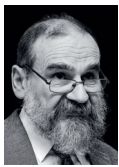


# ORDER IN DISTURBANCE

Turning conflict into cooperation.



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Over the last two years, the gap between the opposing views on how the issue of spruce trees dying as a result of a bark beetle outbreak should properly be handled has widened. This has

become a burgeoning, multi-faceted conflict between those who support vs. those who oppose interference in the natural processes that shape the Białowieża Forest. The key controversy is whether the current bark beetle outbreak should be actively fought or left without intervention. But there are other issues at stake, too, such as: what are the right methods for protecting the Białowieża Forest, and how much of this protection should be passive versus active? Another issue is the proper size of the



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national park: should it cover the entire Białowieża Forest, or only part of it? These various questions are closely intertwined, which does not make it easier to get at the essence of the conflict surrounding the Białowieża Forest.

## To protect natural processes?

The arguments that stress the importance of protecting natural processes in the Białowieża Forest are at the same time arguments against interfering with the bark beetle outbreak or other processes occurring in the Forest. To understand this point of view, it is necessary to briefly explain the concept of a *dynamic balance*, which is not so much about the stability of a forest but about its transformation. This is due to the fact that any forest includes various unstable forms. The larger the forest, the greater the chance that all forms will be present in it, and with time the percentage area covered by specific forms will vary less and less over time.

For a forest to attain such a dynamic balance, it must have a sufficiently large area. Therefore, passive or strict protection of natural processes should

primarily be applied in large forest complexes. No other forest in the Polish Lowlands is more suitable for this than the Białowieża Primeval Forest. First, its area, together with the remains of the Świsłocka and Lacka Forests, measures 1500 km<sup>2</sup>, of which 620 km<sup>2</sup> is on the Polish side of the border. Another reason is the age of the trees. Outside the national park, there are almost 14,000 ha of forests with trees over 100 years old and many nature reserves, whose total area exceeds 12,000 ha. In addition, there are still nearly 9,000 ha of forest stands with trees older than 100 years in the three forest districts outside of the national park, which is three times more than in all forests managed by the State Forests. In the case of tree stands over 120 years old, the difference is almost sevenfold. What's more, three-quarters of the Polish side of the Białowieża Forest consists of nutrient-rich habitats conducive to deciduous forests. It is the only large forest complex in the country where they play such a significant role.

Another crucial notion here is that of an ecological disturbance: a short-term and clearly isolated event that can be considered to be the driving force of forest transformations and its various dynamic states. A bark beetle outbreak is an example of such an ecological disturbance. In a short period of time it causes the death of many spruce trees and creates opportunities for the emergence of a young generation of trees. Thus, it transforms the structure of the forest and its species composition and it changes the conditions of the physical environment, including increased availability of light and temperature at the forest floor and the availability of nutrient resources, which are no longer needed by the dead spruce trees. Also, higher temperatures increase the decomposition rate of organic matter.

It is important to determine the spatial scale of the disturbance, whether we are dealing with the death of a single tree or of the whole stands over large areas. The affected area differs between various types of forests. It is believed that mixed forests in the European lowlands, which include the Białowieża Forest, most often experience disturbances over areas ranging from a few to tens of acres, rarely up a few hectares. This is much less than in the mountain mixed forests or in mountain and boreal coniferous forests. This means that the Białowieża Forest can achieve dynamic balance within an area of only several hundred hectares, which is much less than the area of the Polish part of the Białowieża Forest, and even less than the area of the Białowieża National Park. Other forests require tens of square kilometers, or even thousands, to reach their balance, and in the case of boreal forests perhaps even millions.

Different species groups are associated with different dynamic forms of the forest. Since all forms



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are present in a forest in a state of balance, this would mean that all species groups associated with them would also be present. No method of active protection is able to create appropriate conditions for thousands of species with varied biological properties and requirements in relation to the environmental resources that make up the highly heterogeneous forest biocenosis. Protecting processes in a vast forest complex in a way that allows dynamic balance to endure seems to be the best way to preserve its biological diversity. Strict protection of processes in Polish national parks has so far been applied on only 60,000 ha. In the Bieszczady National Park alone, it applies to over 10,000 ha. It would be beneficial if other, even larger areas of Polish forests were the subject of strict protection, and the Białowieża Forest is most suitable for this. An extensive forest shaped by natural processes and deprived of direct human interference represents a unique study site for scientists. Fundamental research carried out here provides knowledge about how forests function, which can then be used in applied sciences and then in practice. Such research is important not only for nature protection, but also for forest management itself.

## Or to intervene?

However, there are also arguments in favor of intervening in the natural processes that shape the Białowieża Forest. I mentioned that mixed-species forests should be able to achieve dynamic balance within an area of several hundred hectares. However, it cannot be excluded that tree stands in Białowieża Forest may be destroyed over an area stretching many square kilometers. They are not immune to windstorms similar to those observed in Western Europe over the past decades, a few years ago in the Pisz Forest, and this year in Pomerania. Perhaps the location of the Białowieża Primeval Forest makes the probability of such events smaller, but they are not impossible.

Thus we could agree that extensive destruction of stands may in the future affect larger areas than before. As a result, the area required for dynamic balance will increase and the Forest itself will become too small to achieve it. This will cause problems with preserving its unique natural resources. In the face of such prospects, we should designate a certain area of the Forest and create in it a mosaic composed of various dynamic forms of the forest. It may be different from the mosaic created by nature, but the most beneficial for preserving natural resources.

A lack of dynamic balance would not be an issue, if the Białowieża Forest was still a part of the wooded areas that once covered over 90% of Europe and Poland many centuries ago. Currently, it is a large

island separated from the neighboring forest complexes by non-wooded areas. We may think of the Forest as still primeval and naturally formed but science suggests differently: that the processes, which shaped it back when it was just a small part of the endless forests covering Europe differ from those of today, now that it has become an island in the middle of open terrains.

The current spatial discontinuity of the forest cover may be a crucial factor for maintaining the biological diversity of the Białowieża Forest for several reasons. It may bring about the loss of dynamic balance in forests dominated by spruce – such as boreal spruce swamp forest, especially protected under the Nature 2000 program, as well as the mixed damp boreal coniferous forests. In the Białowieża Forest, both of them are at the southern edge of their occurrence. They occupy small areas and their patches are scattered among other types of forest. After the bark beetle outbreak, all these spruce patches may represent a dynamic form with young spruce stand, thus we can expect the species associated with the older spruce stand patches to disappear.

After the regeneration of the spruce stands, which will take decades, it may be difficult for these species to return to the Forest from neighboring woods due to its isolation, and even impossible if they do not occur nearby. In order to preserve the spruce-associated species in the Białowieża Forest, they must be actively protected by maintaining a significant contribution of old spruce trees in spruce stands, at least in some patches.

The Białowieża Forest is a unique forest complex in terms of biodiversity. In a small part of the Białowieża National Park, covering an area of 144 ha, nearly two thousand species of fungi, lichens and plants have been found. Some refer to the Białowieża Forest as a heartland of biodiversity. Among others, this includes species associated with spruce trees, including fungi, lichens, mosses and liverworts. The important role of spruce in shaping the biodiversity of the Forest is apparent in the group of epiphytic lichens, mosses and liverworts associated with this phorophyte and differs from the groupings found on most deciduous trees growing in the Forest. If the number of spruce trees decreases drastically, certain species associated with them may be at risk of disappearing, and after the regeneration of spruce stands, their return from neighboring areas may be difficult due to the isolation of the Białowieża Forest, or even impossible, because most of them probably are absent in the nearest wooded areas.

The Norway spruce is at the southern boundary of its boreal range within the Białowieża Forest, and for some time it has been observed to be in decline, undoubtedly due to climate warming. Note, however, that some species, dependent on spruce trees

and found in spruce forests, will not be able to migrate northwards due to the aforementioned spatial isolation. If the climate cools back down again, a possibility that cannot be ruled out, the spruce itself can easily return to the Forest, but species associated with it may no longer be able to do so. So to ensure that spruce-dependent species will continue to thrive in the Forest in the future, we must protect them in their area today, and one way to do so is to look after the spruce trees themselves.

A number of studies have shown that the whole Białowieża Forest has changed due to changes in its use, and numerous plant species associated with former human activities disappear. The Norway spruce is one of those species. Not only species, but also whole forest communities disappear from Białowieża forest and meso-oligotrophic mixed forest with a substantial participation of Norway spruce is one of them. However, traces of past forest management in the form of the presence of certain groups of species or forest communities are worth preserving, because they also make up the unique diversity of the Białowieża Forest.

## How to cooperate?

Above I have laid out two sets of arguments: some against interfering in the natural processes in the Białowieża Forest, others in favor of such interference. What conclusions should we draw from them? If we focus solely on the Białowieża Primeval Forest itself, the benefits of strict protection predominate, but if we consider this issue in a broader geographical and temporal context, this point of view will change.

First of all, the Białowieża Forest is one of the many forest islands all over Europe. Though it is one of the largest and unique, in terms of biodiversity, it is isolated from other complexes by non-wooded areas, which constitute a barrier impossible to cross for many forest species. Secondly, a different point of view emerges if we take into account the human use of the Forest in the past, which left behind various marks in the form of numerous species, and even forest communities. And thirdly, if we consider its future in the context of anticipated changes to the natural environment.

These points lead to the final conclusion that protecting the processes shaping the Białowieża Forest will not be enough to protect its biodiversity. Most scientists suggest for the entire Forest to be protected as a national park and that strict protection should dominate in it. This was also the project presented about 10 years ago by a team appointed by the late President Lech Kaczyński.

Although I am in favor of a significant enlargement of the National Park and the strictly protected area, the above-mentioned arguments do convince

## The bark beetle vs. the spruce tree

The bark beetle is a small insect that feeds under the bark of living spruce trees. It very rarely attacks other tree species. Under the bark of a 100-year-old spruce, there can be up to 1000 feeding chambers, from which 100,000 young beetles can hatch. The breeding cycle lasts from two to two and a half months, which means that up to three broods can appear during a single year.

The current bark beetle outbreak in Białowieża started in 2013, a year after the logging quota was reduced to 48,000 m<sup>3</sup>. At that time nearly 100,000 dead spruce trees were found in the forest districts, with a total volume of over 100,000 m<sup>3</sup>. By 2016, the number of dead spruces had increased fivefold. Several times over the last 25 years Białowieża has seen surges in bark beetle numbers and the spruce mortality rate but the current outbreak is incomparably larger than previous ones in the past few decades. From the point of view of forest management, the beetle is one of the most dangerous and significant spruce pests. From the perspective of nature protection, on the other hand, it is a so-called "key species", which significantly affects the functioning of forest ecosystems and the occurrence of many other species.

The common spruce, the second species featuring prominently in the Białowieża conflict, reaches over 50 m in height and 2 m in thickness, and lives 300–400 years. It occurs in all types of forests, regardless of soil moisture and fertility. Over 1/3 of spruce stands in the Forest are more than 120 years old, and the beetle prefers old trees. The current physiological condition of the spruces, deteriorated due to unfavorable changes in the hydrological system of the Forest, is also favorable to the beetles. The reproduction rate of these insects has also been bolstered due to high temperature in recent years, shortening the length of the growth cycle and increasing the number of broods in a single year.

me of the need to apply a diverse set of methods of protecting the biological richness of the Białowieża Forest in order to reduce any potential risks of using a single approach. I therefore support the significant expansion of the Białowieża National Park and putting its forests under strict protection. I am also in favor of the most valuable parts of the Forest outside the national park becoming further protected as nature reserves. At the same time, I support active protection and active reduction of bark beetle gradation over a substantial part of the Forest. I believe that the Białowieża Forest should consist of a vast national park, while at the same time sustainable forest management should be implemented within the structure of the State Forests on a large area.

I am in favor of the Białowieża Forest becoming a kind of research laboratory in terms of sustainable



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forest management methods. According to the Forest Act of 1991, the goal of such management is to protect the natural diversity of forests, their genetic resources, landscape qualities and to preserve them for the needs of science. It is necessary to constantly develop this form of management and to adjust its methods by assessing the results obtained with them. This can be done best by comparing the condition of forests under strict protection to those under active protection, as well as managed forests in similar habitats and within the same forest complex.

I believe that such comparison would hardly be possible to carry out in any other place in Poland. Why is it so important? Currently, the area of Poland's forests protected in national parks and nature reserves is just over 250,000 ha. We should consider whether protecting forest ecosystems covering less than 3% of the present forest area is enough to ensure the full preservation of their biodiversity. I believe that all efforts in this case are doomed to failure if they do not include appropriate activities carried out in the area of the managed forests surrounding national parks and reserves. I think that the situation will only slightly improve if we increase the area of these forms of nature protection by twice or three times, as should undoubtedly be done.

Let's return to where we began this discussion. For several years now, there has been a conflict sur-

rounding the Białowieża Forest between two groups who are divided in every aspect. Each side expresses completely different views on the history of the Forest, its current state and what is happening in it today, as well as seeing its future differently. Each side of the conflict believes that if its point of view is neglected, the Forest will be destroyed forever. I believe that this conflict is not in the interests of nature protection, but rather harms it. I am convinced, however, that the Białowieża Forest can and should become a field of cooperation between foresters and natural scientists.

For this to happen, today's enemies must work together on protecting the native nature of the Forest, both the wild natural areas and the ones shaped for centuries by the activities of many generations. And this must be done not only for the sake of the Białowieża Forest's natural resources, but also for the natural wealth of all Polish forests.

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This article is based on the lecture "Bark Beetle Outbreak in the Białowieża Forest – Pros and Cons of Intervening in Natural Processes as Part of Forest Management," delivered at a meeting of the Academy's Division II – Biological and Agricultural Sciences on 9 November 2017.