

What is the use of the research carried out on the permanent plots in the Białowieża National Park?

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Abstract. The purpose of the strictly protected area of the Białowieża National Park (BNP) established in early 1900s, was to protect a compact block of the Białowieża forest from any direct human influence and activity. Its founders considered it a ‘laboratory of nature’ In 1936, five rectangular plots with a total area of 15.5 ha (ca. 0.3% of the BNP) were set up for regular monitoring of stand development with regards to the initial state and variability of soil conditions. During the first 76 years of the project, a steady increase in the proportion of hornbeam and lime tree at the expense of shade-intolerant species was observed. This trend has been interpreted by the researchers involved in the monitoring of the permanent BNP plots to constitute a biodiversity-threatening development caused by preservation efforts. Such an interpretation has been widely incorporated in the public debate by political authorities and the forestry sector. In this critical article I challenge the major arguments presented by the key expert in silviculture, Prof. B. Brzeziecki. My criticism is directed at the methodological approach as well as at the data interpretation.

Keywords: ecological disturbances, ecological history, plots’ representativeness, spatial scale, spruce bark beetle outbreak, stand dynamics

Instead of introduction

Eighty years is a long time, given the history of systematic observations on permanent experimental plots. All experimental plots (five longitudinal rectangles of 15.5 ha in total) established in the Białowieża National Park (BNP) in 1936 by Prof. T. Włoczewski, thanks to the consequent strict protection, became an exceptional ‘laboratory of nature’ on the European level. According to the assumptions defined in that project, regular observations and measurements on the plots were aimed at explanation of the influence of various soil conditions on spatial diversification of stands and their dynamics with respect of their state recorded at the beginning of the study (Włoczewski 1954, p. 167). A possibility of cyclical repetition of measurements on the same plots, with the use of the same method, in the heart of the most recognisable forest complex of Europe is a privilege and also an obligation. The Department of Forest Silviculture of the Warsaw University of Life Science, continuing the study and being the host of the above-mentioned ‘laboratory of nature’, had that privilege. The publication of Prof.

Bernadzki’s team was a very important summary of the first half-century of observations (Bernadzki et al. 1998). It pointed on the trends in the evolution of the monitored stands. Those stands were characterised by significant instability of species composition. Whilst hornbeam, lime, ash and alder revealed a conspicuous expansion, other species, in particular pine, spruce, pioneer species as well as maple and oak, were in regress. The authors noticed that despite the fact that ‘naturalness’ was an important criterion when choosing plots by T. Włoczewski (i.e. lack of visible human presence), the results of the first inventory of 1936 indicate a considerable openness of the stand canopy, a fact that can be interpreted as a result of earlier anthropogenic disturbances.

The examined ecosystems of BNP are special cases of a general rule, according to which the lack of balance is the most natural and common state of environmental systems (Weiner 2009). If there is no Holy Grail of ‘environmental balance’, ‘climax’ does not exist, neither does exist an objective ‘ideal’ reference yardstick, according to which observed states and trends could be assessed. Does the lack of such

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model undermine the sense and the value of observations of dynamic ecosystems? Or maybe lack of balance, constant changes should be the inspiration for further interesting research projects? Such, which would allow for instance better understanding of mechanisms of observed changes such as seeds dispersion, their damage and consumption, germination, early seedlings growth and survival, and influence of pathogenic and mycorrhizal fungi.

Alas, instead of widening the scope of research initiated by Prof. Włoczewski throughout the following half-century, his successor researchers involve advanced methods of data processing (mathematical simulations) in order to re-interpret the processes documented and described in the publication of 1998. For instance, Brzeziecki et al. (2016) explicitly conclude that strict protection is responsible for tree species impoverishment (which was not proved in any of their research), which in turn threatens the overall BNP biodiversity decline. In the context of the dispute over the future of the Białowieża Forest (BF), involving both the minister and the forest administration, such significant deviation from standards of objective scientific publication (as followed by Bernacki et al. 1998) may rise reservations. They are additionally amplified by the main author's public declarations suggesting superiority of the forest management over the preservation leading to the loss of the natural richness.

In this article, I verify the correctness of the theses presented by Prof. Bogdan Brzeziecki in his interview for 'Nasz Dziennik' newspaper (Brzeziecki 2016b) – with regard to their content (referring them to empirical data) as well as to the formal, methodological rigour. It might not be worth undertaking such analysis if it considered a single press statement. However, similar, equally controversial suggestions appeared in the later Prof. Brzeziecki's discussion with the editor of the professional journal for foresters – 'Las Polski' (Brzeziecki 2016a). Because the theses of the well-known silviculturist have become firmly established in the public discourse related with the campaign carried out by the Minister of Environment and the forest administration, I considered such analysis necessary.

Thesis 1. The stands of the Białowieża Forest become more and more simplified with regard to their species composition; the net effect of homogenisation processes under the regime of strict protection is negative

Dynamics of the forest or the study plots?

'Species such as spruce and oak, which is considered symbolic for the Białowieża Forest, are in decline. Other declining species are pine, maple as well as pioneering, shade-intolerant species – birch and aspen' (Brzeziecki 2016b). The last one is almost on the 'verge of extinction' (Brzeziecki 2016a). And

'the whole bunch of species cannot cope in the unmanaged forest, set aside for preservation' (Brzeziecki 2016b).

In order to address this issue (and the quoted citations), one should have put it in a suitable spatial and temporal context. Are the transects established in 1936 a reliable representation of the whole strict reserve? In order to answer that question – fundamental for the interpretation of the phenomena observed on the plots – tests are necessary to evaluate the probability of the risk of the rejection of a potentially true alternative hypothesis. This is a basic procedure required by the formal standards of scientific reasoning. Without a positive settlement of that issue, that is, without the confirmation that the plots are a reliable representation (assuming certain threshold of acceptable error), the observed processes can be referred only to the particular plots and not to the whole ecosystem.

Such is the case of the research led by Prof. Brzeziecki on the permanent plots in the BNP. Whilst journalism does not involve introducing readers to the details of scientific methodology, one may not afford the reasoning going far beyond the studied plots unless one proves their satisfactory similarity to the concerned area. However, even in the above mentioned scientific paper (Brzeziecki et al. 2016) we find no trace of such procedure, which might substantiate referring the conclusions driven from the plots to the whole BNP area.

According to the assumptions of the Prof. Włoczewski's long-term study, the transect plots were supposed to represent spatial variability of soil conditions and diversity of stands' species composition (Włoczewski 1954). The initial dominating position of pine and spruce, accompanied by birch and aspen together with numerous though 'minor' oak (in poorer parts of the transects) as well as the dominance of oak accompanied by birch, alder, lime and the less numerous spruce (in more fertile part of transects) (Włoczewski 1954, p. 175), indicates a transitory character of the plots. It is not surprising that with time passing after a strong disturbance (such as relatively frequent fires until early 1800s and later – intensive game management, combined with grazing), the share of species – both direct beneficiaries of the disturbance, such as 'pyrophilous' pine, pioneering species as well as opportunistic oak, benefiting temporary lack of competition – has to diminish. A more abundant local recruitment of such trees, benefiting from a disturbance, occurs within relatively narrow time window followed by a much longer period of their regression and gradual increase of the role of late-successional species. This is the most typical aspect of the dynamics of temperate forest ecosystems. So why what is commonplace in small selected fragments of a forest ecosystem – gradually strengthening the position of shade-tolerant species at the expense of intolerant species – is presented as something unwanted, negative, disturbing? What is the basis of the belief (unproven by any statistical test) that five, deliberately established, plots

(jointly 0.3% of the strict reserve area) is sufficiently a representative sample for the whole preservation area?

How forest stands could have looked like before plots establishment in 1936?

In 1826, Julius von Brincken, a German forester who was in charge of management of the state forests of the Polish Kingdom, in his monograph of the BF, drew attention to the predominance of pine stands. Occupying about 80% of the BF area, according to the author, they looked like a ‘monotonous sea’ with scattered ‘green islets’ of deciduous forest. Spruce only occurred in wet sites or as an admixture in broadleaf-dominated stands (Brincken 1826). One hundred years later, since late 1800s dominance of spruce is increasing; Józef Paczoski summed up this as ‘taiga’s coming’ (Paczoski 1925). However ‘taiga’ did not settle too long. With escalating, during the last two decades of 20th century, the process of spruce stands dieback, this species seems to be retreating to its safe refuges it occupied in the first half of 19th century.

The new evidence from environmental history studies confirms the correctness of the Brincken’s estimations. They indicate a very important role of frequent anthropogenic fires of the forest floor, which had to result in the dominance of the most fire-proof European tree – Scots pine (Samojlik 2006, 2010; Niklasson et al. 2010). It was an anthropogenic factor that, during the centuries, led to a massive homogenisation of the forest environment. The rigorous ban of burning, imposed by the tsar’s administration in the first half of the 19th century, triggered the recolonisation of the ‘fire pine forests’ (or ‘lado pine forests’) by less fire-resistant oak as well as fire avoiders, including spruce and hornbeam (e.g. Keczyński 2007; Bobiec 2013). This process is documented by numerous pine survivors with deep fire scars, found today in non-inflammable biocoenoses, presently dominated by deciduous species. The time of the forest release from the overriding fire regime also coincides with the conspicuous wave of oak regeneration well documented by the dendroecological studies (Bobiec 2012). Regarding the spectacular regeneration success of spruce, it was presumably the result of the coincidence of at least three favouring factors: (1) cessation of burning; (2) intensive grazing and browsing by numerous, before World War I, wild ungulates and cattle (eliminating competition from preferred deciduous species); and (3) relatively cold climate of the so-called ‘the Little Ice Age’ (Faliński 1986; Bobiec 2013).

How forest stands of the BNP will look like in a hundred years?

From methodological point of view, modelling the future development of forest stands of whole ecosystem on the

basis of fragmentary observations covering the period of only 80 years, without relating them to relatively well-known wider historic context of the BF development, is unacceptable. Eighty years is the physiological old age of the shortest living pioneering tree species, approximately half of the spruce’s life expectancy (in the local conditions), less than one-third of the pine’s and less than a quarter of the oak’s. In 1936, setting the permanent monitoring plots took place at the beginning of the process that leads eventually to the formation of stands characteristic for the contemporary mesic deciduous forests. This process of the gradual replacement of earlier transitional forms has to involve gradual decline of early-successional species. Will it end up with the ultimate petrification of the contemporary observed dominance of hornbeam accompanied by lime, as Prof. Brzeziecki warns?

The experience of the century preceding the establishment of plots provides strong arguments for a cautious interpretation of instantly observed states and trends. Even Prof. Włoczewski, ‘the father’ of long-term monitoring on permanent plots, had not considered assessing the influence of preservation on the BF natural values amongst programme’s objectives. In the conclusion of the first 56 years of observation, the answer for the question *When if at all, will the forest stands in the BNP attain an equilibrium (climax) state?* provided by the team of researchers from the Department of Forest Silviculture of the Warsaw University of Life Science was: *At present it seems that they will never be compositionally stable, because they continuously respond to changes in the environment* (Bernadzki et al. 1998). Does the data obtained during the following 20 years of observation justify Prof. Brzeziecki’s such radical depart from the earlier scientific caution?

Thesis 2. Natural ecological succession leads to impoverishment of biological diversity of forest

The above thesis presumably is, according to its author, a consequence of the earlier discussed process of stand homogenisation. The decline of certain tree species and the decrease of their role allegedly entail dramatic consequences for whole biocoenoses. ‘The changes in the Strict Reserve of the Białowieża National Park show the direction that one can expect when man would cease entirely his influence on the stands of the Białowieża Forest’ (Brzeziecki 2016b). This view is resumed and completed in the interview that Prof. Brzeziecki gave to ‘Las Polski’: ‘Our alternative is: either we protect processes or natural richness. There is no other option, because one thing does not go hand in hand with the other. I assume, that important (more important) is the natural richness’.

The fact is that the present BF stands consist of 12–15 tree species (depending on whether we include relatively rare elms and fir). Reaching the contemporary species composition of the BF dendroflora took a few thousand years,

from the Preboreal (10,000 years ago) to Subatlantic period (around 2,500 years ago). Since that time, it has been undergoing continuous changes, smaller or bigger fluctuations of quantitative relations between species, reflected by both palynological evidence and stands compositional changes observed between particular forest inventories. There is no reason to believe that during the past centuries, except the permanent loss of yew in 1800s, the BF flora has lost another tree species. On the contrary, amongst other things, thank to the forest management, it was enriched in some non-native species, including red oak, Douglas fir and box elder. Would the upcoming future of forests under strict protection turn more bleak for species richness than what the area has experienced in the previous centuries?

Biological diversity (or biodiversity) is a very capacious concept: it can refer to the number of species present in a given area (the so-called alpha diversity), to the diversity deriving from an environmental gradient (the so-called beta diversity) or to the diversity on the landscape level (the so-called gamma diversity) (Whittaker 1972). Biodiversity can allude to genetic, species, biocoenotic (e.g. diversity of plant communities), structural diversity, diversity of trophic interactions and so on. Biological diversity as such is a neutral notion. It means that in spite of common opinions and the dominating narrative, biodiversity being not ‘a value per se’ should always be referred to a precisely defined context. Does the fact that arboretum is more rich in species than bush-grass conifer forest means that the former is more valuable than the latter? In dense, dark forest with substantial amount of dead wood there will be more saproxylic hygrophilous species than in semi-open silvopastoral wood, which instead will harbour more thermophilous and light-demanding species. If a forest community is released from anthropogenic disturbances (e.g. fires, litter raking, cattle grazing), the ecological succession will lead to the disappearance of certain species depending on such disturbances and to restoration of the populations of the so-called ‘primeval forest specialists’. Should we be disturbed by such development in the BF? What biological richness and what kind of biodiversity will be lost as a result of preservation? It certainly disfavours numerous ruderal, meadow, grassland and clear-cut species. Ecotone and open-space species lose to ‘forest interior specialists’, stenotopic species. Thus is it true that preservation (or strict protection) causes the loss of the natural richness?

Thesis 3. Spruce bark beetle outbreak: ecological disaster, Białowieża Forest tragedy

The report published by 17 authors (biologists and foresters) presented a synthetic collection of arguments proving groundlessness of ‘anti-bark beetle hysteria’ (Bobiec,

Buchholz et al. 2016). Unfortunately, those who anticipate ecological disaster and death of the BF, instead of a merit-related discussion with those arguments, undertook emotional journalism. It is not the reason, however, to repeat what ‘Las Polski’ has shared on its pages. Therefore, I will confine my commentary to only few selected statements found in the discussed interviews.

Ecological disaster or a disturbance of ‘catastrophic mode’? This is an important distinction. On the one hand, ecological disaster is, according to PWN Dictionary, ‘a permanent (irreversible in natural way) damage or destruction of large area of natural environment, influencing negatively, directly or indirectly, on health, often life of people’. On the other hand, according to Merriam-Webster, ‘ecocatastrophe’ is *a major destructive upset in the balance of nature especially when caused by the action of humans*. Ecological disasters were caused, for example, by the New Horizon oil rig explosion in the Gulf of Mexico and by the spill of the toxic red sludge in Veszprem in Hungary.

Intensification of the process of spruce stands disintegration caused by bark beetle does not fit the concept of ecological disaster according to the cited definitions. It is a typical ecological disturbance, which, by the definition, has a relatively rapid course. It is *an event or force, of nonbiological or biological origin, that brings about mortality to organisms and changes in their spatial patterning in the ecosystems they inhabit. Disturbance plays a significant role in shaping the structure of individual populations and the character of whole ecosystems* (Encyclopaedia Britannica).

Veblen (1992) distinguished three main ways of stand regeneration in natural forests: (1) continuous mode consisting of gradual replacement of dying trees by new trees, recruited from the existing seedling/sapling bank; (2) gap dynamics, meaning that the exchange of generations takes place in gaps, created as a result of death of at least few neighbouring trees; and (3) catastrophic mode, caused by disturbances inducing the most radical changes of local environmental parameters. Numerous studies carried out in deciduous forests (including Białowieża) prove that neither continuous mode nor gap dynamics can secure the regeneration success of shade-intolerant species. Their substantial presence in the forest ecosystem (however, on spatially and temporarily variable level) is guaranteed by the catastrophic mode dynamics (Bobiec 2007 and other cited there publications). It shows another contradiction in the analysed reasoning. On one hand, strict protection would lead to homogenisation causing extinction of shade-intolerant species (at least on 15 ha of examined transects), and on the other hand, the same form of protection threatens with ‘disaster’ and ‘tragedy’, that is, rapid disintegration of stands, conducive for the re-generation of such species.

Prof. Brzeziecki wonders ‘how this process of replacing certain species with others should look like. Should it follow a model of a huge catastrophe, as it threatens now?’ Does that anxiety apply to the scale (what does ‘huge’ mean?) or to ‘catastrophe’ as such? The interlocutor of ‘Las Polski’ clearly prefers an alternative approach to the course of nature: ‘foresters want to control the process of spruce decline and to give more time to the forest community so it can adapt to changes. The point is that all that should proceed gently and gradually, preventing an ecological disaster on a grand scale’. The problem is, as I mentioned earlier, that different species require different scenarios of the ecosystem dynamics. There are species that prefer ‘gentle and gradual’ scenario. There are, however, some species that require an abrupt and a vast disturbance of a catastrophic mode. Nature implements both scenarios. Silviculturist, however, would prefer to ‘reduce silviculture risk’ by growing mixed stands. He/she would like to ‘give a chance’ to spruce, pine and oak, the species that without his/her help ‘do not cope’ (Brzeziecki 2016a). He/she has to ‘renew [them] purposely’ in order to sustain ‘the primeval character of stands’ (Brzeziecki 2016b). The probability that spruce, unless human help, will go extinct in the BF Prof. Brzeziecki assesses as ‘very high’ (Brzeziecki 2016a).

It is worth to pay attention to the important point made by the interlocutor of ‘Nasz Dziennik’, who observes that because of the spruce stands disintegration ‘in short time (...) large open areas would emerge, covered with grass, raspberries, ferns. Then, after some time, pioneering tree species such as willow, birch or aspen would come’. Exactly such habitats can be observed in the neighbourhood of his study area – the transects set by Prof. T. Włoczewski – where around 20 years ago, older spruce stands decayed and, in some places, were superseded by birch and aspen stands (species that were expected to go extinct under the regime of strict protection). Indeed, a substantial part of those areas still remains open because of the development of thick grassy sod (mainly by reed grass and purple moor-grass), preventing the total colonisation of the area by light-seeded pioneering trees. It is also true that in some places, one can observe abundant raspberry (favourite wisent diet component) and in other places fern – bracken. But, what is the most conspicuous from a forest ecologist perspective is abundant and very successful regeneration of oak – a shade-intolerant species, ‘planted’ in the sod by Jay and requiring (because of slow growth) the retardation (e.g. by grassy sod) of the succession process (cf. Bobiec et al. 2011; Bobiec, Bobiec 2012). Amongst other things, such are the consequences of the ‘ecological catastrophe’ against which the BF would be protected by silviculture proposed by Prof. Brzeziecki.

Resume

Until recently, the answer to the question posed in the title of this article was obvious. It resulted from the very mission of the National Park, as formulated by W. Szafer, according to which it should have been considered a ‘laboratory of nature’. Observations carried out at such laboratory would not only satisfy our hunger of knowledge and curiosity (‘what will it be like, if man stops interfering?’) – what, in the case of the BNP’s uniqueness, would be a sufficient reason for its establishment – but also deliver data of practical interest. This was appreciated by, amongst others, T. Włoczewski – a forester, promoter and manager of the Silviculture Department of Forest Research Institute, co-author of the silviculture textbook. Observations on permanent plots established in the strict protection zone would become the source of the fundamental information on the influence of soil variability on species composition and quality of stands and also on changes in stands subjected to particular environmental conditions. One might ask: to what extent silviculture has used its unique on the European scale, ‘laboratory’ established by Prof. Włoczewski? How much the initial scope of the monitoring mensuration was broadened and supplemented by other detailed studies (paleoecological, paedogenesis, dendroecology, detailed analysis of factors influencing the dynamics of trees regeneration and recruitment, etc.)?

The journalistic activity of Prof. Włoczewski’s successors shows the radical change in the perception of purpose and meaning of the research conducted in the BNP. Silviculture does no longer need his ‘field school’, the place of professional training of foresters such as J.J. Karpiński. It turns out that the time has come when silviculture itself, not nature, is considered a blueprint; a time when silvicultural standards replaced training in the ‘laboratory of nature’; and a time when deliberately chosen fragmentary facts are used to synthesise the narrative of the forest tragedy, irresponsible ecologists and foresters-professionals. In this place, it would be worth quoting some interesting insights of baron von Brincken, a graduate of Dreissigecken forest academy (Turyngia), superintendent of government forests of the Kingdom of Poland. Here is what he wrote in his ‘Memoire descriptif de la foret imperiale de Bialowieza en Lithuanie’ nearly 200 years ago: ‘If pests are ravaging a large area of a forest, then attacked trees decay and fall creating a place for young trees that are forcing their way to the surface or germinating from seeds brought from nearby forests (...)’. ‘This primary forest helps fighting superstitions which still dominate in many countries where there are no forests managed exclusively by nature. It is believed there, that a forest left without exploitation until its physical maturity will certainly vanish. Nature however – as we saw – never destroys

without simultaneously renewing. The regeneration may be sometimes slow, sometimes fast, depending on favourable circumstances or obstacles' (von Brincken 1826).

Conflict of interest

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