt that the environment of the Arctic is under an increasing pressure (both natural and anthropogenic) and that this pressure is concerned with pollution advected to the region from distant sources.
2. Over the last decade, the dramatic summer biomass burning events in Canada, Greenland and Siberia have become a major source of atmospheric pollution to the Arctic. The amounts of chemical compounds and dust from these events are so vast, that they have serious impact on the radiative balance of the region.
3. These events are connected with increasing global warming, due to lack of moisture in the soils and progressive drying, many regions become very vulnerable to wild fire outbreaks. We should expect that this process will only continue to worsen.
4. Still, recent studies on society perception of the Arctic issues among citizens of eight Arctic states and among young learners in Poland show that the Arctic environmental issues are not well understood and people are not interested in learning much about the region and its problems, regardless of age.
5. Very few people are aware of the environmental damage, which is happening in the Arctic and about the human role in this process. Unfortunately, certain issues are less important to people (survey in 2015) than they were in 2010, i.e. perception of the Arctic Council and its role.
6. It is evident from the Polish survey, that young people of various age groups and independent of gender are not too aware of the Arctic issues and they are not too interested in learning much more over what they know now.
7. However, Polish young learners, best absorb knowledge using Internet and during non-formal education activities, such as interactive workshops.
8. Therefore, the authors believe, that the scientists together with educators of all types, formal and non-formal, should join forces and create interesting offers (materials and set of classes/workshops), which can be available online for any educator or any interested party to use them in educational activities, available to the general public.
9. We think that the SIOS Knowledge Center could become such an information/education hub for the Arctic issues.

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ORIGINAL RESEARCH ARTICLE

Lexis of climate phenomena in social sciences students' daily discourse

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Summary An academic degree gained in the field of social sciences also means more extensive knowledge of the surrounding world understood as the natural environment crucial in defining the position and development of humankind. Interpersonal communication, apart from the colloquialisms related to climate phenomena (weather), shows an evolving state of knowledge of the topic, changing attitudes, and possible stances formulating the need for change. Opinion polls conducted among 150 social science students comprise the source material for the lexicological analysis in the areas of the knowledge, time, and responsibility (related to environmentalism and climate) indicating that attitudes towards the natural environment are present in communicative behaviours.

1. Introduction

The decision to acquire higher education in the field of social sciences is also related to the desire to gain a more extensive knowledge of the surrounding world crucial in defining the position of development of the humankind. Humans place their social relations within a value system ontologically defining them and their need for coexistence. The consequences of obtaining a prospective academic degree are tied to a temporal perspective: the past, the present, and the future. The past time is synonymous with progressing towards developmental maturity, also meaning the decision to apply to university. The present time determines all experiences of the candidates, including those related to the realisation of their decision. The future time means a vision of the practical operationalisation of acquired qualifications. Since the justification of attitudes and actions related to environmentalism and climate lies within the temporal perspective, it uniquely emphasises how essential is the ability to comprehend and define future time.

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Students' attitudes towards such issues may be researched indirectly through lexical analysis of their daily discourse, the presence and quality of the lexis used by the students to describe not only climate phenomena but also their present and future roles in the surrounding world. The research will enable to assess how critical climate-related issues are for students concerning their future and the responsibility for future generations. The research assumes that interpersonal communication, apart from the colloquialisms related to climate phenomena (weather), shows an evolving state of knowledge of the topic, changing attitudes, and possible stances formulating the need for change. Questionnaire surveys comprise the source material for lexical analyses aimed to reveal attitudes towards the natural environment present in communicative behaviours.

1.1. The future time as a temporal category: interpretation

This part presents remarks interpreting the category of the future time, which are affected by the psychological approach permeating popular self-help books. Pragmatic aspects have indeed been chosen based on the pragmatic angle revealed in the results of the conducted questionnaire surveys, since the resulting image of the environmental awareness of social science students is to enable the choice of the level, range, and strategies for communicative interactions possibly shaped by demographic aspects, especially by education and age. Barbara Fredrickson offers the approach which is crucial for this paper in her book *Positivity* (2009; Polish edition: Fredrickson, 2017). It is also worth mentioning Katarzyna Skowronek conducted an interesting analysis of the stances establishing the concept of the future time adopted by such authors as Bhagwan Shree Rajneesh (2009), Deepak Chopra (2018), and Barbara Fredrickson mentioned above (Skowronek, 2013). Skowronek's strategy was to analyse works offering three discrete approaches to the construct of the future time presented in best-selling popular psychology self-help books offering motivational and inspirational messages, translated into numerous languages. Skowronek offers the conclusion that, while the authors define and evaluate the future time in different ways, they offer two common concepts: change (or renewal) and the present as the future of a creative individual is determined (changed) in the present. Skowronek asserts that the vision of the future promoted by the self-help guides blends individualism and individual creativity characteristic of the Western culture with the Oriental world view; she characterises the modern "spiritual individual" as possessing significant self-awareness, the autonomy of choices, individualism, and a dislike for forced solutions (Skowronek, 2013).

Fredrickson bases her concept of the understanding of the future time construct on change (transformation) and choice. The quality of human life in the future is determined by the correct choice and conscious completion of present tasks. The tasks are understood as activities aimed at self-change: "If you want – change your f u t u r e right n o w" (Skowronek, 2013, p. 258). An individual has two options to choose from: either flourishing or stagnation, which is possible due to a conscious effort and not wishful thinking. The quality of the future is foreseen in the present. Fredrickson proposes to treat the future as a therapeutic method: the list of twelve tools she created aims to increase the effect of positivity.

1.2. Environmental responsibility of the individual in the perspective of the temporal category

Human fate involves a fundamental choice: to be a responsible individual or to shirk responsibility and to break the bond between the world and oneself. This ambivalent freedom of choice points unambiguously to the conditions of real humanity, which cannot exist without responsibility (Kirkergaard, 1982; Ingarden, 1972) When relating the category of responsibility to the temporal perspective, Picht argues that human responsibility is the responsibility for the future as the direction and boundaries result from the essence of time (Picht, 1981). Marek-Bieniasz uses this epistemological genesis for environmental responsibility (2015). Environmental responsibility possesses all characteristics of human responsibility in general. Invoking the care of the ecosystem as a fragment of the biosphere in the global and local perspective expresses a particular human responsibility whose duties add to its environmental perspective. Relating environmental responsibility to the temporal perspective means the human is currently shaping the future state of the natural environment. This seems the source of Ingarden's claim that human responsibility is possible and realisable in the temporal structure of the world. Simultaneously, it means the responsibility for future generations, namely responsibility for the continued existence of humankind, responsibility for biological health of humankind, or responsibility for the environmental awareness of future generations (Marek-Bieniasz, 2015). The implementation of this vision requires extensive knowledge of the environment and an awareness of the unique role of humankind in the community actions for the good of all beings on Earth. All this establishes the axiology of human activities anchoring environmental responsibility on the planet.

2. Data and methods

Data used in the study come from an original questionnaire filled by Social Science students of Ateneum-University in Gdańsk in 2019. The questioned group consisted of 97 women and 53 men, the average age amounting to 29.7. Fifteen questions were grouped into three problem modules: **Knowledge, Time, Responsibility. Knowledge** module contained the following questions: How do you understand the word "environmentalism"? What do you know about climate change? What is the cause of climate change? Under which circumstances do you use vocabulary connected with climate? What type of vocabulary do you use when adverting to climate? **Time** module took cognisance of the following issues: What period do you advert to most frequently when talking about climate? How distant time perspective do you apply when talking about climate? While talking about climate, do you only think about the present or also about the past and the future? Is time perspective of the future important to you, and how important is it? Do you notice the connection between climate issues and the category of time (of

which one mainly)? **Responsibility** module comprised of the following questions: What place in the importance ranking do you assign to environmental responsibility? Do you fear a global climate crisis? Do you feel responsible for climate change? Which of the scales (local or global) would be closer to you were you to act for the climate? What type of vocabulary is usually used when talking about environmental responsibility? The aforementioned problem modules were interlinked by a common question about contemporary social science students' stance on climate phenomena expressed by the lexis used in their responses. Of primary interest were both conceptual range of words and their terminological relevance, as well as period placement, understanding the duties to self and others, and, more broadly, to the ecosystem. Simultaneously, the modules allowed for noticing axiological characteristics attributed to climate issues by students participating in the study. The present study, analysing stances of young generation's intelligentsia, fits into the global current of alarming against societies' and governments' indifference towards the nearest future of humankind and the planet.

3. Results and discussion

The first problem module involved the type and range of knowledge about environmentalism and climate change possessed by social science students. Analysing the conceptual range of the term "environmentalism" allowed to draw attention to three methods of interpretation, the content of this word (single lexemes, expressions, locutions). The first method combined interpretation with different forms of activity, e.g. *caring for the environment and wildlife, limiting harmful substances, rational managing of waste, eliminating plastic, caring about nature, protecting the Earth from destruction, preventing global warming, fighting with pollution, caring for the climate*. The number of such answers amounted to 47.5%. The next group of interpretation (35%) related to a specific discipline, sciences, e.g. *Earth system science and its existence, biodiversity science, environment science and its influence on surroundings, a field of science referring to wildlife and natural environment, environmental protection and cooperation science, ecology, ecosystem protection science, approach to the world, the environment*, and more. The last type of interpretation activities associated environmentalism with different forms of natural resources (17.5%), e.g. *what surrounds me, wildlife, the climate, people, the world, a healthy environment, the future, lifestyle, clean, well-maintained, litter-free environments*, and more. The given answers prove that only 1/3 of students possess linguistic awareness and consider the formal aspects of lexis, in this case morphological (for instance: eco-logy), almost half of them concentrate on the prevailing content, overlooking the coexisting grammatical information. The last group demonstrates the knowledge not by definitions but by the wording, quoting the names of fragments of reality functionally combined with environmentalism. Generally, it may be stated that a practical aspect related to activity dominates amongst the interpretations, overlapping a theoretical, definitional aspect.

Knowledge about climate change and its causes divides the students' linguistic conceptualisation into several subgroups, although only three references may be indicated concerning the content: wildlife (47.5%), the human factor (42.5%), and technological development (10%). Were human activity and technological development to be combined, students would claim both wildlife and humankind responsible for climate change almost to the same extent. Referring to wildlife, students isolated linguistically two groups of reasons: global warming (35%) and the atmosphere, wildlife (12,5%).

Giving the circumstances under which words connected with climate were applied, students pointed to the context of words' appearance (60%), the place of words' usage (25%) or they admitted to not talking about climate at all (15%). Regarding the context, they suggested the topic of weather, advertising campaigns, political slogans, education, climate change, being an activist for climate, choosing a holiday destination, changing of seasons, environmental development, global warming, and other topics. Home and workplace were mentioned among the places where words connected with climate appear.

In the talks referring to climate issues, students enumerated examples which could be conventionally placed within three groups: phenomena and general concepts (65%), phenomena and specific concepts (20%), occasional lexis (15%). Amidst the general phenomena were: *seasons, global warming, ecosystem, environmentalism, the environment, weather, pollution*, and more. The group of specific phenomena contained: *eliminating plastic, saving water, the ozone hole, recycling, air purity*. An example of occasional lexis could be such lexemes as *glaciers, coal, dangers, changes, health*, and more. The second module referred to the category of tense (past, present, future) and its combination with the content of lexis applied to climate. In the talks about climate, the students pointed mainly to present tense (44%), subsequently to future tense (36%), and lastly to past tense (20%). Defining time perspective crucial for climate phenomena, the students decided to apply periods such as: one year, a few years (30%), 10—20 years (15%), 20—30 years (22%), 50—60 years (13%), 100 years (6.9%), hundreds of years (10.5%), whole life (2.6%). As it is effortlessly noticeable, the most frequently chosen period of perspective is the time up to 30 years, equalling one subsequent generation.

Commenting on climate, students willingly applied future tense (42%), then present tense (34%), and, relatively rarely, past tense (24%). For students, future perspective seems to be the most optimal when addressing climate issues, which was proven by the answers ascribed to three categories: important (73.5%), averagely important (16%), unimportant (10.5%). A similar division may be observed in responses pointing to students' noticing the relation between climate issues and future tense category (44%), then present tense (31%) and lastly past tense (25%). Although time perspective concerns mostly one generation, the students claim future tense to be a category most related to thinking and talking about climate issues.

The third module concerned the sense of environmental responsibility. Establishing the ranking of importance of these issues, students claimed them to be priorities, primary (70%), second (13%), third (5%), fourth (3%), penultimate (3%), ultimate (6%). Students described their having concerns about the global climate crisis as: yes (74%), a lit-

tle (5%), no (21%). 82% of students admitted to being responsible for climate change, the remaining refrained from such responsibility (18%). The next question concerned the choice of scale (local or global) as an area of prospective activity for the climate. Students prominently favoured the local scale (72.5%), and the global scale was chosen by 27.5% of them.

When questioned about vocabulary appearing in their discussions concerning responsibility for climate, the students referred to the following lexemes (and expressions): *environment protection, waste segregation, global warming, ozone hole, environmental responsibility, future, development, logging, renewable energy, frugality, animal protection, air pollution, carbon dioxide, sea levels, chimney filters, solar panels, climate education, greenhouse gases, consumerism, neglect of the environment, smog*, and more.

As stated before, time perspective uniquely indicates the importance of understanding and defining the future tense category, since it is precisely the sphere where justifications of stances and activities concerning environmentalism and climate issues are included. The study confirmed that future tense has developed into a dominating perspective for students wishing to locate their responsibility for climate and the environment. Such a stance is related to the pragmatics of activities for the climate, which was indicated in the form of expressions and locutions. Linguistic formulations present in students' utterances confirm a relatively high level of the sense of responsibility attributed to humankind which, along with its increasing technological development, is leading to environmental disaster. In the importance ranking, care for climate issues was expressed by 3/4 of students, simultaneously almost equal number evinced their concern connected to the global climate crisis. What is also captivating is students' realisation of a need for action for the local environment, as this is the place where they wish to start accomplishing their environmental responsibility. A local perspective means focusing on the place of abode rather than on the whole country.

The conducted lexical analyses of social sciences students' statements indicate the material pragmatisation of used expressions and utterances, which combines their method of expressing issues concerning environmentalism (the climate) with the need for action. Opting for the future tense perspective resulted in reaching for wishfully formulated activity, e.g. *necessary elimination of plastic, essential saving water, prohibiting to burn coal for heat at home*, and more. The students also proved to possess knowledge which, through the size of the conceptual range of given lexemes, enabled to determine the extent of issues and realities included in necessary activity for the climate. It does not mean that educating by raising environmental awareness, knowledge, and responsibility, as well as by taking cognisance of recent research and global trends in care for the climate and the environment, should not be continued. It can be stated that current information activities spread about all the media have substantially developed pro-environmental thinking, with climate issues being brought to the forefront. It is also crucial to notice in the vocabulary used by the students that the main objective of reducing the greenhouse effect was concern about health and future generations, though attention was also paid to the high cost of this activity.

4. Conclusion

Due to the fact that increasing consequences of climate change hold a leading position on the list of the most important tendencies in the repertory of environmental issues, which was also noted in the editing of the National Environmental Policy of Poland 2030, concerns about raising the level of young generations' environmental awareness should remain closely connected to monitoring the state of this very awareness among various populations of citizens. Social science students constitute a group which is particularly aware of civic duties, including concern about wise government, social prosperity, and the environment in a broad sense. The perspective applied to consider these issues should depict the connection between climate and the interim state of the economy, as well as, more broadly, between climate and biodiversity, including species distribution. The tasks awaiting countries, concerning a just and solidary transformation, remain related to pending global energetic transformation, which in turn is connected to environmental policies. It is noticeable that a broad spectrum of climate issues requires a unique type of education. Most frequently, the media reporting on these issues are television and the Internet. The broadcast publicistic and popular science materials define a lexical range acquired by the receivers, as well as the method of understanding the words-terms and the importance of the necessary activity. An opinion poll from 2019 carried out among the social science students focused on the lexis associated with three aspects acting as indicators of stances on the awaiting environmental changes, climate change included. The mentioned indicators are knowledge, time and responsibility. Linguistic forms describing the term "ecology", resulting from the knowledge being the function of students' individual linguistic experience, possess mainly the form of figures of speech, marked by the functioning. It is only after this process that the linguistic formulation of knowledge on this topic takes the form of a definition. Such a system, attributing a crucial role to activity for climate, becomes an essential characteristic of contemporary youth's stance on this matter.

The second indicator is the time perspective. The students clearly gravitated towards the future tense perspective, though they extraordinarily associated it with present tense perspective. Due to the present change of existing reality, future perspective can be created; as it results from the study, the students evidently realise this.

In terms of responsibility, a high rate of students (82%) notice their individual responsibility for the environment, express concern for the future, and postulate that the governments take action not only on a local scale. It is evident from the study that the issues of the environment and the necessity to act in order to save it from progressive biological degradation caused by humankind are noticed and accepted by the young generation, though the instigated activity is mainly of a local scale. It is then indispensable to educate people on a significantly broader, global scale, as it will allow to understand better and improve everything

which, on a local scale, is progressively done for the ecosystem, more broadly — for the biosphere. The consciousness of a relation between local activities and global effects is explained as the very nature of wildlife treated as functional integrity. The students' pointing to the local scale is understandable, as such perspective is appropriate for environmental responsibility, which, in result, co-creates reality of global meaning.

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ORIGINAL RESEARCH ARTICLE

Political dimension of Arctic research

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Summary The article contributes to a better understanding of the role of research in the policies of the states that are scientifically engaged in the High North. The research covers 17 European states: six are Arctic and 11 non-Arctic, which were selected according to the following (at least one) formulated criteria: having an established tradition of carrying out scientific research in the Arctic region; having issued Arctic policy documents and/or Arctic research strategies; participation in the activities of the Arctic Council; and having gained membership of the International Arctic Science Committee (IASC). In the analysis we have applied a mixed research method, since it incorporates elements of both qualitative and quantitative approaches and offers a more comprehensive review of the scrutinised texts. The qualitative analysis relies on a discourse analysis (predicate analysis). The quantitative part of the analysis utilizes the instruments of a software research tool — The AntConc. In the end, the outcomes of both methods are merged and compared. The study reveals that conducting scientific research is not a top priority for all Arctic states. However, it has the highest similarity in terms of applied approaches among Arctic states as compared to other fields (e.g. the economy, security or pollution). At the same time, the environment and climate change are perceived to be the most important drivers behind Arctic research as defined in the Arctic states' strategies. Moreover, there are major differences among both Arctic and non-Arctic states in terms of the level of accuracy in the presentation of their research activities, particularly with regard to the implementation of scientific programmes and research aims. Finally, the research indicates that all states highlight that international scientific cooperation stimulates cooperation also in

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other areas and that research provides information that supports decision making and policy creation.

1. Introduction

The importance of arctic scientific research to the political domain – both nationally and internationally – is a complex and multi-dimensional issue pervaded by divergent and contradictory views. An example of this is the nature of the relations between science and politics. These worlds are considered separate spheres that are in opposition to each other in terms of the logic of their functioning and their operative axiological values (Copeland, 2016). In science, a primary position is reserved for knowledge that is based on ethically obtained objective evidence (evidence-based knowledge), while science itself is perceived as completely free of the influence of politics and ideology. In accordance with this perspective, science would constitute humanity's universal language, and the scholars' sole aim is the understanding of the nature of things. On the contrary, the political sphere characterises itself by the clashing of various influences and interests, where causes and principles are relativized, are unstable and prone to change. Politics is both dialogue and conflict, and diplomacy may only be regarded as the brighter side of politics.

However, another approach that is completely opposite to the former, emphasizes the proximity of the scientific and political domains and their complementariness for the sake of the development of humanity. In this view, the cooperation between scientists and political decision-makers makes politics more effective and responsible and at the same time enables steering the development of science in such a way that it will contribute to the solution of the most vital and urgent challenges to individual states and the international community. What is more, as science is frequently financed by nation-states, it is strictly connected to their needs and interests (Wagner, 2002). Since these views are very much contradictory, one may argue that the real character and scope of the relations between science and politics lies somewhere between these two just indicated positions.

Another dimension relevant to the relationship between science and politics, particularly on the international level, involves their operational forms: international scientific cooperation and so-called science diplomacy (Copeland, 2016; Flink and Schreiterer, 2010). While science diplomacy typically constitutes an element of a state's foreign policy and serves its interests, international scientific cooperation focuses on scientific progress and is animated and conducted by individuals or groups of individuals (Turekian et al., 2015). As indicated by Turekian et al. (2015) since the end of the Cold War, in the period of globalization, one can observe that science and foreign policy have become more aligned, which resulted in the advent of science diplomacy. Subsequently, they argue that science diplomacy is "the process by which states represent themselves and their interests in the international arena when it comes to areas of knowledge – their acquisition, utilization and communication – acquired by the scientific method" (Turekian et al., 2015). For the participants in the workshops organized by the American National Research Council in 2011, science diplomacy is both a way to pursue a national agenda as a component of "soft power" as well as a way of addressing common problems and fostering personal relationships (National Research Council, 2012). Taking a historical perspective, it can be argued that international scientific cooperation tended to be a response to undertakings of a strictly scientific nature, while science diplomacy is frequently presented as an outcome of increased threats to states' existence and development, threats of a trans-border nature, etc. which due to their global scale have forced various states (and other agents) to engage in political cooperation.

While the relationship between science and politics is prone to change depending on the historical era at hand: at times these two worlds function independently while in other periods their trajectories lie close to each other. The same can be said in a geographical context: in some parts of the world scientific research and politics are quite separate, while in others they are very much intertwined.

In the last two decades we have been witnessing the increasing number and growing complexity of international problems that became objects of international politics and diplomatic processes. Moreover, finding their solution often lies within the realm of scientific knowledge. One example of such a state of affairs is the Arctic region, which has gained international significance and became an object of global interest due to multifarious consequences of climate change and processes of globalization.

Arctic research is specific in several environmental and social aspects and hardly comparable to any other region. As such, the nature of science diplomacy in this particular case is hardly comparable to its nature in other areas. Unlike in other regions, climate change effects are most visible in the Arctic. While both the Arctic and Antarctic are the most inhospitable places on the planet, these are concomitantly the two most vulnerable regions on Earth when it comes to the consequences of climate change. However, unlike in the Arctic, there is no permanent human habitation in the South Pole. There are only scientists working on research stations and tourists. Also, there are no commercial industries. The scientific outcomes of polar research aim at providing solutions for ongoing scientific challenges. Yet, it is even more problematic and demanding in the Arctic, since scientific outcomes directly influence Indigenous peoples and local communities residing there. Giving the above-mentioned factors, we assume that the research interests of Arctic states differ from states that have no inhabited territory in the Arctic.

The Arctic region has aroused the curiosity of Europeans for centuries, who explored the stern, wintry and dangerous lands and seas of the High North in a relatively slow manner. The acquisition of knowledge about the Arctic

by the Europeans occurred initially alongside explorations carried out with the purpose of colonization in mind (e.g. the Viking settlement in Iceland and Greenland in the 9 th and 10 th centuries, respectively), or even fishing and whaling expeditions (e.g. the discovery of Novaya Zemlya in the 11 th century or the unconfirmed discovery of Spitsbergen by the Pomors in the 14 th or 15 th century). Arctic exploration assumed a more systemic form in the modern era when some Western European states were forced by the European geopolitical situation (in terms of Spain's and Portugal's naval dominance) to search for a north sea-passage to Asia while the rulers of Russia initiated an intense conquest of Siberia. It will be no exaggeration to claim that the erstwhile discoverers of the Arctic often played the roles of both explorers and representatives of current European rulers, and they were sometimes entrusted with official or secret instructions from their principals (McCannon, 2012).

Geographical discoveries in the High North together with the evolution of theoretical knowledge and successive improvements in the techniques of observation and experimentation in extreme polar conditions have stimulated the development of Arctic scientific research in many areas of science since approximately the second half of the 17 th century. Even though the majority of expeditions into the Arctic circle were typically organized by and were meant to serve the interests of individual European states, in the second half of the 19 th century the concept of international cooperation evolved as a sine qua non condition to further effective development of knowledge about numerous phenomena and processes related to the Arctic, especially in regard to meteorology. This had a key practical significance for the development of navigation and for the understanding of climatic phenomena in the northern hemisphere. An example of this tendency was Weyprecht's initiative to organize coordinated national expeditions to the Arctic instead of 'a race to the North Pole' (Barr, 2008). A wide international research program was then proposed to be realized as part of the International Polar Year by the national expedition and research units of 12 states in 1882/83. It is worth emphasizing that the initiative had its subsequent editions in 1932/33, 1957/58 and 2007/8 (Łuszczuk et al., 2015).

Another factor supporting the development of observation and research in the European Arctic was the Svalbard Treaty, indirectly making it possible for researchers from various states to work in the archipelago. There are many arguments that support the view that scientific cooperation in the Arctic is one of the oldest and most important areas of international cooperation in this part of the world, including many initiatives of a strictly exploratory or competitive nature (the race to the North Pole). Interestingly, even though the significance of research (especially meteorological research) in the Arctic increased during World War II (Selinger and Glen, 1983), the conflict initiated a weakening of international scientific cooperation that lasted throughout the Cold War due to the widening of political and ideological barriers. Clearly, this change was strictly connected with the development of national research projects realized in the Arctic and geared towards the military security of individual states or alliances. With the end of the Cold War, the usefulness of science for state interests somewhat decreased, while at the same time the thematic scope of research was significantly widened (Doel et al., 2014).

Due to its inherent international nature and the fact that a lot of observation and research conducted in the Arctic centres on the specificity of the natural environment and the changes that have taken place therein, arctic scientific research constitutes a starting point for extra-scientific initiatives of regional cooperation. The most important example of this was the so-called Rovaniemi process that is the implementation of the Arctic Environmental Protection Strategy (AEPS) adopted in 1991 (Tennberg, 2000). After a few years this cooperation was transformed into the activity of the Arctic Council.

For a quarter of a century, the International Arctic Science Committee (IASC), established in 1991, has been a basic platform for international scientific cooperation in the Arctic. It is a non-governmental organization whose mission is supporting and facilitating research cooperation between all the states that are involved in gaining knowledge about the Arctic regions. IASC promotes and supports interdisciplinary research aimed at gaining deeper knowledge and understanding of the Arctic region and its role in the Earth's system. IASC's major functions include: (a) providing unbiased, independent scientific counselling as regards the Arctic and providing the public with vital information; (b) undertaking actions to protect, exchange and provide access to scientific data concerning the Arctic; and (c) supporting easy access of scientists to all geographical areas and sharing knowledge as well as logistics and other resources (IASC, 2018).

Undoubtedly, scientific cooperation in the Arctic plays a crucial role in a period of intense climatic change, for it makes it possible not only to learn more about the processes and phenomena under way, but it also constitutes the basis for the preparation of strategies of adaptation to the new situation in the 21st century. At the same time, research in some areas may have a particular significance for the socio-economic, political or strategic interests of individual states of the region and beyond. This is the case, for example, with research into the structure of the Arctic Ocean's seabed and continental shelf, with the prognosis of extreme weather conditions, or with the development of state-of-the-art technologies of civilian or military use. On the one hand, these conditions contribute to an increase in the number of international research projects, while on the other hand they motivate states to move toward a more active deployment of research results in their Arctic policies.

So far, no detailed research has been carried out to establish the role of research into the policies of states that are scientifically engaged in the High North. This study aims to fill this gap by presenting the results of the quantitative and qualitative content analysis of the main policy documents and Arctic research strategies issued by the selected European Arctic states.

One of the key features of this selection is its dual composition — both Arctic and non-Arctic states were considered. It is worth emphasizing, however, that this distinction is not limited only to geographical location. It is assumed that being or not being an Arctic state implies different needs or motivations behind conducting Arctic research, and this results in different positions or roles of scientific research in the overall involvement of states in the Arctic region. Countries with Arctic territories generally have a longer, stronger and more comprehensive tradition

of undertaking Arctic research, while non-Arctic states due to their distance to the region have a different scientific perspective. The detailed characteristics of the examined group of states are provided in the following section.

2. Methodology and data examined in the analysis

The research covers a set of 17 European states, which includes both six Arctic states (Finland, Iceland, the Kingdom of Denmark, Norway, Russian Federation, Sweden) and 11 non-Arctic states (Austria, the Czech Republic, France, Germany, Italy, the Netherlands, Poland, Portugal, Spain, Switzerland, the United Kingdom). This selection was determined by the application of at least one of the following criteria: having an established tradition of carrying out scientific research in the Arctic region; issued Arctic policy documents and/or Arctic research strategies; participation in the works of the Arctic Council; and membership in the International Arctic Science Committee (IASC).

From this group of 17 analysed countries, there are six countries – Austria, Czech Republic, the Netherlands, Poland, Portugal, Switzerland – which have not issued any, publicly available in English and in full version, political documents relating to the Arctic region. However, all of these participate in the different working groups of IASC. In addition, some of these – Poland, Portugal and Switzerland – are engaged in the Arctic Council as Observers. Therefore, despite the lack of official documents, their involvement in and contribution to Arctic research is not negligible. These countries are certainly part of the developments in the region and therefore it is relevant to include these in this analysis. The lack of official positions could be explained by various factors, which would need additional research. However, this possibly leads to (1) a lack of political willingness or readiness to involve adequate resources in the formulation of Arctic policy documents or to (2) systemic barriers preventing the research communities to efficiently inform policy-makers about the political importance of the Arctic region. Figure 1 presents a list of countries selected for the analysis, their participation in the Arctic Council and International Arctic Science Committee and their documents related to the Arctic and Arctic research.

The research design of this study is based on a mixed research method since it incorporates elements of both qualitative and quantitative research approaches for the broader purposes of breadth and depth of understanding (Johnson et al., 2007). The quantitative method relies on a software research tool – The AntConc (Laurence, 2019. The qualitative method includes the discourse analysis, or more specifically, the predicate analysis. Eventually, the outcomes of both methods are merged and compared by applying a comparative analysis.

As Phillips and Hardy (2002) explain: "social reality is produced and made real through discourses, and social interactions cannot be fully understood without reference to the discourses that give them meaning". The method of discourse analysis pays particular attention to the language issues in the construction of social reality (see also: Milliken, 1999). Individual elements of discourse are the speech acts that fit into it. Such an act of speech is the Arctic policy document, the creator of which is the selected state. Predicate analysis focuses on the language practices of predication – verbs, adverbs, adjectives and other nouns that are attached to reference nouns. The AntConc software, a tool used to analyse the corpus, is used to apply this method to the Arctic policy documents. This software allows users to create basic corpus analysis categories, e.g. a word list and a keyword list but also helps to find advanced categories like collocates, clusters and n–grams in the text. Collocates are all predicates close to the word with a short window span (around, from left to right of the word). Clusters are the predicates that are placed next to the reference word. Together with the reference word they form logical word clusters and they could be present in general written English. In other words, a cluster is a logical phrase.

The second method used in the research is a comparative analysis, which allows to determine convergences and contradictions in the parts of the documents regarding the scientific research. The comparative analysis is applied as a research method, especially with comparative explanation and the method of agreement in mind. The method of agreement is suitable for use when there is a difference in the structures of the compared agents while a similarity exists in their function (Hopkin, 2018).

The core of the analysis are the official documents (see: Appendix 2) – Arctic strategies of Arctic and non-Arctic states (Denmark, 2011, Denmark, 2013; Finland, 2010, 2013; France, 2016; Germany, 2013, 2019; Iceland, 2006, 2007, 2009, 2011; Italy, 2016; The Netherlands, 2014; Norway, 2006, Norway, 2009, Norway, 2011, 2014, 2017; Poland, 2017; Russian Federation, 2001, 2008, 2013; Spain, 2017; Sweden, 2011, Sweden, 2016; Switzerland, 2015; UK, 2013, 2018). In order to operationalise the corpus analysis, two groups of words were selected to be examined using the AntConc software (Laurence, 2019). These are 'research' and 'science' and their related forms or lemmas (researchers, researchers', researcher; sciences, scientists, scientific, scientifically). In written English both groups often appear together. Both words form a phrase 'scientific research', the reference object of this study. A preliminary test revealed that research is the third most popular word in all documents (excluding commonly used grammatical elements in English such as 'the', 'and', etc.). The most popular words are Arctic; north; research; cooperation (see: Appendix 1). Based on this we can claim the prominence of research in Arctic policies. The use of the software consists of a quantitative dimension of the analysis. This software enables a broadening of the analysis because of the quantity of processed data where non-software investigation could not have provided such in-depth results.

During the research several barriers emerged, including limited accessibility of documents (some of which were not in an editable format) and in three cases there were no documents at all (Czech Republic, Austria, Portugal). Moreover, it appears that the software does not offer relevant statistics and result comparisons for different types of discourse analysis. This research tool is crucial in performing such analysis. This is highlighted by the obtained results that are presented below. Nonetheless, due to the characteristics of the software, it does not provide many opportunities to compare different types of documents with different lengths. It was particularly difficult to obtain a percentage

State	Arctic state (Arctic Council member)	Non-Arctic state (Arctic Council observer)	IASC member	Issued Arctic strategy/ policy	Arctic research strategy
Austria			■		
Czech Republic			■		
Finland	■		■	■	
France		■	■	■	
Germany		■	■	■	
Iceland	■		■	■	
Italy		■	■	■	
The Kingdom of Denmark	■		■	■	
The Netherlands		■	■		■
Norway	■		■	■	
Poland		■	■		■
Portugal		■	■		
Russian Federation	■		■	■	
Spain		■	■	■	
Sweden	■		■	■	
Switzerland		■	■		■
United Kingdom		■	■	■	

Figure 1 List of countries selected for analysis, their participation in the Arctic Council and International Arctic Science Committee and their documents related to the Arctic and Arctic research. Grey cells show if and how states are engaged in the Arctic organisations and if/what documents they issue.

distribution for the phrases in the text. Therefore, these findings need to be interpreted with some measure of caution.

3. Presentation of results of the analysis

An application of the mixed research method used in this study allows for the integration of qualitative and quantitative approaches which results in a better, more insightful understanding of the political dimension of the Arctic research. Although the main premise of this methodology is that such methodological integration allows for a more complete and synergistic utilization of data compared to separate quantitative and qualitative data collection and analysis, it is still conceivable to present the results of the qualitative and quantitative analysis separately and to explain all findings in the discussion and conclusion sections.

3.1. Qualitative analysis

In this section the outcomes of the qualitative analysis are presented. The qualitative approach allows us to investigate single cases in detail. The analysis is divided into two groups of states — Arctic and non-Arctic states — that illustrate comprehensive observations of the political dimension of Arctic research. As mentioned above, the choice behind categorizing the selected countries into two groups is driven by the assumption that each country follows its own research needs or interests that are determined by their territorial presence (or absence) in the Arctic. Hence, we assume that the research interests involved (supporting the countries' foreign policy goals) would be different for Arctic and non-Arctic states.

3.1.1. Single cases — Arctic states

The field of science is not a top priority for all Arctic states. However, it has the highest similarity among the Arctic states as compared to other fields (e.g. economy, security, pollution, etc.) (Padrtova, 2019). At the same time, the environment and climate change are seen as the most important drivers behind the Arctic research defined in the Arctic states' strategies. Indeed, all Arctic stakeholders are dependent on scientific research and international cooperation in science because of climate change (Heininen et al., 2019).

In the case of Finland, the government emphasizes the importance of making scientific contributions. The two Finish strategies also outline other purposes of the research that is undertaken, such as decision making, economic, and social purposes. In particular, the 2013 strategy states that "the new knowledge generated by research needs to be actively disseminated to support decision making, expand business opportunities and increase general awareness of the Arctic among the public at large" (Finland, 2013, 2010). Furthermore, the document explains that research can be used for gaining and maintaining geopolitical influence in the region because "Finland will be able to consolidate its position and increase its appeal as a leading world-class expert in the Arctic" (Finland, 2013).

For Iceland research is clearly a priority highlighted in their two documents that cover the Arctic policies (Iceland, 2009, 2011). The 2011 strategy document provides a long list of topics that research should cover including "climate change, glacier research, marine biology, international politics and law, security, oil and gas extraction, history and culture, economic and social development, gender equality, health care issues and Arctic shipping" (Iceland, 2011). Additionally, its 2009 strategy document suggests that research should help inform policy (Iceland, 2009). Furthermore, Iceland emphasizes a need "to promote the involvement of Icelandic scholars and institutions in international cooperation on Arctic science such as the International Arctic Science Committee, and work carried out by the Arctic Council working groups" (Iceland, 2011).

The perspective for the political dimension of Arctic research is also presented extensively in the policy documents of The Kingdom of Denmark, where research is among the main priorities. The two Danish documents identify the different drivers for Arctic science development. The main driver in both documents appears to be climate change, followed by pollution (Denmark, 2011). Similar, to Finland, Danish documents emphasize the multipurpose nature of Arctic research, which could aid the Kingdom in its decision making e.g. in regard to the management of living resources like fish (Denmark, 2011). In addition, research can also help inform climate agreements, as well as be of benefit to economic development. Importantly, both documents state that "research will help with the Kingdom's continental shelf claim" (Denmark, 2011).

In Norwegian Arctic policy documents research is of high importance, although not specifically listed among the state's priorities. Norway also emphasizes that the research can also be used for different purposes. For instance, both strategy documents (2014 and 2017) suggest that research and knowledge can help improve Norway's economy as well as inform its economic decisions, including on sustainable development (Norway, 2017, 2014). The 2017 strategy directly links climate and environmental research to business development. The document states that "more knowledge about interactions between oceans, ice, biodiversity, and ecosystems is necessary for overall management of the northern sea areas and business development and value creation" (Norway, 2017). For Norway, "it is [also] important to have a research-based approach when evaluating environmental consequences before making decisions about new activity" (Norway, 2014).

In its 2013 strategy, the Russian Federation identifies 'the development of science and technology' as one of the five main priorities of the state in the Arctic region. However, research is among the least discussed topics compared to other Arctic states. The 2013 strategy document identifies several drivers of science such as natural hazards, climate change, and the environment (Russian Federation, 2013). The document states that research can also be used for other purposes and contribute to a better understanding of social and economic conditions. The 2013 strategy document explains that other research areas include "history, culture and economy of the region, as well as the legal regulation of economic and other activities in the Arctic". Indeed, research can help improve health and wellbeing, and contribute to greater international cooperation (Russian Federation, 2013). The 2008 strategy also recognizes the importance of research related to social and economic issues (Russian Federation, 2008).

Finally, for Sweden research plays a considerably important role, although it is not explicitly mentioned among the listed priorities (Sweden, 2011). The strategy recognizes the need for interdisciplinary research. Particularly, the document states that "Sweden will continue to be a leading nation as regards climate and environmental research, focusing also on the impact of climate change on humans" (Sweden, 2011). Climate change and the environment are the key drivers of science and research. Besides that, Arctic research serves other purposes as well. For instance, Sweden's long history of Arctic research can be used to ensure Sweden's place as an Arctic stakeholder (Sweden, 2011). Sweden also recognizes the importance of international research cooperation. Indeed, "cooperation across national

borders in the North helps to maintain good relations in the High North" (Sweden, 2011).

Summing up the observations relating to the Arctic states, it can be concluded that in most cases Arctic research has a very pragmatic meaning, very often it is associated with economic developments and social needs. Emphasis is also put on the aspect of international cooperation within the field of research. Surprisingly, it is not linked with the sustainable development of the region, which would have been expected. In general, the political dimension of Arctic research is not presented as a key political issue for Arctic countries.

3.1.2. Single cases — non-Arctic states

The following section provides a detailed content analysis of six non-Arctic states' Arctic strategies – France, Germany, Italy, the Netherlands, Spain, and the United Kingdom. The remaining five non-Arctic states included in this research (Austria, the Czech Republic, Poland, Portugal, Switzerland) are excluded from this section since they do not have any official political Arctic documents to be analysed.

In the case of France, scientific research and cooperation is one of the seven priorities of its 'National Roadmap for the Arctic' (France, 2016). There is a long-standing polar exploration and research tradition in France as "France was the first country to set up, in 1963, a scientific research base in (…) Svalbard, where it shares a permanent base with Germany" (France, 2016). The document also states that "in historical terms, the polar regions have had a special place in international scientific cooperation" (France, 2016). Moreover, "France's scientific activities relating to the Arctic strengthen its legitimacy in dealing with Arctic affairs" (France, 2016). Although the French document is very clear about the political importance of Arctic research for the state, it still seems to be quite vague in this respect.

In German strategy there are no explicitly stated priorities. Nevertheless, the document lists 11 issues which are of high interest to the Federal Government – research being one of these. Although, the research drivers tend to be related to the environment and climate change (Germany, 2013), there are also other purposes that underpin the research. Economic reasons for instance. That is why the Federal Government "is convinced that, as a partner with vast expert knowledge in the areas of research, technology and environmental standards, Germany can contribute to sustainable economic development in this region" (Germany, 2013). Arctic research can also be used as an instrument to create policy and inform decision making. Therefore, the Federal Government "is working to guarantee the freedom of Arctic research, based on the conviction that scientific findings are of fundamental importance for Arctic policy" (Germany, 2013).

The Italian Arctic Strategy refers to the "Scientific dimension" which is one of the key areas to focus on in the Arctic. Research is thus clearly a priority. The expeditions to the North Pole are noted as "the first Italian scientific missions in the Arctic region". The document highlights that "a major role is to be played by scientific and technological research, in which Italy excels". The strategy also informs and addresses how "the Italian scientific community, supported by the national research agencies ... [is about] to reinforce Italian presence in the Arctic". Finally, the strategy provides a specific example of implementing the interplay between science, politics and business, the recently reactivated Tavolo Artico (Arctic Table), as "an informal, open-ended consultation group on the Arctic, [including] members from academic, scientific and business communities".

The Dutch strategy outlines clear Arctic priorities in its Strategy Plan. The document provides guidelines for future polar research as "the Netherlands continues to play a role in international (polar) issues" (The Netherlands, 2014). The Netherlands in its research "combines 'space for science' and 'space for policy'" (The Netherlands, 2014). Within this context, there are four key drivers behind the scientific agenda that addresses both science and policy i) "ice, climate and rising sea levels", ii) "polar ecosystems", iii) "sustainable exploitation", iv) "social, legal and economic landscape" (The Netherlands, 2014). In addition to creating knowledge, as one of the main functions of the research, there are four other purposes of the research. One of these is to support policy as "the results of Dutch research into the polar climate system are increasingly finding an audience with (inter) national policymakers" (The Netherlands, 2014).

In the case of Spain there is a substantial focus on scientific research. Polar research, which includes education, is defined as a "strategic priority for the Spanish scientific system". In addition, "scientific cooperation is one of the most effective forms of international cooperation, as it can be transformed into essential political capital enabling effective action [and] defend both its own interests and global interests". The Spanish strategy considers "polar research to be a strategic priority for the Spanish scientific system, both due to its scientific importance and to its high internationalization and repercussions in areas of interest to Spain, both strategically and socio-economically". The document also calls for the establishment of its own Spanish scientific infrastructure in the region.

The United Kingdom is portrayed as "a world leader in Polar affairs where British views have long held sway in the fields of polar science, exploration, diplomacy, business and environmental protection". Moreover, "the UK research community has a strong record of collaborating internationally and delivering high impact Arctic research … [and] high-level agreements with Arctic states … [and] provides strong frameworks for collaborative research" (UK, 2018). As the policy outlines "highly regarded UK science is present in most areas of Arctic research and also helps to underpin good policy, stable governance and responsible commerce" (UK, 2013). Indeed, "by its nature, science contributes directly to diplomacy, policy and our understanding of the Arctic" (UK, 2013), therefore the UK "will encourage the timely feedback of robust evidence into decision making mechanisms" (UK, 2013).

All of the six non-Arctic states pay attention to the importance of their involvement in polar research. Specifically, their presence in the Arctic through scientific activities could strengthen their legitimacy in dealing with Arctic affairs. At the same time, the research could help inform decision making, support policy and contribute to stable governance of the region. Non-Arctic states also put emphasis on the contribution of research to the sustainable development of the Arctic.

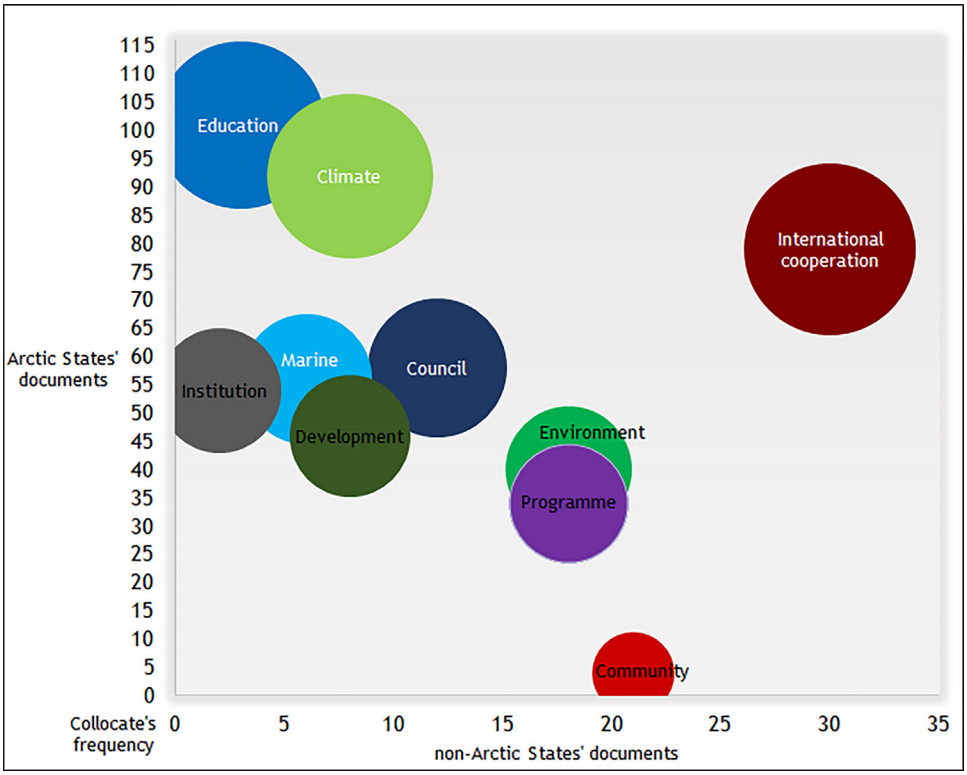

Figure 2 Frequency of the collocates with 'research' between the Arctic states and non-Arctic states. The size of the circle in the figure shows the aggregated frequency of the collocate. The position of the circle indicates stronger correlation with particular states. For better visibility, the scales of the axes differ.

3.2. Quantitative analysis

Further examination reveals the context in which the reference words of research and science occur. Studying collocates is the essence of predicate analysis. Collocates of reference words indicate different contexts. The most frequent predicates obtained from this analysis are: education, climate, international cooperation, marine, environment, institution, development, community and economy. Research tends to be a strong catalyst for international cooperation in the Arctic. Despite its international dimension, it is crucially important on a local level in the Arctic states. The context of scientific research also includes the education system and issues regarding Indigenous peoples. However, most of the research stems from science in which environmental issues and climate change are hot topics. Moreover, in the Arctic policy documents 'research' and 'science' collocates frequently with economic matters; broadening the sphere of human activity in the Arctic.

Figure 2 depicts a graphical presentation of the frequency of collocates with the word 'research'. The ten most popular collocates are placed between two coordinate axes. The axes refer to the frequency of the selected collocates where a distinction is made between the documents of Arctic states' and non-Arctic states. Hence, it suggests that the environment is a focal point when conducting research in the Arctic. Nevertheless, non-Arctic states pay slightly more attention to international science cooperation and Arctic science is recognized as being embedded in a community of researchers. Correspondingly, many research institutions in the Arctic states are involved in Arctic science. It influences both domestic education and directions of economic development. Figure 2 illustrates the frequency of the collocates with 'research' as distinguished between Arctic states and non-Arctic states.

Another type of research technique used in text analysis is cluster analysis. Further analysis of clusters in the text highlights the collocates examined below. It reveals the most popular clusters in the corpus; e.g. international research, research cooperation, research and education, climate research, research and innovation and research and development. Moreover, this branch of analysis underlines the prominence of the research itself. In the analysed texts, states relatively often mention the collocates research centre; research programmes; research institutes and research stations in the context of scientific research.

Generally, hits of reference words are conspicuously dispersed in all documents. In the majority of cases the Arctic states' documents are longer than those of non-Arctic states. Interestingly, there is no evident correlation between being an Arctic state or not and the number of hits. Scientific research is a focal point in the discussion of the Arctic, and this is an important topic also for non-Arctic states. Moreover, there is an explicit tendency in non-Arctic states' documents to have a higher 'hits to all—text characters ratio' than in the documents of Arctic states. It is a positive and directly proportional correlation. In other words, scientific research occurs relatively more often in the documents of non-Arctic states. It suggests that

scientific research is often the only on-site activity that non-Arctic states could provide in the region, because of the obvious reason of the sovereignty of Arctic states. In closing, it needs to be mentioned that every state has a similar section on research in its documents. There is no significant difference in this area between Arctic and non-Arctic states.

An in-depth analysis of the image of scientific research can be illustrated by recognizing its five underlying pillars. This is the result of categorising all relevant quotes into subjects in the analysed documents. The name of the particular pillar describes the nature of the main category of quotes. The following five pillars are listed in order of the highest frequency of occurrence in the processed data:

- own achievements and prominence;
- aims and challenges of the research;
- international cooperation;
- describing the region through science;
- connections with the economy.

A more comprehensive description of these pillars is presented below. In the first two pillars, the states pay attention to their own achievements and aims to stand out from others. The next two pillars are specifically about the international dimension of the research and how it influences the understanding of the region itself. The latter pillar applies to the science-based economy, which is especially important in the Arctic. An amplification of these reflections with citations of the selected phrases from the documents can be found below. The quotes were selected from each category to describe the pillar in the context of a specific example.

3.2.1. Own achievements and prominence

Firstly, the states are trying to present their own close connections with Arctic research and the region itself. For example, The Kingdom of Denmark "will maintain its leading position internationally in a number of research fields concerning the Arctic and will promote national and international Arctic research" (Denmark, 2011). Sweden's strategy states that "Swedish ice-breakers are uniquely qualified to support Arctic research and monitor the vulnerable marine environment" (Sweden, 2011). In a similar way, Finland perceives itself as "an Arctic expert. The Arctic region is undergoing a major transition. Finland possesses the top-level expertise and the know–how it takes to understand, adapt to- and even make use of this transition" (Finland, 2013). Indeed, non-Arctic states take a similar approach, for example "Germany is internationally recognised for- and very active in a wide range of Arctic research activities" (Germany, 2013). Furthermore, "Italian research agencies (CNR, ENEA, INGV, OGS) already take an active part in international Arctic initiatives". Similarly, "excellence of France's polar scientific research and its integration with international research constitute a major asset of French foreign policy in the Arctic and underpin its legitimacy" (France, 2016).

Both the Arctic states and non-Arctic states present their scientific activities as closest to the core of Arctic research. It is a matter of prestige and is substantially important to diplomacy. Analysis of own achievements and prominence revealed that there are no significant differences between the states, however in the case of Arctic states it is naturally tied to its internal dimension.

3.2.2. Aims and challenges of research

Similar to the above, states present aims and challenges for their scientific research. For example, Denmark's strategy indicates that "cooperation between research institutions must constantly be consolidated and developed and researchers have to be familiar with the available options for the funding of Arctic research. Continuity and stability in the research environment must be assured, for example, by the recruitment of young researchers" (Denmark, 2011). Other Arctic states formulate these challenges similarly. Sweden highlights that "stronger forms of cooperation and better research infrastructure are needed to create opportunities for interaction between research, higher education, politics and society" of Sweden and other actors engaged in Arctic issues (Sweden, 2011). In Finland's case, "knowledge of the Arctic nature and the special features of the geophysical environment require long-term basic research and field work" (Finland, 2013).

Some broader comments on this topic can be found in the documents of non-Arctic states. Above all, "continuously amassing knowledge about the polar regions and the changes occurring there is necessary in order to deal properly with the changing conditions" (The Netherlands, 2014). On the other hand, Italy's efforts "will contribute to the geographical expansion of our research activities and to the promotion of the Italian research system in Europe". In general, climate change and its effects pose the greatest challenges in the region. However, the states are willing to connect the research with the other forms of human activity.

3.2.3. International cooperation

Turning to international cooperation, scientific research in the Arctic could be both the subject of cooperation but also an independent catalyst for the broadening of cooperation. The states mention both scientific and non-scientific institutions that stimulate international research cooperation. For example, the Kingdom of Denmark "will work to strengthen international cooperation on scientifically based management of shared fish stocks and fisheries in international waters with a view to promoting consensus" (Denmark, 2011). Particularly, the most important institution is the Arctic Council which "has compiled research and environmental monitoring data on specific Arctic climate processes" (Sweden, 2011). At the same time, Germany "does its part to support international cooperation in all areas of Arctic research through the International Arctic Science Committee (IASC), which is based in Potsdam" (Germany, 2013). Similarly, the Government of Norway "will give priority to Norwegian participation in international research cooperation, for example under the Arctic Council and EU research programmes" (Norway, 2017).

Moreover, the non-Arctic states pay attention also to unit-level research. For example, Spain facilitates "Spanish researchers' access to land–based installations through the agreements necessary for exchanging scientific capabilities with other countries or institutions" (Spain, 2017). Likewise, the United Kingdom is keen "to undertake high quality research in partnership with the best Canadian researchers across a wide range of marine terrestrial and other fields" (UK, 2018).

3.2.4. Describing the region through science

Another way of presenting the scientific research in the Arctic policy documents is by using it to describe the region. The Arctic is a unique region where research results are crucial in defining its borders and explaining the main processes that are taking place there. As the Polish document states "Polar regions (...) are both the fastest changing and the most important areas on Earth for understanding global changes" (Poland, 2017). Russia's strategy further explains that the region can be characterised by "extreme climatic conditions, including low temperatures, strong winds and the presence of ice in the waters of the Arctic seas" (Russian Federation, 2013). Indeed, "recent scientific studies conclude that warming in the Arctic since 1980 has been twice as much as the rest of the globe" (Denmark, 2011).

The document analysis also shows a number of statements that link the policy of a particular state with science. France's strategy argues that "the Arctic is a zone of global scientific interest" (France, 2016). In addition, "the Arctic region extends both to the North Pole area proper and the part of the North Atlantic Ocean which is closely connected to it" (Iceland, 2011). Correspondingly, Switzerland's strategy reveals that "special interest that Swiss researchers have in the Arctic and Antarctic can also be explained by the close relationship between polar and high altitude research" (Switzerland, 2015).

3.2.5. Connections with the economy

The fifth biggest pillar of the research image is about connections between science and the economy. There is a tendency to present research as an inevitable component of the many forms of human activity. On the one hand, it has been suggested that "research and education are closely connected – and must be tightly linked with economic and industrial development" (Denmark, 2011). On the other hand, "research plays a key role in the area of planning, licensing procedures and evaluation of risks and threats in connection with the various activities (Finland, 2013).

States especially stress their role in economic activities. For example, "Italy has a long tradition in the research and development of offshore hydrocarbons". In the same way, "France will do everything that it can, here in the Far North of the planet, to take action, mobilise its researchers and its businesses, to enable us to preserve this part of the world" (France, 2016). It should also be noted that in terms of connections with the economy, the states affirm the need to facilitate "research and development into innovative technical solutions, which have the views and needs of the indigenous people and those in remote communities at their heart will bridge this gap" (UK, 2018).

These are the elements of the scientific research image that occur in all studied Arctic policy documents. Further analysis shows that there are a further three topics that are present in a few of the analysed documents: the European Union (EU) involvement in research, freedom of conducting scientific research and the connection between research and indigenous peoples issues. There is no difference in the documents of Arctic and non-Arctic states concerning the involvement of the EU. Eight of the nine selected states are EU Member states. Furthermore, the rule of freedom of scientific research is presented in the non-Arctic states' documents. As explained above, scientific research is often the only one form of activity of non-Arctic states in the region. It should be noted that indigenous people issues are common to Arctic states and for obvious reasons are of less importance to other states.

To summarise this part of the study, using software in our analysis has enabled us to process a vast amount of data. In this case, the quantitative analysis facilitated the categorisation of the content of Arctic policy documents. Together with the qualitative analysis, it is an attempt at the comprehensive evaluation of the role of research in Arctic policies.

4. Discussion

Despite the fact that obvious differences exist between Arctic and non-Arctic states in terms of the manners of engagement in the Arctic region, several intriguing findings are discussed in this section. Firstly, it is interesting to observe that through the years and editions of the Arctic documents, the research is presented increasingly in connection with other fields of human activity (e.g. business, education, healthcare). In the case of the Arctic states' documents, relations of research with other fields are more comprehensive (e.g. development, innovation, social, infrastructure). For non-Arctic states, the main political dimension of their strategies ties their research activities to the European Union and highlights the role of the Arctic Council Observers. In the research strategies, three non-Arctic states (the Netherlands, Poland, Switzerland) paid the most attention to international cooperation and knowledge–based activities. There is a tendency to underline the usefulness of studies undertaken by non-Arctic states' researchers.

Secondly, this analysis reveals that common research influences common policy goals. International scientific cooperation stimulates cooperation in other areas, which is a matter of great importance, especially in the Arctic; an environmentally vulnerable region. "Research also is important in providing information in support of decision making and the Arctic policy" (Finland, 2013). Norway's Arctic strategy underlines "research–based value creation" (Norway, 2017). Moreover, "in diplomatic terms, global scientific interest in the Arctic helps to preserve a common interest dimension" (France, 2016). Finally, the Arctic policy document has the explicit purpose – "to supplement the resulting analysis, [with] a policy report [that] was developed to facilitate dialogue between scientists and decision–makers" (UK, 2018).

Thirdly, it is clear that the political dimension of Arctic research is differently perceived and approached in these two categories of states. While the Arctic states hold respectful legitimate positions in Arctic international cooperation, they do not treat the research as any kind of foreign policy activity, even when they engage in more or less broad international scientific cooperation. Moreover, their scientific focus is more driven by regional or even local needs then by more general or global concerns. In their Arctic strategies these states are much more eager to refer to climate change as a factor shaping socio-economic developments than to deal with it as an exclusive subject of scientific research. They do not ignore the value of scientific knowledge in this respect, however, in general they are less likely to highlight political aspects. In the case of

non-Arctic states, scientific activities are much more accentuated and prioritised, what in the context of the political character of the studied documents can also be understood as the politicisation of their Arctic research. In some cases, the research is more or less consciously treated as political arguments or resources. The scope of our study does not allow for commentary on domestic contexts and the determinants and consequences of such situations (e.g. if non-Arctic states are paying more attention and better support Arctic research institutions to strengthen their activities in the Arctic today as compared to some decades ago).

Finally, as the analysis illustrates there are also major differences among Arctic and non-Arctic states in the level of accuracy in the presentation of their research activities in the Arctic; particularly in regard to the implementation of the declared scientific programmes and aims. To some extent, due to the strategic nature of the studied political documents, this may be understandable. However, it should also be considered as an important element determining the consistency and impact of the presented arguments.

5. Conclusions

In this article we have explored the societal relevance of science through an analysis of the interplay between science and politics. The research findings of this article contribute to a better understanding of the role of research in the policies of 17 European states (6 Arctic and 11 non-Arctic) that are scientifically engaged in the High North. The core of the research focuses on the qualitative and quantitative analysis of national policy documents and Arctic research strategies issued by the selected states. The qualitative analysis relies on the discourse analysis (predicate analysis). The quantitative part of the analysis exploits the instruments of a software research tool — The AntConc. In the end, the outcomes of both methods have been merged and compared.

Based on the research findings, we argue that there is a clear difference of perception of the political dimension of Arctic research in two categories of states — Arctic states and non-Arctic states. Interestingly, although scientific research is among the countries' priorities in the Arctic, it occurs slightly more frequently in the documents of non-Arctic states. Indeed, scientific research is often the only on-site activity that non-Arctic states could provide in the region. Furthermore, this article illustrates that the research is often presented in Arctic documents together with other fields of human activity (e.g. business, education, healthcare). In addition, in the case of the Arctic states' documents, the connection of Arctic research with other fields is more comprehensive and includes i.e. development, innovation, and infrastructure. For non-Arctic states, the main political dimension of their strategies is often presented in relation to the European Union.

Importantly, this article has revealed that research and science could be one of the drivers for states to get engaged in political cooperation. The states realize that the increasing threats are often of a trans-border character and could threaten their existence. Therefore engaging in international cooperation is crucial to their survival. Apart from this, both categories of analysed states highlight that international scientific cooperation stimulates cooperation also in other areas and that research provides information which supports decision making and the creation of policies. Science diplomacy then is among the core elements of what constitutes the state's foreign policy.

Last but not least, this article also contributes to a better understanding of international initiatives concerning scientific cooperation in the Arctic, like the implementation of the "Agreement on Enhancing International Arctic Scientific Cooperation", signed in May 2017 and the organisation of the Arctic Science Ministerials in 2016 (in Washington, D.C., USA) and in 2018 (in Berlin, Germany). In both cases the interplay between Arctic and non-Arctic states' understanding of the political dimension of Arctic research is a significant concern, but it also helps to understand what the potential is of the further development of their cooperation. From this perspective the upcoming 3rd Arctic Science Ministerial in 2020 (in Tokyo, Japan) can contribute to a more developed and better constructed cooperation offering common ground for not only presenting the political value of Arctic research, but also in the creation of a joint perspective.

Appendix 1. Lists of the most frequent words in all documents of the Arctic States and non-Arctic States (excluding common words used in English, i.e. 'the', 'and', 'is', etc.)

	Arctic States' documents	
	Word	**Frequency**
1	arctic	3834
2	north	1593
3	cooperation	1464
4	sea	1137
5	development	1097
6	area	1063
7	region	1038
8	research	1007
9	norway	982
10	government	868
11	international	866
12	ship	860
13	activity	714
14	ice	701
15	council	695
16	resource	692
17	northern	664
18	climate	651
19	environment	588
20	russian	587
21	route	586
22	change	585
23	state	585
24	develop	576

(*continued on next page*)

25	finland	575
26	environmental	565
27	policy	559
28	russia	541
29	barents	537
30	country	532

	Non-Arctic States' documents	
	Word	**Frequency**
1	arctic	1773
2	research	658
3	polar	570
4	international	389
5	uk	384
6	region	378
7	ice	333
8	change	316
9	climate	292
10	sea	287
11	scientific	269
12	state	269
13	ocean	260
14	area	253
15	council	227
16	policy	218
17	work	199
18	environment	192
19	science	188
20	global	187
21	development	185
22	environmental	184
23	government	183
24	antarctic	182
25	marine	177
26	support	166
27	ship	165
28	interest	161
29	activity	158
30	economic	155

Appendix 2. Lists of the analysed documents

		Title	Type of the document	Year of publication	Number of pages
Arctic States	**The Kingdom of Denmark**	Strategy for the Arctic 2011–2020	strategy/policy	2011	58
		The Faroes Islands – a nation in the Arctic	strategy/policy	2013	43
	Finland	Finland's strategy for the Arctic region	strategy/policy	2010	98
		Strategy for the Arctic Region	strategy/policy	2013	70
	Iceland	North meets North. Navigation and the Future of the Arctic	government report	2006	38
		Breaking the ice	conference paper	2007	64
		A parliamentary resolution on Iceland's Arctic policy	parliamentary resolution	2011	11
	Norway	The Norwegian government's High North strategy	strategy/policy	2006	76
		New building blocks in the North. The next step in the government's High North strategy	strategy/policy	2009	94
		The High North. Visions and strategies	strategy/policy	2011	23
		Norway's Arctic policy	strategy/policy	2014	44
		Norway's Arctic strategy	strategy/policy	2017	40
	Russian Federation	Basics of the state policy of the Russian Federation in the Arctic	strategy/policy	2001	9
		Basics of the state policy of the Russian Federation in the Arctic for the period till 2020 and for a further perspective	strategy/policy	2008	10
		Russian strategy of the development of the Arctic zone and the provision of national security until 2020	strategy/policy	2013	21

(continued on next page)

	Sweden	Sweden's strategy for the Arctic region	strategy/policy	2011	52
		New Swedish environmental policy for the Arctic	strategy/policy	2016	5
Non—Arctic States	**France**	The great challenge of the Arctic. National roadmap for the Arctic	strategy/policy	2016	62
	Germany	Germany's Arctic policy guidelines. Assume responsibility, seize opportunities	strategy/policy	2013	22
		Germany's Arctic Policy Guidelines. Assuming responsibility, creating trust, shaping the future	strategy/policy	2019	25
	Italy	Towards an Italian strategy for the Arctic	strategy/policy	2015	21
	The Netherlands	Pole Position — NL 2.0. Strategy for the Netherlands Polar Programme 2016—2020	research strategy	2014	36
	Poland	Strategy of Polish polar research - concept for 2017—2027	research strategy	2017	44
	Spain	Guidelines for a Spanish polar strategy	strategy/policy	2017	36
	Switzerland	Swiss polar research. Pioneering spirit, passion and excellence	research strategy	2015	36
	United Kingdom	Adapting to change. UK policy towards the Arctic	strategy/policy	2013	40
		Beyond the ice. UK policy towards the Arctic	strategy/policy	2018	21

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ORIGINAL RESEARCH ARTICLE

Punk's not dead, even at the Czech Arctic Scientific Station in Svalbard

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Summary In the last few years, the newly opened Czech Arctic Scientific Infrastructure in Svalbard — Josef Svoboda Station — has closely collaborated with UiT — The Arctic University of Norway on very productive research related to climate change and the impact of the sea and land ice disappearance. Professor Josef Elster, the Head of the Czech station and a researcher in the diversity, ecology and ecophysiology of polar algae and cyanobacteria, and the glacial microbiologist Marie Šabacká and their team try to find the answer to questions concerning how the Arctic ecosystem responds to global warming and how global warming affects human activity. The results of their research can be used, for example, in the treatment and refinement of drinking and sewage water, the pharmaceutical industry and medicine, livestock nutrition including aquaculture and in the production of nutritional supplements for people. However, even the most exciting scientific information and results are not readily available to a non-professional audience. Interdisciplinarity and a suitable cultural framework can bring new life to the results of scientific research. If the presentation of science is interconnected with cultural disciplines such as literature, art, music or theatre, its account can be enriched and media interest can be increased. The scientific-cultural festivals AT HOME IN SVALBARD 2018 and ARCTIC FESTIVAL 2019 are just two good examples. The presentation of scientific research through culture is a very distinctive and innovative attempt. Moreover, the interest of the public can

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influence the stakeholders' approach to providing and increasing finances for further scientific research.

1. Czech Arctic Scientific Infrastructure

A research group of scientists from the University of South Bohemia in České Budějovice operates in the Arctic archipelago of Svalbard, where they, in the period 2010—2015, with the support of the Czech Ministry of Education, established the Czech Arctic Scientific Infrastructure — Josef Svoboda Station. The station bears the name of a political prisoner of the 1950s who went into exile in Canada in 1968, where he contributed significantly to the elucidation of the ecological and plant ecological patterns of the Arctic. Josef Svoboda is one of the founders of Czech polar research.

The following units form the Josef Svoboda Station: the Centre for Polar Ecology at the Faculty of Science of the University of South Bohemia in České Budějovice (CPE), the Julius Payer House at the Svalbard administrative centre of Longeyearbyen, "Nostoc" Field Station in the south-west part of the archipelago and the motorsailer "Clione", which sails between "Nostoc" and Longyearbyen. The most important Czech scientific base at Longyearbyen — the Julius Payer House — got its name after the greatest Arctic researcher from the Czech lands (he was born in Teplice), the discoverer of Franz Joseph Land and the most famous realistic painter of polar landscapes in general.

2. Polar research of professor Josef Elster and his team

The main force in establishing the Czech Arctic Scientific Infrastructure "Josef Svoboda Station" was Professor Josef Elster. He participated in British, Polish, Belgian, Japanese and several Czech expeditions to various parts of Antarctica (altogether 9 expeditions). He completed 27 Arctic expeditions (including the Canadian, Japanese, Norwegian and Polish ones), of which four took place in winter.

Josef Elster is a researcher in the diversity, ecology and ecophysiology of polar algae and cyanobacteria. In his research, he focuses on several topics related to the ecological role of photosynthetic microorganisms in the polar environment, e.g. winter survival strategies, and reconstructing living conditions in polar lakes and soil surfaces (so-called biological soil crusts). The reconstruction of past and current conditions can be used to predict how these biological systems will behave under the pressure of climate change — for example, what happens in the Arctic when all glaciers melt, the "Arctic Greening".

Josef Elster has close collaborations with, for example, the glacial microbiologist Marie Šabacká from the Centre for Polar Ecology. Marie uses a combination of genomic analyses, ecosystem production measurements and nutrient cycling in order to create a comprehensive picture of glaciers as ecosystems (where the energy comes from, how it passes through the system, which organisms live there, what substances they produce, etc.). She integrates this information into a global context by comparing glaciers from the tropics to those in the polar regions. In her research, Marie has described the unknown diversity and productivity of African glaciers. By comparing them with temperate and polar glaciers, she hopes to determine whether tropical glaciers are just the southernmost outposts of large polar ecosystems or host unique and isolated communities. Finally, yet importantly, she is interested in how individual organisms have colonised these glaciers and whether their expansion has followed glacier movements since the last ice age.

Josef Elster and his team currently focus primarily on the two most important issues related to the development of the Arctic ecosystem: How the Arctic ecosystem responds to global warming and how global warming affects human activity. The results of their research can be used, for example, in the treatment and refinement of drinking and sewage water, the pharmaceutical industry and medicine, livestock nutrition including aquaculture and in the production of nutritional supplements for people.

The Czech Arctic Scientific Infrastructure offers a unique opportunity to study local organisms all year round. It is a new topic in ecology in general, gaining in importance with climate change. Winter thaws have recently become more frequent in Svalbard with temperatures reaching above zero during the polar night, resulting in the melting of the tundra for a short time and its subsequent refreezing. The Czech scientists are currently preparing a project that will measure how individual organisms prepare for winter, how they behave in winter and how they subsequently react to the arrival of spring.

There has been close collaboration in the last few years between the Josef Svoboda Station and UiT — The Arctic University of Norway (Department of Arctic and Marine Biology, Tromsø, Norway) at the Billefjorden area (the northern tip of the Isfjorden where the Czech field station "Nostoc" is located). This collaboration has led to very productive research related to climate change and the impact of the sea and land ice disappearance.

Different forms of freshwater impacts, including the melting of glaciers, influence the Arctic fjord systems. Freshwater inflow leads to unique physical and biological patterns, which vary drastically in temporal and spatial ranges. Glaciers are retreating and melting, consequently, freshwater inflow is increasing. Climate change has also impacted the landscape in terms of the loss of sea ice. No one knows how the marine ecosystem will respond to such changes in terms of land-ocean interactions, biogeochemistry, diversity and food web interactions. In the

Svalbard archipelago, several research teams have studied the changes in marine fjords ecosystems. One team, led by the Norwegian Polar Institute, UiT – The Arctic University of Norway, Tromsø and Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, studied the ecosystem of Kongsfjorden near Ny-Ålesund for many years (see Hop et Wiencke, 2019). A second team, led by the Institute of Oceanology, the Polish Academy of Sciences, Sopot, Poland, studied the fjord system in the Hornsund area, where the Polish research station is located (Garcia-Soto et al., 2019, Grabowski et al., 2019, and many others).

Near the Czech field station "Nostoc" (the north tip of Isfjorden, Billefjorden, the Central part of Svalbard), there is a wide spectrum of glaciers (from almost disappearing small valley glaciers to large ice sheets). The diversity and abundance of microbes (from viruses to invertebrates, the whole food chain) living in these glaciers in all parts (subglacial, inglacial, supraglacial) is more or less unknown. During the melting of the glaciers, most of the organic carbon developed and stored in the glacial bodies, together with mineral nutrients accumulated in microbial cells, is transported by melting water to the terrestrial and/or marine ecosystem. Meltwater together with silt, organic carbon, microbial inoculum and mineral nutrients are inserted to the marine ecosystem by glacial stream/rivers or can be transported directly to the seawater by direct ice calving. How are these waters, minerals, organic carbon, and microbial inoculum utilized in the sea ecosystem? How do these inputs influence the marine ecosystem and the marine food chain? Based on Czech research experiences in terrestrial and glacial microbiology (e.g. Vonnahme et al., 2016), the UiT – The Arctic University of Norway, Tromsø began research collaboration at the Billefjorden area. Billefjorden is a tidewater outlet glacier in Svalbard at the end of Isfjorden. It is seasonally ice-covered and protected from Atlantic inflow by a shallow (ca 40 m) sill at the entrance of the fjord. The fjord receives freshwater inputs from larger rivers, fed by land-terminating glaciers and the tidewater outlet glacier (Vonnahme et al., 2019). Based on these ecological features, Billefjorden differs from previously studied Svalbard fjords. Its detailed study is a very urgent task for understanding the processes related to climate change and 'Atlantification' of the high Arctic fjord ecosystem.

3. Science and culture – a new approach to science communication

The above-mentioned results of Czech Arctic research in light of new global challenges, such as climate change and food security, are surely succeeding very well internationally, thanks in part to the newly established Czech Arctic Scientific Infrastructure in Svalbard. Now, the scientists have to use science communication to raise awareness of their achievements, to inform their potential partners, and domestic and foreign publics. The 'inreach' or expert to expert communication, i.e. scholarly communication and publication in scientific journals, may not be enough. Outreach science communication, typically consisting of professional scientists speaking to non-expert audiences, is today more and more appreciated. Science communicators can use culture, entertainment and humour, storytelling and metaphors, as seen for example in the FameLab project – an international science communication competition organized in 31 countries to find and support the world's most talented science communicators. Participants have three minutes to win over the judges and audience with a scientific talk that excels for its content, clarity and charisma.

Such an undogmatic approach to science communication can be supported by the theory of multiple intelligences (Gardner, 1983; 1993), which describes eight different abilities (intelligence modalities) of a human's brain. Apart from the logical-mathematical ability (intelligence modality) of a scientist, his/her visual-spatial and musical-rhythmic and harmonic abilities ('artistic' or 'creative' intelligence modalities) can be used as well.

Today's widely used term is interdisciplinarity. The interconnection of science and culture on the basis of a common theme or interest can be very interesting. For example, researchers examine the patterns of ice movement and their environmental impact, the occurrence of microorganisms in the northernmost part of the world, etc. An artist dealing with the same subject may be interested in the symbolism of melting and ephemerality; he or she can defend the environment by artistic means and mediate a certain philosophical or metaphysical approach to this theme. Through an artistic experience or dialogue with artists, fact-centered scientists focused on data collecting and cataloguing, can discover another legitimacy of their work, a kind of intangible encouragement, a sense of belonging to human emotions and desires. An artist, on the other hand, can learn many details about a given topic and find more associations and symbolism in them. He or she can also be inspired by the enthusiasm for revealing the unknown, by systematic and persistent approaches, conceptualism and erudition, which are, after all, common features of both scientists and artists.

There is a very effective way how to make exciting scientific information and results available to a non-professional public – organizing scientific-cultural festivals. Such festivals are great opportunities for looking at the activities of both scientists and artists from different angles. Moreover, such festivals – or cultural events themselves – can increase media interest in scientific research and make science more visible and understandable to a broader audience as evidenced by the following examples.

4. At Home in Svalbard 2018

The cultural and scientific festival AT HOME IN SVALBARD 2018 took place from 21 August to 13 September 2018 at Longyearbyen, the Svalbard administrative centre, and in the former Russian mining town of Pyramida. It was held in honour of the 100th anniversary of Czechoslovakia, the 25th anniversary of the Czech Republic's establishment and the 10th anniversary of regular research stays of Czech scientists in Svalbard. The Festival was named after the focal point of the whole event – a concert by the avant-garde punk-rock band "Už jsme doma/UJD" (Already at Home) and the release of their new CD entitled *Floes*. The project, also called the Days of Czech Science and Culture, was held in cooperation with Svalbard partners. The following

exhibitions, lectures and cultural performances formed the Festival's programme:

The scientific part of the project culminated on 6–8 September 2018 in a scientific conference at the premises of the University of Svalbard (UNIS) hosted by its Managing Director, Harald Ellingsen. The opening speeches were delivered by Tomáš Machula, Rector of the University of South Bohemia, František Vácha, Dean of the Faculty of Science of the University of South Bohemia, Kim Holmén, International Director of the Norwegian Polar Institute, Josef Elster, Director of the Centre for Polar Ecology of the University of South Bohemia, Zdeněk Lyčka from the Czech Ministry of Foreign Affairs and Miroslav Wanek, leader of the punk-rock band UJD. The presentations of twelve lecturers took place at UNIS, at the Julius Payer House (part of the Josef Svoboda Station in Svalbard) and at the Svalbard Church (all at Longyearbyen).

The cultural part of the project consisted of several events. The project by artists from the Academy of Arts, Architecture and Design in Prague (UMPRUM) called *Three Women: Art Objects in Space* was presented at Longyearbyen (Dana Elsterová: *Flying Message*, Anna Leschingerová: *Luminous Chime* and Anežka Podzemská: *Beams of the Midnight Sun*). At the Svalbard Gallery, illustrations accompanying the Czech translation of Inuit myths and legends by Martin Velíšek were exhibited from 21 August to 13 September (the festive opening with the author's presence took place on 7 September). At the same time, Luboš Drtina's illustrations accompanying the Czech translation of Saami fairy tales and legends were exhibited at the Svalbard Church (the opening took place on 7 September).

The theatre group "Buchty a loutky/Cakes and Puppets" led a workshop for children from two local kindergartens and the art school with the aim to prepare stage properties for the musical-puppet show *Five Hits to a Hat*, which took place on 8 September at the HUSET Culture Centre. The theatre piece was performed in Norwegian, including the accompanying text by Zdeněk Lyčka and songs by UJD sung by the Norwegian singer Stefan Lindal Theofilakis.

On 8 September, UJD performed a concert at the HUSET Culture Centre. This event was the cultural culmination of the Days of Czech Science and Culture. During the evening, a new CD by UJD entitled *Floes* was launched. The following day, UJD played two mini-concerts at the Culture House and at the Tulip Hotel in the former Russian mining town of Pyramida, northeast of Longyearbyen.

The Czech media was keenly interested in Czech Science and Culture Days. Czech Television broadcast reports on 9 and 26 September in "Events in Culture" (Czech Television, 2018), other media outputs took place in dailies, weeklies, magazines and on the Internet. Based on media responses, Czech Television started shooting a documentary that would raise awareness of the international work of Czech scientists in Svalbard.

5. Arctic Festival 2019

From November 2019 to January 2020, a reciprocal continuation of the above-mentioned cultural-scientific project took place in the Czech Republic (Prague, České Budějovice, Teplice and Plzeň) under the name of ARCTIC FESTIVAL 2019, or the Days of Arctic and Czech Culture and Science. The main aim of the festival was to make a follow-up to the 2018 event in Svalbard, deepen the acquired contacts and to start cooperation between new partners. The Czech public became acquainted with the achievements of Nordic and Czech scientists in Arctic research, the culture and history of the Arctic nations, and with joint Czech-Arctic cultural and scientific activities in Czechia and the Arctic. In addition to being introduced to the core points of the AT HOME IN SVALBARD 2018 project, the Czech professional audience, the public and all interested people in Czechia had the possibility to enjoy the unique Arctic culture from Svalbard, Lapland, Greenland, Norway and Denmark.

The official opening of the Festival took place at Charles University's Carolinum on 7 November. The speakers were: Josef Elster, Head of the Centre for Polar Ecology, University of South Bohemia, Harald Ellingsen, Managing Director of UNIS at Longyearbyen, Robert Kvile, Ambassador of Norway to the Czech Republic, Jan Dusík, Principal Adviser, UNEP, and Zdeněk Lyčka, Ministry of Foreign Affairs of the Czech Republic. The Festival opening was completed by a short musical performance by the Inuit shaman Hivshu.

The scientific part of the Festival began at the Municipal Library of Prague on 7 November 2019 with a lecture by Zdeněk Lyčka (MFA) called *Canadian Inuits as part of the original Inuit people and the beginnings of the Inuit literature in Canada*, followed by the screening of the Canadian documentary *If the Weather Permits*.

The scientific conference continued on 8 November on the premises of Charles University with the following lectures in English simultaneously interpreted into Czech: *Arctic Environment: global asset, global victim or global danger?* by Jan Dusík (Principal Adviser, UNEP), *Czechoslovak/Czech science in the Arctic and the role of the University of South Bohemia* by Hana Šantrůčková (Dean of the Faculty of Science, University of South Bohemia), *Czech Arctic Research Infrastructure "Josef Svoboda Station" in Svalbard; Scientific and Cultural Embassy in the Arctic* by Josef Elster (Director, Centre for Polar Ecology, University of South Bohemia), *Science in a changing environment* by Harald Ellingsen (Managing Director, UNIS, Longyearbyen), *Svalbard: Nature in rapid transformation with a changing climate* by Kim Holmén (International Director, Norwegian Polar Institute, Longyearbyen), *The Arctic in Norway: Between Politics and Identity* by Pål Wilter Skedsmo (Fridtjof Nansen Institute, Oslo) and *Vikings in the North Atlantic and the Norse in Greenland: demise of a Christian community* by Naja Mikkelsen (GEUS, Copenhagen).

The following lectures were delivered in Czech: *Czech Antarctic Scientific Infrastructure* by Peter Váczi (Masaryk University, Brno), *The involvement of the Czech Arctic Scientific Infrastructure in the international INTERACT project* by Alexandra Bernardová (CPE), *International law in the Arctic* by Vladimír Balaš (Charles University, Prague), *Arctic Geopolitics and its importance in International Relations* by Barbora Padrtová (Masaryk University, Brno) and *Denmark's relations to Greenland and the Faroe Islands: Postcolonial authority or partner on the way to independence?* by Adam Kočí (University of Ostrava).

The afternoon scientific programme continued at the Gallery of the Czech Centres with the screening of the film *Polar Ecology* with a commentary by Václav Pavel (CPE), and

the following popular lectures in Czech: *Artscape Norway* by Dan Merta (Jaroslav Fragner Gallery, Prague), *Mission of the Moravian Church in Greenland* by Daniel Freitinger (evangelic pastor, Domažlice), *Coexistence of Aleuts and Alutiiqs with Inuits* by Stanislav Chládek (USA), *Julius Payer, a Great Guy from Šanov* by Jitka Bažantová (Regional Museum in Teplice and the Society of Friends of Julius Payer) and *Crossing Greenland on skis* by Zdeněk Lyčka (MFA). (All abstracts in English and Czech are available at CPE's web site, 2019.)

The set of lectures ended on 11 November at the Institute of Geophysics of the Czech Academy of Sciences with the lecture *Julius Payer — Starvation Cove* by Jitka Bažantová (Regional Museum in Teplice and the Society of Friends of Julius Payer) and a public viewing of Julius Payer's original painting *"Starvation Cove"* (1897).

The cultural part of the Festival consisted of several events. On 7 November, four exhibitions were officially opened at the Gallery of the Czech Centres: the panel exhibition *Czechia in the Arctic/The Arctic in Czechia*, the photo exhibition *Canada's Arctic — Vibrant and Thriving*, the photo exhibition *3913 Tasiilaq* from East Greenland by Ole G. Jensen and *Landart Objects* by "Three Women" from the Academy of Arts, Architecture and Design in Prague (UMPRUM): Dana Elsterová, Anna Leschingerová and Anežka Podzemská. All exhibitions were shown at the Gallery until 16 November. The exhibition part of the Festival was accompanied by a film presentation on melting icebergs by Bjørn Anders Nymoen (Svalbard), the photo presentation *South Bering Sea Animals* by Stanislav Chládek (USA) and by the video presentation *Artscape Norway* on Norwegian architecture. On 9 November, two other Arctic exhibitions were opened at the Archa Theatre as part of the theatre, literary and music events of the Festival: *Saami Fairy Tales and Legends/Illustrations by Luboš Drtina* and *Greenlandic Myths and Legends/Illustrations by Martin Velíšek*. Later, some of these exhibitions were shown at the Regional Museum in Teplice, the birth city of Julius Payer, at the University of South Bohemia in České Budějovice and at Europa House Gallery in Plzeň.

At the Archa Theatre, the theatre group "Buchty a loutky/Cakes and Puppets" together with the music group "Už jsme doma/UJD" performed two musical-puppet shows *Five Hits to a Hat* — one in Norwegian with the Norwegian singer Stefan Lindal Theofilakis, the second one in Czech, on 9 November.

Three literary events also took place at the Archa Theatre on 9 November: A literary debate with the Norwegian writer Monica Kristensen, the presentation of a new edition of the book issued on the 150th anniversary of Julius Payer's birth and a re-edition of the Czech translation of his book *The North Pole Expedition*, and the presentation of the Czech translation of the novel *HOMO sapienne* by the contemporary Inuit writer Niviaq Korneliussen.

Evening concerts by the Inuit shaman Hivshu, the music group Vassvik from Sápmi/Lapland and by the B.A. Nymoen music group Kapp Mitra from Svalbard were the cultural highlights of the Festival at the Archa Theatre.

The last but not least cultural event of the Festival was the screening of Arctic films realized together with the Nordic Film Club's *Nordic Film Autumn* in Prague (Institute of Germanic Studies, Municipal Library, Evald Cinema, Ponrepo Cinema and Lucerna Cinema) and 13 other cities and towns in Czechia.

ARCTIC FESTIVAL 2019 was organized by the Centre for Polar Ecology of the University of South Bohemia in České Budějovice in cooperation with UNIS in Longyearbyen and with the financial support of the Fund for Bilateral Relations within the EEA and Norway Grants 2014—2021. Other international cooperating partners included the Embassy of Norway in Prague, the Embassy of Canada in Prague, the Embassy of Denmark in Prague, the Embassy of Finland in Prague, the Norwegian Polar Institute and the Fridtjof Nansen Institute. Czech Television broadcast interviews with the Festival's speakers Jan Dusík, Harald Ellingsen and Josef Elster. On 8 November, Zdeněk Lyčka was invited to the Czech TV studio for a morning interview about the Arctic Festival (Czech Television, November 2019). Zdeněk Lyčka was also a guest in a live broadcast of Czech Radio. The French section of Radio Prague International broadcast long interviews with Jan Dusík and Zdeněk Lyčka, and an article was published on the French section's internet site (Radio Prague International, 2019). Other media outputs included an article in the daily Lidové noviny on 9 November, and exposure on Czech TV (Czech Television, December 2019) and Czech Radio (Czech Radio, 2019). Czech Television continues shooting the documentary on the international work of Czech scientists in Svalbard.

6. Conclusion

It turns out that the presentation of scientific research through culture is not a purposeless scream to the darkness, but rather a very distinctive and innovative achievement. Even the most serious scientific results do not often hold the attention of the non-professional public for a very long time if they ever reach them. People must continually struggle with the overpressure of new or constantly recycled information coming to them from media, social networks and through the generally accelerated pace of life. If science is interconnected with a cultural discipline, such as literature, art, music or theatre, its account can be enriched. A suitable cultural framework can bring new life to the results of scientific research. That, in exceptional cases, can evoke such a strong experience that people who have yet had very little or no awareness of science may become interested in it.

In 2018, a group of 30 Czech cultural tourists, mostly followers of the UJD band, arrived in Svalbard for joining the launch of the band's new CD. During their stay at Longyearbyen, the Czech group also attended the scientific part of the AT HOME IN SVALBARD 2018 project — the scientific conference at UNIS, the Julius Payer House and the Svalbard Church. In this way, people who had no idea of Arctic science had the possibility to follow the efforts of Czech scientists in collaboration with their Norwegian partners.

The Czech Television broadcast and other Czech media outputs in dailies, weeklies, magazines and on the Internet were focused both on the cultural and scientific points of the Festival, i. e. they attracted the attention of both scientists and culture-oriented audiences.

A very important part of the ARCTIC FESTIVAL 2019 was the Arctic Film Festival, which focused both on

documentaries and feature films, and thus spread both special knowledge/expertise and culture. Some of the exhibitions depicted both scientific and cultural points of the Festival, e. g. "Czechia in the Arctic/The Arctic in Czechia" or "Julius Payer and the Legends of Far North". B.A. Nymoen's video presentation focused on the environment. The scientific and cultural themes of the conference attracted the attention of both the specialized and non-professional public, as well as television and radio broadcasts.

It is not possible to judge the non-professional public's interest in polar issues, but the TV scientific-cultural broadcast in prime time certainly helped broaden the audience's perception.

Scientific-cultural festivals are not just about the programme, but also about meetings between scientists and artists — like science conferences or art workshops. Moreover, the interest of the public can influence the stakeholders' approach to providing and increasing finances for further scientific research.

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ORIGINAL RESEARCH ARTICLE

Climate and aging. Selected aspects from the psychological perspective

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Climate change;
Psychology of aging;
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Summary The main focus of my research lies within the psychology of human development, especially in late adulthood. There are many reasons why psychologists are interested in climate change. One of the fathers of modern medicine, Hippocrates, proclaimed that the climate affects the mood (liquids) existing in the human body. I wrote an article about climate change and its relationship to the psychological functioning of people in old age. As we enter adulthood, the new generation will severely experience increasingly extreme weather events. Already this phenomenon is more frequent than several decades ago and takes a deadly toll. Heat waves will be more frequent and so the children and older people will be often exposed to that phenomenon. It may have a detrimental effect on those in the declining period of their lives. In my opinion, an important question is to what extent modern living should (in a moral sense) limit the current consumption of many goods because of the duty to care for the standard of living and its quality and the interests of people who will live in the future.

1. Introduction

Climate crises, which recur in varying intensity every dozen, several dozens, several hundreds of years, as much as today, affect the evolution of species, including the evolution of *Homo sapiens* and its civilization. Through the processes of adapting species to a changing living environment (suffering, stress invoking organism adaptation to the environment), nature has led to, inter alia, an improvement of the human brain and to the creation of the *homo sapiens* society and civilization. Human society, as a result of joint actions,

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has freed man from the total dominion of nature. It can be said that our world is perfect because we perfectly adapt to it in the process of evolution. Humanity has developed the ability to become independent of the natural environment, an ability to produce food and energy. However, environmental changes, such as climate change, periodically caused a decrease in the food supply, which could sometimes exceed the adaptability of the human population. This often led to the diversification of human groups driven by instinct to wars over areas rich in food. The development of civilization, including food production methods, has allowed for a rapid development of the human population. In addition to nature, in effect the society has also become a human environment, providing various means of life and possibilities of individual development. All individual human activities within a community result from knowing the needs of the entire human community. Society, through the development of individual specialization and the opportunity to exchange information, has developed the knowledge necessary to rule the environment. However, new abilities solely to meet social needs have become necessary. Thus, socialization can be considered a form of adaptation to social requirements. All human activities are focused on meeting social needs. The aim of people's individual wishes is often some common social good, while the aim and the highest good for people is harmonious coexistence in society. In other words, the aim of society is harmonious existence in the natural environment as well as the development of knowledge about it, which is required to create a new world (Wilson, 2003).

Prevention of climate changes caused by human activity may soon affect human life. This applies to heat waves and floods that can take many lives and, consequently, cause famine, disease and migration. According to the vast majority of scientific theories, people are not accidental passers-by on Earth: it is people who by using cars, electricity and, generally speaking, the benefits of civilization, contribute to climate change. However, people who do not take climate change seriously should remember about their obligations towards future generations. An important question is: what and to what extent should modern man sacrifice from his own welfare to prevent climate change?

According to the Stern Report of 2006 by the British government, the estimation of the costs of climate change has led to the conclusion that governments should spend about 1 percent of global GDP per year on combating global warming (in 2006 it was approximately 500 billion USD) because it simply pays off. However, if this money is not spent now, then in the future — in 20 or 100 years — the costs that humanity will have to bear due to climate change will be significantly higher. Moral obligations to future generations are just as real as to those living today, even if we do not have yet relevant tools to compare the interests of people living in distant times (Żuradzki, 2020).

2. Discussion

There is a thesis that people living today should (in a moral sense) limit the current consumption of many goods out of the duty to care for the standard of living and interests of those who will live in the future. The practical effects of the problem can be demonstrated through the example of setting greenhouse gas emission limits, the issue that is currently being debated. It is now widely accepted that the emission of greenhouse gases into the atmosphere is an important factor in global warming. Even slight global warming can significantly effectuate the consequences for people who will live in the future. Firstly, extreme weather such as hot weather, floods, storms, etc. — can kill many people, and e.g. deprive others of property or shelter. Secondly, various tropical diseases, e.g. malaria, will result from rising temperatures because insects, vectors of malaria are performing better in high-temperature environments. Thirdly, changes to the amount and frequency of precipitation can lead to drought and food shortages, as well as to floods, which in turn will harm agriculture and significantly reduce access to clean water. In addition, climate change can have many other indirect adverse effects, e.g. it can contribute to great migrations which will start when the seas and oceans flood lower land areas, which in turn may lead to armed conflicts (Bromme, 2008; Żuradzki, 2010; Żuradzki, 2015).

A changing climate will transform all aspects of life. Tens of millions of jobs are already disappearing because of the heat that prevents working outside. Droughts, floods and other climate change effects will negatively affect agriculture, which can contribute to food shortages. Children, especially in the countries of the global South, will be at risk of malnutrition. The range of tropical diseases that will reach Europe will change. Currently, the number of fire incidents is increasing in 3/4 countries of the world. Deteriorating conditions can cause unprecedented migrations and armed conflicts over water and other resources. Warming will contribute to the extinction of species, and scientists are already talking about the sixth mass extinction. Upon entering adulthood, the new generation will experience and be severely affected by increasingly extreme weather events. Today this phenomenon is already more frequent than several decades ago and takes a deadly toll. Heat waves, by which children and the elderly will be more and more affected, will be more frequent and stronger (Strzałkowski, 2019).

So far, the spectacular measure of the progress of past eras has been the extension of the average life expectancy. Demographic forecasts for the next decades show that the observed aging process in societies is progressive. Nowadays, this parameter, without losing its attractiveness, directs civilizational health standards based on qualitative, not just quantitative criteria. The widespread extension of human life today and old age place medical sciences and social services face to face with new challenges, in particular systemic changes that are necessary and difficult to implement, on a scale previously unknown in history. On February 3, 2009, the European Parliament listed demographic problems among the three main tasks for Europe alongside globalization and climate change (European Parliament, 2009).

Aging is an inevitable, irreversible and one-way process. It cannot be reversed but can be slowed down. There are several stages of aging that lead to the terminal phase in the life of an organism. Life expectancy and speed of aging are determined by a genetic factor (long-lived parents have long-living offspring), but not only. The fundamental genetic program of an individual can also be affected by environ-

mental and individual factors, individual mental characteristics, conditioning the individual's biography. The search for answers to the question concerning longevity has initiated many studies on the environmental and personality conditions of older people (Mamak-Zdanecka, 2015).

Below is shown the correlation of life expectancy with the physical and social environment:

Okinawa. An important factor was the diet consisting of low-calorie, sweet potatoes, green and yellow vegetables, soy products, fish, small amounts of meat, tofu. The sense of meaning in life was also important for the length of life.

Sardinia. Factors such as pastoral lifestyle and simple dishes (whole-grain fritters, tomatoes, garlic, olives, broad beans, sheep's cheese, local red wine with strong antioxidant properties) have been indicated. The term "blue zones" was adopted by demographers who are studying just a group of hundred-year-old residents of Sardinia.

Loma Linda. The life expectancy of 8 years compared to residents of other US states was associated with sociocultural factors. Residents, followers of the Seventh-day Adventist Church, follow the rules of religion — abstinence from alcohol, drugs, vegetarian diet and the Sabbath (leaving one day a week just to rest).

The Nicoya Peninsula. The main reason was seen in the climate and physical environment. A favorable, dry and warm climate and water with the high calcium content. In addition, papaya fruit is often an ingredient in the residents' diet, which in addition to antioxidants contains nicotinic acid regulating cholesterol levels.

Ikaria. A high percentage of residents living up to 90 years (1/3 of the community) was recorded. The diseases that are most responsible for shortening life expectancy are cancer, cardiovascular disease, senile dementia, which are very rare among this population. Active life, a diet based on whole grains, fruit, goat milk rich in tryptophan and regular rest during the day were indicated as factors favoring longevity (Wróblewska, 2012; Mamak-Zdanecka, 2015).

Bearing in mind the above correlations, demographers introduced the term 'blue zones' in order to study the correlation of above-average life expectancy with external environment and lifestyle factors. These zones include Okinawa in Japan, Sardinia in Italy, Loma Linda in California, the Nicoya Peninsula in Costa Rica and the Greek island of Ikaria. One of the high-profile cases of inference about long-lived communities — was the study of the inhabitants of Georgia during the period of belonging to the USSR, among which there was a very high percentage of centenarians. Conclusions regarding the genetically determined longevity of life and behavioral factors of Georgians turned out to be false. In fact, older Georgians used their parents' birth certificates to avoid being incorporated into the Soviet army, adding to their calendar age between 20 and 30 years (Kirkwood, 2005; Mamak-Zdanecka, 2015; Stuart-Hamilton, 2006).

There are several reasons why psychologists are interested in climate change. One of the fathers of modern medicine, Hippocrates, proclaimed that the climate affects the humours (liquids) existing in the human body: blood, bile, mucus and black bile, which translate into personality. In turn, the Roman architect, Vitruvius, whose work inspired Leonardo da Vinci, claimed that geographical and climatic conditions affect people's diligence and character. Psychology as a science discipline observes with concern the undermining of the role of science and building distrust of scientists by those who claim that global warming is not true. Social and environmental psychologists study interactions, i.e. the mutual influence of man and the environment. It should be remembered that it is a man who, through his own decisions, contributes to the climate crisis, which impacts back on the man. Third, psychologists study attitudes, their origins, and how they affect behavior. The concept of 'climate anxiety', or 'climate depression', functions in psychology. This term is understood to be a chronic fear resulting from fear of annihilation, which may be a consequence of the climate crisis. This fear is related to the fear of the collapse of social structures, war, hunger, economic crisis, and the destruction of the world. From a psychological point of view, this can result in symptoms such as insomnia, a sense of meaningless life, and tormenting thoughts about an impending disaster. As a result of these symptoms, various life decisions made by a person can be impacted (e.g. not having children). In such a situation, it is difficult to talk about depression or climate anxiety in the disorder category, because the anxiety has adaptive properties, as it warns about a threat, allowing survival and motivating to act. The problem is too high anxiety, paralyzing anxiety, disorganizing action or 'non-adaptive fear'.

Until now, man has lived in the belief that thanks to the development of science and rapid civilizational and technological changes every next generation will live better. Currently, however, we are not so sure. This awareness that the next generation will live in a world of crisis and anxiety can keep you from deciding to enlarge your family. On the other hand, we are dealing with an overpopulation crisis, which is why such decisions can be an expression of ecological awareness (Jaśkiewicz, 2019).

In a special way, all changes, especially those related to the environment, affect the elderly, who upon starting their retirement should create particularly favorable living conditions. This is often associated with a deterioration of the socio-economic situation, which may reduce the motivation to achieve and strengthen the need for security and peace. Listed below are elements of the elderly's situation, both those that make up the picture of all life inconveniences, but also attempts to answer in the form of adaptive behavior. It should be noted that people in late adulthood may experience fear of loneliness and rejection (Straś-Romanowska, 2007). Therefore, for some older people, old age can be a period of crisis that is strongly associated with environmental determinants (place of residence, getting used to the geographical and natural environment, climate, etc.).

Experienced crises can be understood as difficult situations that can trigger various strategies to deal with them. According to P. Oleś, these strategies are associated with personality maturity (Oleś, 2000). In his opinion, when choosing a strategy to deal with difficult situations, man is guided by the cognitive assessment of the situation understood as the primary assessment, and his own ability to cope with the difficulties experienced as the secondary assessment. A person affected by a crisis can interpret their problems in terms of challenges and then it will trigger the so-called active ways of coping, but if a man interprets the crisis as a loss or threat then strategies may appear that

reduce those unpleasant emotions. In the cognitively oriented concept of R.S. Lazarus and S. Folkman, the choice of active strategies (when experiencing crisis as a challenge) can be attributed to people with the so-called mature personality, which cannot be said about individuals who interpret experienced stress and life problems as phenomena and situations with 'no way out', resorting to the use of defense mechanisms. In both possible variants, the importance of mature personality (psychological maturity) in the selection of adaptive mechanisms is clearly drawn (Olszewski, 2003). It is particularly visible in the period of old age, when the last period of life depends to a large extent on how a given older person deals with crises of this period. It can be assumed that the life experience, attitudes that have evolved during life, will bear fruit and they helped in the choice of strategy, but it may be that the negative traits coexisting with senile crises will be stronger and they will dominate over the active search for optimal solutions, ultimately affecting the quality of adaptation processes (ibid., p. 45; Dyczewski, 1994).

The difficulties and crises experienced by man trigger defensive activities, thanks to which emotional tension is reduced without changing the stress reality (Lewicki, 1972). These are "unconscious and habitual techniques used to deal with tension and anxiety, which are aimed at reducing anxiety and causing substitute satisfaction of needs. At the same time, defense mechanisms, in addition to the positive function of defense against fear, also have negative properties. The man who uses them distorts information about the world and also distorts knowledge about himself, which is the reason for further mental disorders" (Sęk, 2001). The consequences of using defense mechanisms can be destructive or constructive. Destructive ones include symptoms leading to psychosomatic diseases (asthma, stomach ulcers), loss of objectivity, excessive defensive attitude, lowering insight into one's personality resulting in less self-understanding, development regression, and increased neurosis. Constructive, desirable consequences may include new, positive character traits, emotional balance, positive health, finding consciously accepted substitute goals. These consequences are most desirable for building a high level of quality of life in old age (Płużek, 1991).

Quality of life is a very complex construct regarding human expectations, exploring both the subjective and objective aspects of life from the point of view of a human or social group (Ratajczak, 2005). Essential to psychology is this subjective aspect of the quality of life because it reflects the mental states that occur in the process of satisfying needs and achieving important goals. "These states are the result of a cognitive assessment of the relationship between man and the environment, with an assessment of their own achievements and failures, in their own struggles with the environment and an assessment of the chances of achieving their own aspirations, desires and life goals" (ibid. p. 236). In psychological studies of the quality of life of people over 60 years of age carried out by Brzezińska (Brzezińska, 2000; Obuchowski, 2002), they were asked to assess the satisfaction of five groups of needs, i.e. safety, relationships with people, doing things for others, activity and work, leisure and free time. Studies have shown that four out of the five categories showed the highest declared quality of life. Only in the safety category was the quality of life poor.

The implementation of a development task, which is to create favorable living conditions that take into account environmental conditions, is important for the subjective sense of the quality of one's own life, which can be understood as physical, mental, material and social well-being. The perceived quality of life is influenced by assessing your own productivity, satisfaction with social contacts and meeting your needs. When the tasks faced by people of a certain age are carried out successfully, then their life satisfaction increases (Raeburn and Rootman, 1996), i.e. a global assessment of the whole life according to the criteria chosen by the individual (Shin and Johnson, 1978).

Some socio-territorial indicators, such as gross domestic product and economic resources, contribute to the environment, and individual assessment of this environment may affect the quality of life of the people who live in it (Hawthorne et al., 2006). Studies show a link between a place of living and physical and mental health (Kawachi and Berkman, 2003). The quality of life of people living in an area may be related to a sense of community with the area and the community that lives there (Wen et al., 2006). The inhabited neighborhood has a multidimensional impact on health through living and landscape conditions, a sense of belonging to the community and attachment to the place, and climatic conditions (Kagan et al., 2011). Many studies show that the correct relationship of a person with his life environment correlates with well-being, allows you to feel at ease, gives you a sense of trust and security. Few people change their place of residence during old age. However, maintaining social continuity and the physical environment is an important element of optimal aging (Atchley, 1999). Studies confirm a stronger attachment to the place and living conditions of people in late adulthood. The reason for this may be that with age, the period of residence in a particular place usually increases. It should be assumed that both neighbors one knows, as well as friends or sellers in stores, give the elderly a sense of security and stability, which they need especially during this period of life. Despite the fact that you do not enter into close relationships with them, they allow you to believe that if such a situation arose in which you needed the help of the community, someone would provide this support.

Elderly people develop a sense of continuity and the prospect of changing the environment and living conditions could be very unfriendly for them. It is also associated with an increased sense of need for security and a focus on stability in people in late adulthood. Stronger attachment to the place by people in late adulthood may, therefore, result from the specifics of this development period and relevant development tasks. Robert Havighurst (1972) indicates that the period of late adulthood is characterized by adaptation to biological and social regressive changes occurring at that time, then physical forces may decrease, which may result in less mobility. Social contacts with people of a similar age and adopting appropriate new social roles, such as the role of grandmother or grandfather, are particularly important for these people. Forming social bonds with peers and new family members not only increases life satisfaction but can also be a factor deepening attachment to the place they live in and to the conditions of their own life

(Mandal and Latusek, 2015). The role of attachment to the place of residence increases with age, which is why older people maintain a sense of continuity in their lives, and the past, which took place in the same area, provides memories in the same conditions and may seem alive. This subjective feeling of permanence and lack of changes can also protect older people from a sense of the passage of time, a sense of dependence on others or a decrease in certain skills (Rubinstein and Parmelee, 1992; Mandal and Latusek, 2015).

It should be noted that weather changes have a significant impact on the appearance of various ailments, such as headaches, joint aches, muscle aches, excessive sweating, breathing problems, palpitations, impaired concentration, irritability, anxiety, low mood, depression. People with chronic illnesses may experience an exacerbation of the above conditions. It is recommended to make simple changes in the daily life of seniors to improve the comfort of daily existence and reduce the risk of serious complications or events. In this regard, it is important to ensure a proper diet and regular physical activity.

3. Conclusions

Awareness of the role of global warming and climate change in the daily lives of Europeans, including seniors, has been the subject of a separate European Investment Bank study. As for Poles, 40 percent do not think climate change is a threat to humanity, with the European average half as much, and this differs significantly across age ranges: 34 percent of younger respondents aged 18 to 34 are of the opinion that climate change is a danger, and in the older age group, 35—54 years, this percentage increases to 48 percent. Research shows that in most countries of the European Union the opposite is true. Older respondents are less aware of the threat than the younger ones, which may be related to the level of education, but also to the way they perceive these changes.

Elders generally associate global warming with more frequent and intense summer heat waves that are bothersome and even dangerous to them. On the other hand, heat is not disturbing for young people. On the contrary, they want heat waves to happen more often, so they do not perceive them as a real threat. Therefore, it is worrying that younger generations do not realize that the pollution which contaminates our air and warms our planet has accumulated for generations, and it is high time to stop this process. And although the awareness of the elderly is filled with real anxiety that falls under the crises described by psychologists, their possibilities for climate change are significantly limited.

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SHORT COMMUNICATION

Polar Research in public discourse — setting the stage

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KEYWORDS
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Summary Polar Research gained bigger than ever extent and support, both on the state-political and the wide public level. We want to start the discussion on how the public concern is formed, and what are the inspirations that drive researchers to choose this type of career. It seems that in the non-Arctic country like Poland the sentiment, associated with the historical polar events together with widely accessible and attractive documentary films, was essential in shaping the societal support for spending public money on polar studies.

1. Introduction

The majority of scientific research is being funded for its usefulness, application or commercial perspective. Even the 'basic research' needs to be motivated with its relevance to the gaps in knowledge and strength our understanding of the physical world. The natural and very much anticipated curiosity of the scientist alone, will not bring the necessary financial and technical support for doing the research. Presently most of the research funds come from the taxpayers, hence the public acceptance for spending is essential.

Since its start to the present day, Polar research belongs to the most expensive, logistically demanding type of scientific activity — next to the Space and Marine studies. During the heroic era of polar exploration, the most difficult part of the enterprise was the fundraising (Bown, 2012; Huntford, 1979, 1997). Usually, rich merchants (companies) or state authorities (Kings, Governments) were the main sources of support. Even at that time, the public support was critical — explorers were routinely on the long raids for lecturing and fundraising themselves, and the media (newspapers) were essential in keeping the interest alive (Capellotti, 2016; Riffenburgh, 1994). On one hand, the public interest was raised by the sporty and nationalistic character of early explorations, on the other hand, there were many important, critical voices claiming that polar exploration brings nothing better than suffering, human and material losses with no return (Todd, 1961). The role of the Arctic territories for the defence was rapidly growing with the technological

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Table 1 Most common motivations for the support of polar research in public and state domains

Motivation for support	Example	Need for public support	Material support from
Sport – game	Race to the Pole, extreme sports	Very high	Private donations
National pride, the flag	Territorial claims, priority rules	Very high	State, government
Commercial use of resources	Oil, gas and biological resources extraction	Moderate	State, companies
Tradition, national identity	Native populations, first nations	High	NGO, state education
Defence, military	Early warning system, concealed military infrastructure	Low	State, defence ministry
Technology and innovation	Space-like technology tested in ultimate conditions	Low	Companies
Culture and art	Local communities	Moderate	NGO, state ministry for culture
History and sentiment	Early exploration, forced migrations	High	NGO, state ministry for culture
Basic science, curiosity	Understanding the Earth-Biosphere system	High	International and governmental research units
Global responsibility	Common concern about climate change	Very high	International and governmental research units
Peer pressure	Everyone else is doing it, so we shall too	High	Public

advancement of submarine and rocket installations and still remains high, even more so with the melt of the pack ice cover (Richardson, 2019). Nowadays almost all EU countries have their own activity in polar regions (both Antarctic and Arctic). Here I want to answer the questions:

(1) Where is public support needed?
(2) What are the main motivations behind the interest in polar research in the broad public?

There was little interest in economic use of the polar regions until the early XX century, as the fur trade and whaling were loosing its original economic importance, typical for XVIII–XIX centuries. The navigation routes were of interest (search for the shortcuts between Europe and Asia), yet the technology before the era of nuclear icebreakers was not suitable to meet the challenge of transpolar navigation.

Land claims were always important, yet the remote islands and coasts of polar regions were not a subject of serious conflict. Almost all potential conflicting cases were resolved peacefully – either by money (Alaska sold to the US in 1867), international negotiations (East Greenland and Norwegian claim) or harmless direct action like possession of Franz Josef Land by the Soviet Union in 1926 (Barr (Ed.) 1987, Barr, 1995). In Antarctica, the original territory claims were frozen by the international treaty, and practically the continent is under the international control (Antarctic Treaty Documents, 2019). Research, as an excuse for the state presence or argument for the land claims, was commonly used and here the scientists were supported by the high-rank political decisions (Arctic Council, 2019). The development of technology, the discovery of mineral resources in the Arctic and political tensions of the mid-XX century, lead to the massive interest in setting the infrastructure – from the research stations to radar and military installations. Since that time the defence sector was involved in funding the polar research, like massive nuclear submarine cruises to measure the sea ice thickness (Sambrotto et al., 2013).

The new era of support for the polar research started with the common notion that for understanding the global climate change polar regions are critical. In this context, large international research programs were funded, and a number of researchers involved in polar research is higher than ever before (ACIA, 2006).

There are obvious differences between countries that are connected with territorial claims or actual settings in polar regions – members of the Arctic Council. There is also a historical- and tradition-based motivation for polar research. Here the UK, Netherlands, Germany and Poland to name just a few EU countries, use to call examples of historical events, where their citizens were struggling to explore or simply survive the polar regions.

Different sectors of the community (administration, companies, NGO's, wide public) may support the Polar Research for various reasons. Author's personal observations after participating in a number of national and international

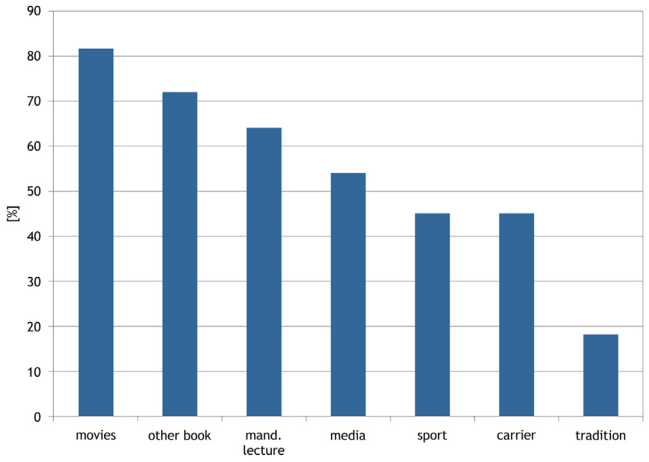

Figure 1 Declared sources of inspiration for undertaking polar research (active polar researchers in Poland, age 30 to 65, PhD) — a percentage of answers YES (n=23). The expression 'mand. lecture' states for the obligatory books in early education schools.

polar research meetings are summarized in Table 1. For the wide public, the sporty and peer pressure motivation seems to be of importance, along with history and sentiment.

In Poland in particular public education plays a significant role in shaping the public opinion about polar regions. As a non-Arctic country, Poland provided massive education about polar regions and research in 1950—1980 in the form of mandatory lectures in public schools (e.g. Centkiewicz and Centkiewicz, 1966). A couple of authors (Alina and Czesław Centkiewiczowie) wrote several books for school children about Arctic and Antarctic, presenting both the historical heroes (Nansen and Amundsen) as well as the cold-war actors (Soviet expeditions in both polar areas). To a smaller extent, the Inuit presence was shown in the form of short novels, known to every school kid at that time. The effectiveness of this period of education is reflected in the results of public opinion polls, in which the older generation points at the school required reading as the main source of knowledge and inspiration about polar areas, while for youngsters, the movies and other books were more important (Kotyńska-Zielińska et al., 2019). The author conducted a small scale study during the annual meeting of Polish polar scientists associated with the Center for Polar Studies at Silesia University in 2018. There were full-time employed professionals with the PhD plus degree in the field of environmental and earth sciences, aged between 35 and 65. Twenty-three members of that gathering (about 30 people) agreed to answer the simple, anonymous (age and sex were not revealed) questionnaire about their source of polar inspiration. The documentary movies and books were named as the key inspiration for choosing this type of career (Figure 1). Besides fulfilling the political and commercial needs, the public interest in polar research may also support building the modern, concerned society and, for the common good, environmental literacy among citizens. Communication of polar science via professionals in an attractive way may reduce the amount of fake believes, and be regarded as the first-hand respected expert information. The open question is how and if, the interest in polar research will upgrade the citizens' climate and environmental concern?

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